Maharashtra State Board of Technical Education, Mumbai

Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Computer Engineering Groups

Program Code : CO/CM/CW **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters **Duration : 16 Weeks**

Semester : Third **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Object Oriented Programming Using C++	OOP	22316	3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
2	Data Structure Using 'C'	DSU	22317	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
3	Computer Graphics	CGR	22318	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Database Management System	DMS	22319	4	2	2	8	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
5	Digital Techniques	DTE	22320	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
			Total	**17**	**4**	**10**	**31**	--	**350**	--	**150**	--	**500**	--	**125**	--	**125**	--	**250**	--	**750**

Student Contact Hours Per Week: **31 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **750**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Third**

Course Title : **Object Oriented Programming using C++**

Course Code : **22316**

1. RATIONALE

In the modern world of Information technology, the Object Oriented Programming has become the most preferred approach for software development. It offers a powerful way to cope up with complexity of real world problems. Among the OOP languages available, C++ is the primitive language which develops fundamental understanding of Object Oriented Concepts. This course enables students to develop programs in 'C++' using Object Oriented Programming approach.

2. COMPETENCY

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

- **Develop applications Using OOPs concepts in C++.**

3. 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 C++ programs to solve problems using Procedure Oriented Approach.
b. Develop C++ programs using classes and objects.
c. Implement Inheritance in C++ program.
d. Use Polymorphism in C++ program.
e. Develop C++ programs to perform file operations.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20	

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

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course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

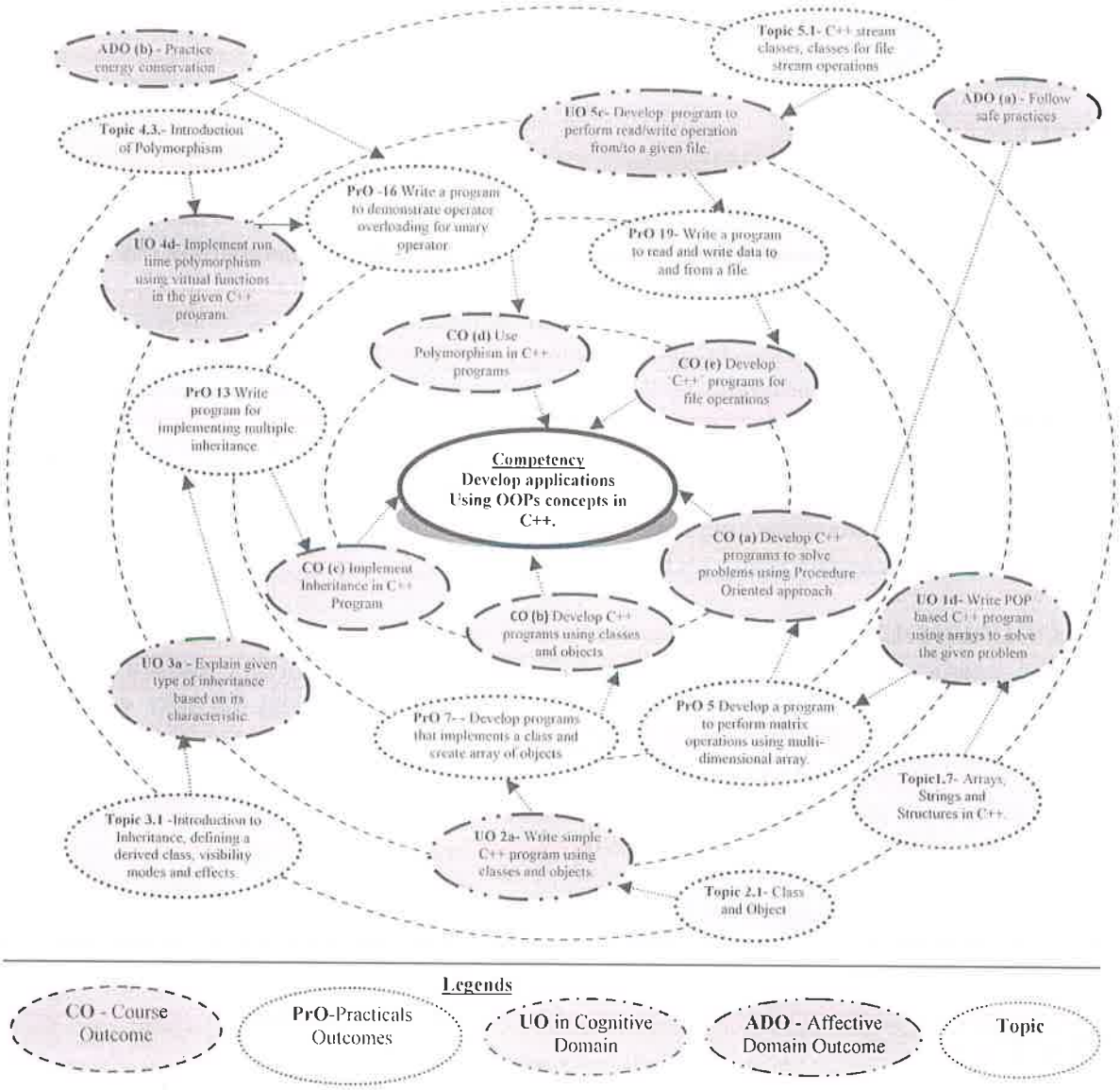

Figure 1 - Course Map

6. 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.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Develop minimum 2 programs using constants, variables, arithmetic expression, operators, exhibiting data type conversion.	I	02*
2	Develop a program to implement decision making statements (If-else, switch).	I	02
3	Develop a program to demonstrate control structures (for, while, do-while).	I	02

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Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4	Develop a program to implement 1-dimension array.	I	02 *
5	Develop a program to perform matrix operations using multi-dimensional array.	I	02
6	Develop programs that implements a class and use it with objects.	II	02*
7	Develop programs that implements a class and create array of objects.	II	02*
8	Write a program to implement friend function.	II	02*
9	Write a program to implement inline function.	II	02
10	Write a program to implement all types of constructors (constructor overloading) with destructor.	II	02*
11	Write a program for implementing single inheritance	III	02*
12	Write a program for implementing multi level inheritance.	III	02
13	Write a program for implementing multiple inheritance.	III	02*
14	Develop minimum 1 program to demonstrate Pointer to object.	IV	01 *
15	Develop minimum 1 program to demonstrate Pointer to derived class	IV	01 *
16	Write a program to demonstrate operator overloading for Unary operator.	IV	02
17	Write a program to demonstrate operator overloading for Binary operator	IV	02
18	Write a program to demonstrate function overloading	IV	02*
19	Write a program to read and write data to and from a file.	V	02
	Total		**38**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. 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.	Answer to sample questions	20
e.	Submit report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO S. No.
1	Computer system (Any computer system with basic configuration)	All
2	'C++' Compiler (Turbo C++ compiler/GCC compiler or any other C++ compiler)	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Principles of Object Oriented Programming	1a. Write simple C++ program for solving the given expression using POP approach. 1b. Write POP based C++ program using decision making and loop structure for the given situation. 1c. Write POP based C++ program using arrays to solve the given problem. 1d. Use the structure in C++ program for solving the given problem.	1.1 Procedure Oriented Programming (POP) verses Object Oriented Programming (OOP), 1.2 Basic concepts of Object Oriented Programming, Object Oriented Languages, Applications of OOP. 1.3 C verses C++, Structure of C++ program, Simple C++ Program. 1.4 Tokens, keywords, variables, constants ,basic data types, User defined data types, type casting, operators, expressions. 1.5 Control structures: Decision making statements and Loops 1.6 Scope resolution operator, memory management operators. 1.7 Arrays, Strings and Structures in C++.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II Classes and Objects	2a. Develop relevant friend functions to solve the given problem. 2b. Write C++ program to use array of given objects. 2c. Write C++ program to create the given object using constructor. 2d. Write program to delete the given object using destructor in C++ program.	2.1 Class & Object: Introduction, specifying a class, access specifies, defining member functions, creating Objects, memory allocations for objects. 2.2 Static data members, static member function, friend Function 2.3 Array of Objects, Object as function arguments. 2.4 Concepts of Constructors, Types of constructors. 2.5 Multiple Constructors in a Class, Constructors with default arguments. 2.6 Destructors.
Unit-III Extending classes using Inheritance	3a. Explain given type of inheritance based on its characteristic. 3b. Implement given type of inheritance in C++ program. 3c. Write C++ program using virtual base class. 3d. Use constructor in the given derived class.	3.1 Introduction to Inheritance, defining a derived class, visibility modes and effects. 3.2 Types of Inheritance : Single, multilevel, multiple, hierarchical, hybrid 3.3 Virtual base class, abstract class, constructors in derived class.
Unit –IV Pointers and Polymorphism in C++	4a. Create C++ programs to perform the given arithmetic operations using pointers. 4b. Use function overloading to solve the given problem 4c. Use operator overloading to solve the given problem 4d. Implement run time polymorphism using virtual functions in the given C++ program.	4.1 Concepts of Pointer: Pointer declaration, Pointer operator, address operator, Pointer arithmetic. 4.2 Pointer to Object: Pointer to Object, this pointer, Pointer to derived class. 4.3 Introduction of Polymorphism, Types of Polymorphism. 4.4 Compile time Polymorphism: Function overloading, operator overloading, overloading of unary and binary operators, Rules for operator overloading. 4.5 Run time polymorphism: Virtual functions, rules for virtual functions, pure virtual function
Unit-V File operations	5a. Identify relevant class for performing the given file operation. 5b. Write statement to open and close the given file in C++. 5c. Develop C++ program to perform read/write operation from/to the given file.	5.1 C++ stream classes, Classes for file stream operations. 5.2 Opening files, closing files, reading from and writing to files. 5.3 Detection of end of file, file modes.

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Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. 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	Principles of Object Oriented Programming	08	2	4	8	14
II	Classes and Objects	14	2	4	12	18
IV	Inheritance: Extending classes	10	2	4	10	16
V	Pointers and Polymorphism in C++	10	-	4	10	14
VI	Working with files	06	-	2	6	08
Total		**48**	**6**	**18**	**46**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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 of practicals.
b. Undertake micro-projects using Object Oriented Concepts.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning 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 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.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

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Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Develop library management application.
b. Develop hotel management application.
c. Develop bank management application.
d. Develop store management application.
e. Develop hospital management application.
f. Any other micro-projects suggested by subject faculty on similar line.
(Use Object Oriented concepts and may also use file handling features of 'C++' to develop above listed applications)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Object Oriented Programming with C++	Balgurusamy, E.	McGraw Hill Education, New Delhi 2015, ISBN: 9781259029936
2	The C++ Programming Language	Stroustrup,B.	Pearson Education, New Delhi 2015, ISBN:9780201889543
3	Object Oriented Programming in C++	Lafore,R.	Sams Publication, New Delhi 2015, ISBN:9780672323089
4	C++ The Complete Reference	Schildt, H.	McGraw Hill Professional, New Delhi 2015, ISBN:9780072226805
5	Object Oriented Programming in C++	Subburaj ,R.	Vikas Publication, New Delhi 2015, ISBN:9789325969964
6	C++ Programming	Dr. Rajendra Kawale	Devraj Publications

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm
b. http://www.studytonight.com/cpp/cpp-and-oops-concepts.php
c. https://www3.ntu.edu.sg/home/ehchua/programming/cpp/cp3_OOP.html
d. https://www.hscripts.com/tutorials/cpp/cpp-oops-concepts.php
e. https://www.khanacademy.org/
f. http://www.nptel.ac.in

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Third**

Course Title : **Data Structures Using 'C'**

Course Code : **22317**

1. RATIONALE

Data structure is an important aspect for Computer Engineering and Information Technology Diploma graduates. Data structure is a logical & mathematical model of storing & organizing data in a particular way in a computer. The methods and techniques of Data Structures are widely used in industries. After learning this subject student will be able to identify the problem, analyze different algorithms to solve the problem & choose most appropriate data structure to represent the data.

2. COMPETENCY

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

- **Implement relevant algorithms using Data Structures.**

3. 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. Perform basic operations on arrays.
b. Apply different searching and sorting techniques.
c. Implement basic operations on stack and queue using array representation.
d. Implement basic operations on Linked List.
e. Implement program to create and traverse tree to solve problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

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This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the center of this map.

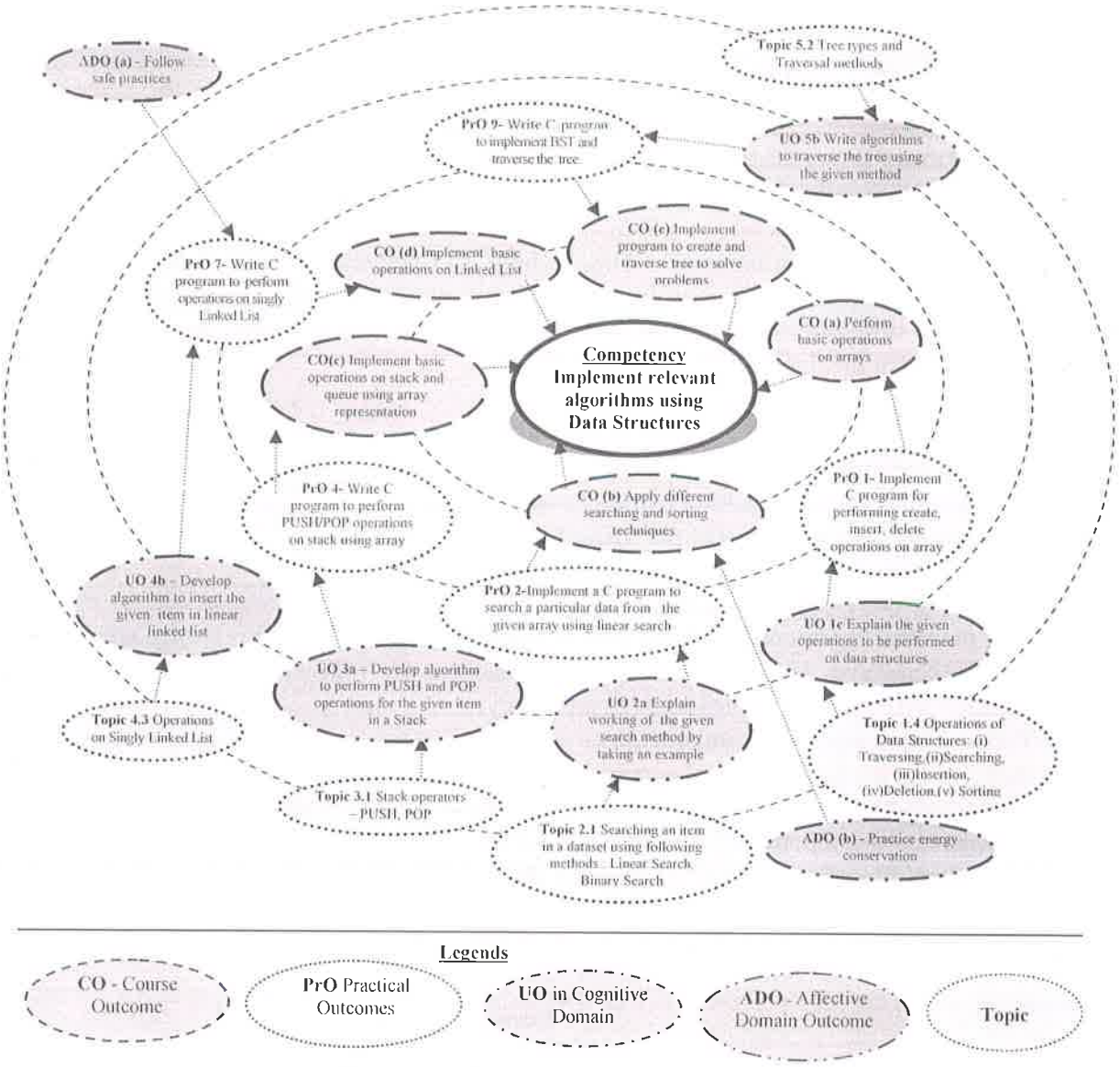

Figure 1 - Course Map

6. 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:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Implement a 'C' program for performing following operations on Array: Creation, Insertion, Deletion, Display	I	02*
2	Implement a 'C' program to search a particular data from the given Array using: (i)Linear Search,	II	02*
3	Implement a 'C' program to search a particular data from the given	II	02*

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S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Array using Binary Search		
4	Implement a 'C' program to sort an array using following methods: (i)Bubble Sort, (ii) Selection Sort (iii) Insertion Sort	II	02*
5	Implement a 'C' program to sort an array using following methods: (ii) Selection	II	02
6	Implement a 'C' program to sort an array using following methods: (iii) Insertion Sort	II	02
7	Write C program to perform PUSH and POP operations on stack using array.	III	02*
8	Write C program to perform INSERT and DELETE operations on Linear Queue using array. Part - I	III	02
9	Write C program to perform INSERT and DELETE operations on Linear Queue using array. Part - II	III	02
10	Write C program to perform INSERT and DELETE operations on Circular Queue using array. Part - I	III	02
11	Write C program to perform INSERT and DELETE operations on Circular Queue using array. Part - II	III	02
12	Write C program to perform the operations (Insert, Delete, Traverse, and Search) on Singly Linked List. Part - I	IV	02*
13	Write C program to perform the operations (Insert, Delete, Traverse, and Search) on Singly Linked List. Part - II	IV	02
14	Write C program to perform the operations (Insert, Delete, Traverse, and Search) on Circular Singly Linked List. Part - I	IV	02*
15	Write C program to perform the operations (Insert, Delete, Traverse, and Search) on Circular Singly Linked List. Part - II	IV	02
16	Write C program to Implement BST (Binary Search Tree) and traverse the tree (Inorder, Preorder, Post order).	V	02*
	Total		**32**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Correctness of data structure representation	20
b.	Correctness of algorithm	35
c.	Debugging ability	10
d.	Quality of input and output displayed	10
e.	Answer to sample questions	15
f.	Submit report in time	10
	Total	**100**

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The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO S. No.
1	Computer system (Any computer system which is available in laboratory)	All
2	'C' Compiler / GCC Compiler	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to Data Structures	1a. Classify the given type of Data Structures based on their characteristics. 1b. Explain complexity of the given algorithm in terms of time and space. 1c. Explain the given operations to be performed on the given type of data structures.	1.1 Concept and need of DS, Abstract Data Type 1.2 Types of Data Structures: (i) Linear Data Structures (ii) Non-Linear Data Structures 1.3 Algorithm Complexity: (i)Time (ii)Space 1.4 Operations on Data Structures: (i) Traversing,(ii)Searching, (iii)Insertion, (iv)Deletion,(v) Sorting
Unit– II Searching and Sorting	2a. Explain working of the given search method with an example. 2b. Write an algorithm to search the given key using binary Search method.	2.1 Searching: searching an item in a data set using following methods: (i) Linear Search (ii) Binary Search 2.2 Sorting: sorting of data set in an order using following methods:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2c. Write an Algorithm to sort data using a specified sorting method. 2d. Explain the working of given sorting method step-by-step with an example and small data set.	(i) Bubble Sort (ii) Selection Sort (iii) Insertion Sort (iv) Quick Sort (v) Radix Sort.
Unit– III Stacks and Queues	3a. Develop an algorithm to perform PUSH and POP operations for the given item in a Stack. 3b. Convert the given expression from Infix to Prefix/Postfix using Stack. 3c. Write steps to evaluate the given expression using the stack. 3d. Develop a program to perform the given operation on a linear Queue. 3e. Write Algorithm to perform the given operations on circular queue.	3.1 **Introduction to Stack** - Stack representation in memory using array - Stack as an ADT - Stack Operations – PUSH, POP - Stack Operations Conditions – Stack Full / Stack Overflow, Stack Empty / Stack Underflow. - Applications of Stack • Reversing a list • Polish notations 3.2 Conversion of infix to postfix expression, Evaluation of postfix expression, Converting an infix into prefix expression, Evaluation of prefix expression , Recursion, Tower of Hanoi 3.3 **Introduction to Queue:** - Queue representation in memory using array - Queue as an ADT - Types of Queues :- Linear Queue, Circular Queue, Concept of Priority Queue - Queue Operations – INSERT, DELETE - Queue Operations Conditions – Queue Full, Queue Empty - Applications of Queue
Unit-IV Linked List	4a. Create relevant structure to represent the given node using linked list. 4b. Develop algorithm to insert the given item in linear linked list. 4c. Develop algorithm to delete the given item from linear linked list 4d. Develop algorithm to traverse a circular linked list.	4.1 Introduction to Linked List Terminologies: node, Address, Pointer, Information field / Data field, Next pointer, Null Pointer, Empty list. 4.2 Type of lists: Linear list, Circular list 4.3 Operations on a singly linked list: Traversing a singly linked list, Searching a key in linked list, Inserting a new node in a linked list, Deleting a node from a linked list
Unit –V Trees and Graphs	5a. Draw Binary Search Tree for the given data set. 5b. Write algorithms to traverse the tree using the	**Introduction to Trees** **5.1** Terminologies: tree, degree of a node, degree of a tree, level of a node, leaf node, Depth / Height of a tree, In-degree & Out-Degree,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	given method. 5c. Construct Expression tree for the given data. 5d. Represent the given Graph using adjacency matrix and adjacency list.	Path, Ancestor & descendant nodes 5.2 Tree Types and Traversal methods Types of Trees: General tree, Binary tree, Binary search tree (BST). Binary tree traversal : In order traversal, Preorder traversal, Post order traversal 5.3 Expression tree. 5.4 Introduction to Graph terminologies: graph, node (Vertices), arcs (edge), directed graph, undirected graph, in-degree, out-degree, adjacent, successor, predecessor, relation, path, sink, articulation point. 5.5 Adjacency List, Adjacency Matrix of directed / undirected graph.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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 Data Structures	04	02	02	02	06
II	Searching and Sorting	08	02	02	08	12
III	Stacks and Queues	16	02	04	14	20
IV	Linked Lists	10	02	04	10	16
V	Trees and Graphs	10	02	04	10	16
Total		**48**	**10**	**16**	**44**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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 of practical.
b. Undertake micro-projects.
c. Prepare a chart to classify Data Structures.
d. Prepare charts for logical representation of Data Structures.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning 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 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.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 a program in 'C' to evaluate an arithmetic expression using Stack with linked list representation.
b. Develop a program in 'C' that creates Queue of given persons. Shift the original position of person to a new position based on its changed priority or remove a person from the Queue using Linked List implementation.
c. Develop a program in 'C' that creates tree to store given data set using linked list representation. Locate and display a specific data from the data set.
d. Develop a 'C' program for performing following banking operations: Deposit, Withdraw and Balance enquiry. Select appropriate data structure for the same.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Data Structures using 'C'	Balgurusamy, E.	McGraw Hill Education, New Delhi 2013, ISBN: 978-1259029547

S. No.	Title of Book	Author	Publication
2	Data Structures using 'C'	ISRD Group	McGraw Hill Education, New Delhi 2013, ISBN: 978-12590006401
3	Data Structures with 'C' (SIE) (Schaum's Outline Series)	Lipschutz	McGraw Hill Education, New Delhi 2013, ISBN: 978-0070701984
4	Practical 'C' programming	Steve Oualline	O'Reilly Media
5	Data Structures	Dr. Rajendra Kawale	Devraj Publications

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/courses/106102064/1
b. www.oopweb.com/algorithms
c. www.studytonight.com/data-structures/
d. www.cs.utexas.edu/users
e. Iiscs.wssu.edu
f. http://www.academictutorials.com/data-structures
g. http://www.sitebay.com/data-structure/c-data-structure
h. http://www.indiabix.com
i. https://www.khanacademy.org/

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/CW**

Semester : **Third**

Course Title : **Computer Graphics**

Course Code : **22318**

1. RATIONALE

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. The emphasis of the course will be placed on understanding how the various elements that underlie computer graphics (algebra, geometry, algorithms) interact in the design of graphics software systems and also enables student to create impressive graphics easily and efficiently.

2. COMPETENCY

The aim of this course is to help the student to attain the following ***industry identified*** competency through various teaching learning experiences:

- **Develop programs using core graphical concepts.**

3. 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. Manipulate visual and geometric information of images.
b. Implement standard algorithms to draw various graphics objects using C program.
c. Develop programs for 2-D and 3-D Transformations.
d. Use projections to visualize objects on view plane.
e. Implement various clipping algorithms.
f. Develop programs to create curves using algorithms.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

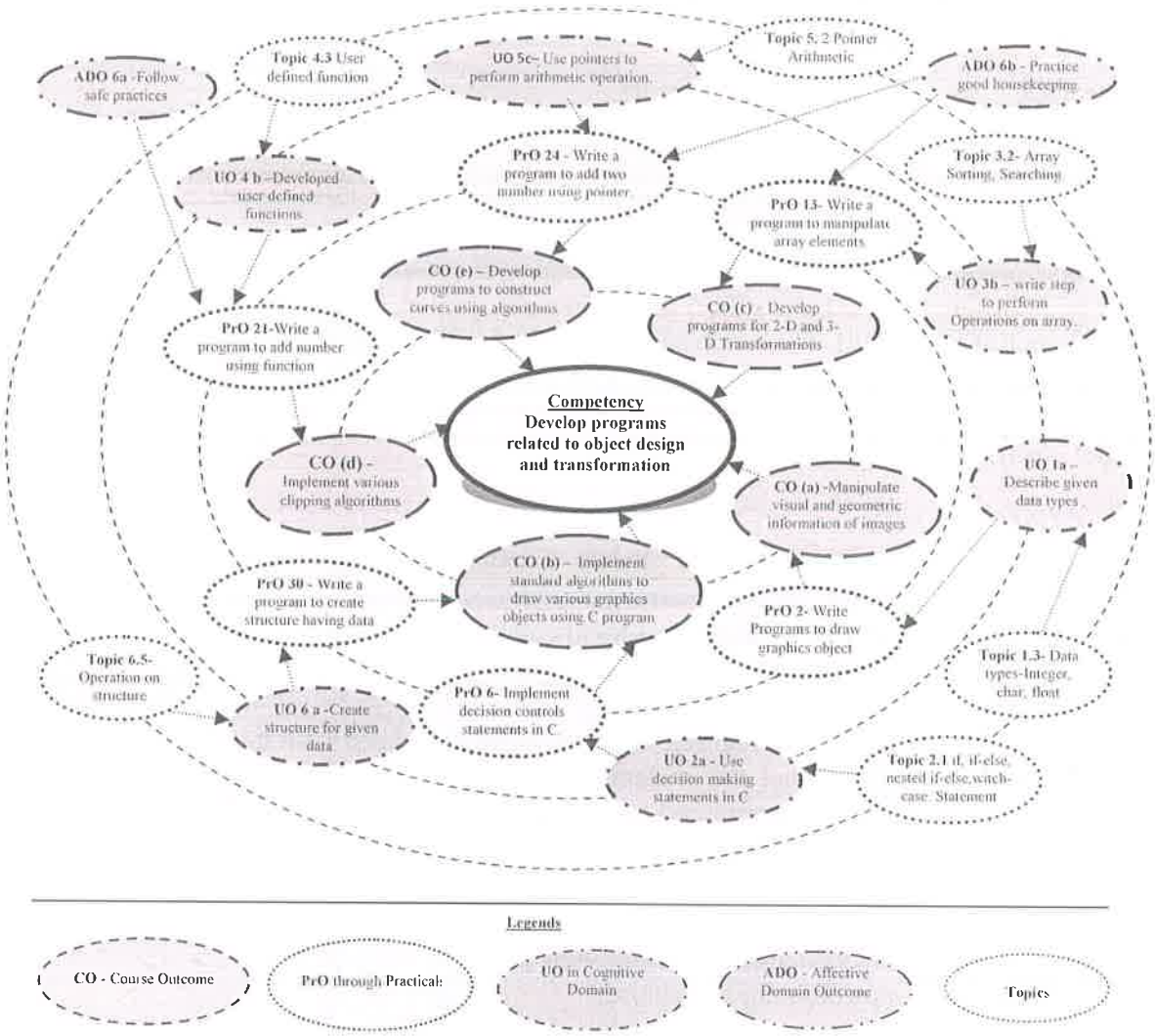

Figure 1 - Course Map

6. 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:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Write Programs to draw following graphics object using built-in "C" functions. i) Pixel ii) Lines iii) Circles iv) Rectangle v) Ellipse	I	02*
2	Implement following algorithms to draw line. i) DDA algorithm	II	02*
3	ii) Bresennham's algorithm	II	02

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S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4	Implement Bresennham's algorithm to draw a circle.	II	02
5	Write a program to fill Polygon using following methods: i) Flood fill	II	02
6	ii) Boundary fill	II	02
7	Write a program for two-dimensional transformation i) Translation ii) Scaling	III	02*
8	iii) Rotation	III	02
9	iv) Reflection v) Shearing	III	02
10	Write a program for three-dimensional transformation i) Translation ii) Scaling	III	02
11	iii) Rotation	III	02
12	Write a program to clip line using following algorithms. Cohen- Sutherland algorithm	IV	02*
13	Write a program to clip line using following algorithms. Cohen Midpoint subdivision algorithm	IV	02
14	Write a program to clip polygon using Sutherland -Hodgeman. Algorithm.	IV	02
15	Write a program to draw (any one) following type of curves. i) Hilbert's Curve	V	02*
16	Write a program to draw (any one) following type of curves. i) Koch curve ii) Bezier curves	V	02*
		Total	**32**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Write program to draw graphics objects.	20
2	Use graphics software tool for programming to create, edit, compile the programs/applications	40
3	Debug, test and execute the programs/applications	20
4	Able to answer oral questions.	10
5	Submission of report in time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Handle command prompt environment.
b. Experiment with graphics environment.
c. Plan, construct, compile, debug and test programs.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. S.No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	For all Experiments
2	Operating system: Windows XP/Windows 7/LINUX onwards.	
3	Software: turbo C with dosbox or Emulated C.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of Computer Graphics	1a. Differentiate attributes of the given mode. 1b. Compare features of the given Scan Display. 1c. Write a program to draw the given type of primitives using "C". 1d. Describe application of the given display device. 1e. Convert the given 2D co-ordinates to physical device co-ordinates.	1.1 Image and Objects, pixel and resolution, Text mode, Graphics mode, Basic Graphics Pipeline, Bitmap and Vector Based Graphics, Applications of Computer Graphics. 1.2 Display Devices: Raster-Scan Display, Random-Scan Display, Flat Panel Display, LED, LCD display, Plasma, Touch screen. 1.3 Output primitives: line, polygon, marker, text. 1.4 Graphics functions and standards. 1.5 Latest trends in Computer Graphics: Virtual reality, Augmented reality.
Unit– II	2a. Write a program to draw a	2.1 Basic concepts in line drawing: Line

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Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Raster Scan Graphics	line using the given algorithm. 2b. Use the given algorithm to rasterize the given line. 2c. Apply the given algorithm to generate the circle. 2d. Draw the Polygon using the given algorithm. 2e. Apply character generation method to display the given character.	drawing algorithms: Digital Differential Analyzer (DDA) algorithm, Bresenham's algorithm. 2.2 Circle generating algorithms: Symmetry of circle, Bresenham's circle drawing algorithm. 2.4 Polygons – Types of polygons, inside –outside test, Polygon Filling : Seed fill algorithms: Flood fill, Boundary fill, scan line algorithms 2.5 Scan conversion, Frame Buffers. 2.6 Character generation methods: stroke, starburst, bitmap.
Unit– III Overview of Transformations	3a. Perform the given operation in 2D transformation. 3b. Perform the given operation in 3D transformation. 3c. Solve the given problem based on Composite Transformations. 3d. Apply the given type of projection on object.	3.1 Two Dimensional Transformations: Translation, Scaling, Rotation, Reflection, Shearing. 3.2 Matrix representations and homogeneous coordinates: Translation Scaling, Rotation, Reflection, Shearing. 3.3 Composite Transformations- rotation about an arbitrary point. 3.4 Three dimensional transformations: Translation, Scaling, Rotation. 3.5 Types of Projections: Perspective and Parallel projection.
Unit-IV Windowing and clipping	4a. Apply Window to-viewport transformation on the given object, 4b. Write a program using the given line clipping algorithms. 4c. Apply the given line clipping algorithms to clip the line. 4d. Apply text clipping on the given text. 4e. Write a program using the given polygon clipping algorithm.	4.1 Windowing and clipping concepts: Window to-viewport transformation. 4.2 Line clipping: Cohen Sutherland clipping algorithm, Cyrusbeck, Liang Barsky, Midpoint subdivision. 4.3 Polygon clipping: Sutherland -Hodgeman. 4.4 Text clipping.
Unit –V Introduction to Curves	5a. Describe the given curve generation methods. 5b. Draw curve using the given curve algorithms. 5c. State properties of the given curve. 5d. Generate arc using the given algorithm.	5.1 Curve generation: Arc generation using DDA algorithm, Interpolation 5.2 Types of curves: Hilbert's Curve, Koch curve, B-Spline, Bezier curves.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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 Computer Graphics	06	04	04	-	08
II	Raster Scan Graphics	12	02	06	10	18
III	Overview of Transformations	12	02	06	10	18
IV	Windowing and clipping	10	-	06	08	14
V	Introduction to Curves	08	-	04	08	12
Total		**48**	**8**	**26**	**36**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. 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. Draw perspective and parallel projection for any object on view plane.
c. Give seminar on relevant topic.
d. Prepare power point presentation or animation for showing different types of graphics Applications.
e. Undertake a market survey of different graphics application and compare with the following points.
    i. Available Applications.
    ii. Application Profile.

11. 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. ***'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 COs through classroom presentations (see implementation guideline for details).

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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.
f. No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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) Program to Design Flying Balloons - Each group will design balloons using pieslice (), ellipse () functions and apply delay operation of process.h header file.
b) Program to Display a moving car.
c) Develop a miniature tic-tac-toe game.
d) Design an analog clock.
e) Design a rotating fan.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computer Graphics	Donald Hearn , Baker M.Pauline	Pearson Education , New Delhi June 2012, , ISBN:817758765X.
2	Computer Graphics	Maurya Rajesh K.	Wiley-India 2011, Delhi ISBN: 978-81-265-3100-4.
3	Computer Graphics	Dr. Chopra Rajiv	S.Chand 2016, New Delhi. ISBN: 978-93-856-7633-8.
4	Computer Graphics principles and practices	Foley James	Pearson Education. New Delhi 2014, ISBN:978-0-321-39952-6.

14. SOFTWARE/LEARNING WEBSITES

a. https://www.tutorialspoint.com/computer_graphics
b. http://www.dailyfreecode.com/tutorial_simple_cpp-16/computer-graphics-215.aspx
c. http://www.newtechnologysite.com/graphics.html
d. http://www.nptelvideos.in/2012/11/computer-graphics.html
e. https://www.khanacademy.org/

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Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/CW**

Semester : **Third**

Course Title : **Database Management System**

Course Code : **22319**

1. RATIONALE

Each and every organization like shopping mall, hospital, banking, institutes, industry needs to share huge amount of data in effective manner. This course aims to develop skills in students to create, store, modify, manage and extract information from a database. Database system can be used as a backend for developing database applications.

2. COMPETENCY

The aim of this course is to help the student to attain the following ***industry identified*** competency through various teaching learning experiences:

- **Apply Database management concept using SQL.**

3. 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. Design Normalized database on given data.
b. Create and Manage Database using SQL command.
c. Write PL/SQL code for given database.
d. Apply triggers ob database also create procedure and function according to condition.
e. Apply security and confidentiality on given Database.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	2	2	8	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

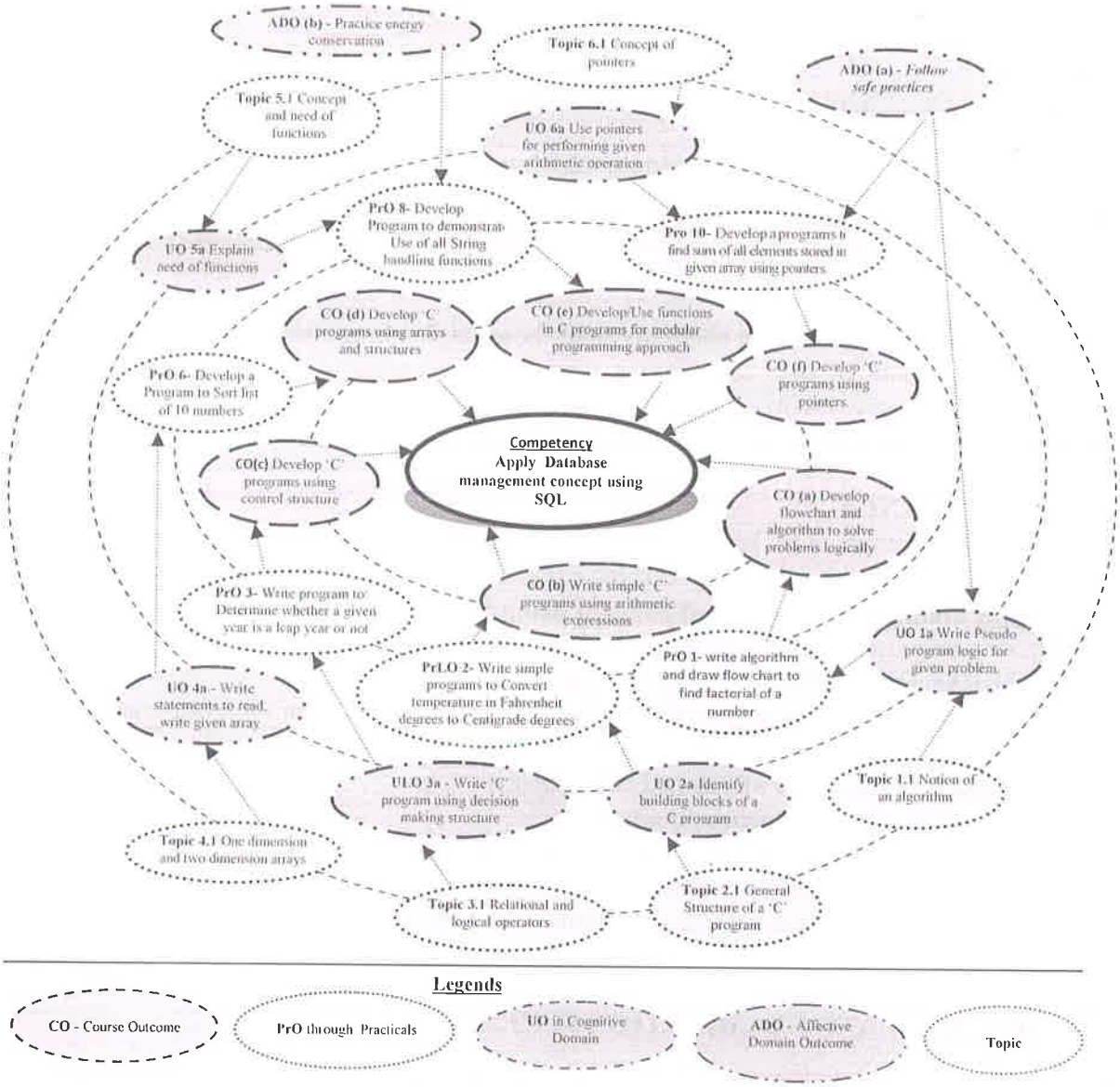

Figure 1 - Course Map

6. 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:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Perform following in GUI based database software using GUI only i) Create Database ii) Create tables and assign primary key . iii) Modify the table structure-add column ,change the data type of column, delete the column from table. iv) Insert, update and delete the record from table. v) Retrieve data from the table according to condition given.	II	02*
2	Perform following in GUI based database using GUI only	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	i) Apply given validation on table and set error messages. ii) Set default value for column. iii) Set and remove database password.		
3	Design E-R diagram and Create Normalized Database on given data.	II	02
4	i) Create and Execute DDL commands using SQL. ii) Apply following Integrity constraints on table: iii) Primary key, Foreign key, Unique key constraint, Null , Not Null and Check constraint.	II	02*
5	Create and Execute DML commands using SQL.	II	02*
6	Write Queries using following operators: Arithmetic Operators, Comparison Operators,Logical Operators, Set Operators, Range Searching operators-Between, Pattern matching operators-Like.	II	02*
7	Write Queries using following Functions: String, Arithmetic, Date and time, Aggregate Functions.	III	02*
8	Execute Queries using the Select command with Where, Having, Group by and order by clauses.	III	02*
9	Execute the queries for implementation of Inner and Outer Join.	III	02
10	Implement Views i) Create different views ii) Insert, modify and delete records through views. iii) Delete the views.	III	02
11	Create and Execute Indexes, Sequences, and synonyms in SQL.	III	02*
12	Write a PL/SQL programs using if then else, for, while and nested loop.	IV	02*
13	Write a PL/SQL code to implement implicit and explicit cursors.	IV	02
14	Write PL/SQL Programs based on Exceptions handling.(Predefined and user-defined exceptions)	IV	02
15	Write PL/SQL code to create Procedures and functions.	IV	02
16	Write PL/SQL code to create triggers on given database.	IV	02
17	Executing DCL commands using SQL i) Create users ii) Grant privileges to users iii) Revoke privileges from users.	V	02*
	Total		**34**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %

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S. No.	Performance Indicators	Weightage in %
a.	SQL queries and PL/SQL programming	60
b.	Database Integrity	10
c.	Quality result displayed by SQL queries.	10
d.	Answer to sample questions	10
e.	Submit report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
1	Computer system (Any computer system with basic configuration)	All
2	Any GUI based database software (MS-Access/Visual Foxpro/MySQL)	1-2
3	Any RDBMS software (MySQL/SQL server)	3-16

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Database System Concept	1a State the importance of DBMS over file processing in the given situation. 1b Describe the overall structure of the given	1.1 Concept of Data, database, DBMS, advantages of DBMS over file processing system, Application of database. 1.2 Three level Architecture for Database System. 1.3 Data abstraction: Different levels of Data

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	DBMS 1c Identify the relevant database model in the given situation. 1d Draw the E-R diagram of the given database and identify relationship between the entities.	abstraction, Instance and schema, Data independence - Logical and Physical Independence. 1.4 Overall Structure of DBMS. 1.5 Data Modeling: Record based logical model- Relational, Network, Hierarchical 1.6 Data Modeling Using the E-R Model: Entity Relationship Model , Strong Entity set, Weak Entity set, Types of Attributes, E-R Diagrams.
Unit– II Relational Data Model	2a Explain the concept of RDBMS also appropriateness for the given problem. 2b Design Normalized database structure in the given problem. 2c Design SQL queries to create Relational database and apply in the given data constraints. 2d Identify the operators for queries implementation of the given problem.	2.1 Fundamentals of RDBMS – Record, fields, data types, tables and database 2.2 Concept of RDBMS, E.F.Codd's Rule for RDBMS, Key concepts- Candidate key, Primary key, Foreign key. 2.3 Normalization: Normalization Concepts, Need of Normalization, Types of Normalization- 1NF,2NF,3NF 2.4 Introduction to Structured Query Language, Data Types in SQL, components of SQL- DDL,DML,DCL,DQL 2.5 DDL Commands: CREATE, ALTER, DROP, TRUNCATE, DESC, RENAME 2.6 Data Integrity Constraint: Types of Data Integrity Constraint: I/O constraint- Primary key, Foreign key, Unique key constraint, Business Rule Constraint-Null, Not Null and Check constraint. 2.7 DML Commands: INSERT, UPDATE, DELETE 2.8 DCL Commands: COMMIT, SAVEPOINT, ROLLBACK, GRANT, and REVOKE. 2.9 DQL Commands: SELECT. 2.10 SQL Operators: Arithmetic Operators, Comparison Operators, Logical Operators, Set Operators, Range Searching operators- Between, Pattern matching operators-Like.
Unit III- Interactive SQL and Advance SQL: SQL Performanc e Tuning	3a. Write the given queries using relevant functions. 3b. Write query to combine the given multiple table using Join. 3c. Design SQL queries to implement VIEWS	3.1 In-built Functions: String, Arithmetic, 3.2 Date and time, Aggregate functions. 3.3 Queries using Group by, having, and Order by clause, Joins-Inner and Outer Join, Sub queries. 3.4 Views: Concept of View, The Create View Command, Updating Views, Views and Joins, Views and Sub queries, Dropping Views. 3.5 Sequences: Creating Sequences, Altering

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	on the given tables. 3d. Apply and drop INDEXES and SYNONYM on the given table.	Sequences, Dropping Sequences. 3.6 Indexes: Index Types. Creating of an Index: Simple Unique, and 3.7 Composite Index, Dropping Indexes 3.8 Synonyms: Creating Synonyms, Dropping Synonyms.
Unit IV- PL/SQL Programming	4a. Write simple PL/SQL Code using control structure and handle various exceptions in the given situation. 4c. Create cursor for retrieving multiple records in the given situation. 4d. Create and Execute stored procedures and functions in the given situation. 4e. Create and apply database trigger using PL/SQL in the given situation.	4.1 Introduction of PL/SQL, Advantages of PL/SQL, The PL/SQL Block Structure, PL/SQL execution environment, PL/SQL data Types, Variables, Constants. 4.2 Control Structure: Conditional Control, Iterative Control, Sequential Control. 4.3 Exception handling: Predefined Exception, User defined Exception. 4.4 Cursors: Implicit and Explicit Cursors, Declaring, Opening and Closing a Cursor, Fetching a Record from Cursor, Cursor for loops, Parameterized Cursors. 4.5 Procedures: Advantages, Creating, Executing and Deleting a Stored Procedure. 4.6 Functions: Advantages, Creating, Executing and Deleting a Function. 4.7 Database Triggers: Use of Database Triggers, How to apply database Triggers, Types of Triggers, Syntax for Creating Trigger, Deleting Trigger.
Unit V- Database security and Transaction Processing	5a. Provide security to the given database by assigning various privileges to the user. 5b. Create and manage the given database Users. 5c. Explain the importance of Transaction in the given situation. 5d. Explain advantages of Database Backup and Recovery in the given situation.	5.1 Database security: Introduction to database security, Data security Requirements, Types of Database Users-Creating, altering and Deleting Users. 5.2 Protecting the data within database-Database Privileges: Systems privileges and object Privileges, Granting and Revoking Privileges: Grant and Revoke command. 5.3 Transaction: Concept, Properties and States of Transaction. 5.4 Database Backup -Types of Failures, Causes of failures. Database Backup Introduction, Types of Database Backups-Physical and Logical. 5.5 Database Recovery-Recovery concept, Recovery Techniques-Roll forward, Rollback,

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

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Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Database System Concepts	10	04	04	04	12
II	Relational Data Model	16	02	04	12	18
III	Interactive SQL and Advance SQL: SQL Performance Tuning	14	02	04	08	14
IV	PL/SQL Programming	14	02	04	10	16
V	Database security and Transaction Processing	10	02	04	04	10
Total		**64**	**12**	**20**	**38**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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 of practical.
b. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning 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 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.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab..

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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. Survey on various database System Software and compare it.
b. Design E-R Diagram for Hospital/college/medical/Jewellery Shop/Library/Blood Bank.
c. Design Normalized Database for Hospital/college/medical/Jewellery Shop / Library / Blood Bank.
d. Apply trigger on given database.
e. Create procedure and function according to given condition.
f. Any other micro-projects suggested by subject faculty on similar line.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Introduction to Database Management Systems	ISRD Group	McGraw Hill Education, New Delhi, 2015
2	Introduction to Relational databases & SQL programming	Allen	McGraw Hill Education, New Delhi, 2015
3	Database System Concepts McGraw Hillin ANSI C	Korth	McGraw Hill Education, New Delhi, 2015
4	Complete Reference:Mysql	Vikram Vaswani	McGraw Hill Education, New Delhi, 2015

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.tutorialpoint.com (Important website)
b. wielyIndia.com or DreamtechPress.com
c. http://phindia.com/gupta/chapter/chapter1.pdf
d. www.williamstannings.com
e. www.nptel.ac.in
f. https://www.khanacademy.org/

Program Name : **Computer and Electronics Engineering Program Group**

Program Code : **CO/CM/CW/DE/EJ/ET/EN/EX/EQ/IE/IS/IC/MU**

Semester : **Third**

Course Title : **Digital Techniques**

Course Code : **22320**

1. RATIONALE

In the present scenario most of the electronic equipment like computers, mobiles, music systems, ATM, automation and control circuits and systems are based on digital circuits which the diploma electronic engineering passouts (also called technologists) have to test them. The knowledge of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs will enable the students to interpret the working of equipment and maintain them. After completion of the course, students will be able to develop digital circuits based applications.

2. COMPETENCY

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

- **Build/ test digital logic circuits consist of digital ICs.**

3. 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. Use number system and codes for interpreting working of digital system.
b. Use Boolean expressions to realize logic circuits.
c. Build simple combinational circuits.
d. Build simple sequential circuits.
e. Test data converters and PLDs in digital electronics systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical				
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends:* L**-*Lecture;* **T** – *Tutorial/Teacher Guided Theory Practice;* **P** - *Practical;* **C** – *Credit,* ***ESE - *End Semester Examination;* ***PA*** - *Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

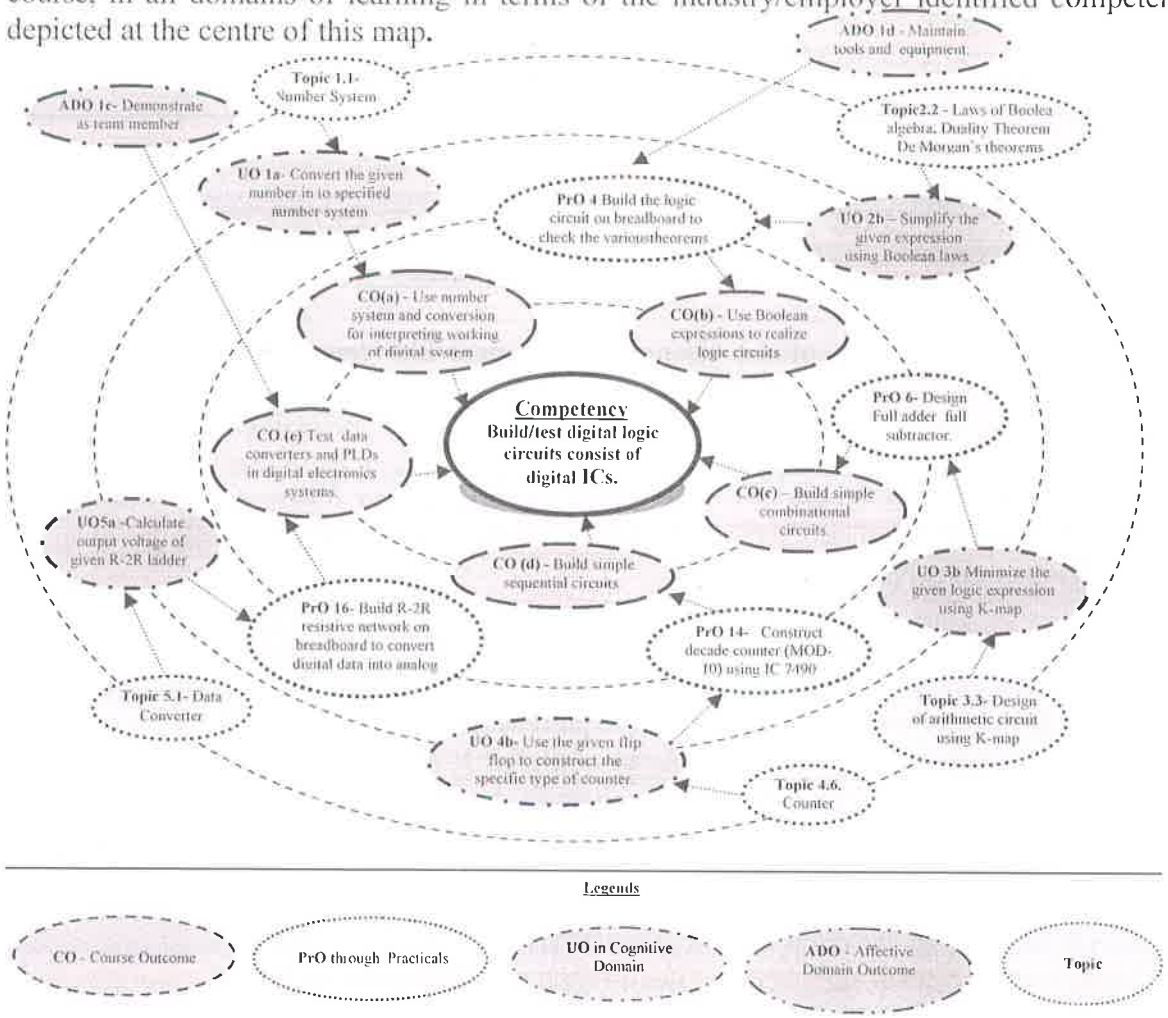

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Test the functionality of specified logic gates using breadboard. (IC 7404, 7408, 7432, 7486)	II	02*
2	Test the functionality of NAND and NOR gate of using breadboard (IC 7400 and 7402)	II	02
3	Construct AND, OR, NOT gates using universal gates.	II	02
4	Build the logic circuit on breadboard to check the De Morgan's theorems.	II	02
5	Design Half adder and Half subtractor using Boolean expressions.	III	02*
6	Design Full adder and full subtractor.	III	02
7	Construct and test BCD to 7 segment decoder using IC 7447/ 7448.	III	02
8	Build / test function of MUX 74151/74150/any other equivalant.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
9	Build / test function of DEMUX 74155/74154/any other equivalant.	III	02
10	Build / test function of RS flip flop using NAND Gate.	IV	02*
11	Build / test function of MS JK flip flop using 7476.	IV	02
12	Use IC 7476 to construct and test the functionality of D and T flip flop.	IV	02
13	Implement 4 bit ripple counter using 7476.	IV	02
14	Use IC 7490 to construct decade counter (MOD-10).	IV	02
15	Implement 4 bit universal shift register.	IV	02
16	Build R-2R resistive network on breadboard to convert given digital data into analog.	V	02*
		Total	**32**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year

- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Digital Multimeter: 3 and ½ digit with R, V, I measurements, diode and BJT testing.	All
2	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz X10 magnification 20 ns max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out.	16
3	Pulse Generator: TTL pulse generator	10-15
4	DIGITAL IC tester: Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	1-15
5	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable , digital voltmeter , ammeter, LED indicators 8 no, logic input switches 8 no, 7 segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points, Potentiometer, relay etc	1-15
6	Trainer kits for digital ICs: Trainer kit shall consists of digital ICs for logic gates, flop-flop, shift registers, counter along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	1-15
7	Regulated power supply: Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1-16
8	Trainer kit for 4 bit Counter using Flip Flops: 4 bit ripple counter, Synchronous Counter, IC 7476 based circuit. Input given by switches and output indicated on LED. Facility to select MOD 8 or MOD 16 mode. Built in DC power supply and manual pulser with indicator.	13

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Number System and Codes	1a. Convert the given number into the specified number system. 1b. Perform the binary arithmetic operation on the given binary numbers. 1c. Convert the given coded number into the other specified code.	1.1 Number System: base or radix of number system, binary, octal, decimal and hexadecimal number system. 1.2 Binary Arithmetic: Addition, subtraction, multiplication, division. 1.3 Subtraction using 1's complement and 2's complement. 1.4 Codes: BCD, Gray Code, Excess-3, and ASCII code.

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Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Add the given two decimal numbers using BCD code.	1.5 BCD Arithmetic: BCD Addition
Unit – II Logic gates and logic families	2a. Develop the basic gates using the given NAND/NOR gate as universal gate. 2b. Simplify the given expression using Boolean laws. 2c. Develop logic circuits using the given Boolean expressions. 2d. Compare the salient characteristics of the given digital logic families.	2.1 **Logic gates**: Symbol, diode/ transistor switch circuit and logical expression , truth table of basic logic gates (AND, OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR),Tristate logic 2.2 **Boolean algebra**: Laws of Boolean algebra, Duality Theorem, De-Morgan's theorems 2.3 **Logic Families**:Characteristics of logic families : Noise margin, Power dissipation, Figure of merit , Fan-in and fan-out, Speed of operation, Comparison of TTL, CMOS, types of TTL NAND gate
Unit– III Combinational Logic Circuits	3a. Develop logic circuits in standard SOP/ POS form for the given logical expression. 3b. Minimize the given logic expression using K-map. 3c. Use IC 7483 to design the given adder/ subtractor. 3d. Draw MUX/DEMUX tree for the given number of input and output lines. 3e. Write the specifications of the component for the given application. 3f. Develop the specified type of code converter.	3.1 **Standard Boolean representation:** Sum of Product (SOP) and Product of Sum(POS), Min-term and Max-term, conversion between SOP and POS forms, realization using NAND /NOR gates 3.2 **K-map reduction technique for the Boolean expression:** Minimization of Boolean functions up to 4 variables (SOP and POS form) 3.3 **Design of arithmetic circuits and code converter using K-map:** Half and full Adder, half and full Subtractor , gray to binary and binary to gray (up to 4 bits) 3.4 **Arithmetic circuits:** (IC 7483) Adder and Subtractor, BCD adder 3.5 **Encoder/Decoder:** Basics of encoder, decoder, comparison, (IC 7447) BCD to 7 segment decoder/driver 3.6 **Multiplexer and Demultiplexer:** working , truth table and applications of Multiplexers and Demultiplexures, MUX tree, IC 74151as MUX; DEMUX tree, DEMUX as decoder, IC 74155 as DEMUX 3.7 **Buffer:** Tristate logic, unidirectional and bidirectional buffer (IC74LS244,74LS245)

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– IV Sequential Logic Circuit	4a. Use relevant triggering technique for the given digital circuit. 4b. Use the given flip-flop to construct the specific type of counter. 4c. Use excitation table of the given flip-flop to design synchronous counter. 4d. Design the specified modulo-N counter using IC7490. 4e. Construct ring/ twisted ring counter using the given flip-flop.	4.1 **Basic memory cell**: RS-latch using NAND and NOR 4.2 **Triggering Methods:** Edge trigger and level trigger 4.3 **SR Flip Flops**: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks of SR flip flop 4.4 **JK Flip Flops**: Clocked JK Flip flop with preset and clear, race around condition in JK flip flop, Master slave JK flip flop, D and T type flip flop Excitation table of flip flops, Block schematic and function table of IC-7474, 7475 4.5 **Shift Register**: Logic diagram of 4-bit Shift registers – Serial Input Serial Output, Serial Input Parallel Output, Parallel Input Serial Output, Parallel Input Parallel Output, 4 Bit Universal Shift register **4.6 Counters:** Asynchronous counter: 4 bit Ripple counter, 4 bit up/down Counter, modulus of counter Synchronous counter: Design of 4 bit synchronous up/down counter Decade counter: Block schematic of IC 7490 Decade counter, IC 7490 as MOD-N Counter, Ring counter, Twisted ring counter
Unit– V Data Converters and PLDs	5a. Calculate the output voltage of the R-2R ladder for the given specified digital input. 5b. Calculate the output voltage of the weighted resistor DAC for the given specified digital input. 5c. Explain with sketches the working principle of the given type of ADC. 5d. Explain with sketches the working principle of the given types of memories. 5e. Explain with basic block diagram the working principle of the given type of programmable logic device.	5.1 **Data Converter**: DAC: Types, weighted resistor circuit and R-2R ladder circuit, DAC IC 0808 specifications ADC: Block Diagram, types, and working of Dual slope ADC, SAR ADC, ADC IC 0808/0809, specification 5.2 **Memory**: RAM and ROM basic building blocks, read and write operation ,types of semiconductor memories 5.3 **PLD:** Basic building blocks and types of PLDs, PLA, PAL, GAL 5.4 CPLD: Basic Building blocks, functionality.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	Number System	06	2	2	4	08
II	Logic gates and logic families	10	4	4	4	12
III	Combinational Logic Circuits	16	4	6	8	18
IV	Sequential Logic Circuit	16	4	6	8	18
V	Data Converters and PLDs	16	4	4	6	14
Total		**64**	**18**	**22**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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 the survey report on the applications of different types of number system and code converters used in the design of digital system.
b. Compare technical specifications and applications of various types of memory, PLDs, CPLDs and Prepare report.
c. Test digital IC's using various testing equipment like digital IC tester, Digital multi-meter etc.
d. Give seminar on any course relevant topic.
e. Conduct library / internet survey regarding different data sheet and manuals.
f. Prepare power point presentation on digital circuits and their applications.
g. Undertake a market survey of different digital IC's required for different applications.
h. Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning 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 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***.

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e. Guide student(s) in undertaking micro-projects.
f. PPTs/Animations may be used to explain the construction and working of electronic circuits.
g. Guide students for using data sheets / manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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. Micro project report may be of four to five pages.

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

a. Build a Digital IC tester circuit.
b. Build a 4bit parity generator and parity checker circuit.
c. Build a circuit to implement 4 bit adder.
d. Build a circuit to test 7 segment display.
e. Build a circuit to implement debounce switch.
f. Build a circuit for LED flasher.
g. Build a circuit for LED BAR display
h. Design and analyze digital arithmetic circuit

Note: *Use general purpose PCB for making micro projects*

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009 ISBN: 9780070669116
2	Digital Circuits and Design	Salivahanan S.; Arivazhagan S.	Vikas Publishing House, New Delhi, 2013, ISBN: 9789325960411
3	Digital Electronics	Puri, V.K.	McGraw Hill , New Delhi, 2016, ISBN: 97800746331751
4	Digital Principles	Malvino, A.P.; Leach, D.P.; Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405
5	Digital Design	Mano, Morris; Ciletti, Michael D.	Pearson Education India, Delhi, 2007, ISBN: 9780131989245
6	Digital Electronics, Principles and Integrated Circuits	Maini, Anil K.	Wiley India, Delhi, 2007, ISBN: 9780470032145

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S. No.	Title of Book	Author	Publication
7	Digital Fundamentals	Floyd, Thomas	Pearson Education India, Delhi, 2014, ISBN : 9780132737968

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.cse.yorku.ca/~mack/1011/01.NumberSystems.ppt
b. www.people.sju.edu/~ggrevera/arch/slides/binary-arithmetic.ppt
c. www.mathsisfun.com/binary-number-system.html
d. www.codesandtutorials.com/hardware/electronics/digital_codes-types.php
e. www.ee.surrey.ac.uk/Projects/Labview/gatesfunc/
f. www.ee.surrey.ac.uk/Projects/Labview/boolalgebra/
g. www.eng.auburn.edu/~strouce/class/elec2200/elec2200-8.pdf
h. www.maxwell.ict.griffith.edu.au/yg/teaching/dns/dns_module3_p3.pdf
i. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
j. www.eng.wayne.edu/~singhweb/seql.ppt
k. www.cs.sjsu.edu/faculty/lee/Ch2Problems2.ppt
l. www.rogtronics.net/files/datasheets/dac/SedraSmith.pdf
m. www-old.me.gatech.edu/mechatronics_course/ADC_F04.ppt
n. www.allaboutcircuits.com/vol_4/chpt_13/3.html
o. www.youtube.com/watch?v=5Wz5f3n5sjs
p. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
q. www2.cs.siu.edu/~hexmoor/classes/CS315-S09/Chapter9-ROM.ppt
r. www.cms.gcg11.org/attachments/article/95/Memory2.ppt
s. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
t. www.webopedia.com/TERM/R/RAM.html
u. www.cs.sjsu.edu/~lee/cs147/Rahman.ppt

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Maharashtra State Board of Technical Education, Mumbai

Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Computer Engineering Groups

Program Code : CO/CM/CW **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters **Duration : 16 Weeks**

Semester : Fourth **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Java Programming	JPR	22412	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
2	Software Engineering	SEN	22413	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Data Communication and Computer Network	DCC	22414	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Microprocessors	MIC	22415	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	GUI Application Development using VB.Net	GAD	22034	2	-	4	6	--	--	--	--	--	--	--	50#	20	50~	20	100	40	100
			Total	**16**	**-**	**14**	**30**	--	**280**	--	**120**	--	**400**	--	**175**	--	**175**	--	**350**	--	**750**

Student Contact Hours Per Week: **30 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **750**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**
- **In-Plant Training during Summer vacation for minimum Six Weeks at the end of Fourth Semester (Second Year).**

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Fourth**

Course Title : **GUI Application Development using VB.Net**

Course Code : **22034**

1. RATIONALE

VB.NET is the programming language based on Object Oriented Concepts which is prominently used to develop GUI based Applications. Graphical User Interface (GUI) based application includes various user friendly controls to accept or display data. This course will give the students an in-depth understanding of the concepts used in VB .NET and necessary skills to use programming techniques to develop .NET based applications and deploy the same.

2. COMPETENCY

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

- **Develop GUI based application using VB.net.**

3. 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. Use Visual Studio IDE to design application.
b. Develop GUI Application using Form Controls and its events.
c. Apply Object Oriented concepts in GUI Application.
d. Use Data access controls to store data in Database and retrieve it.
e. Use Data Binding in GUI Application.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
2	-	4	6	--	--	--	--	--	--	--	50#	20	50~	20	100	40	

'#':No practical Examination, *(~[2]): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment, **'#':** No Theory Examination

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course. in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

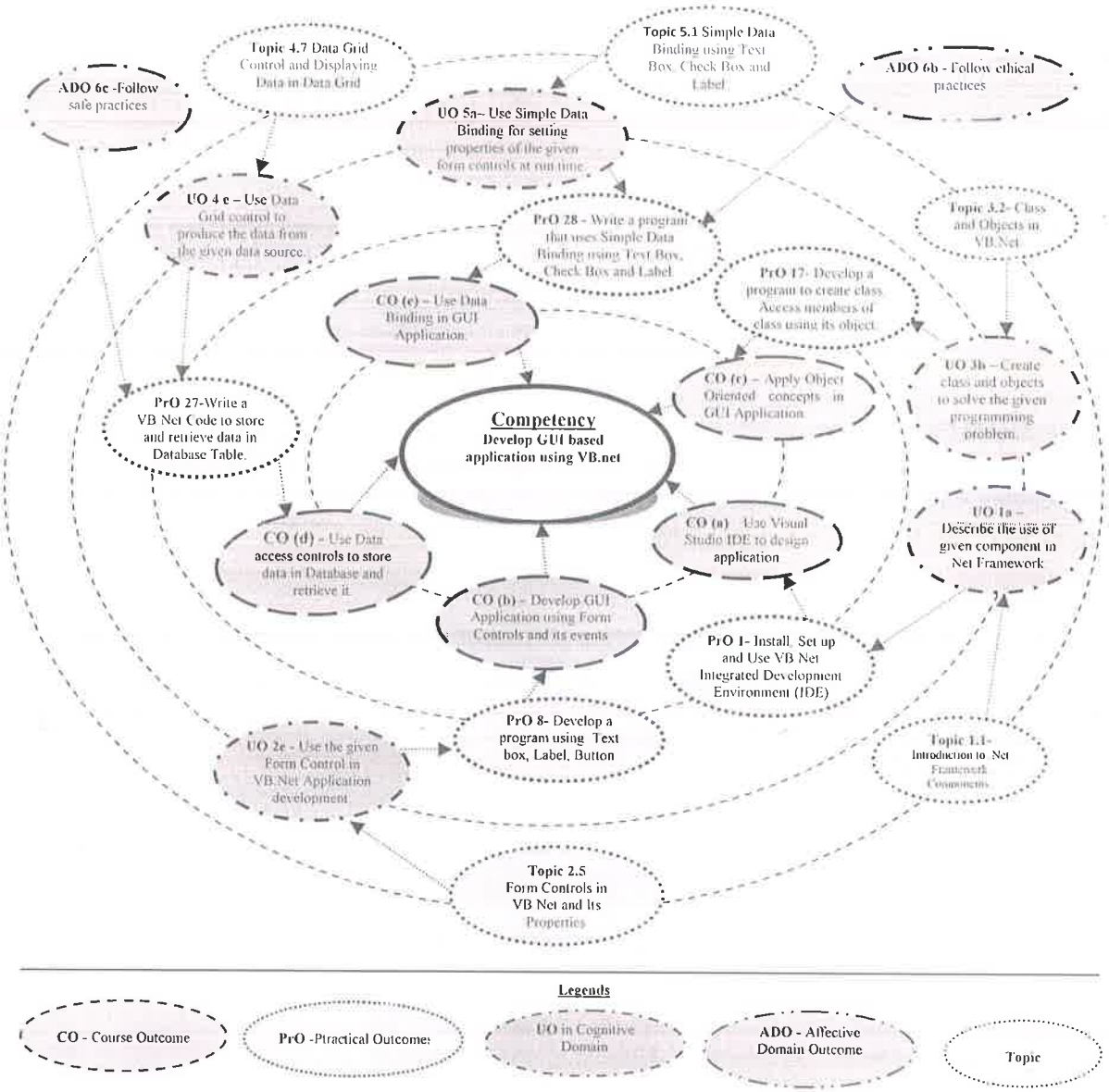

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Install, Set up and Use VB.Net IDE (Integrated Development Environment).	I	
2.	Use Existing Namespaces and Create user defined Namespace in VB.Net.	I	

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
3.	(a) Write a simple program to display a welcome message using *msgbox()*. (b) Develop programs to solve Arithmetic expressions.	II	02*
4.	Develop programs to demonstrate use of *IF*, *IF-else* Control structures in VB.net.	II	02*
5.	Develop programs to demonstrate use of *Case* Control structures in VB.net.	II	02*
6.	Develop programs to demonstrate use of *While, DO Loops* in VB.net.	II	02*
7.	Develop programs to demonstrate use of *For, For-each* Loops in VB.net.	II	02*
8.	Develop a program using Text box, Label, Button	II	02*
9.	Develop a program using Radio button, check box,	II	02*
10.	Develop a program using List box, Combo box.	II	02*
11.	Write a program using Picture Box, Panel.	II	02*
12.	Write a program using Tab Control, and Timer.	II	02*
13.	Write a program to perform validation using regular expression and error provider.	II	02*
14.	Write a program to perform validation using regular expression and error provider.	II	02*
15.	Write a program to demonstrate use of Sub-procedures and Parameterized Sub-Procedures.	III	02
16.	Write a program to demonstrate use of Simple function and parameterized Functions.	III	02*
17.	Develop a program to create class. Access members of class using its object.	III	02*
18.	Create constructor to initialize object of class. Use Destructor to de-allocate memory using *finalize* method.	III	02*
19.	Develop a program to inherit members of super class in sub class using simple inheritance.	III	02*
20.	Develop a program to demonstrate Overloading a method	III	02*
21.	Develop a program to demonstrate Overriding in inheritance	III	02*
22.	Develop a program to demonstrate Shadowing in inheritance		02
23.	Construct a program to handle runtime errors by using Exception handling.	III	02*
24.	Write a program to fetch data from table and display in Data Grid.	IV	02*
25.	Write a program to perform following operation using Data Adapter: Fill and Update data in Database.	IV	02*
26.	Write a program to perform following operation using Data Adapter: Fetch data from multiple tables in Dataset.	IV	02
27.	Write a VB.Net Code to store and retrieve data in Database Table.	IV	02*
28.	Write a program that uses Simple Data Binding using Text Box, Check Box and Label.	V	02*
29.	Write a program that uses Complex Data Binding using Combo	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Box.		
30.	Write a program that uses Complex Data Binding using List Box.	V	02
31.	Write a program to Navigate across existing data in table.	V	02
32.	Create Executable file of VB.Net Application and Deploy it to other computer.	V	02*
	Total		**64**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Use of relevant VB.Net tool to design given GUI application.	20
2	Write appropriate code to generate desired output in GUI Application.	30
3	Debug, test and execute the programs/modules.	30
4	Able to answer oral questions.	10
5	Submission of report in time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO S. No.

S. No.	Equipment Name with Broad Specifications	PrO S. No.
1	Personal computer, (preferably i3-i5 processor based), RAM minimum 2 GB, Hard disk 10 GB minimum available space.	For all Experiments
2	Operating system: Windows 7/8/10	
3	Microsoft Visual Studio 2012 or later.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of GUI Programming	1a. Describe use of the given component in .Net Framework. 1b. Describe use of use the given element in VB.Net IDE. 1c. Apply the given System Namespace in VB.net Application. 1d. Create Event Handler to respond to the given event.	1.1 Introduction to .Net Framework Components. i. Common Language Runtime (CLR) ii. Microsoft Intermediate Language (MSIL) iii. Just-In-Time Compiler 1.2 Exploring VB.Net IDE 1.3 System Namespaces in VB.Net 1.4 Events and Event handling
Unit– II Decision control and Loop control	2a. Select relevant data type for the given problem with justification. 2b. Write expression using operators for the given VB.Net Application. 2c. Use relevant control structure to apply the given criteria for decision making and branching. 2d. Implement relevant type of loop to solve the given iterative problem. 2e. Use the given Form Control in VB.Net Application development.	2.1 Data Types in VB.Net 2.2 **Operators in VB. Net** ii. Arithmetic Operators iii. Logical Operators iv. Bit Shift Operators v. Relational Operators vi. Assignment Operators 2.3 **Control Structures** ii. IF Statement iii. IF – ELSE Statement iv. Select Case Statement 2.4 **Loops in VB.Net** i. For Loop ii. While Loop iii. Do Loop iv. For Each Loop 2.5 **Form Controls in VB.Net and Its Properties** - Button, Text box, Label, Radio button, Check Box, List Box, Combo Box, Picture Box, Panel, Tab Control, Timer.
Unit– III Object Oriented	3a. Write Sub-procedure/function to solve the given problem. 3b. Create class and objects to solve	3.1 Sub Procedures and Functions 3.2 Class and Objects in VB.Net 3.3 Constructors and Destructors in

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Programming in VB.Net	the given programming problem. 3c. Create constructor to initialize the given object. 3d. Apply Inheritance to inherit members of the super class in the given problem. 3e. Use Overloading/Overriding/ Shadowing in the given situation. 3f. Develop exception handling mechanism to handle the given exception.	VB.Net 3.4 Inheritance in VB.Net, Simple Inheritance using *Override* Keyword 3.5 Overloading, Overriding and Shadowing 3.6 Exception Handling
Unit-IV Data access in VB.NET	4a. Use the relevant component of ADO.Net architecture based on the given situation. 4b. Select relevant data provider to solve the given problem. 4c. Use the given data provider to the given Access database. 4d. Produce data using Data Adapter Control for communication between the given dataset and the data source. 4e. Use Data Grid control to produce the data from the given data source.	4.1 Architecture of ADO.Net. 4.2 Accessing Data with Server Explorer. 4.3 Data Providers. 4.4 Connections, Data Reader, Data Adapters and Datasets. 4.5 Creating new Data Connection. 4.6 Creating Dataset. 4.7 Data Grid Control and Displaying Data in Data Grid. 4.8 Data Access using Data Adapter.
Unit –V Data Binding and Deployment	5a. Use Simple Data binding for setting properties of the given form control at run time. 5b. Use Complex Data binding for setting properties of the given form control at run time. 5c. Implement VB.Net Application to navigate data in the given database. 5d. Deploy the given VB.Net Application.	5.1 Simple Data Binding using Text Box, Check Box and Label. 5.2 Complex Data Binding using Combo box and List box. 5.3 Navigating Database. 5.4 Deploying VB.Net Application.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER

–Not Applicable-

10. 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. Library/E-Book survey regarding 'VB.Net' used in software industries.
c. Undertake a survey of different GUI applications and compare with the following points.
   i. Available Applications.
   ii. Application Profile.

11. 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. ***'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 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.
f. Demonstrate students thoroughly before they start doing the practice.
g. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. **Hotel Management applications**– Prepare
   - Hotel room booking system having variety of rooms,
   - Hotel billing system for various services used by the guest.
b. **Store Management Application** - Prepare a menu driven application for inventory management in Store.
c. **Students' Record System** -Prepare a menu driven application to Maintain Academic record of students from multiple streams.
d. **Traffic signals control Design**- Design an application for traffic signal control using Timer Control.

13. SUGGESTED LEARNING RESOURCES

STATE BOARD OF TECHNICAL EDUCATION MUMBAI

S. No.	Title of Book	Author	Publication
1	Visual Basic .NET The Complete Reference	Jeffrey R. Shapiro	McGraw–Hill, California, USA ISBN0–07–213381–3
2	Visual Basic .NET Programming Black Book	Holzner Steven	Dreamtech Press, 2015, New Delhi, ISBN-13:978-81-7722-609-6.
3	Beginning Visual Basic 2012	Bryan Newsome	Wrox Press, USA, Edition: 2012; ISBN: 9781118311813,
4	GUI Application Development using VB.Net	Dr. Rajendra Kawale	Devraj Publication,

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://www.vbtutor.net/index.php/visual-basic-2012-tutorial
b. http://howtostartprogramming.com/vb-net
c. https://www.tutorialspoint.com/vb.net
d. http://vb.net-informations.com
e. http://www.java2s.com/Tutorial/VB/CatalogVB.htm
f. http://www.functionx.com/vbnet
g. http://www.dfit.dfinalsolution.com/dotnet%20tutorial%20for%20beginners.pdf

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Fourth**

Course Title : **Java Programming**

Course Code : **22412**

1. RATIONALE

Java is platform independent, open-source object oriented programming language enriched with free and open source libraries. In current industrial scenario Java has the 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.

2. COMPETENCY

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

- **Develop Applications using Java**.

3. 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. Apply concept of inheritance for code reusability.
c. Develop programs using multithreading.
d. Implement Exception Handling.
e. Develop programs using graphics and applet.
f. Develop programs for handling I/O and file streams.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment.*

5. COURSE MAP(with sample COs, PrOs, UOs, ADOs and topics)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

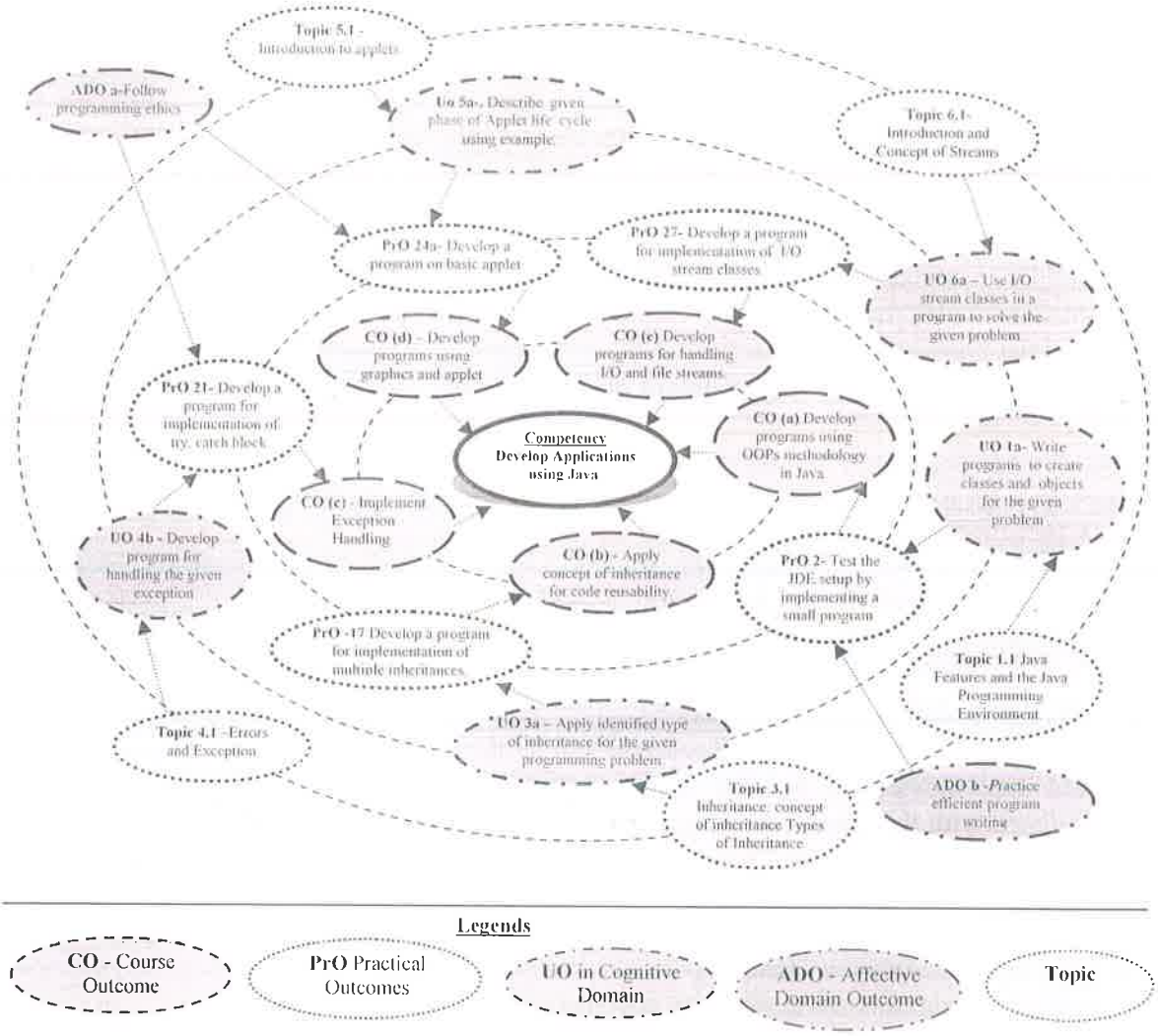

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Setup a Java Programming development environment by using: a) Command prompt.(Classpath and path setup) b) Any IDE (Eclipse, Jcreator etc.).	I	02*
2.	Test the JDE setup by implementing a small program.	I	02
3.	Develop programs to demonstrate use of if statements and its different forms.	I	02*
4.	Develop programs to demonstrate use of- a) Switch – Case statement b) Conditional if (? :)	I	02*
5.	Develop programs to demonstrate use of Looping Statement 'for'	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6.	Develop programs to demonstrate use of 'while', 'do-while'	I	02*
7.	Develop a program for implementation of implicit type casting in Java. Part-I	I	02
8.	Develop a program for implementation of implicit type casting in Java. Part-II	I	02
9.	Develop a program for implementation of explicit type conversion in Java.		02*
10.	a) Develop a program for implementation of Constructor. b) Develop a program for implementation of multiple constructors in a class.	II	02*
11.	Develop a program for implementation of different functions of String Class. Part-I	II	02
12.	Develop a program for implementation of different functions of String Class. Part-II	II	02
13.	Develop a program for implementation of Arrays in Java.	II	02*
14.	Develop a program for implementation of Vectors in Java.	II	02*
15.	Develop a program for implementation of Wrapper Class to convert primitive into object.	II	02*
16.	Develop a program for implementation of Wrapper Class to convert object into primitive.	II	02*
17.	Develop program which implements the concept of overriding.	II	02*
18.	Develop a program for implementation of Single and Multilevel inheritance.	III	02*
19.	Develop a program for implementation of multiple inheritances.	III	02*
20.	Develop a program to import different classes in package.	III	02*
21.	Develop a program for implementation of multithreading operation Part-I	IV	02*
22.	Develop a program for implementation of multithreading operation Part-II	IV	02
23.	Develop a program for implementation of try, catch block. Part-I	IV	02
24.	Develop a program for implementation of try, catch block. Part-II	IV	02
25.	Develop a program for implementation of try, catch and finally block.	IV	02*
26.	Develop programs for implementation of throw, throws clause. Part-I	IV	02*
27.	Develop programs for implementation of throw, throws clause. Part-II	IV	02*
28.	Develop minimum two basic Applets. Display output with applet viewer and browser. a) Develop a program on basic applet.	V	02*
	b) Develop a program using control loops in applets.	V	02
29.	Write a program to create animated shape using graphics and applets. You may use following shapes: a) Lines and Rectangles. b) Circles and Ellipses.	V	02*
	c) Arcs d) Polygons with fillPolygon method.		02
30.	Develop a program to draw following shapes, graphics and applets. a) Cone b) Cylinders	V	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	c) Cube		
	d) Square inside a circle e) Circle inside a square		02
31.	Develop a program for implementation of I/O stream classes.	VI	02*
32.	Develop a program for implementation of file stream classes.	VI	02*
	Total		**64**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicators	Weightage in %
1	Representation of classes and objects.	10
2	Coding.	40
4	Testing and Debugging of the Program.	30
5	Correctness of ProgramOutput.	10
6	Submission of report in time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

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S. No.	Equipment Name with Broad Specifications	Pro S.No.
1	Computer with JDK1.8 or above	All
2	Any IDE for Java Programming such as Eclipse, Jcreator or any other product.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basic Syntactical constructs in Java	1a. Write programs to create classes and objects for the given problem. 1b. Explain the characteristics of the given Java token. 1c. Explain the function of the given operator with example. 1d. Construct the expressions using implicit and explicit type conversions to solve the given problem. 1e. Develop the programs using relevant control structure to solve the given problem.	1.1 Java Features and the Java Programming Environment, Object Oriented, Compiled, Interpreted, Platform independent, Portable, Robust and Secure, Dynamic. 1.2 Defining a class, creating object, accessing class members 1.3 Java Tokens and Data types, Constants and Symbolic Constants, variables, dynamic initialization, data types, array and string, scope of variable, typecasting, and standard default values. 1.4 Operators and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Increment and Decrement, Conditional Operators, Bit wise Operators, Instance of Operators, Dot Operators, Operator precedence and associativity, Evaluation of 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 Do while statement, the 'for' statement, break, continue and return statement, nested loops, labeled loops, for-each version of the for loop.
Unit-II Derived Syntactical Constructs in Java	2a. Use Constructors for the given programming problem. 2b. Identify scope and lifetime of a variable in the given program code. 2c. Describe the given visibility control with example. 2d. Write the programs by implementing arrays to solve	2.1 Constructors and methods, types of constructors, nesting of methods, argument passing the 'this' keyword, command line arguments, varargs: variable-length arguments, garbage collection, finalize() method, the object class. 2.2 Visibility Control Public, Private, Protected, default, friendly private

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given problem. 2e. Develop programs using vectors and wrapper classes for the given problem.	Protected access. 2.3 Arrays and Strings: Types of arrays, creating an array, strings, string classes and string buffer, vectors, wrapper classes, enumerated types.
Unit– III Inheritance , Interface and Package	3a. Apply the identified type of inheritance for the given programming problem. 3b. Differentiate between overloading and overriding for the given example. 3c. Develop program using the specified interface. 3d. Create user defined package for the given problem. 3e. 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 constructor 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 and methods, extending interfaces, interface references, nested interfaces 3.4 Package: Define package, type of package naming and creating packages, accessing package, import statement, static import, adding class and interfaces to a package.
Unit– IV Exception Handling and Multithreading	4a. Distinguish the errors and exceptions (if any) in the given example. 4b. Develop program for handling the given exception. 4c. Crate threads to run the given multiple processes in the given program. 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, try and catch statement, nested try statement, throws and Finally statement, build-in exceptions, chained exceptions, creating own exception(throw clause), subclasses. 4.2 Multithreaded Programming Creating a Thread: By extending to thread class and by implementing runnable Interface, Life cycle of thread: Thread Methods:wait(), sleep(), notify(), resume(), suspend(), stop().Thread exceptions, thread priority and methods, synchronization, inter-thread communication, deadlock.
Unit –V Java Applets and Graphics Programming	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 program for implementing the given geometric shape. 5d. Develop program for implementing the given font	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, setColor(), getColor(), setForeGround(), setBackGround(), font class, variable defined by font class: name, pointSize,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	settings.	size, style, font methods: getFamily(). getFont(), getFontname (), getSize(). getStyle(), getAllFonts() and get available font family name() of the graphics environment class.
Unit –VI Managing Input /Output/ Files in Java	6a. Use I/O stream classes in a program to solve the given problem. 6b. Write programs for reading and writing character streams to and from the given files. 6c. Write programs for reading and writing bytes to and from the given files. 6d. Write program to demonstrate use of primitive Data types with the specified stream.	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 Exceptions, Creation of Files, Reading/Writing characters, Reading/Writing Bytes, Handling Primitive Data types.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	Basic Syntactical constructs in Java	06	02	04	04	10
II	Derived Syntactical Constructs in Java	10	02	06	10	18
III	Inheritance, Interface and Package	10	02	04	06	12
IV	Exception Handling and Multithreading	08	02	04	06	12
V	Java Applets and Graphics Programming	08	02	04	04	10
VI	Managing Input/Output/Files in Java	06	02	02	04	08
Total		**48**	**12**	**24**	**34**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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. Follow coding standards.
c. Develop variety of programs to improve the logical skills.
d. Develop Application oriented real world programs.
e. Prepare power point presentation or animation for understanding different Object Oriented Concepts.

11. 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. ***'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 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. Use different Audio Visual media for Concept understanding.
f. Guide student(s) in undertaking micro-projects.
g. Demonstrate students thoroughly before they start doing the practice.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Mini Banking System for handling deposits and withdrawal.
b. Medical Store stock Management System.
c. Library book issue Management System.
d. Bus Reservation System.
e. Attendance Management System.
f. Develop a small animation using applet, graphics and multithreading.

GUIDELINES FOR DEVELOPING MICRO PROJECTS:

i. Declare four to five classes and may include Interfaces if required.
ii. Must use Most of the Object Oriented Concepts.

iii. Must implement concepts of Inheritance and Exception Handling.
iv. Must Create Own Package.
v. May use the constructor overloading and overriding.
vi. May Use Multithreading if required.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Programming with JAVA	Balagurusamy E.	Mcgraw Hill Education (India) Private Limited, New Delhi, 5th Edition ISBN-13: 978-93-5134-320-2
2.	Java 8 Programming Black Book	DT Editorial Services	Dreamtech Press, New Delhi, ISBN:978-93-5119-758-4
3.	Java Complete Reference	Schildt Herbert	Mcgraw Hill Education, New Delhi ISBN:9789339212094
4.	Advanced Java Programming	Roy Uttam K	Oxford University Press, New Delhi ISBN :0-19-945550-3
5.	Jawa Programming	Dr. Rajendra Kawale	Devraj Publication

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://docs.oracle.com/javase/8/docs/
b. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
c. http://nptel.ac.in/courses/106105084/25
d. http://www.iitk.ac.in/esc101/08Jul/notes.html

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Fourth**

Course Title : **Software Engineering**

Course Code : **22413**

1. RATIONALE

Software Engineering is the foundation for professional processes to be followed involving principles, techniques, and practices for software development. The course provides a framework for software professionals for building quality assured software products. It enables students to blend the domain specific knowledge with the programming skills to create quality software products.

2. COMPETENCY

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

- **Use relevant software process model for developing software products.**

3. 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. Select suitable Software Process model for software development.
b. Prepare software requirement specifications.
c. Use Software modeling to create data designs.
d. Estimate size and cost of software product.
e. Apply project management and quality assurance principles in software development.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

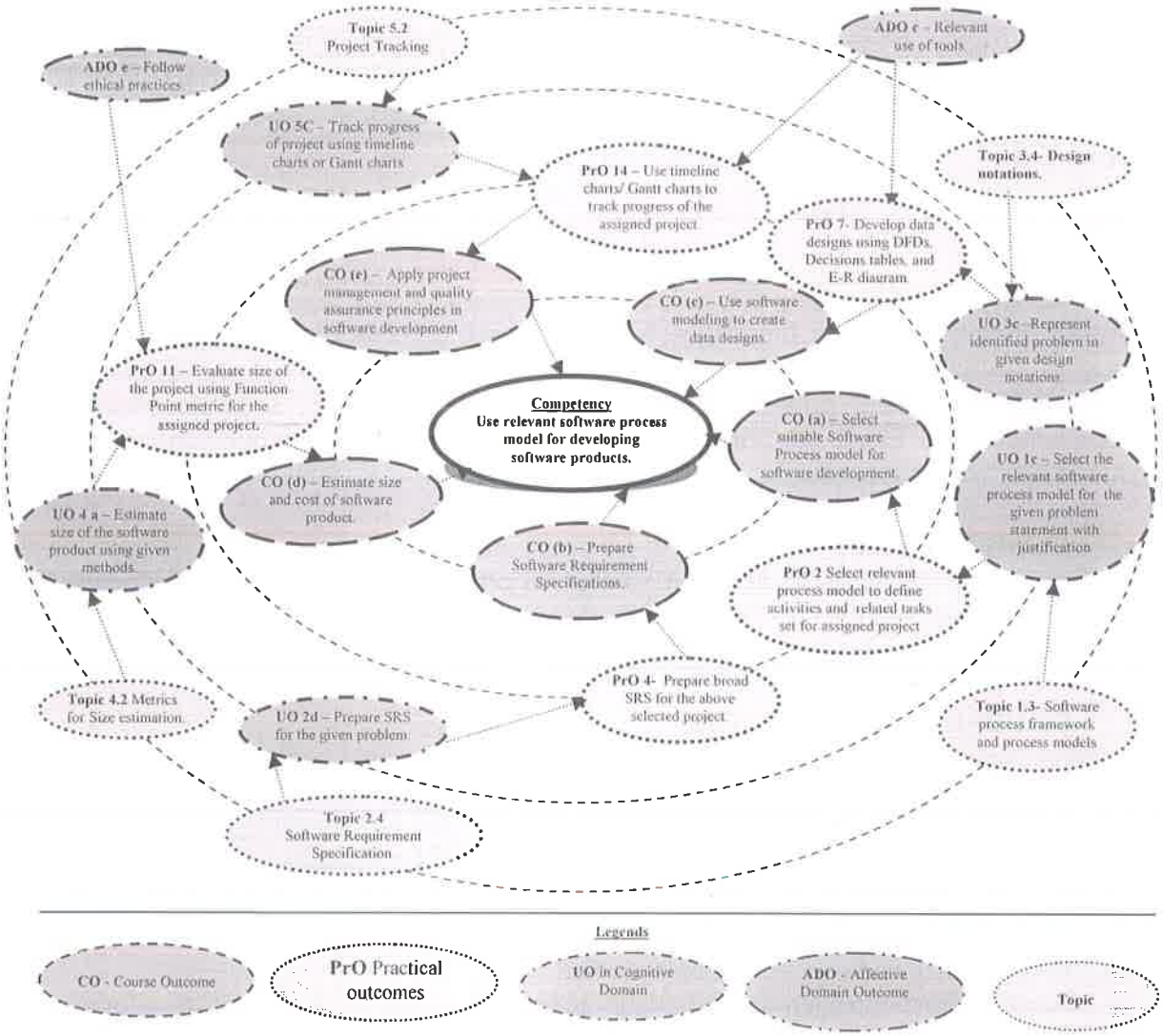

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Write problem statement to define the project title with bounded scope of the project.	I	02*
2	Select relevant process model to define activities and related tasks set for assigned project.	I	02*
3	Gather application specific requirements for assimilate into RE (Requirements engineering) model.	II	02*
4	Prepare broad SRS (software requirement software) for the above selected project.	II	02*
5	Prepare use-cases and draw use – case diagram using Software Modeling Tool.	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Develop the activity diagram to represent flow from one activity to another for software development.	II	02
7	Develop data designs using DFDs (data flow diagram), Decision tables and E-R (entity-relationship) diagram.	III	02*
8	Draw class diagram, Sequence diagram, Collaboration diagram, State Transition Diagram for the assigned project.	III	02
9	Write test cases to validate requirements of assigned project from SRS document.	III	02*
10	Identify risks involved in the project and prepare RMMM (RMMM-Risk Management, Mitigation and Monitoring) plan.	IV	02
11	Evaluate size of the project using Function point metric for the assigned project.	IV	02*
12	Estimate cost of the project using COCOMO (Constructive Cost Model) / COCOMO II approach for the assigned project.	IV	02*
13	Use CPM (Critical Path Method) / PERT (Programme Evaluation and Review Technique) for scheduling the assigned project.	V	02*
14	Use Timeline charts/ Gantt charts to track progress of the assigned project.	V	02
15	Prepare SQA plan that facilitates various attributes of quality of process.	V	02*
16	Prepare SQA plan that facilitates various attributes of quality of product.	V	02*
	Total		**32**

Note

i. *To carry out above listed practical /tasks, relevant* software tool may be chosen (preferably open-source based).

ii. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.*

iii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

i.

S.No.	Performance Indicators	Weightage in %
1	Problem selection and its feasibility study	20
2	Logical thinking to decompose problem into modules	30
3	Ability to Estimate size and cost of a software	30
4	Presentation and technical documentation skills	10
5	Submission of reports within time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.

d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB	For all Experiments
2	Operating system: Windows 7/Windows 8/Windows 10/LINUX or any other .	
3	Software tools: Any UML tool	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Software Development Process	1a. Suggest the attributes that match with standards for the given software application. 1b. Recommend the relevant software solution for the given problem with justification. 1c. Select the relevant software process model for the given problem statement with justification. 1d. Suggest the relevant activities in Agile Development Process in the given situation with justification	1.1 Software, Software Engineering as layered approach and its characteristics, Types of software. 1.2 Software development framework. 1.3 Software Process Framework, Process models: Perspective Process Models, Specialized Process Models. 1.4 Agile Software development: Agile Process and its importance, Extreme Programming, Adaptive Software Development, Scrum, Dynamic Systems Development Method (DSDM), Crystal. 1.5 Selection criteria for software process model.
Unit– II Software Requirement Engineering	2a. Apply the principles of software engineering for the given problem. 2b. Choose the relevant	2.1 Software Engineering Practices and its importance, Core principles. 2.2 Communication Practices, Planning Practices, Modelling practices.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	'requirement engineering' steps in the given problem. 2c. Represent the 'requirement engineering' model in the given problem. 2d. Prepare SRS for the given problem.	construction practices, software deployment (Statement and meaning of each principle for each practice). 2.3 Requirement Engineering: Requirement Gathering and Analysis, Types of requirements (Functional, Product, organizational, External Requirements), Eliciting Requirements, Developing Use-cases, Building requirement models, Requirement Negotiation, Validation. 2.4 Software Requirement Specification: Need of SRS, Format, and its Characteristics.
Unit– III Software Modelling and Design	3a. Identify the elements of analysis model for the given software requirements. 3b. Apply the specified design feature for software requirements modeling. 3c. Represent the specified problem in the given design notation. 3d. Explain the given characteristics of software testing. 3e. Prepare test cases for the given module.	3.1 Translating Requirement model into design model: Data Modelling. 3.2 Analysis Modelling: Elements of Analysis model. 3.3 Design modelling: Fundamental Design Concepts (Abstraction, Information hiding, Structure, Modularity, Concurrency, Verification, Aesthetics). 3.4 Design notations: Data Flow Diagram (DFD), Structured Flowcharts, Decision Tables. 3.5 Testing – Meaning and purpose, testing methods - Black-box and White-box, Level of testing – Unit testing. 3.6 Test Documentation – Test Case Template, test plan, Introduction to defect report, test summary report.
Unit-IV Software Project Estimation	4a. Estimate the size of the software product using the given method. 4b. Estimate the cost of the software product using the given empirical method. 4c. Evaluate the size of the given software using CoCoMo model. 4d. Apply the RMMM strategy in Identified risks for the given software development problem.	4.1 The management spectrum – 4P's 4.2 Metrics for Size Estimation: Line of Code(LoC), Function Points(FP). 4.3 Project Cost Estimation Approaches: Overview of Heuristic, Analytical, and Empirical Estimation. 4.4 COCOMO (Constructive Cost Model), COCOMO II. 4.5 Risk Management: Risk Identification, Risk Assessment, Risk Containment, RMMM strategy.
Unit –V Software	5a. Use the given scheduling technique for the	5.1 Project Scheduling: Basic principles, Work breakdown structure, Activity

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
quality assurance and Security	identified project. 5b. Draw the activity network for the given task. 5c. Prepare the timeline chart/ Gantt chart to track progress of the given project. 5d. Describe the given Software Quality Assurance (SQA) activity. 5e. Describe features of the given software quality evaluation standard.	network and critical path Method, Scheduling techniques (CPM, PERT). 5.2 Project Tracking: Timeline charts, Earned Value Analysis, Gantt Charts 5.3 Software Quality Management vs. Software Quality Assurance. Phases of Software Quality Assurance: Planning, Activities, audit, and review 5.4 Quality Evaluation standards: Six Sigma, ISO for software, CMMI: Levels, Process areas. 5.5 Software Security,Introduction to DevOps,Secure software engineering

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	Software development process	08	04	04	04	12
II	Software Requirement Engineering	10	02	04	08	14
III	Software Modelling and Design	10	-	04	10	14
IV	Software Project Estimation	10	04	04	08	16
V	Software Project Management and quality assurance	10	04	04	06	14
Total		**48**	**14**	**20**	**36**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. 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. Give seminar on relevant topics.
c. Study and analyze college website from perspective of software application.
d. Study and analyze any available application software from perspective of software engineering.

11. 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. ***'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 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.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Study and analyze given software and write the characteristics and functions of the same.
b. Case study of application specific software product for requirement engineering
    i. Identify the problem statement
    ii. Perform feasibility analysis
    iii. Identify application specific requirements by following RE steps
    iv. Prepare SRS
c. Choose any problem statement and use data models to represent the solution
    i. Search and utilize different UML tools to represent models
d. Choose a problem, create activity network and use different project scheduling and tracking tools for the same.

13. SUGGESTED LEARNING RESOURCES

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

S. No.	Title of Book	Author	Publication
1	Software Engineering: A practitioner's approach	Pressman, Roger S.	McGraw Hill Higher Education, New Delhi, (Seventh Edition)ISBN 978–0–07–337597–7
2	Software Engineering Concepts	Fairly, Richard	McGraw Hill Education New Delhi – 2001, ISBN-13: 9780074631218
3	Software Engineering: Principles and practices	Jain, Deepak	Oxford University Press, New Delhi ISBN 9780195694840

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://www.rspa.com/spi/
b. www.tutorialspoint.com//software_engineering/
c. www.versionone.com/agile-101/
d. www.sei.cmu.edu
e. www.nptel.ac.in/courses/
f. https://techbeacon.com/secure-devops

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/IF/CW**

Semester : **Fourth**

Course Title : **Data Communication and Computer Network**

Course Code : **22414**

1. RATIONALE

A data communication and computer networks has been growing with rapid technological progress. Computer communication through networking becomes essential part of our life. By considering importance of networking in day today life, it is essential for students to know the basic concept of networks like network classification, network topologies, network devices. This course deal with the important concepts and techniques related to data communication and enable students to have an insight in to technology involved to make the network communication possible.

2. COMPETENCY

The aim of this course is to help the student to attain the following ***industry identified*** competency through various teaching learning experiences:

- **Maintain data communication and computer network**

3. 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. Analyze the functioning of data communication and computer network.
b. Select relevant transmission media and switching techniques as per need.
c. Analyse the transmission errors with respect to IEEE standards.
d. Configure various networking devices.
e. Configure different TCP/IP services.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course. in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

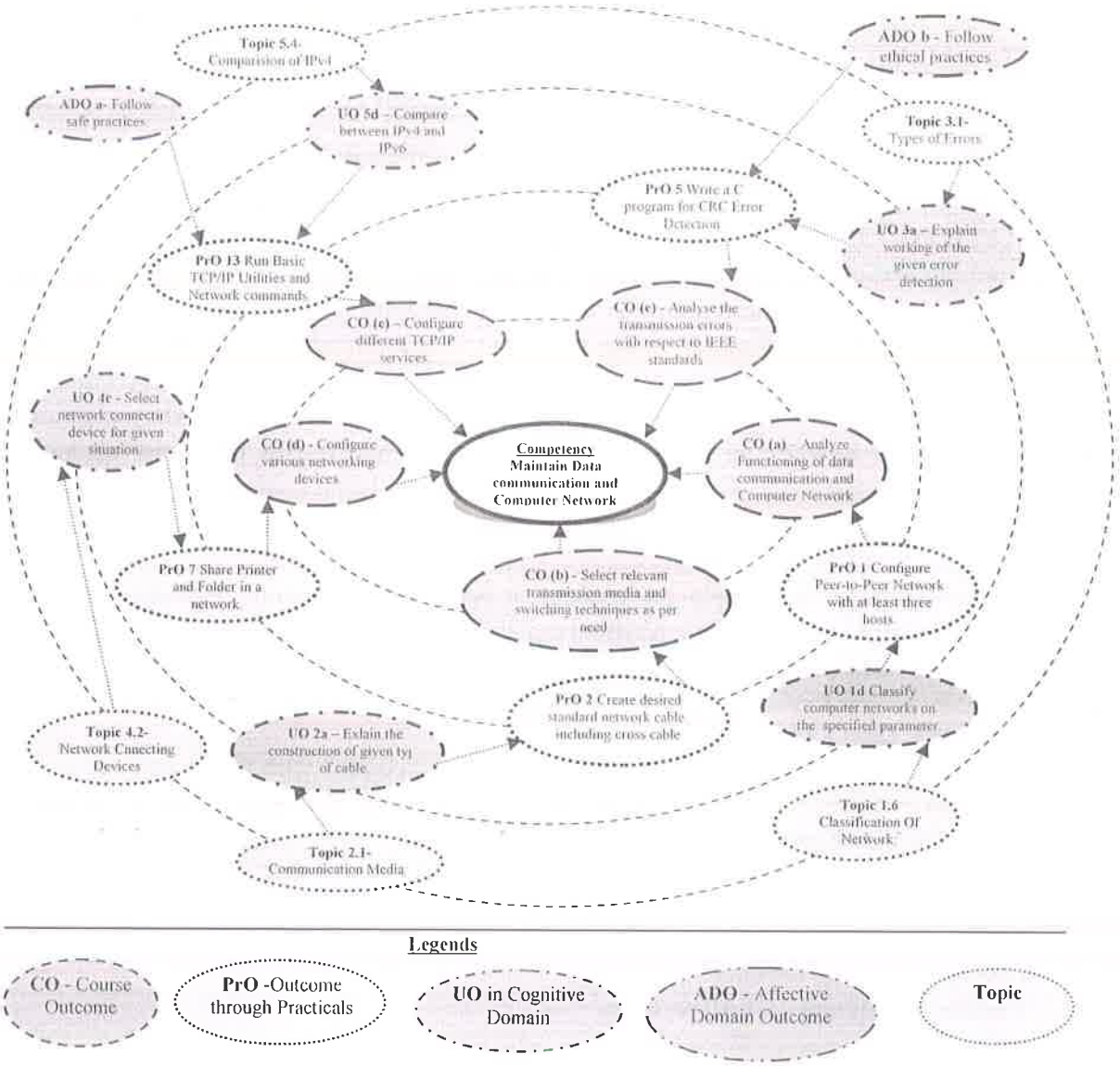

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Configure Peer-to-Peer Network with at least three hosts.	I	02*
2.	Create desired standard network cable including cross cable and test by using cableTester	II	02*
3.	Connect Computers using given topology with wired media	III	02*
4.	Connect Computers using wireless media	III	02
5.	Write a C program for CRC Error Detection.	III	02
6.	Create a Network Using Bluetooth-(Piconet/Scatternet)	III	02
7.	Share Printer and Folder in a network and transfer a file from one computer to another.	IV	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
8.	Install operating system(Windows/Linux-RedHat/Ubuntu)	IV	02*
9.	Configure File Server	IV	02
10.	Configure Client To File Server and use file services.	IV	02
11.	Configure Static and Dynamic IP addresses	V	02*
12.	Configure DHCP server.	V	02*
13.	Run Basic TCP/IP Utilities and Network commands : ipconfig. ping , tracert, netstat, pathping, route	V	02*
14.	Install Wireshark and configure as packet sniffer	V	02
15.	Set access rights and security permissions for user	V	02
16.	Create IPV6 based small computer network using a simulator (prferebaly open source based simulator)	V	02
17.	Setting up a wireless network	IV	02
	Total		**34**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Effective practical implementation within specified time	60
b.	Effective handling of network component	10
c.	Answer to sample questions	20
d.	Submit report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Handle network components carefully.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1.1	Computer system (Any computer system with basic configuration)	All
1.2	Network connecting device, transmission media	All
1.3	Network cable Tester, crimping tool, RJ-45 connectors, Ethernet cable	2
1.4	Wireshark sniffing tool	15

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of Data Communication and Computer Network	1a. Describe role of the given component in the process of data communication. 1b. Compare the characteristic of analog and digital signals on the given parameter. 1c. Explain the process of data. communication using the given mode. 1d. Classify computer networks on the specified parameter. 1e. Select network architecture for the given situationwith justificsation.	1.1 Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocol. 1.2 Protocols, Standards, Standard organizations.Bandwidth, Data Transmission Rate, Baud Rate and Bits per second. 1.3 Modes of Communication (Simplex, Half duplex, Full Duplex). 1.4 Analog Signal and Digital Signal, Analog and Digital transmission:Analog To Digital ,Digital To Analog Conversion 1.5 Fundamental Of Computer Network: Definition And Need Of Computer Network,Applications,Network Benefits. 1.6 Classification Of Network: LAN,WAN,MAN 1.7 Network Architechture:Peer To Peer, Client Server Network
Unit-II Transmission Media and Switching	2a. Explain with sketches the construction of given type of cable. 2b. Explain with sketches the characteristics of the given type of unguided transmission media. 2c. Explain with sketches the working of the given Multiplexing technique. 2d. Describe with sketches the working principle of the given switching technique.	2.1 Communication Media: Guided Transmission Media Twisted-Pair Cable, Coaxial Cable Fiber-Optic Cable 2.2 Unguided Transmssion Media Radio Waves, Microwaves, Infrared, Satellite 2.3 Line-of-Sight Transmission Point to Point, Broadca 2.4 Multiplexing: Frequency-Division Multiplexing Time -Division Multiplexing 2.5 Switching: Circuit-switched networks.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2e. Compare different Switching techniques on the given parameter.	Packet -swtiched networks
Unit– III Error Detection,Correction and Wireless Communication	3a. Explain working of the given error detection and correction method. 3b. Explain features of the given IEEE communication standard. 3c. Explain characteristics of the given layer in IEEE 802.11 architecture. 3d. Compare the specified generations of mobile telephone system on the given parameter. 3e. Explain with sketches the process of creating Bluetooth environment using the given architechture.	3.1 Types of Errors:Single Bit Error and Burst Error, Redundancy 3.2 Error Detection:Longitudinal Redundancy Check(LRC),Vertical Redundancy Check(VRC),Cyclic Redundancy Check(CRC)Forward 3.3 Error Correction: Forward error Correction 3.3 IEEE standards: 802.1, 802.2, 802.3, 802.4, 802.5 3.4 Wireless LANs: 802.11 Architecture, MAC Sublayer,Addressing Mechanism 3.5 Bluetooth Architecture: Piconet, Scatternet 3.6 Mobile Generations: 1G, 2G, 3G, 4G and 5G
Unit– IV Network Topologies And Network Devices	4a. Identify relavent network topology for the given situation. 4b. Compare different topologies on the given parameter. 4c. Select network connecting device for the given situation. 4d. Describe with sketches the procedure to configure the given networking device.	4.1 Network Topologies : Introduction, Definition, Selection, Criteria, Types of Topology- i) Bus ii) Ring iii) Star iv)Mesh v)Tree vi)Hybrid 4.2 Network Connecting Devices:Hub, Switch, Router, Repeater, Bridge, Gateway, Modem, Wireless infrastructure Components
Unit –V Reference Models	5a. Identify functions and features of the given layer of OSI Reference model. 5b. Compare the specified service on the given parameters. 5c. Classify IP Addresses on the basis of its class from the given set of addresses. 5d. Distinguish between IPv4 and IPv6 on the given parameters. 5e. Describe with sketches the	5.1 OSI Reference Model: Layered Architecture , Peer-to- Peer Processes-Interfaces between Layer, Protocols, Organization of the Layers, Encapsulation Layers of the OSI Reference Model (Functions and features of each Layer) – Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer 5.2 TCP/IP Model: Layered Architechture, Data Link Layer:Nodes and links,services,two categoriesof links,two

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	procedure to configure the given TCP/IP service.	sub layers, Link layer addressing:three types of addresses,address resolution protocal(ARP), Network Layer: Addresses: address space,classful and classless addeessing, dyanamic host configuration protocol(DHCP), network address resolution(NAT). Transport layer protocal:transport layer services, connectionless and conection oriented protocol. 5.3 Introduction –Addressing mechanism in the Internet IP Addressing – IP Address classes, classless IP addressing, Subnetting, supernetting, Masking, 5.4 IPv4 and IPv6 5.5 OSI and TCP / IP Network Model.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	Fundamental Of Data Communication And Computer Network	10	04	04	04	12
II	Transmission Media and Switching	14	04	06	06	16
III	Error Detection,Correction and Wireless Communication	14	02	04	06	12
IV	Network Topologies And Network Devices	10	02	04	04	10
V	Reference Models	16	06	06	08	20
Total		**64**	**18**	**24**	**28**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. 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 specification table for Guided media and Unguided media.
B. Classify network connecting devices with their specifications.

11. 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. ***'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 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. Use animations to explain various network topologies,OSI Layers,network connecting devices.
f. Guide student(s) in undertaking micro-projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Create a small Network install, configure various devices and perform at least one peer-to-peer service and client/server service over it.
b. Prepare a report on recent and widely used Unguided media in industries depending on Cost, speed, efficiency, reliability.
c. Design layout of a Network for department, Deciding upon type of network, number/length of components with their specifications.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Data communications and networking.	Forouzan Behrouz A.	Tata McGraw Hill, New Delhi, 2006, ISBN : 9780-07-296775-3
2	Computer Networks	Tanenbaum Andrew S.	PHI Learning Pvt Ltd, Delhi ISBN-13: 978-0-13-212695-3

S. No.	Title of Book	Author	Publication
3	Data Communication and Networks	Godbole Achyut	Tata McGraw Hill, New Delhi, 2006, ISBN : 0070472971
4	Internetworking with TCP/IP Principles, Protocols and Architechtures	Comer Douglas E.	PHI Learning Pvt Ltd, Delhi ISBN: 81-203-2065-4
5	Computer Networking	T. M. Bansod	---

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.nptelvideos.in/2012/11/data-communication.html
b. http://www.myreadingroom.co.in/notes-and-studymaterial/68-dcn/750-analog-to-analog-conversion-techniques.html
c. http://www.tutorial-reports.com/wireless/wlanwifi/wifi_architecture.php
d. http://standards.ieee.org/about/get/802/802.11.html
e. www.tutorialspoint.com/data_communication_computer_network/
f. http://www.studytonight.com/computer-networks/overview-of-computer-networks
g. http://whirlpool.net.au/wiki/windows_nw_diag_cmds
h. http://nptel.ac.in/downloads/106105080/
i. http://scanftree.com/programs/c/c-program-to-implement-crc-cyclic-redundancy-code/

Program Name : **Computer Engineering Program Group**

Program Code : **CO/CM/CW**

Semester : **Fourth**

Course Title : **Microprocessors**

Course Code : **22415**

1. RATIONALE

Microprocessor is the main component of computer where 8086 is the base of all upward developed processors till current processors. This course will cover the basics of 8086 and its architecture along with instruction set, assembly language programming with effective use of procedure and macros. This course also covers the architectural issues such as instruction set program and data types. On top that, the students are also introduced to the increasingly important area of parallel organization. This subject serves as a basic to develop hardware related projects. This course will enable the students to inculcate assembly language programming concepts and methodology to solve problems.

2. COMPETENCY

The aim of this course is to help the student to attain the following ***industry identified*** competency through various teaching learning experiences:

- **Develop assembly level language programming using 8086.**

3. 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. Analyze the functional block of 8086 microprocessor.
b. Write assembly language program for the given problem.
c. Use instructions for different addressing modes.
d. Develop an assembly language program using assembler.
e. Develop assembly language programs using procedures, macros and modular programming approach.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment, **'#':** No Theory Examination

5. COURSE MAP(with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

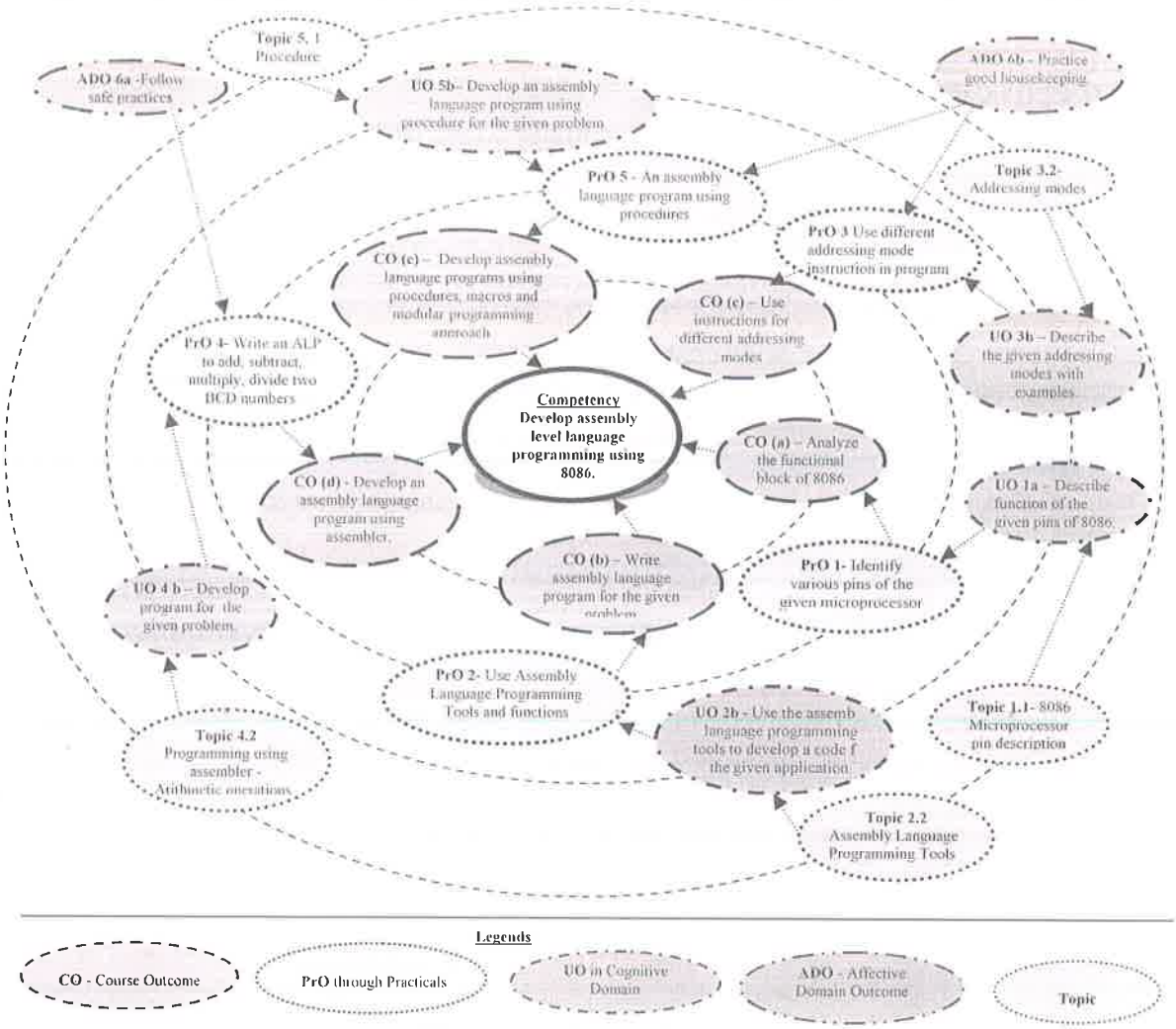

Figure 1 - Course Map

6. 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various pins of the given microprocessor.	I	02*
2	Use Assembly Language Programming Tools and functions	II	02*
3	Use different addressing mode instruction in program (a) Write an Assembly Language Program (ALP) to add two given 8 and 16 bit numbers.	III	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	(b) Write an Assembly Language Program (ALP) to subtract two given 8 and 16 bit numbers.		
4	(a) Write an ALP to multiply two given 8 and 16 bit unsigned numbers. (b) Write an ALP to multiply two given 8 and 16 bit signed numbers.	III	02
5	(a) Write an ALP to perform block transfer data using string instructions (b) Write an ALP to perform block transfer data without using string instructions.	III	02
6	(a) Write an ALP to compare two strings without using string instructions. (b) Write an ALP to compare two strings using string instructions	III	02
7	(a) Write an ALP to divide two unsigned numbers (b) Write an ALP to divide two signed numbers	III	02
8	Write an ALP to add, subtract, multiply, divide two BCD numbers.	IV	02
9	Implement loop in assembly language program (a) Write an ALP to find sum of series of Hexadecimal Numbers. (b) Write an ALP to find sum of series of BCD numbers.	IV	02*
10	(a) Write an ALP to find smallest number from array of n numbers. (b) Write an ALP to find largest number from array of n numbers.	IV	02 *
11	(a) Write an ALP to arrange numbers in array in ascending order. (b) Write an ALP to arrange numbers in array in descending order.	IV	02
12	(a) Write an ALP to arrange string in reverse order (b) Write an ALP to find string length. (c) Write an ALP to concatenation of two strings.	IV	02
13	(a) Write an ALP to check a given number is ODD or EVEN. (b) Write an ALP to count ODD and/or EVEN numbers in array.	IV	02
14	(a) Write an ALP to check a given number is POSITIVE or NEGATIVE (b)Write an ALP to count POSITIVE and/or NEGATIVE numbers in array.	IV	02
15	(a) Write an ALP to count number of '1' in a given number (b) Write an ALP to count number of '0' in a given number	IV	02
16	An assembly language program using procedures (a) Write an ALP for addition, subtraction, multiplication and division. (b) Write an ALP using procedure to solve equation such as Z = (A+B)*(C+D)	V	02*
17	Write an assembly language program using macros. (a) Write an ALP for addition, subtraction, multiplication and division. (b) Write an ALP using MACRO to solve equation such as 01Z =	V	02*

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S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	(A+B)*(C+D)		
	Total		**34**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Able to write algorithm and draw flow chart.	20
2	Use Assembly language programming tools to create, edit, assemble and link the assembly language programs.	40
3	Debug, test and execute the programs	20
4	Able to answer oral questions.	10
5	Submission of report in time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year and
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	For all Experiments

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
2	Operating system: Windows XP/Windows 7 onward	
3	Software: Editor: EDIT, NOTEPAD Assembler: TASM/MASM Linker: TLINK/LINK Debugger: TD/Debug of Windows Operating System	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I 8086-16 Bit Microprocessor	1a. Describe function of the given pin of 8086. 1b. Explain with sketches the working of given unit in 8086 microprocessor. 1c. State functions of the given registers of 8086 microprocessor. 1d. Calculate the physical address for the given segmentation of 8086 microprocessor.	1.1 8086 Microprocessor: Salient features, Pin descriptions 1.2 Architecture of 8086: Functional Block diagram, Register organization 1.3 Concepts of pipelining 1.4 Memory segmentation, Physical memory addresses generation
Unit– II The Art of Assembly Language Programming	2a. Describe the given steps of program development /execution. 2b. Write steps to develop a code for the given problem using assembly language programming. 2c. Use relevant command of debugger to correct the specified programming error. 2d. Describe function of the given assembler directives with example.	2.1 Program development steps:Defining problem and constrains, Writing Algorithms, Flowchart, Initialization checklist, Choosing instructions, Converting algorithms to assembly language programs 2.2 Assembly Language Programming Tools: Editors, Assembler, Linker, Debugger 2.3 Assembler directives
Unit– III Instruction Set of 8086 Microprocessor	3a. Determine the length of the given instruction. 3b. Describe the given addressing modes with examples. 3c. Explain the operation performed by the given instruction during its execution. 3d. Identify the addressing modes in the given instructions.	3.1 Machine Language Instruction format 3.2 Addressing modes 3.3 Instruction set, Groups of Instructions: Arithmetic instructions, Logical Instructions, Data transfer instructions, Bit manipulation instructions, String Operation instructions, Program control transfer or branching instructions, Process control instructions

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-IV Assembly Language Programming	4a. Use the given model of assembly language programs for the given problem. 4b. Develop the relevant program for the given problem. 4c. Apply relevant control loops in the program for the given problem. 4d. Use string instructions for the given strings/block to manipulate its elements.	4.1 Model of 8086 assembly language programs 4.2 Programming using assembler : Arithmetic operations on Hex and BCD numbers, Sum of Series, Smallest and Largest numbers from array, Sorting numbers in Ascending and Descending order, Finding ODD,EVEN, Positive and Negative numbers in the array, Block transfer, String Operations - Length, Reverse, Compare, Concatenation, Copy, Count Numbers of '1' and '0' in 16 bit number.
Unit –V Procedure and Macro	5a. Apply the relevant 'parameter-passing' method in the given situation. 5b. Develop an assembly language program using the relevant procedure for the given problem. 5c. Develop an assembly language program using MACROS for the given problem. 5d. Compare procedures and macros on the basis of the given parameters.	5.1 Procedure: Defining and calling Procedure - PROC, ENDP, FAR and NEAR Directives; CALL and RET instructions; Parameter passing methods, Assembly Language Programs using Procedure 5.2 Macro: Defining Macros, MACRO and ENDM Directives, Macro with parameters, Assembly Language Programs using Macros

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. 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	8086- 16 Bit Microprocessor	08	02	02	10	14
II	The Art of Assembly Language Programming	12	-	02	06	08
III	Instruction Set of 8086 Microprocessor	16	02	04	10	16
IV	Assembly Language Programming	16	02	02	16	20
V	Procedure and Macro	12	02	02	08	12
Total		**64**	**8**	**12**	**50**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual*

distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. 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. Library/E-Book survey regarding assembly language programming used in Computer industries.
c. Prepare power point presentation for showing different types of Assembly language Programming Applications.

11. 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. ***'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 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.
f. No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. 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 are given here. Similar micro-projects could be added by the concerned faculty:

a. **Conversion of Number System** - Each group will develop a program to perform following operations (Any One):
   i. Convert Hexadecimal number to equivalent BCD.

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ii. Convert BCD number to Equivalent Hexadecimal Number

b. **Array** - Each group will develop a program to perform following operations (Any One):
   i. Separate ODD and EVEN number from given array, store them in separate array and find the sum.
   ii. Separate ODD and EVEN number from given array, store them in separate array and find the smallest or largest among them.
   iii. Separate ODD and EVEN number from given array, store them in separate array and sort numbers in ascending or descending order.

c. **Basic mathematic functions** - Each group will develop a program to perform following operations (Any One):
   i. Generate Fibonacci Series
   ii. Find Factorial of Number

d. **String Manipulation project** - Each group will develop a program to perform following operations (Any One):
   i. Convert lower case string to upper case string and vice versa.
   ii. Check string for Palindromes.
   iii. Search given character in string; find how many times it is present in string and its position.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Microprocessor and interfacing (programming and hardware)	Hall, Douglas V.	McGraw Hill Education, New Delhi, 2015, ISBN-13: 978-0070257429
2	The 8088 and 8086 Microprocessors	Triebel, Walter A., Singh, Avtar	Pearson Publications, New Delhi, 2015, ISBN 13: 9780130930811
3	Microprocessors and Microcontrollers	Latha, C., Murugeshwari, B.	SCITECH Publications, Chennai, 2015, ISBN: 978-81-8371-702-1

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Assembler TASM/MASM, Linker LINK/TLINK, Debugger OS Debuge/TD
b. www.intel.com
c. www.pcguide.com/ref/CPU
d. www.CPU-World.com/Arch/
e. www.techsource .com / engineering- parts/microprocessor.html
f. https://www.elprocus.com/8051-assembly-language-programming/
g. https://www.tutorialspoint.com/assembly_programming/
h. http://www.slideshare.net/search/slideshow?searchfrom=headerandq=assembly+language+programming+of+8086andud=anyandft=allandlang=**andsort=

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