Maharashtra State Board of Technical Education, Mumbai
Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Diploma in Computer Hardware & Maintenance

Program Code : HA

Duration of Program : 6 Semesters   **With Effect From Academic Year: 2021 - 22**

Semester : Fourth   **Duration : 16 Weeks**

Pattern : Semester   **Scheme : I**

S.N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme														Grand Total
								Theory							Practical							
				L	T	P		Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total			
									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	Microcontroller	MCR	22483	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.

Theory and practical periods of 60 minutes each.

Total Marks : 750

Medium of Instruction: English

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.**

MSBTE – Final Copy Dt. 10.01.2023

Program Name	: Computer Engineering Program Group/ Diploma in Computer Hardware and Maintenance
Program Code	: CO/CM/IF/CW/HA
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.
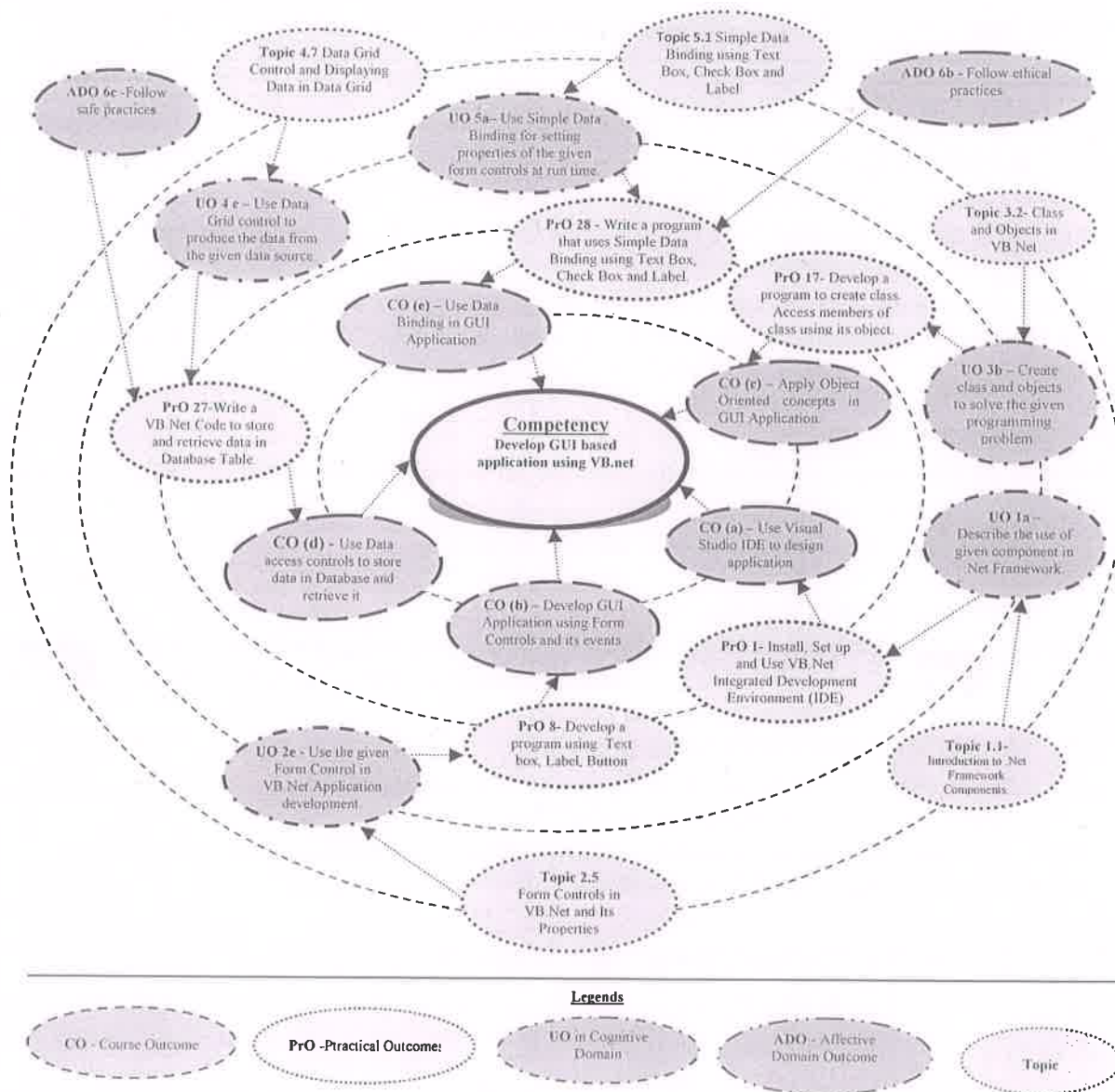

Figure 1 - Course Map

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	02
2.	Use Existing Namespaces and Create user defined Namespace in VB.Net.	I	02

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

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

Program Name	: Computer Engineering Program Group / Diploma in Electronics and Computer Engineering/Diploma in Computer Hardware & Maintenance / Diploma in Cloud Computing and Big Data / Diploma in Artificial Intelligence and Machine Learning
Program Code	: CO/CM/IF/CW/TE/HA/BD/AN
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											
				Paper Hrs.	Theory						Practical					
L	T	P			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)

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	
3.	Develop programs to demonstrate use of if statements and its different forms.		02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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*
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*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	c) Arcs d) Polygons with fillPolygon method.		02
30.	Develop a program to draw following shapes, graphics and applets. a) Cone b) Cylinders c) Cube	V	02*
	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.
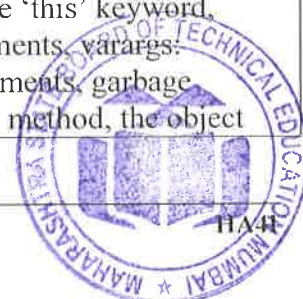
7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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.

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	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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	control with example. 2d. Write the programs by implementing arrays to solve the given problem. 2e. Develop programs using vectors and wrapper classes for the given problem.	class. 2.2 Visibility Control Public, Private, Protected, default, friendly private 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	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(),

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	geometric shape. 5d. Develop program for implementing the given font settings.	getColor(), setForeGround(), setBackGround(), font class, variable defined by font class: name, pointSize, 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/ Diploma in Electronics and Computer Engineering / Diploma in Computer Hardware & Maintenance/ Diploma in Cloud Computing & Big Data/Diploma in Artificial Intelligence and Machine Learning
Program Code	: CO/CM/IF/CW/TE/HA/BD/AN
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.
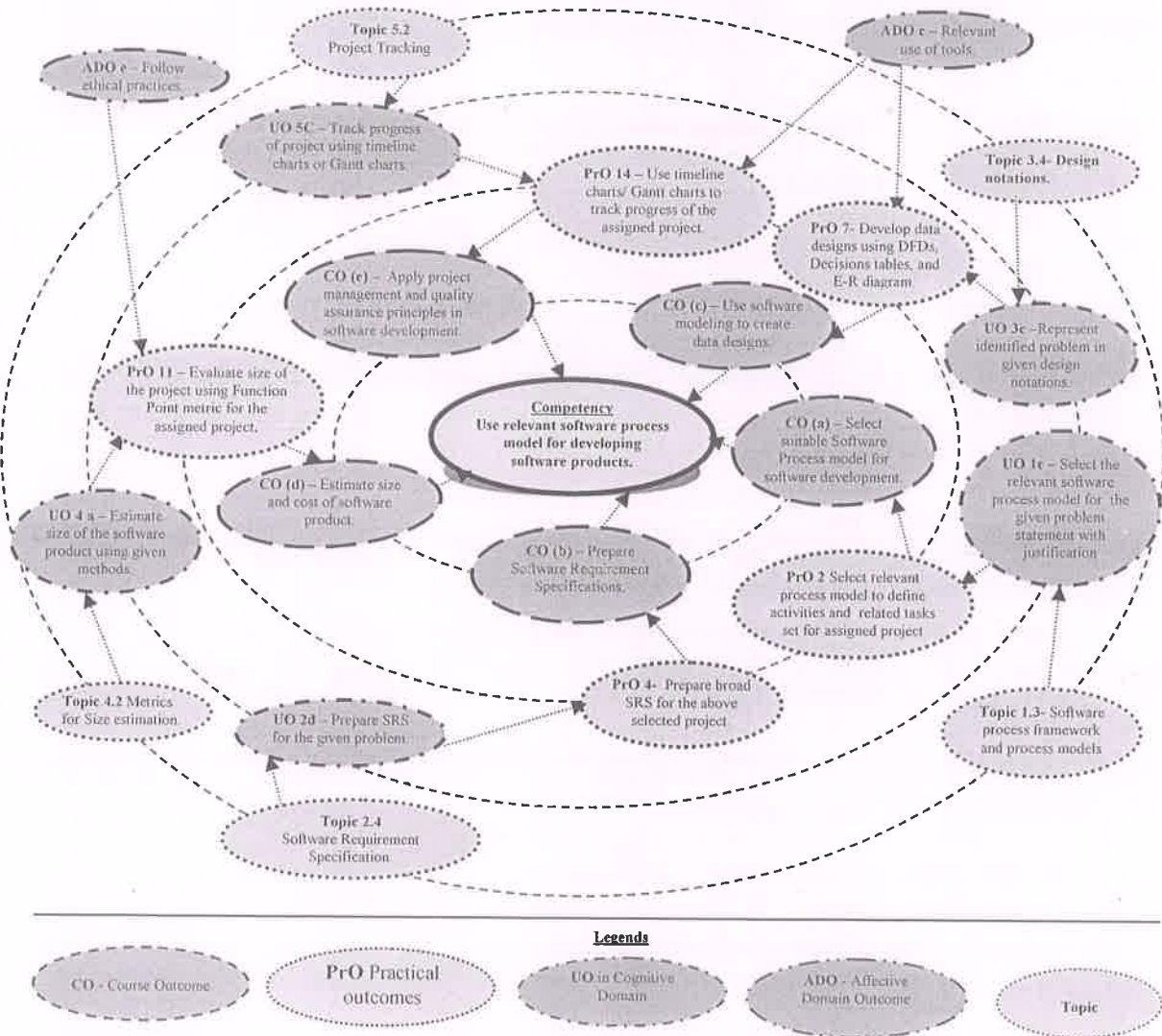

Figure 1 - Course Map

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.	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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*
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:*

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	
2	Operating system: Windows 7/Windows 8/Windows 10/LINUX or any other.	For all Experiments
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	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	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given situation with justification	
Unit– II Software Requirement Engineering	2a. Apply the principles of software engineering for the given problem. 2b. Choose the relevant 'requirement engineering' steps in the given problem. 2c. Represent the 'requirement engineering' model in the given problem. 2d. Prepare SRS for the given problem.	2.1 Software Engineering Practices and its importance, Core principles. 2.2 Communication Practices, Planning Practices, Modelling practices, 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	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	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	for the given software development problem.	
Unit –V Software quality assurance and Security	5a. Use the given scheduling technique for the 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.	5.1 Project Scheduling: Basic principles, Work breakdown structure, Activity 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 quality assurance and Security	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
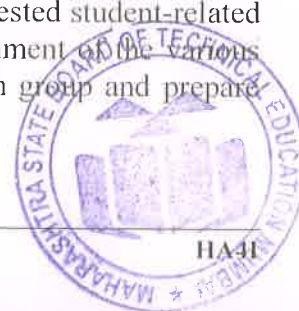
reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
   a. Prepare journals based on practical performed in laboratory.
   b. Give seminar on relevant topics.
   c. Study and analyze college 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

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 / Diploma in Computer Hardware & Maintenance / Diploma in Artificial Intelligence and Machine Learning**
Program Code	: **CO/CM/IF/CW/HA/AN**
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												
				Paper Hrs.	Theory						Practical					
					ESE		PA		Total		ESE		PA		Total	
L	T	P			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.
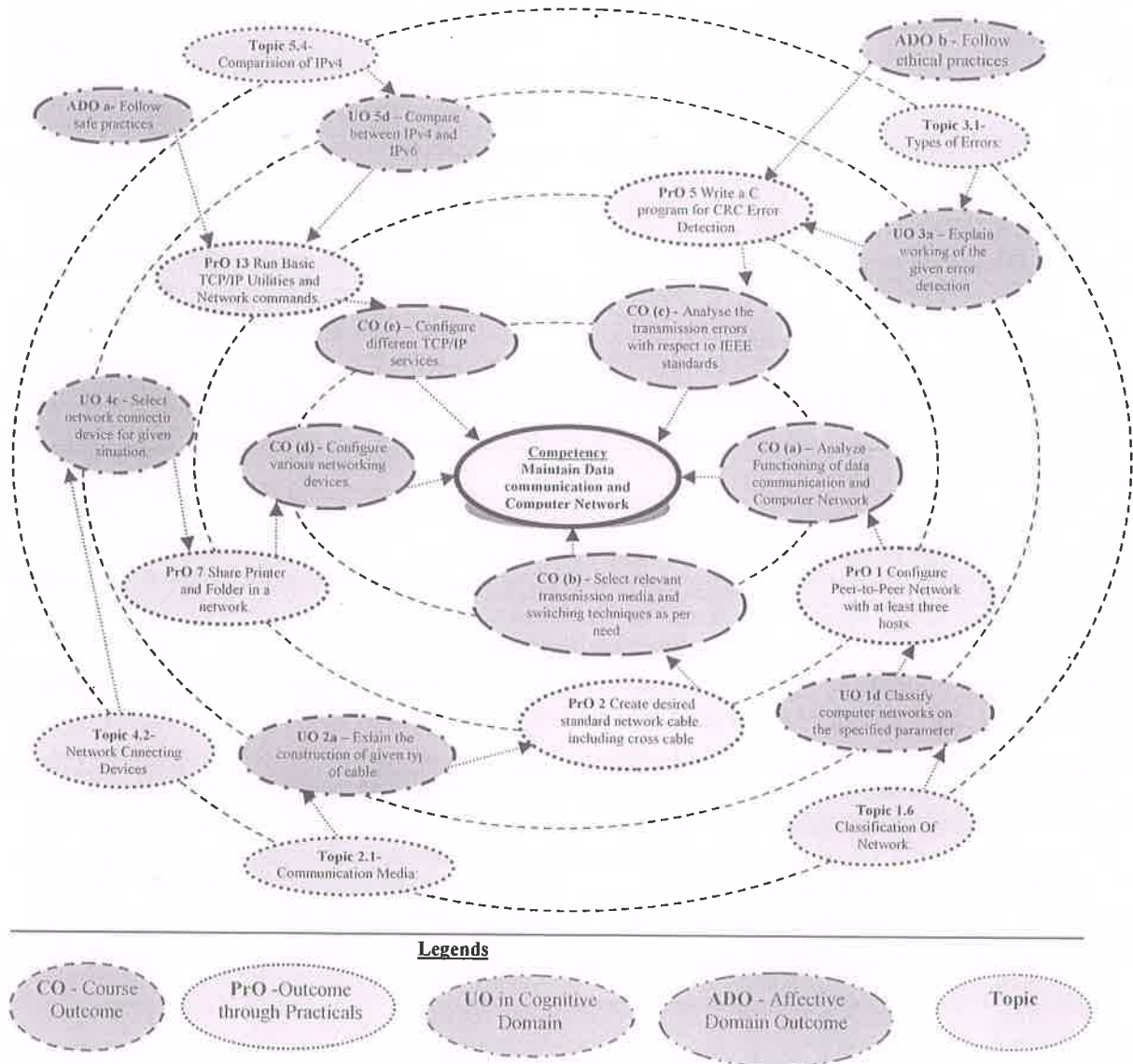

Figure 1 - Course Map

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		
4.	Connect Computers using wireless media	III	02
5.	Write a C program for CRC Error Detection.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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*
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

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.	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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2d. Describe with sketches the working principle of the given switching technique. 2e. Compare different Switching techniques on the given parameter.	Multiplexing Time -Division Multiplexing 2.5 Switching: Circuit-switched networks, 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	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:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	and IPv6 on the given parameters. 5e. Describe with sketches the procedure to configure the given TCP/IP service.	Data Link Layer:Nodes and links,services,two categoriesof links,two 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

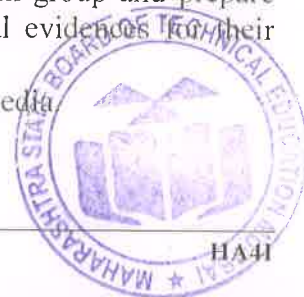| Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamental Of Data Communication And Computer Network	10	04	04	04	12
II	Transmission Media and Switching	14	04	06	06	16
III	Error Detection,Correction and Wireless Communication	14	02	04	06	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
3	Data Communication and Networks	Godbole Achyut	Tata McGraw Hill, New Delhi, 2006, ISBN : 0070472971

S. No.	Title of Book	Author	Publication
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	: **Diploma in Computer Hardware & Maintenance**
Program Code	: **HA**
Semester	: **Fourth**
Course Title	: **Microcontroller**
Course Code	: **22483**

1. RATIONALE

In the rapidly growing digital world, the role of microcontroller based systems is increasingly vital in various domains such as industrial, home automation, entertainment systems, medical equipment and computer based systems. Microcontrollers are used in computer based systems to reduce the size and cost compared to a design that uses a separate microprocessor, memory and input/output devices. Microcontrollers make it economical to digitally control even more devices and processes. To increase the performance of the system application specific hardware and microcontrollers are used in computing systems. It is therefore evident to impart the knowledge of the related technology and hands on skills to develop and maintain microcontroller based systems.

2. COMPETENCY

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

- **Maintain Microcontroller Based Systems.**

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. Analyse architecture of Microprocessor and Microcontroller.
- b. Develop the program for 8051 in C language for Data transfer, Arithmetic and Logical operations.
- c. Develop the program for Timer, Interrupt and Serial port/Parallel port.
- d. Interface the external memory and I/O devices to 8051 Microcontroller.
- e. Use Arduino board for various applications.

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 attainment of COs and the remaining 20 marks is the average of 2 test to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

@: Internal Exam, 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 center of this map.
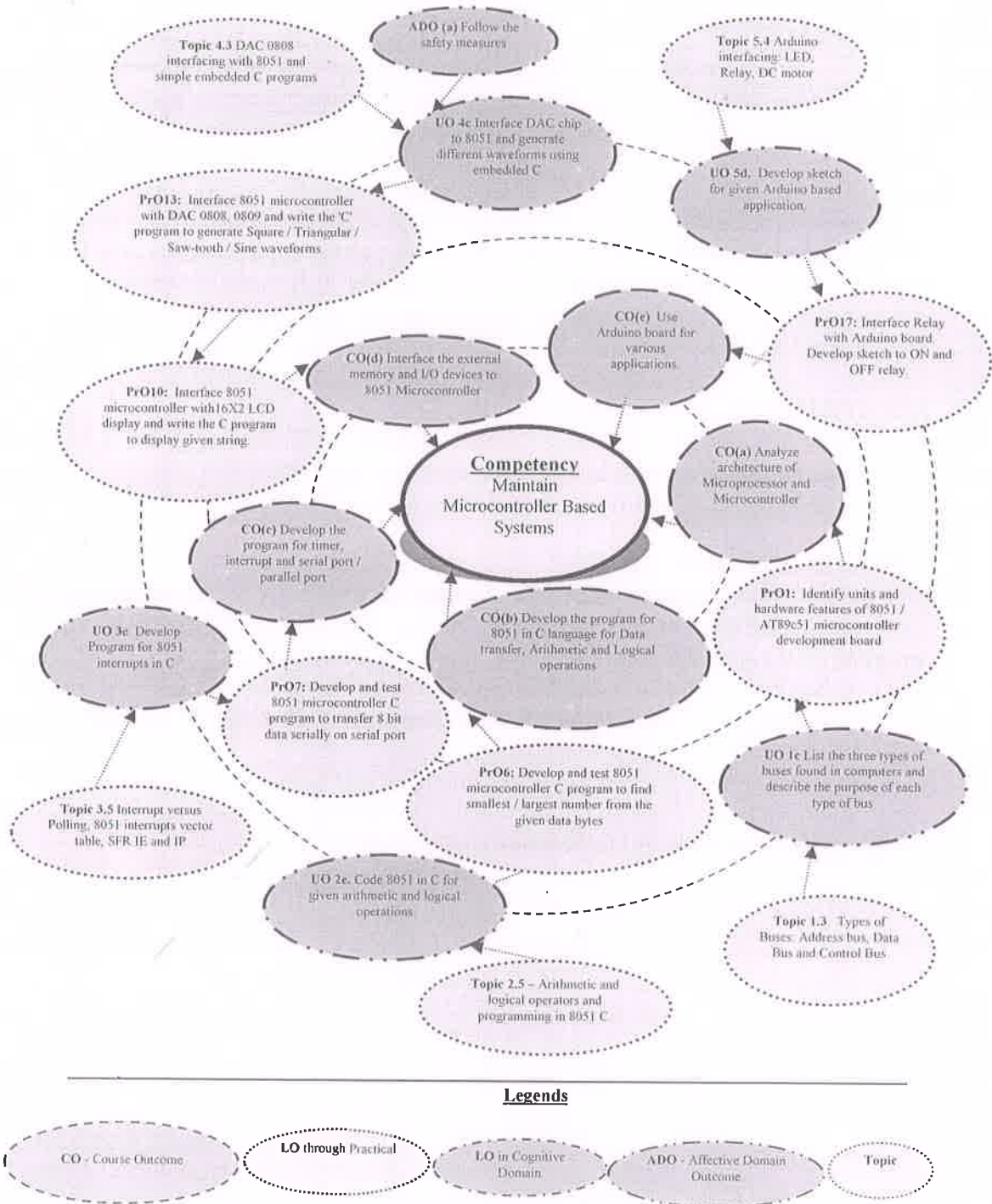

Figure 1: Course Map

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

Sr No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify units and hardware features of 8051/ AT89c51 microcontroller development board.	I	02
2	Identify units and hardware features of PIC and ARM microcontroller development board.	I	02*
3	Develop and test 8051 microcontroller C program to perform arithmetic operations on 8-bit data such as addition, subtraction, multiplication and division.	II	02*
4	Develop and test 8051 microcontroller C program to perform Logical operations on 8-bit data such as AND, NOT, OR, EX-OR, Left shift and Right shift.(Any 4)	II	02
5	Develop and test 8051 microcontroller C program to perform data transfer from source to destination of given size of data.	II	02
6	Develop and test 8051 microcontroller C program to find smallest / largest number from the given data bytes	II	02
7	Develop and test 8051 microcontroller C program to transfer 8 bit data serially on serial port.	III	02
8	Develop and test 8051 microcontroller C program to generate square wave using timer of given duty cycle.	III	02*
9	Develop and test 8051 microcontroller C program to turn ON LED with Key press by interrupt method.	III	02
10	Interface 8051 microcontroller with 16X2 LCD display and write the C program to display given string.	IV	02*
11	Interface 8051 microcontroller with 4X4 matrix keyboard and 16X2 LCD display. Write the C program to read key code from keyboard and display on LCD	IV	02
12	Interface 8051 microcontroller with ADC0808/0809 and write the C program to convert given DC analog signal into digital signal and store the converted digital data in internal memory.	IV	02
13	Interface 8051 microcontroller with DAC 0808/0809 and write the C program to generate Square/ Triangular/ Saw-tooth/ Sine waveforms.	IV	02*
14	Interface 8051 microcontroller with stepper motor and write the C program to rotate stepper motor using Half/Full stepping in clockwise and counter clockwise direction.	IV	02
15	Identify units and hardware features of Arduino UNO board and Use Arduino Integrated Development Environment (Arduino IDE) tool for developing sketch.	V	02
16	Interface Key and LED with Arduino board. Develop sketch to blink LED upon Key press.	V	02*
17	Interface Relay with Arduino board. Develop sketch to ON and OFF relay.	V	02
18	Interface DC motor with Arduino board. Develop sketch to rotate motor at different speed.	V	02
	Total		**36**

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 practical's 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.	Identification of Components	20
b.	Correctness of code and Tools Usage	20
c.	Interpretation of result and conclusion	20
d.	Follow safety measures	10
e.	Answer to sample questions	20
f.	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.   Maintain tools and equipment.
   d.   Follow ethical practices.
   e.   Maintain team harmony.

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 as 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.
   • '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.

Sr No.	Equipment Name with Broad Specifications	Pr. Sr. No.
1	Microcontroller kit (8051,PIC,ARM): Single board systems with minimum 8K RAM, ROM memory with battery backup, 16X2 LCD display, PC keyboard interfacing facility, 4X4 matrix keyboard, cross c-compiler, USB interfacing facility with built in power supply.	1 to 15
2	Digital Multimeter 3 1/2 digit display. 9999 counts digital multimeter measures: Vac, Vdc, (1000V max) , Adc, Aac (10 amp max) , Resistance(0-100MΩ) , Capacitance and Temperature measurement	12,13

3	Arduino Board with AVR microcontroller UNO R3 Development Board - Compatible Model.	15,16,17,18
4	Desktop PC with Integrated Development Environment (MicroPro C/ Keil / Proteus).	ALL
5	Stepper Motor- 1.8 degree step angle with driver circuit.	14
6	CRO- Bandwidth AC 10Hz — 20MHz (-3dB). DC — 20MHz (-3dB), X10 Probe. OR DSO - DSO with Bandwidth: 50-100 MHz TFT color LCD Dual channel real time sampling 1GSa/s equivalent sampling 25 GSa/s Memory 1M pts 10 waveforms and 10 Set ups can be stored.	8,13
7	ADC (0808) trainer board compatible with 8051 microcontroller.	12
8	DAC (0808) trainer board compatible with 8051 microcontroller.	13

8.   UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (In cognitive domain)	Topics and Sub-topics
Unit – I Microprocessors and Microcontrollers	1a. Explain the features of given processor. 1b. Explain given type of CPU Architecture with block diagram. 1c. List the three types of buses found in computers and describe the purpose of each type of bus. 1d. Compare the given derivatives of the microcontrollers. 1e. List embedded products used for computers.	1.1 Evolution of Microprocessor, Intel Pentium 4 and Core 2, I3, I5, I7, I9 and X Series Processor's features. 1.2 CPU Architecture: Harvard and Von-Neumann architecture. Concept of pipelining and superscalar architecture. RISC and CISC. 1.3 Types of buses: address bus, data bus, control bus. 1.4 Criteria for selection of microcontroller Derivatives of 8051 (8031,8951,8751,8952) 1.5 Features of 8051, PIC, AVR and ARM. microcontrollers with their applications. 1.6 Embedded products used for computers: List.

Unit– II
 	
 8051 Architecture and Programming In C Language
	2a. Explain various blocks of 8051.
	 2b. Describe given pins of 8051.
	 2c. Use data types for given program.
	 2d. Code 8051 in C for given I/O operations.
	 2e. Code 8051 in C for given arithmetic and logical operations.
		2.1 Architecture of 8051: Internal organization,
		     Pin description of 8051
		 2.2 C - Data types for 8051: Unsigned char, int
		     Signed char,int, sbit, bit.
		 2.3 Software development Tools: Editor, Compiler, Debugger, Linker, Locator.
		 2.4 Input/ Output Programming in 8051 C
		 2.5 Arithmetic and Logical operators and programming in 8051 C

Unit	Major Learning Outcomes (In cognitive domain)	Topics and Sub-topics
Unit– III 8051 Timer/Counter, Serial Communication and Interrupts	3a. Describe the various modes of the 8051 timers. 3b. Develop Program for 8051 in C to generate given time delays. 3c. Develop Program for 8051-serial port in C. 3d. Compare Interrupt with polling method. 3e. Develop Program for 8051 interrupts in C.	3.1 8051 Timer: Timer register, TMOD, TCON. 3.2 Timer/Counter modes and programming in embedded C 3.3 Asynchronous serial communication: baud rate in 8051, RS232 standards, 8051 connections to RS232 with MAX232, SFR: SBUF, SCON and PCON. 3.4 Programming the 8051 to transmit and receive data serially in C 3.5 Interrupt versus Polling, 8051 Interrupt Vector table, SFR: IE, IP. 3.6 Programming timer, serial communication using Interrupt.
Unit-IV 8051 I/O device and memory Interfacing	4a. Describe interfacing of the given I/O device. 4b. Interface ADC chip to 8051 and develop program in embedded C. 4c. Interface DAC chip to 8051 and generate different waveforms using embedded C. 4d. Describe interfacing of the given external memory.	4.1 Input/output Interfacing: Switch, LED, 16x2 LCD, 4 x 4 matrix Keypad, Stepper motor 4.2 ADC 0808 interfacing with 8051 and embedded C program 4.3 DAC 0808 interfacing with 8051 and simple Embedded C programs. 4.4 Memory interfacing: external Program and Data memory.
Unit –V Arduino	5a. Describe the features of given Arduino board. 5b. Explain purpose of the given Arduino hardware. 5c. Explain the functions of Arduino IDE. 5d. Develop sketch for given Arduino based application.	5.1 Arduino Hardware: Arduino boards, shields, Arduino R3 Uno board features. 5.2 ATmega 328 microcontroller features, Arduino: ISP and bootloaders. 5.3 Arduino software: Arduino IDE, Sketch,C, C++ functions setup(), loop(), pinMode(), digitalWrite(), digitalRead() and delay(). 5.4 Arduino Interfacing: LED, Relay, DC motor.

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	Microprocessors and Microcontrollers	10	2		4	10

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	8051 Architecture and Programming In C Language	12	4	4	6	14
III	8051 Timer/Counter, Serial Communication and Interrupts	16	4	8	6	18
IV	8051 I/O device and memory Interfacing	14	4	4	8	16
V	Arduino	12	2	4	6	12
	Total	**64**	**16**	**24**	**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. Download and interpret the data sheets of all the components used in the practical.
b. Prepare power point presentation on applications of microcontroller.
c. Deliver seminar on reverent applications of microcontroller.
d. Library/Internet survey regarding different data books and manuals.
e. Undertake a market survey of different microprocessors and microcontrollers.
f. Prepare the report on AMD processors.

11.   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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 (MOOC's) 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 I scheme 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.

i. Use different videos, animations to explain various I/O devices.
j. Arrange industrial visit to explore microcontroller application in industry.

12.   SUGGESTED MICRO-PROJECTS

Only one microproject is planned to be undertaken by a group of students *(minimum 3 or maximum 5 Students/Group)* that needs to be assigned to them at the beginning of the semester. 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 presentation of it before submission as per course teacher's rubrics. 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. Build a circuit using microcontroller to control the speed of DC motor.
b. Build circuit using microcontroller to blink LED.
c. Build circuit using microcontroller and LCD to display 0 to 9 no's.
d. Build a Microcontroller based Moving Message Display on LCD.
e. Build a circuit to class period bell using Raspberry Pi microcontroller.
f. Build a circuit using microcontroller temperature controlled fan.
g. Build a circuit to measure room temperature using a microcontroller.
h. Build traffic controller for specified delay.
i. Build a circuit to Interface LCD with Arduino board
j. Build a circuit using Arduino board to automatic watering plant.
k. Build a circuit to Temperature Monitoring with Arduino
l. Build a circuit using Arduino board for Detecting Obstacles
m. Build circuit for Stepper motor controller.
n. Build a circuit using Arduino for testing various parameters of soil.

13. SUGGESTED LEARNING RESOURCES

Sr No.	Title of Book	Author	Publication
1	8051 Microcontroller Architecture, Programming and Application	Kenneth Ayala	PHI Learning New Delhi, July 2004, ISBN:9781401861582
2	Microcontroller Theory and Application	Ajay V.Deshmukh McGraw Hill,	McGraw Hill, New Delhi, 2011, ISBN-9780070585959
3	Microcontrollers Principle and Application	Ajit Pal	PHI Learning, New Delhi, 2014, ISBN: 9788120343924
4	The 8051 Microcontroller and Embedded system Using Assembly and C	Ali Mazidi, Janice Gillispie Mazidi,Rolin D.Mckinlay	Pearson /Prentice Hall, Delhi,2008, ISBN-9788177589030
5	Microcontroller Architecture Programming, Interfacing and System Design	Raj Kamal	Pearson Education, Delhi, 2012, ISBN:9788131759905

Sr No.	Title of Book	Author	Publication
6	Microprocessors and Microcontrollers	Sunil Mathur, Jeebananda Panda	PHI Learning, New Delhi, 2016, ISBN:9788120352315
7	Microprocessors and Microcontrollers: Architecture programming and System Design	Krishna Kant	PHI Learning, New Delhi, 2016, ISBN: 9788120348530
8	Programming Arduino: Getting started with Sketches.	Simon Monk	McGraw-Hill Education New Delhi 2016, ISBN: 9781259641633
9	Getting Started with Arduino.	Massimo Banzi	O'Reilly Media, Inc. Mumbai 2014 ISBN: 9780596155513

14. SUGGESTED SOFTWARE WEBSITES

Following websites are suggested for different programming language and/or simulation software to enhance psychomotor domain skill. Any other equivalent open-source software can be used if required.

Sr. No.	Keyword	QR Code	Web Links
1	Microcontroller Programming		Simulation software:- www.keil.com
2	8051 Simulator		Software:- https://www.edsim51.com/
3	Arduino		https://www.arduino.cc/

15. SUGGESTED ONLINE TEACHING/ LERANING RESOURCES

Following learning websites are suggested to students to enhance their skill in specific learning domain. It helps student to visualize and demonstrate the concept easily using given online resources.

Sr. No.	Keyword	QR Code	Web Links
1	Microcontroller		https://www.mikroe.com/

Sr. No.	Keyword	QR Code	Web Links
2	Microcontroller applications		https://www.eeweb.com/microcontroller-types-and-applications/
3	Microcontroller		https://nptel.ac.in/courses/108105102
4	Memory		www.slideshare.net/aismahesh/memory-8051
5	Microcontroller instructions		https://www.electronicshub.org/8051-microcontroller-instruction-set
6	Microcontroller		https://www.classcentral.com/course/youtube-8051-microcontroller-lecture-series-53060/classroom
7	Arduino		https://create.arduino.cc/projecthub
8	Arduino		https://opensource.com/resources/what-arduino
9	Arduino programming		https://www.hackster.io/arduino
10	Arduino		https://gitconnected.com/learn/arduino