Government Polytechnic, Mumbai

Department of Computer Engineering

Semester II

(Course Contents)

For P-19 Curriculum

Programme Diploma in Computer Engineering
(Sandwich Pattern)

(Approved Copy)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Computer Engineering (Sandwich Pattern) **Term / Semester - II**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
HU19101	Communication Skills	2	2	--	4	4	60	20	20	25*	--	25	150
SC19110	Engineering Mathematics	4	--	--	4	4	60	20	20	--	--		100
CO19202	Programming in C++	3	2	--	5	5	60	20	20	25*	--	25	150
CO19203	Computer Hardware and Maintenance	--	4	--	4	4	--	--	--	50*	--	50	100
CO19204	Data Structures	3	2	--	5	5	60	20	20	25*	--	25	150
IT19204	Digital Techniques	3	2	--	5	5	60	20	20	25	--	25	150
CO19205	Linux OS (Spoken Tutorial)	--	3	--	3	3#	--	--	--	--	--	--	--
	Total	**15**	**15**	**--**	**30**	**30**	**300**	**100**	**100**	**150**	**--**	**150**	**800**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test , **#** indicates Self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 minutes, PR/OR – 3 hours per batch, SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, on- line learning Mode through MOOCs /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Department Coordinator,
Curriculum Development,
Dept. of Computer Engineering

Head of Department
Dept. of Computer Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in CE/ME/IT/CO/IS/EE/EC/LG/LT (Sandwich Pattern)**										
Course Code: **HU19101**				Course Title**: Communication Skills**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs. 30 Min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
02	**02**	**-**	**04**	**60**	**20**	**20**	**25***	-	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale: Communication skills play a vital and decisive role in career development. In this age of globalization, competition is tough. Hence effective communication skills are important. The subject Communication Skills introduces basic concepts of communication. It also describes the verbal, non-verbal modes and techniques of oral & written communication.

In this context, it will help the engineering diploma students to select and apply the appropriate methods of communication in various situations and business communication. Students are also required basics of communication and use of different skills.

This course will guide and direct to develop a good personality and improve communication skills. It will enable the students to utilize the skills necessary to be a competent communicator.

Course Outcomes: Student should be able to

CO1	Apply proper communication technique to cope up with the challenges of the modern world.
CO2	Interpret feedback at various situations by using appropriate body language and avoid the barriers in effective communication.
CO3	Able to participate in Group Discussion and Acquire the practical knowledge of an interview.
CO4	Able to develop PowerPoint Presentation and Business correspondence.
CO5	Write letters, circulars, memos, notices, reports and communicate effectively in written communication.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Communication** 1.1 Elements of Communication 1.2 Communication Cycle 1.3 Types of communication 1.4 Definition and Types of Barriers- a)Mechanical b)Physical c)Language d)Psychological 1.5 How to overcome Barriers **Course Outcome: CO1 Teaching Hours :6 hrs Marks: 14 (R- 2, U-4, A-8)**
2	**Non- verbal Communication** 2.1 Meaning and Importance of Non-verbal Communication 2.2 Body Language 2.3 Aspects of Body Language 2.4 Graphic language **Course Outcome: CO2 Teaching Hours :6 hrs Marks: 12 (R- 4, U-4, A-4)**
3	**Group Discussion And Interview Skills** 3.1 Need and Importance of Group Discussion 3.2 Use of Knowledge and Logical sequence. 3.3 Types of Interview 3.4 Preparing for an Interview **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R-2, U-4, A-4)**
4	**Presentation Skills** 4.1 Presentation Skills - Tips for effective presentation 4.2 Guidelines for developing PowerPoint presentation **Course Outcome: CO4 Teaching Hours :4 hrs Marks: 08 (R- 2, U-2, A-4)**
5	**Business Correspondence** 5.1 Office Drafting – a) Notice b) Circular c) Memo d) Email-writing. 5.2 Job Application with resume. 5.3 Business Letters – a) Enquiry b)Order c)Complaint 5.4 Report Writing – a) Fall in Production b) Accident Report **Course Outcome: CO5 Teaching Hours: 8 hrs Marks: 16 (R- 4, U-4, A-8)**

List of experiments: Any 10 experiments out of 15

Sr. No.	Unit No	COs	List of Experiments	Hours
1	1	CO1,CO4	Conversation between students on various situations.	02
2	3	CO2,CO4	Non- Verbal Communication.	02
3	3	CO3,CO4	Group Discussion	02
4	4	CO3,CO4	Mock Interview	02
5	5	CO4,CO5	Business Communication a) Advertisement, Tender, Diary writing. b) Job Application With Resume.	02
6	1	CO1	Communication Barriers	02
7	5	CO5	Business Letters – a) Enquiry b)Order c)Complaint	02
8	4	CO1,CO4	Speeches- a)Welcome Speech b)Farewell Speech c) Vote of Thanks	02
9	5	CO5	Report Writing – a) Fall in Production b) Accident Report	02
10	All	CO4	Showing Videos on different types of Communication.	02
11		CO1	*Articles	02
12		CO1	*Preposition and Conjunction	02
13		CO1	*Direct Indirect Speech	02
14		CO1	*Change the voice	02
15		CO1	*Vocabulary Building	02
			Total	**30**

Note: Experiments No.1 to 10 are compulsory. Remaining experiments are to be performed on availability of time.* These experiments will be performed during practical hours only.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Communication Skills	Joyeeta Bhattacharya - Reliable Series	9780000176981, 0000176982
2	Communication Skills	Sanjay Kumar, PushpaLata- Oxford University Press	13: 978-0199488803
3	Successful presentation Skills	Andrew Brad bury- The Sunday Times	13: 9780749456627

E-References:

1) Website: www.mindtools.com/page8.html-99k
2) Website:www.inc.com/guides/growth/23032.html-4
3) Website: www.khake.com/page66htm/-72k
4) Website: www.BM Consultant India Consultant India.Com
5) https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-English
6) MYCBSEGUIDE
7) Website: www.letstak.co.in
8) https://learnenglishteens.britishcouncil.org/

CO Vs PO and CO Vs PSO Mapping (Civil Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1	2	1
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	2	1
CO4	3	3	2	1	2	3	2	1	2	
CO5	3	3	2	1	2	3	2	1	2	

CO Vs PO and CO Vs PSO Mapping (Mechanical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	3	2	3	2	2	1
CO2	3	3	2	3	2	3	2	2	1
CO3	3	2	2	1	2	3	2	2	1
CO4	3	3	2	1	2	3	2	2	1
CO5	3	3	2	1	2	3	2	2	1

CO Vs PO and CO Vs PSO Mapping (Electronics Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	1	1
CO4	3	3	2	1	2	3	2	1		
CO5	3	3	2	1	2	3	2	1		

CO Vs PO and CO Vs PSO Mapping (Electrical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1	2	3
CO2	3	3	2	3	2	3	2	2		3
CO3	3	2	2	1	2	3	2	2		3
CO4	3	3	2	1	2	3	2	1		2
CO5	3	3	2	1	2	3	2			

CO Vs PO and CO Vs PSO Mapping (Instrumentation Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	3	2	3	2	1	2
CO2	3	3	2	3	2	3	2	1	2
CO3	3	2	2	1	2	3	2	1	2
CO4	3	3	2	1	2	3	2		2
CO5	3	3	2	1	2	3	2		

CO Vs PO and CO Vs PSO Mapping (Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1	2	1
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	2	1
CO4	3	3	2	1	2	3	2		2	
CO5	3	3	2	1	2	3	2		2	

COVs PO and CO Vs PSO Mapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	1	1
CO2	3	3	2	3	2	3	2	2	1	1
CO3	3	2	2	1	2	3	2	1		2
CO4	3	3	2	1	2	3	2	1		
CO5	3	3	2	1	2	3	2	1		

CO Vs PO and CO Vs PSO Mapping (LG/LT Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1		2
CO2	3	3	2	3	2	3	2	1		2
CO3	3	2	2	1	2	3	2	1	1	2
CO4	3	3	2	1	2	3	2	1		2
CO5	3	3	2	1	2	3	2	1		2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Ms Shilpa D. Khune	Corporate Consultant Trainer	Mahindra Pride Classroom
3	Mrs.S.S. Kulkarni	Lecturer in English	Government Polytechnic Pune
4	Mrs. K.S.Pawar	Lecturer in English	Government polytechnic Mumbai
5	Ms.N.N.Dhake	Lecturer in English	Government polytechnic Mumbai

Coordinator,

Curriculum Development,
Department of Science And Humanities

Head of Department

Department of Science And Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in CE/ME/CO/IF/EC/EE/IS(Sandwich Pattern)**										
Course Code: **SC19110**				Course Title: **ENGINEERING MATHEMATICS**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 Min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**--**	**--**	**4**	**60**	**20**	**20**	**--**	---	**--**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR- Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

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Rationale:

This subject is kept under the branch of sciences. This subject intends to teach student basic facts ,concepts, principles, and procedure of mathematics as a tool to analyze engineering problems and as such lays down foundation for understanding the engineering and core technology subject.

Course Outcomes: Student should be able to

CO1	Define the basic principles of function, limits, derivatives, complex number and relations between two variables.
CO2	Apply rules, concept and properties to solve the problems
CO3	Solve the given problems of integration using suitable method.

Course Content Details:

Unit No	Topics / Sub-topics
1	**1. Function** 1.1 Definition of variable,constant,intervals such as open,closed,semi-open etc 1.2 Definition of function,value of function and types of functions and simple examples **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**2. Limits** 2.1 Definition of neighbourhood,concept and definiton of limit 2.2 Limits of Algebraic function 2.3 Limits of Trigonometric Functions with simple examples **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U-4 , A-4)**
3	**3. Derivatives & Application of derivative** 3.1 Definition of the derivative. 3.2 Derivatives of standard function.(No proof by first principle) 3.3 Differentiation of sum, difference, product and quotient of two or more functions 3.4 Differentiation of composite function with simple example. 3.5 Second order derivative. 3.6 Geometrical Meaning of Derivative 3.7 Tangents & Normals to the curve, 3.8 Maxima & minima of the function 3.9 Radius of curvature **Course Outcome: CO2 Teaching Hours : 10 hrs Marks:10 (R-4 , U- 4 , A-2)**
4	**4. Integration & Application of integration** 4.1 Definition of integration as antiderivative ,Integration of standard function 4.2 Rules of integration(Integration of sum, difference,scalar multiplication) without proof 4.3 Integration by substitution 4.4 Integration of composite function 4.5 Definiton of definite integral 4.6 Properties of definite integral with simple problems 4.7 Area under the curve 4.8 Area bounded by two curves **Course Outcome: CO3 Teaching Hours :10 hrs Marks:10 (R-4, U- 4 , A-2)**
5	**5. Complex Number:-** 5.1 Definition of complex number Cartesian ,Polar ,Exponential form of complex number 5.2 Algebra of complex number :-Equality , addition ,Substraction ,Multiplication & Division with simple examples **Course Outcome: CO2 Teaching Hours :10hrs Marks:10 (R- 2 , U-4 , A-4)**
6	**6. Numerical Analysis** 6.1 Solution of Algebraic equations using – i) Bisectional method ii) Regular – Falsi method , iii) Newton- Raphson method 6.2 Solution of simultaneous equation (i) Gauss elimination method (ii) Jacobi's method (iii) Gauss-Seidal method **Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4 , A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Function**	04	04	02	10
2	**Limits**	02	04	04	10
3	**Derivatives & Application of Derivatives**	04	04	02	10
4	**Integration & Application of Integration**	04	04	02	10
5	**Complex Number**	02	04	04	10
6	**Numerical Analysis**	02	04	04	10
	Total	**18**	**24**	**18**	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students	S.P.Deshpande, Pune Vidyavardhini Graha Prakashan	-
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

E-References:

1. www.math-magic.com
2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1		1
CO2	3			1			1	1		1
CO3	3			1			1	1		1

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			1			1	1	
CO2	3			1			1	1	
CO3	3			1			1	1	

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1	1	
CO2	3			1			1	1	1	
CO3	3			1			1	1	1	

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1		1
CO2	3			1			1	1		1
CO3	3			1			1	1		1

CO Vs PO and CO Vs PSO Mapping (ELCTRONICS ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1		1	1
CO2	3			1			1		1	1
CO3	3			1			1		1	1

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1		1	
CO2	3			1			1		1	
CO3	3			1			1		1	

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			1			1	1	1
CO2	3			1			1	1	1
CO3	3			1			1	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Mrs. Deepawali S. kaware	Lecturer in Mathematics	Government polytechnic Vikaramgad
3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
4	Mr.V.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Sci. & Humanities

Head of Departments
Department of Science & Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Computer Engineering (Sandwich Pattern)**										
Course Code: **CO19202**				Course Title: **Programming in C++**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 Mins)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**25***	--	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

The goal of this course is to provide the students with the fundamental knowledge of C++ language. The basic programming ability has already been developed in students in the course Programming in C. In this course they will learn how to solve real life problems more efficiently and with fewer efforts using features of C++ language. Basic file handling, Parametric Polymorphism have also been included in the course and emphasis is given on use of GCC compiler on Ubuntu platform so that a habit of programming in professional manner as per the needs of the industry will be developed in the students.

Course Outcomes: Student should be able to

CO1	Write basic programs for a given problem statement.
CO2	Write functions to solve given problem.
CO3	Define classes in C++.
CO4	Develop programs using the concepts of Inheritance and Polymorphism..
CO5	Manipulate the file and Console IO, Templates and STL.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction** 1.1 Installation GCC Compiler 1.2 Main(), printf(), scanf() 1.3 Variables and data types 1.4 Loops, Conditionals, Arrays 1.5 Function Declaration and calls 1.6 Iterations and Recursions **Course Outcome: CO1 Teaching Hours: 06 hrs Marks: 06 (R- 2, U- 4, A- --)**

2	**Structs and Pointers** 2.1 Defining Structs 2.2 Nested Structs 2.3 Predeclaration 2.4 Type Conversion 2.5 Manipulating memory with Pointers 2.6 Implementing Data Structures using structs and pointers **Course Outcome: CO1 Teaching Hours: 06 hrs Marks: 08 (R- --, U- 4, A- 4)**
3	**Functions** 3.1 Function Prototype 3.2 Reference Arguments 3.3 Default Argument 3.4 Const Arguments 3.5 Returning const 3.6 Varargs 3.7 Multidimensional Arrays as Arguments **Course Outcome: CO2 Teaching Hours: 06 hrs Marks: 08 (R- 2, U- 2, A- 4)**
4	**Classes and Objects** 4.1 Defining a class 4.2 Creating Objects 4.3 Destroying Objects 4.4 Access Control 4.5 Separation of Definition from Declaration 4.6 Static Members **Course Outcome: CO 3 Teaching Hours: 08 hrs Marks: 10 (R- 2, U- 4, A- 4)**
5	**Constructors and Destructors** 5.1 Defining Constructors 5.2 Default Constructors 5.3 Copy Constructors 5.4 Move Constructors 5.5 Destructors **Course Outcome: CO 3 Teaching Hours: 04 hrs Marks: 06 (R- --, U- 2, A- 4)**
6	**Inheritance and Polymorphism** 6.1 Base Class and Derived Class 6.2 Access Control in Inheritance 6.3 Virtual Functions 6.4 Function Overriding 6.5 Pure Virtual Functions and Abstract Classes 6.6 Function Overloading 6.7 Operator Overloading 6.8 Copy Assignment Operator 6.9 Move Assignment Operator **Course Outcome: CO 4 Teaching Hours: 08 hrs Marks: 10 (R- 2, U- 4, A- 4)**

7	**IO Handling: Console and Files** 7.1 C++ Streams 7.2 Formatted Console IO Operations 7.3 File Stream Classes 7.4 Opening and Closing a File 7.5 Deleting a File 7.6 File Modes **Course Outcome: CO 5 Teaching Hours: 05 hrs Marks: 06 (R- 2, U- 2, A- 2)**
8	**Parametric Polymorphism** 8.1 Function Template 8.2 Class Template 8.3 Using STL Vector class **Course Outcome: CO 5 Teaching Hours: 02 hrs Marks: 06 (R- 2, U- 4, A- --)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction	02	04	--	06
2	Structs and Pointers	--	04	04	08
3	Functions	02	02	04	08
4	Classes and Objects	02	04	04	10
5	Constructors and Destructors	--	02	04	06
6	Inheritance and Polymorphism	02	04	04	10
7	IO Handling: Console and Files	02	02	02	06
8	Parametric Polymorphism	02	04	--	06
	Total	12	26	22	60

List of experiments:

(Note: All the programs must be compiled and executed on GCC. Any code editor like Visual Studio Code can be used. Use of Turbo C/ Turbo C++ is strictly prohibited.**)**

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	**Beginning with C++** 1.1 Install GCC and Visual Studio Code Editor on Ubuntu. 1.2 Write a program to print "Hello World" on Console. 1.3 Write a program to print "Hello GPM" on Console. 1.4 Write a program to print addition of two integers. 1.5 Write a program to print addition of two integers input from user. 1.6 Write a program to take two integers from user, subtract the smaller number from the greater and print the result. 1.7 Write a program to take n integers from user (where n is also input by user) and print their addition. 1.8 Write a program to take n integers from user (where n is also input by user) and print their sum of product (product of first number and last number added to product of second number and second last number and so on). 1.9 Write a function with two integers and return the sum of sum of their squares. 1.10 Write a function called power which will take two arguments of type double (say x and n) and return the value of x raised to the power of n. 1.11 Write a function which will take a long argument and return its factorial using iteration. 1.12 Write a function which will take a long argument and return its factorial using recursion. 1.13 Write a function which will take a double argument (say theta) and return the value of sin(theta). $\sin(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} x^{2k+1} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$ 1.14 Write a function squareRoot which will take a double argument and return its square root using Heron's method of finding square root.	04
2	2	CO1	**Structs and Pointers** **2.1** Define a struct Point with two double members (say x and y). **2.2** Define a struct Circle with a member of type struct Point as center and a double member radius. 2.3 Write a function which will take two arguments of type struct Circle and will return 1 if the two circles are intersecting and return 0 otherwise. 2.4 Define a struct LineSegment having two members of type strut Point (say p1 and p2). 2.5 Write a function which will take two arguments of type struct LineSegment and will return 1 if the two line segments are intersecting and return 0 otherwise.	04

			2.6 Write a function to delete an element into a Doubly Circular Linked List	
3	3	CO2	**Playing with Functions** 3.1 Write a function which will take a string as a parameter and will remove the blank spaces before and after a string. 3.2 Write a function which will find sum of all the prime numbers up to n. where n is input by user.	04
4	4	CO3	**Classes and Objects** 4.1 Define a class representing a CartesianComplexNumber. Define member functions: add, subtract, multiply, divide, conjugate, modulus, argument, print in Cartesian and polar form. **4.2** Create a class Matrix with size 3 x 3 for floating point data. Declare a member function inside the class which will find transpose of the matrix. **4.3** Define a member function which will find discriminant of matrix. Consider all the possibilities. 4.4 Define a member function which will find inverse of matrix. Consider all the possibilities.	06
5	5	CO3	**Constructors and Destructors** 5.1 Create a class String which has two members- length and pointer to first character. a. Implement copy constructor b. Implement move constructor c. Implement destructor d. Implement the function: char getCharAt(int index) e. Implement the function: void setCharAt(int index, char char) f. Implement the function: int getLength()	04
6	6	CO4	**Inheritance and Polymorphism** 6.1 Define a class representing a PolarComplexNumber. Define member functions: add, subtract, multiply, divide, conjugate modulus, argument, print in Cartesian and polar form. 6.2 Create an Abstract class ComplexNumber. 6.3 Define virtual functions with same prototype as CartesianComplexNumber class. 6.4 Inherit ComplexNumber in CartesianComplexNumber and PolarComplexNumber classes.	04
7	7	CO5	**Console and File IO** 7.1 Write a program to display the following output. 1 1 2 1 1 2 3 2 1 1 2 3 4 3 2 1 1 2 3 4 5 4 3 2 1 7.2 Write a menu-driven program to create, update, display a CSV file containing customer records.	04
8	8	CO5	**Parametric Polymorphism**	02

			8.1 Given a vector of Circles and sort them into increasing order of radii.	
9	3	All	**Assignment** Solve 200 Multiple Choice Questions based on the above contents.	--
10	4	All	**Mini Project** **(**To be done in groups of 2-3 students.)	
Total				**32**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	An Introduction to Programming through C++	Abhiram G. Ranade, McGraw Hill Education; First edition (1 July 2017)	9332901511 978-9332901513
2	Object Oriented Programming with C++, 6th Edition.	E. Balagurusamy, McGraw Hill Education (India) Private Limited, New Delhi.	978-0-07-066907-9
3	C++ The Complete Reference, 4th Edition.	Herbert Schildt, McGraw Hill/ Oshome, New Delhi	0-07-150239-4 (eBook) 0-07-222680-3 (print)
4	Programming with C++, 2nd Edition	John R. Hubbard, Schaum's Outlines	0-07-030837-3
5	Let Us C++	YashwantKanetkar,	8176561061 13: 9788176561068

E-References:

1. https://spoken-tutorial.org/tutorial-search/?search_foss=C+and+Cpp&search_language=English
2. https://www.youtube.com/watch?v=-J_xL4IGhJA&list=PLE18841CABEA24090
3. https://www.hackerrank.com/home?utm_expid=.2u09ecQTSny1HV02SEVoCg.1&utm_referrer=https%3A%2F%2Fwww.google.com%2F

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	3	1	-	1	3	1	1	-
CO2	1	3	3	2	-	3	3	1	2	1
CO 3	1	3	3	2	-	3	3	1	2	1
CO 4	-	3	3	2	-	3	3	1	3	2
CO 5	-	3	3	2	-	3	3	1	3	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Ms. Varshali Cholake	Senior Software Engineer	Volkswagen IT Services India Pvt. Ltd.
2	Mr. Mohan Khedkar	Lecturer in IT	Government Polytechnic, Nashik
3	Ms. Jijnasa S. Patil	Lecturer in Computer Engineering	Government Polytechnic. Mumbai
4	Mrs. Rupali V. Molawade	Lecturer in Computer Engineering	Government Polytechnic. Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell

Principal

Programme:**Diploma in Computer Engineering and Information Technology (Sandwich Pattern)**										
Course Code: **CO19203**				Course Title: **Computer Hardware and Maintenance**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs) 30 Mins	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	04	--	04	--	--	--	50*	--	50	100

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

It is hard to imagine our lives without computers. For most of us, the days are few and far between when we do not use our computers to pay bills, play games, surf the internet. Most people need computers to get their professional work done as well. Since computers are such an integral part of our lives, it is crucial that we take care of them by having them properly maintained.

Diploma students must be able to use and maintain computer system and its peripherals. This course will help them know computer hardware basics and to develop basic skills such as assembling PC and troubleshooting its peripherals.

Course Outcomes: Student will be able to

CO1	Identify various types of computer systems with its components and peripherals.
CO2	Demonstrate BIOS settings.
CO3	Partition Hard Disk Drive.
CO4	Troubleshoot common hardware problems.
CO5	Install various operating systems and basic softwares.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Computer Hardware and Devices**:- Desktop Computers, Laptops, Tablets, Mainframe computers, Supercomputers. Features Descriptions:- Hardware components of desktop system, laptop and tablet. Types of Servers, Server features, description and its applications. **Course Outcome: CO1**
2	**Motherboard:-** Components, Layout and Connections. Types and features of motherboard. Enhancing features of motherboard:- adding and replacing components. Troubleshooting problems of motherboard. **Course outcome:CO1CO4**
3	**CPU, BIOS and Power Supply** Processor basic features, Types of Processors,Cache,System Bus. BIOS:- Basic input output system services, BIOS interaction, Date and Time, Password Security, Boot Device Priority. Installing OS. SMPS and UPS importance . **Course Outcome:CO1 CO2 CO5**
4	**Hard Disk Drive:-** Hard Disk Interface:- EIDE, Serial ATA, SCSI, USB and IEEE 1394 (Firewire), RAID, Solid State Drives. Disk Structure:- Head, Tractor, Sector, Cylinders, Cluster, Landing Zone, MBR, Zone Bit Recording. Disk Performance Parameters Characteristics:- Disk access time ,seek and latency time, Data transfer rate. File System:- FAT 16, FAT32, NTFS, RAID Troubleshoot Hard Disk problems. **Course Outcome: CO1CO3**

5	**I/O Devices:-** StudyKeyboard, Mouse, Scanner, Monitor, Printer, Speaker & Mike, LCD Projetor**.** I/O cables :- Specification of I/O cables, Types of I/O cables, Types of I/O Ports. Use of Polycom Soundstation IP. Learn various Preventive Maintenance Techniques. **Course Outcome: CO1**

Suggested Specifications Table (Theory): NA

List of experiments:Total 10-12 experiments(or turns) out of 15-16 experiments(or turns)

Sr. No.	Unit No	CO	Experiments/ Laboratory Activities	Hours
1.	1	CO1	Identify type of desktop and laptop and verify its specifications.	4
2.	2	CO1	Identify various components located on motherboard.	4
3.	3	CO2	Configure BIOS settings.	4
4.	4	CO3	Partitioning of HardDisk.	4
5.	4	CO3	Format HardDisk Drive with various file systems.	6
6.	5	CO1	Connect Keyboard, Mouse, Monitor, Speaker, Microphone.	6
7.	5	CO1	Set LCD Projector.	4
8.	4	CO4	Troubleshoot Hard Disk problems.	6
9.	3	CO5	Install Operating System Windows Family.	4
10.	3	CO5	Install Operating System- Linux	4
11.	3	CO5	Installation of basic software's (Such as MS-Office).	4
12.	3	CO4	Test SMPS.	4
13.	5	CO4	Undertake preventive maintenance by using tools like blower,vacuum cleaner.	6
14.	5	CO1	Case Study:Understand use of Polycom soundstation IP.	4
			Total	64

E-References:

1. https://computer.howstuffworks.com/computer-hardware-channel.htm
2. https://www.youtube.com/results?search_query=how+to+test
3. https://edu.gcfglobal.org/en/subjects/basic-skills/

CO vs.PO and CO vs. PSO Mapping(Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	1	2	3	2	1
CO2	1	2	3	2	2	1	2	3	3	3
CO3	1	2	2	3	2	1	2	2	2	2
CO4	1	2	2	3	2	1	2	3	3	3
CO5	1	2	3	2	2	1	2	3	3	3

CO vs.PO and CO vs. PSO Mapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	1	2	2	2	3
CO2	1	2	3	2	2	1	2	3	3	3
CO3	1	2	2	3	2	1	2	3	3	3
CO4	1	2	2	3	2	1	2	3	3	3
CO5	1	2	3	2	2	1	2	3	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Prof. Prathmesh Churi	Asst Prof.in Computer Engineering	School of Technology Management and Engg ,NMIMS University ,Mumbai
2	Ms. Sonali Udhav Lahane	Director	Digital Asthetics Multi Services
3	Ms. Pooja Chame	Lecturer in Computer Engineering	Government Polytechnic. Mumbai

Coordinator, Curriculum Development, Department of Computer Engineering

Head of Department Department of Computer Engineering

I/C, Curriculum Development Cell Principal

Programme : **Diploma in Computer Engineering and Information Technology (Sandwich Pattern)**										
Course Code:**CO19204**				Course Title: **Data Structures**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs30m in)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25***	---	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

The study of Data Structure is essential is essential part of Computer Science. Data structure is a logical and mathematical model for storing and organizing data in a particular way in a computer. The study of data structure helps the students in developing logic and structured programs

Course Outcomes: Student should be able to

CO1	Demonstrate thedifferent data structures.
CO2	Use Stack and recursion concept.
CO3	Implement the Queue concept .
CO4	Use Linked List ,Tree and Graph Concept, Blockchain concepts.
CO5	Implement different Searching and Sorting Techniques.

Course Content Details:`

Unit No	Topics / Sub-topics
1	**Introduction to Data Structures:** **1.1** Need of data structures. **1.2** Definition of Data structure and Abstract data type. **1.3** Classification of Data structures: Linear, non-linear, homogeneous, non-homogeneous, static & dynamic. **Course Outcome: CO1 Teaching Hours :05 hrs Marks: 08(R- 02, U-04, A-02)**
2	**Linked List** 2.1 Introduction and Terminologies :Node, Next Address and Pointer, Null pointer, Empty list 2.2 Types of Linked List:Single Linked List,Doubly Linked List,Circular Linked ListDoubly Circular Linked List 2.3 Operations on Single Linked List:

	Searching, Insertion - (At Front ,In between and At End), Deletion - (From Front ,In between, From End) 2.4 Blockchain data structure:Introduction to Blockchain, Applications of Blockchain **Course Outcome:CO4 Teaching Hours :08 Marks: 12 (R- 02 , U- 04 , A- 06)**
3	**Stacks** 3.1 Definition & examples of Stack, Stack as an abstract data type implementations using arrays and dynamic memory allocation 3.2 Operations on Stack PUSH POP Top Of The Stack 3.3 Overflow & Underflow of Stack 3.4 Applications of Stack 3.5 Polish Notation 3.6 Reversing a List 3.7 Recursion **Course Outcome: CO2 Teaching Hours : 06 Marks: 08 (R- 02 , U- 04 , A- 02)**
4	**Queue** 4.1 Definition & examples of Queue Queue as an abstract data type implementations using arrays and dynamic memory allocation 4.2 Operations on Queue 4.3 Types of Queue Priority queue Circular queue 4.4 Application Of Queue 4.5 Job Scheduling **4.6** Task Scheduling **Course Outcome:CO3 Teaching Hours :08 Marks: 08 (R- 02 , U- 02 , A- 04)**
5	**Trees and Graphs** 5.1 Introduction and Terminologies : Sub-tree, root ,leaf , left, non-leaf, right, parent, child, ancestor, descendant, brother, level, depth, height. 5.2 Types of Tree General Tree Binary Tree Binary Search Tree 5.3 Representation of Tree 5.4 Operations on Trees Insertion Deletion

	Searching - Depth-first search and Breadth-first search 5.5 Traversing - Pre-order, In-order ,Post-order **5.6** Introduction to GRAPHS Terminologies: graph, node (Vertices), arcs (edge), directed graph, in-degree, out-degree, adjacent, successor, predecessor, relation, weight, path, length. **Course Outcome: CO4 Teaching Hours :10 Marks: 12 (R- 02 , U- 04 , A- 06)**
6	**Searching and Sorting** 6.1 Searching Linear Search, Binary Search , Hash Search. 6.2 Sorting Bubble Sort Insertion Sort Selection Sort Merge Sort Quick Sort **Course Outcome: CO5 Teaching Hours :08 Marks: 12 (R- 02 , U- 04 , A- 06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Data Structures	02	04	02	08
2	Linked List	02	04	06	12
3	Stack	02	04	02	08
4	Queue	02	02	04	08
5	Trees and Graphs	02	04	06	12
6	Searching and Sorting	02	04	06	12
	Total	12	22	26	60

List of experiments:Total 10 experiments(or turns) out of 15 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Write a program for insertion and deletion of an element in an Array at given position.	02
2	2	CO4	Write a program to implement following operations on Singly Linked Lista)Create b)Insertion c)Deletion	02
3	3	CO4	Write a program to implement following operations on Doubly Linked Lista)Create b)Insertion c)Deletion	02
4	4	CO4	In a "Suryan" Shopy multiple Items are available for selling , the store wants to automate the billing system so that the customer gets printed bill .Each Item has unique Id, name and its rate associated with it. Write a menu driven program which will ask the customer to select the Items and quantity of the Items and will generate bill in following format.	02
5	5	CO2	Write a program to implement the PUSH and POP operation of Stack	02
6	6	CO2	Write a program to implement the do and undo activity using Stack	02
7	1	CO2	Write a program to implement Infix Prefix and Postfix Operation	02
8	2	CO3	Write a program to implement different operations on Queue.	02
9	3	CO3	Write a program to implement the concept of Doubly ended Queue.	02
10	4	CO4	Write a program to implement Ticket Reservation of system which is based on following priorities VIP=5,Senior =4,Handicap=3,Ladies=2,General =1	02
11	5	CO4	Write a program to insert and delete nodes in a Tree.	02
12	6	CO4	Write a program to implement Inorder Preorder and Postorder of Tree nodes	02
13	5	CO5	Write a program to implement DFS and BFS.	02
14	6	CO5	Write a program to implement Linear and Binary Search Techniques.	02
15	5	CO5	Write a program to implement a)Quick sort b)Bubble sort c)Insertion d)Selection	02
		Total		**30**

Sr.no	Items	Rate	Quantity			Tota
Grand Total						

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Data Structure	Seymour Lipschutz , Tata McGraw Hill	10: 0070701989 13: 9780070701984
2	An Introduction to Data Structures with applications	Tremblay, Sorenson,Tata McGraw Hill	0070651507

E-References:

1) https://www.javatpoint.com/data-structure-tutorial
2) https://www.geeksforgeeks.org/data-structures/

CO Vs PO and CO Vs PSO Mapping (Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	3	3	2	3	3	2	3	3
CO2	2	2	3	3	1	3	2	2	3	2
CO3	2	3	3	2	2	2	2	2	2	2
CO4	2	3	2	3	2	3	3	2	3	3
CO5	1	2	3	3	2	3	3	2	3	3
CO6	2	2	3	3	2	3	3	2	3	3

CO VsPO and CO Vs PSOMapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	3	3	2	3	3	2	3	2
CO2	2	2	3	3	1	3	2	2	3	2
CO3	2	3	3	2	2	2	2	3	2	2
CO4	2	3	2	3	2	3	3	2	3	3
CO5	1	2	3	3	2	3	3	3	3	3
CO6	2	2	3	3	2	3	3	2	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr.ShubhamShimpi	Analyst	Course5i
2	Mr.VaibhavVasani	Assistant Professor	k J. SomaiyaEngg College
3	Mrs.VandanaS.Lokhande	Lecturer	G P Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Information Technology and Computer Engineering (Sandwich Pattern)**										
Course Code: **IT19204**				Course Title: **Digital Techniques**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25**	**---**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

This course forms the foundation of computers. This course is introduced with the view that students will become familiar with various digital devices and circuits that are used in microprocessor, microcontroller, computers and other digital systems. It will enable the students to assemble, design, and test logical circuits like multiplexer, demultiplexer, counters, registers etc. This course covers the number systems, logic gates, combinational & sequential logic circuits, analog to digital and digital to analog converters which are important parts of digital systems.

Course Outcomes: Student should be able to

CO1	Perform binary, BCD arithmetic, number conversions and code conversions.
CO2	Understand different logic gates, their symbols, truth tables and pin configuration
CO3	Simplify Boolean expressions using Boolean laws, K map and realize them using logic gates.
CO4	Design various combinational and sequential circuits
CO5	Understand analog, digital signals and their conversions ADC and DAC

Course Content Details:

Unit No	Topics / Sub-topics
1	**Number Systems and codes** 1.1 Introduction to digital signal, Difference between analog signal and digital signal, Advantages of digital systems over analog systems, positive and negative logic 1.2 Concept of base of number system 1.3 Decimal number system 1.4 Binary number system, 1.5 Octal number system 1.6 Hexadecimal number system 1.7 Conversion of one number system to another number system (fractional point numbers) 1.8 Types of codes : BCD, Excess 3, Gray code 1.9 Conversion of Binary to Gray and Gray to Binary

	Course Outcome: CO1, CO5 Teaching Hours :4 hrs Marks: 6 (R- 0, U-2, A-4)
2	**Binary Arithmetic** 2.1 Rules for Binary addition and subtraction 2.2 Concept of 1's and 2's complement of a binary number 2.3 Binary subtraction using 2's complement 2.4 Signed and unsigned binary numbers 2.5 BCD addition and BCD subtraction using 9's & 10's complement (Numericals based on above topic) 2.6 Parity, Definition of even and odd parity **Course Outcome: CO1 Teaching Hours :4 hrs Marks: 6 (R- 2, U-2, A-2)**
3	**Logic Gates:** 3.1 Basic Gates (AND, OR, NOT): circuit of basic gates using discrete components, symbol, truth table, logical expression 3.2 Derived gates (EX-OR, EX-NOR): symbol, truth table and logical expression 3.3 Universal gates (NAND, NOR) : symbol, truth table and logical expression, deriving all gates using universal gates **Course Outcome: CO2 Teaching Hours :4 hrs Marks: 6 (R- 2, U-2, A-2)**
4	**Boolean Algebra:** 4.1 Boolean laws, De Morgan's theorems, 4.2 Simplification of Boolean expression using Boolean laws and De Morgan's theorems. 4.3 Construction of logic circuits using logic gates for Boolean expression 4.4 Concept of SOP & POS, Minterm & Maxterm 4.5 Karnaugh map (K-map) representation of logic function 4.6 Simplification of K-map for 2, 3 and 4 variables with don't care condition 4.7 Realization of reduced expression using logic gates. **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 8 (R- 0, U-2, A-6)**
5	**Combinational Circuits:** 5.1 Design of Half adder and full adder using K-map and realization using gates 5.2 Design of Half subtractor and full subtractor using k-map and realization using gates 5.3 4 bit parallel binary adder (IC7483) 5.4 Code converter using K-map: Binary to Gray code and Gray code to binary (upto 4 bit) 5.5 BCD to seven segment decoder/driver (IC 7447 and IC 7448) 5.6 Comparator: 1 bit, 2 bit (design using K-map and realization using logic gates), 4 bit comparator using IC 7485 5.7 Multiplexer: Necessity of multiplexing, Principle of multiplexing, types of multiplexing 2:1, 4:1, 8:1 and 16:1, multiplexer tree 5.8 Demultiplexer: Necessity of demultiplexing, Principle of demultiplexing, types of demultiplexing 1:2, 1:4, 1:8 and 1:16, demultiplexer tree, concept of decoder **Course Outcome: CO4 Teaching Hours :11 hrs Marks: 14 (R- 2, U-4, A-8)**

6	**Sequential circuits** 6.1 Difference between combinational and sequential circuits 6.2 Basic concept of Flip-flop 6.3 Types of flip flop: SR, JK, D and T flip flops, circuit of SR FF using transistors. Truth table, symbol and operation of all FFs 6.4 Concept of preset and clear inputs 6.5 Race around condition in JK FF, Master slave JK FF 6.6 Triggering methods: Edge trigger and level trigger 6.7 Excitation table of SR, JK, D and T FF 6.8 Counters: basic concept of counters, classification (synchronous and asynchronous counter), concept of Up and Down counter, Modulus of counter(MOD N counter) a. Design of asynchronous up and down counter (3/4 bit) and their timing diagram b. Design of synchronous up and down counter (only 3bits) 6.9 Shift Registers: Definition, classification (SISO, SIPO, PISO, PIPO), their circuit diagram and working, Universal shift register, bidirectional shift register, Ring counter, Twisted ring counter (circuit and timing diagrams) **Course Outcome: CO4 Teaching Hours :12 hrs Marks: 14 (R- 2, U-4, A-8)**
7	**Data Converters** 7.1 Need of data conversion 7.2 Types of data converters ADC and DAC and their specifications 7.3 Circuit diagram and working of R-2R ladder type DAC (mathematical derivation) 7.4 Successive approximation and Ramp type ADC (their block diagram and working) **Course Outcome: CO5 Teaching Hours :4 hrs Marks: 6 (R- 2, U-4, A-0)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Number Systems and codes**		02	04	06
2	**Binary Arithmetic**	02	02	02	06
3	**Logic Gates**	02	02	02	06
4	**Boolean Algebra**		02	06	08
5	**Combinational Circuits**	02	04	08	14
6	**Sequential circuits**	02	04	08	14
7	**Data Converters**	02	04		06
	Total	**10**	**20**	**30**	**60**

List of experiments: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	3	CO2 CO5	To verify Truth Table of basic gates AND, OR, NOT using ICS.	02
2	4	CO3	To implement given Boolean expression using logic gates.	02
3	5	CO4	To construct Half Adder and Half subtractor & verify the Truth Table	02
4	1, 5	CO1 CO4	To construct binary to gray code converter using gates and verify truth table.	02
5	3	CO2	To verify Truth Table of NAND, NOR, Ex-OR, Ex-NOR gates using ICS.	02
6	4	CO3	To verify De Morgan's theorems	02
7	5	CO4	To construct Full Adder verify the Truth Table	02
8	1, 5	CO1 CO4	To construct gray code to binary code converter using gates and verify truth table.	02
9	3	CO2	To implement basic logic gates using only NAND gates.	02
10	3	CO2	To implement basic logic gates using only NOR gates.	02
11	5	CO4	To construct Full subtractor & verify the Truth table	02
12	6	CO4	To verify truth table of SR and JK FF using ICs.	02
13	6	CO4	To verify truth table of D and T FF using ICs.	02
14	6	CO4	To construct 3 bit ripple counter using Flip Flop and verify its operation	02
15	6	CO4	To construct and test MOD-6 asynchronous counter using IC 7490.	02

Note: Experiments No. 1 to 5 are compulsory. Remaining 5 experiments should be performed as per the importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Modern Digital Electronics	R. P. Jain, Tata McGraw Hill, Education, Fourth Edition, 2009	978-0070669116
2	Digital Principles and Applications	Malvino A. P. and Leach, Tata McGraw Hill, Education, Seventh Edition, 2011	978-0070141704
3	Digital Electronics: an introduction to theory and practice	William Gothmann, Prentice Hall, Second Edition, 1982	0132122170

E-References:

1. www.electronics-tutorials.ws
2. www.wisc-online.com/learn/technical/electronics-digital
3. www.electricaltechnology.org
4. www.vlab.co.in

CO Vs PO and CO Vs PSO Mapping (Information Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1				1	2	
CO2	3	3	3	3	1		1	1	3	
CO3	3	3	3	3					2	
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	1							2	

CO Vs PO and CO Vs PSO Mapping (Computer Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1				1	2	
CO2	3	3	3	3	1		1	1	2	
CO3	3	3	3	3					3	
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	1							2	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Mandar Mhapsekar	Software Engineer	J. P. Morgan Chase & Co.
2	Mrs. Nagargoje	Lecturer in Electronics	Govt. Polytechnic Thane
3	Mr. Vijay Patil	Lecturer in Information Technology	Vidyalankar Polytechnic Mumbai
4	Dr. R. A. Patil (Curriculum Content Designer)	Lecturer in Electronics	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

I/C, Curriculum Development Cell

Principal