BANGLADESH TECHNICAL EDUCATION BOARD

Agargaon, Sher-E-Bangla Nagar

Dhaka-1207.

04-YEAR DIPLOMA IN ENGINEERING CURRICULUM
COURSE STRUCTURE & SYLLABUS
(PROBIDHAN-2022)

COMPUTER SCIENCE & TECHNOLOGY TECHNOLOGY

TECHNOLOGY CODE: 66

4TH SEMESTER

(Effective from 2022-2023 Academic Sessions)

DIPLOMA IN ENGINEERING CURRICULUM
COURSE STRUCTURE
(PROBIDHAN-2022)
TECHNOLOGY NAME: COMPUTER SCIENCE & TECHNOLOGY (85)
(4TH SEMESTER)

Sl. No.	Subject Code & Name		Period Per Week		Credit	Marks Distribution						
						Theory Assessment			Practical Assessment			Grand Total
	Code	Name	Theory	Practical		Continuous	Final	Total	Continuous	Final	Total	
1	25831	Business Communication	2	-	2	40	60	100	-	-	-	100
2	28541	Java Programming	2	3	3	40	60	100	25	25	50	150
3	28542	Data Structure & Algorithm	2	3	3	40	60	100	25	25	50	150
4	28543	Computer Peripherals & Interfacing	3	3	4	60	90	150	25	25	50	200
5	28544	Web Design & Development-I	1	6	3	20	30	50	50	50	100	150
6	26841	Digital Electronics-II	2	3	3	40	60	100	25	25	50	150
7	29041	Environmental Studies	2	3	3	40	60	100	25	25	50	150
Total			**14**	**21**	**21**	**280**	**420**	**700**	**175**	**175**	**350**	**1050**
Total Period				**35**								
Theory: Practical (%)			**40.0%**	**60.0%**								

Subject Code	Subject Name	Period per Week		Credit
25841	Business Communication	T	P	C
		2	0	2

Rationale	Business communication plays a vital role in modern time. Business communication the process of sharing information between employees within and outside a company. Business communication is essential for success and growth of every organization. By studying this course students will be able to acquire knowledge on communication, Communication model and feedback, Types of communication, Formal and informal communication, Report writing, Methods of communication, effective listening, Essentials of communication, Office management and developed skills on delivered effective presentation, interpersonal communication, listening, report writing and business letter.
Learning Outcome	**After completion of this course, students will be able to** • Effective business communication. • Developing and delivering effective presentations. • Effective interpersonal communications. • Good time management. • Effective problem solving. • Acquiring Knowledge of Information and Communication Technology. • Effective business report writing.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	**Business communication.** 1.1 Define business. 1.2 Define communication. 1.3 Define business communication. 1.4 Describe the scope of business communication. 1.5 Mention the Importance of communication in modern business. 1.6 State the objectives of business communication. 1.7 State the functions of business communication. 1.8 Discuss the principles of communication. 1.9 Mention the essential elements of communication process.	**4**	**8**
2.	**Communication model and feedback.** 2.1 Define communication model. 2.2 State the Importance of communication model. 2.3 State the basic functions of Communication model. 2.4 Mention the Limitation of communication model. 2.5 Define feedback. 2.6 State the basic principles of effective feedback. 2.7 State the essential feedback to complete communication process.	**3**	**6**
3.	**Types of communication.** 3.1 Define channel of communication. 3.2 Mention the channel of communication. 3.3 State the different types of communication. 3.4 Distinguish between upward and downward communication. 3.5 State the merits and demerits of upward communication. 3.6 State the merits and demerits of downward communication. 3.7 Define two-way communication. 3.8 Explain-`Two-way communication is more important now a day. 3.9 State the merits and demerits of two-way communication.	**5**	**9**
4.	**Formal and informal communication.** 4.1 Define the formal and informal communication. 4.2 Describe the advantages and disadvantages of formal communication**.** 4.3 Describe the advantages and disadvantages of informal communication. 4.4 Difference between formal and informal communication.	**2**	**4**

5.	**Methods of communication.** 5.1 Define communication methods. 5.2 Discuss the various methods of communication. 5.3 Discuss the merits and demerits of oral communication. 5.4 Discuss the merits and demerits of written communication. 5.5 Difference between oral and written communication.	**3**	**6**
6.	**Effective listening** 6.1 Define listening. 6.2 State the different types of listening. 6.3 State the importance of listening. 6.4 Define effective listening. 6.5 Discuss the barriers to effective listening. 6.6 Discuss the way for overcoming barriers to effective listening.	**3**	**5**
7.	**Essentials of communication** 7.1 Discuss the essential qualities of good communication. 7.2 Discuss the barriers of communication. 7.3 Discuss the way for overcoming barriers to good communication.	**2**	**4**
8.	**Report writing** 8.1 Define report, business report and technical report. 8.2 State the essential features of a good report. 8.3 Mention the factors to be considered while drafting a report. 8.4 State the components of technical report. 8.5 Distinguish between a technical report and general report. 8.6 Prepare a technical report.	**4**	**7**
9.	**Office management.** 9.1 Define office and office work. 9.2 State the characteristics of office work. 9.3 Define filing and indexing. 9.4 Discuses the method of filing. 9.5 Discuses the method of indexing. 9.6 Distinguish between filing and indexing.	**3**	**5**
10.	**Business letter, official and semiofficial letters.** 10.1 Define then business letter, official and semiofficial letters. 10.2 State the Importance of business letter. 10.3 Prepare Curriculum vitae (CV), Appointment letter, joining letter, leave letter, Complain Letter and tender notice.	**3**	**6**
	Total	**32**	**60**

REFERENCE BOOK:

1. Business Communication and Report Writing-Professor Murtaza Ali
2. Business Communication-মো: খালেকুজ্জামান ও মো: মোশারফ হোসেন চৌধুরী

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
28541	JAVA PROGRAMMING	T	P	C
		2	3	3

Rationale	Java is fully object-oriented programming. One of the most significant advantages of Java is its ability to move easily from one computer system to another. The ability to run the same program on many different systems is crucial to World Wide Web software, and Java succeeds at this by being platform-independent at both the source and binary levels.
Learning Outcome (Theoretical)	**Upon completing a theoretical course the learners should be able to:** • Define features of java. • Describe java environments. • Explain Data types and variables. • Describe operators. • Perform control statements. • Develop Array structure. • Perform Classes and objects. • Develop Methods and constructor in class. • Explain inheritance and polymorphism. • Develop packages. • Describe interfaces.
Learning Outcome (Practical)	**Upon completing a Practical course, the learners should be able to:** 1. Install a Java Development Kit /Net beans software. 2. Write and execute java program for displaying text messages. 3. Write and execute java programs using arrays. 4. Write and execute java programs using control flow statements. 5. Write and execute java programs using class, object. 6. Write and execute java programs using method and constructor. 7. Write and execute java programs using polymorphism. 8. Write and execute java programs using inheritance. 9. Write and execute java programs using package. 10. Write and execute java programs using interface.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	**Overview of Java** 1.1. Describe the history of Java. 1.2. Mention the features of Java. 1.3. Describe Java Environment setup for windows. 1.4. Describe programming style and convention of Java. 1.5. Write the structure of Java Program.	**3**	**3**
2	**Data types and Variables** 2.1. State the data types. 2.2. Explain primitives, non-primitive and literals data types. 2.3. Describe the declaration of variables . 2.4. Explain dynamic initialization of variables.	**2**	**3**
3	**Operators** 3.1. Mention various types of operators used in Java. 3.2. Describe different types of operators. 3.3. Explain the uses of different types of operators. 3.4. Write programs using java operators.	**3**	**7**
4	**Control Statements** 4.1. State conditional and unconditional statements in Java. 4.2. Describe the syntax of different types of decision making statements. 4.3. Describe the syntax of different types of looping statement. 4.4. Explain " try-catch-finally" control statement. 4.5. Write Java programs using decision making statements. 4.6. Write java programs using loops.	**4**	**7**
5	**Arrays** 5.1. State Array in java. 5.2. Explain Array dimensions. 5.3. Declare Array Variables. 5.4. Describe processing of arrays. 5.5. Write Java programs for processing arrays.	**2**	**4**
6	**Classes and Objects** 6.1. State class and Object. 6.2. Describe types of class variables. 6.3. Describe the declaration (syntax) of class and object in Java 6.4. Write java programs relating to class and object.	**2**	**3**
7	**Methods and Constructors** 7.1. State method and constructor. 7.2. Explain Method with syntax. 7.3. State the procedure of adding Method to class. 7.4. Mention the advantages of Method. 7.5. Explain the overloading Method in java. 7.6. Describe the constructor in java. 7.7. Create overloading constructor in java. 7.8. Write java programs using method and constructor.	**3**	**8**
8	**Inheritance and Polymorphism** 8.1. State inheritance and polymorphism. 8.2. Define super class and sub class. 8.3. Describe the multilevel hierarchy of inheritance. 8.4. Explain the overridden methods in java. 8.5. State dynamic run-time polymorphism in java.	**6**	**14**

	8.6. State the abstract and object classes in java. 8.7. Mention the uses of *final* and *super* keyword. 8.8. Write java programs relating to inheritance and polymorphism.		
9	**Packages** 9.1. State packages. 9.2**.** Explain the syntax of packages declaration. 9.3. Explain different function of packages. 9.4. Mention the different levels of class member access. 9.5. Write java programs that related to package.	**3**	**6**
10	**Interfaces** 10.1. State interfaces. 10.2. Declare the interfaces with syntax. 10.3. Describe the implementation of interfaces. 10.4. Explain the nested interfaces. 10.5. Describe the variables in interfaces. 10.6. Write java programs that related to interface.	**4**	**5**
	Total	**32**	**60**

DETAILED SYLLABUS (PRACTICAL)

Sl.	Experiment Name	Class (3 Period)	Marks (Continuous)
1	**SET UP JAVA DEVELOPMENT ENVIRONMENT.** 1.1 Install JDK. 1.2 Set environmental Variable. 1.3 Test installation successful.	**1**	**2**
2	**PERFORM SIMPLE JAVA PROGRAMS FOR DISPLAYING TEXT MESSAGES:** 2.1 Prepare Algorithm for given problems 2.2 Draw the flowchart as per the prepared algorithm 2.3 Write code for the given problem 2.4 Compile the code and debug if required. 2.5 Execute the compiled code. 2.6 Maintain the Record of Performed Job.	**1**	**2**
3	**PERFORM JAVA PROGRAMS USING ARRAYS:** 3.1 Prepare Algorithm for given problems 3.2 Draw the flowchart as per the prepared algorithm 3.3 Write code for the given problem 3.4 Compile the code and debug if required. 3.5 Execute the compiled code. 3.6 Maintain the Record of Performed Job.	**1**	**2**
4	**PERFORM JAVA PROGRAMS USING CONTROL FLOW STATEMENTS:** 4.1 Prepare Algorithm for given problems 4.2 Draw the flowchart as per the prepared algorithm 4.3 Write code for the given problem 4.4 Compile the code and debug if required. 4.5 Execute the compiled code. 4.6 Maintain the Record of Performed Job.	**2**	**3**
5	**PERFORM JAVA PROGRAMS USING CLASS & OBJECT:** 5.1 Prepare Algorithm for given problems 5.2 Draw the flowchart as per the prepared algorithm 5.3 Write code for the given problem 5.4 Compile the code and debug if required.	**1**	**3**

	5.5 Execute the compiled code. 5.6 Maintain the Record of Performed Job.		
6	**PERFORM JAVA PROGRAMS USING METHOD & CONSTRUCTOR:** 6.1 Prepare Algorithm for given problems 6.2 Draw the flowchart as per the prepared algorithm 6.3 Write code for the given problem 6.4 Compile the code and debug if required. 6.5 Execute the compiled code. 6.6 Maintain the Record of Performed Job.	**2**	**3**
7	**PERFORM JAVA PROGRAMS USING POLYMORPHISM:** 7.1 Prepare Algorithm for given problems 7.2 Draw the flowchart as per the prepared algorithm 7.3 Write code for the given problem 7.4 Compile the code and debug if required. 7.5 Execute the compiled code. 7.6 Maintain the Record of Performed Job.	**2**	**3**
8	**PERFORM JAVA PROGRAMS USING INHERITANCE:** 8.1 Prepare Algorithm for given problems 8.2 Draw the flowchart as per the prepared algorithm 8.3 Write code for the given problem 8.4 Compile the code and debug if required. 8.5 Execute the compiled code. 8.6 Maintain the Record of Performed Job.	**2**	**3**
9	**PERFORM JAVA PROGRAMS USING PACKAGE:** 9.1 Prepare Algorithm for given problems 9.2 Draw the flowchart as per the prepared algorithm 9.3 Write code for the given problem 9.4 Compile the code and debug if required. 9.5 Execute the compiled code. 9.6 Maintain the Record of Performed Job.	**2**	**2**
10	**PERFORM JAVA PROGRAMS USING INTERFACE:** 10.1 Prepare Algorithm for given problems 10.2 Draw the flowchart as per the prepared algorithm 10.3 Write code for the given problem 10.4 Compile the code and debug if required. 10.5 Execute the compiled code. 10.6 Maintain the Record of Performed Job.	**2**	**2**
	Total	**16**	**25**

NECESSARY RESOURCES (TOOLS, EQUIPMENT'S AND MACHINERY):

Sl	Item Name	Quantity
01	Desktop Computer	1 nos
02	Netbeans software	1nos

RECOMMENDED BOOKS:

Sl	Book Name	Writer Name	Publisher Name & Edition
01	The Complete Reference of Java	Herbert Schildt	Mc Graw Hill, 7th Edition
02	JAVA How to Program	P.J. Deitel and H.M. Deitel	Pearson College Div,9th Edition
03	*জাভা প্রোগ্রামিং*	*এএনএম বজলুর রহমান রোকন*	দ্বিমিক প্রকাশনি, ২য় সংস্করণ।

WEBSITE REFERENCES:

Sl	Web Link	Remarks
01	www.tutorialspoint.com/java	Related topics
02	https://chat.openai.com/chat	Related topics

SUBJECT CODE	SUBJECT NAME	PERIOD PER WEEK		CREDIT
28542	DATA STRUCTURE & ALGORITHM	T	P	C
		2	3	3

Rationale	Data structures and algorithms are essential tools in computer science and engineering. A well-designed data structure and algorithm can improve the performance of software systems, reduce memory usage, and provide better user experiences. A data structure is a way of organizing data in memory so that it can be accessed and used efficiently. The most common data structures include arrays, linked lists, stacks, queues and trees. An algorithm is a step-by-step procedure for solving a problem or performing a task. Some common algorithms include searching, sorting, and path finding. By understanding the different types of data structures and algorithms, developers can choose the best option for a specific problem and optimize the performance of software systems.
Learning Outcome (Theoretical)	**Upon completing a theoretical course, the learners should be able to:** • Describe array, pointer and string. • Explain Stack. • State Queue, De-queue. • Explain the concept of linked list. • Describe traversing, searching, insertion & deletion in linked list. • Explain tree structure. • Describe the operation of Searching. • Describe the operation of different types of Sorting.
Learning Outcome (Practical)	**Upon completing a Practical course, the learners should be able to:** • Perform a program for data insertion and deletion into a Linear Array/list. • Perform a program using PUSH and POP Operation in Stack structure & test. • Perform a program for data insertion and deletion from a Queue structure. • Perform a program for inserting and deleting nodes into / from a Linked List. • Perform a program for inserting/Deleting item into/ from a tree structure. • Perform a program to find out data using linear search (item searching, location searching, max & min element, etc.) • Perform a program to find out data using binary search. • Perform a program to arrange Data Ascending and Descending using Bubble sort & selection sort algorithm.

DETAILED SYLLABUS (THEORY)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	**Data structure** 1.1 Define data & information. 1.2 Mention standard data types. 1.3 State Data Structure. 1.4 State types of data structure. 1.5 List the different types of data operation. 1.6 State Static and dynamic memory allocation.	**3**	**3**
2	**Algorithm** 2.1 State algorithm. 2.2 Mention the characteristics of algorithm. 2.3 State flowchart and pseudo code. 2.4 Explain algorithmic notations. 2.5 Describe the Complexity of algorithm. 2.6 Mention different types of algorithm.	**2**	**4**
3	**Arrays, Pointers and Strings** 3.1 Define Array, Pointer and String. 3.2 Mention different dimension of array with diagram. 3.3 Explain the initialization of Pointer. 3.4 Explain String declaration and initialization. 3.5 Describe the operations of String with example. 3.6 Write an algorithm for traversing in array. 3.7 Write an algorithm for inserting and deleting element of array.	**3**	**5**
4	**Stack** 4.1 Define stack. 4.2 Write the applications of stack in data structure. 4.3 State PUSH and POP. 4.4 Write an algorithm for adding & removing data into & from Stack. 4.5 Explain the concept of Infix, Postfix & Prefix expression. 4.6 Convert the simple infix expression to postfix or prefix expression.	**4**	**6**
5	**Queue** 5.1 Define queue. 5.2 Write the applications of queue in data structure. 5.3 State FIFO & LIFO. 5.4 Distinguish between stack and queue. 5.5 Express the algorithms for data insert, delete into & from queues. 5.6 State the de-queue data structure.	**4**	**6**
6	**Linked list** 6.1 Define linked list. 6.2 State memory allocation in linked list. 6.3 Explain the algorithms to traverse a linked list. 6.4 Explain the algorithms for searching a linked list. 6.5 Express the algorithms for data insert ,delete into & from linked list.	**4**	**8**

7	**Tree** 7.1 State the tree. 7.2 State Root, Node, Leaf, Keys, Sub-tree, Level of tree. 7.3 List the types of trees in data structure with diagram. 7.4 Discuss the properties of tree. 7.5 Explain the algorithms for data insertion, deletion into & from a tree. 7.6 Explain the algorithm for traversing a tree.	**4**	**8**
8	**Searching operation** 8.1 State different technics of search operation. 8.2 Explain the technic of linear & binary search. 8.3 Explain algorithm for linear search. 8.4 Explain the algorithm for binary search. 8.5 Compare between complexity of linear & binary search algorithms.	**4**	**10**
9	**Sorting operation** 9.1 List the sorting technics. 9.2 Describe the technics of bubble sort, quick sort & merge sort. 9.3 Write the algorithms for bubble sort, quick sort & merge sort. 9.4 Compare among complexity of bubble sort, quick sort & merge sort algorithms.	**4**	**10**
	Total	**32**	**60**

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Continuous Marks
1	**Write & execute programs for addition, subtraction, multiplication & division of two numbers.** 1.1 Prepare algorithm for given problem. 1.2 Draw the flowchart as per the prepared algorithm. 1.3 Write code for algorithm. 1.4 Compile the code and debug if required. 1.5 Execute the compile code. 1.6 Maintain the record of performed job.	**1**	**2**
2	**Write & execute a program for traversing in array.** 2.1 Prepare algorithm for given problem. 2.2 Draw the flowchart as per the prepared algorithm. 2.3 Write code for given problem. 2.4 Compile the code and debug if required. 2.5 Execute the compile code. 2.6 Maintain the record of performed job.	**1**	**2**
3	**Write & execute a program for inserting and deleting element of array.** 3.1 Prepare algorithm for given problem. 3.2 Draw the flowchart as per the prepared algorithm. 3.3 Write code for given problem.	**1**	**2**

	3.4 Compile the code and debug if required. 3.5 Execute the compile code. 3.6 Maintain the record of performed job.		
4	**Write & execute a program for adding & removing data into/from Stack.** 4.1 Prepare algorithm for given problem. 4.2 Draw the flowchart as per the prepared algorithm. 4.3 Write code for given problem. 4.4 Compile the code and debug if required. 4.5 Execute the compile code. 4.6 Maintain the record of performed job.	**2**	**2**
5	**Write & execute a program for data insert & delete into/from queues.** 5.1 Prepare algorithm for given problem. 5.2 Draw the flowchart as per the prepared algorithm. 5.3 Write code for given problem. 5.4 Compile the code and debug if required. 5.5 Execute the compile code. 5.6 Maintain the record of performed job.	**1**	**2**
6	**Write & execute a program for data insert & delete into/from linked list.** 6.1 Prepare algorithm for given problem. 6.2 Draw the flowchart as per the prepared algorithm. 6.3 Write code for given problem. 6.4 Compile the code and debug if required. 6.5 Execute the compile code. 6.6 Maintain the record of performed job.	**1**	**2**
7	**Write & execute a program for data insertion & deletion into/from a tree.** 7.1 Prepare algorithm for given problem. 7.2 Draw the flowchart as per the prepared algorithm. 7.3 Write code for given problem. 7.4 Compile the code and debug if required. 7.5 Execute the compile code. 7.6 Maintain the record of performed job.	**1**	**2**
8	**Write & execute a program to find out data using linear search (item searching, location searching, max and min element, etc)** 8.1 Prepare algorithm for given problem. 8.2 Draw the flowchart as per the prepared algorithm. 8.3 Write code for given problem. 8.4 Compile the code and debug if required. 8.5 Execute the compile code. 8.6 Maintain the record of performed job.	**2**	**3**
9	**Write & execute a program to find out data using binary**	**2**	**2**

	search. 9.1 Prepare algorithm for given problem. 9.2 Draw the flowchart as per the prepared algorithm. 9.3 Write code for given problem. 9.4 Compile the code and debug if required. 9.5 Execute the compile code. 9.6 Maintain the record of performed job.		
10	**Write a program to arrange Data Ascending & Descending using Bubble sort.** 10.1 Prepare algorithm for given problem. 10.2 Draw the flowchart as per the prepared algorithm. 10.3 Write code for given problem. 10.4 Compile the code and debug if required. 10.5 Execute the compile code. 10.6 Maintain the record of performed job.	**2**	**3**
11	**Write a program to arrange Data Ascending and Descending using Quick Sort and Merge sort.** 11.1 Prepare algorithm for given problem. 11.2 Draw the flowchart as per the prepared algorithm. 11.3 Write code for given problem. 11.4 Compile the code and debug if required. 11.5 Execute the compile code. 11.6 Maintain the record of performed job.	**2**	**3**
	Total	**16**	**25**

Necessary Resources (Tools, equipment's and Machinery):

Sl.	Item Name	Quantity
01	Updated PC/Laptop	1 set per student
02	Windows Operating System	
03	Programming Language such as: Python, C	
04	Internet Connection	

Recommended Books:

Sl.	Book Name	Writer Name	Publisher Name & Edition
01	Data Structures	Seymour Lipchitz	(Schaum's Outline Series)
02	Data Structure and Algorithm	Md. Mokter Hossain Md. Masud Karim Md. Moynul Hoque	Systec Publications
03	Fundamentals of Computer Algorithms	Horowitz, Sahni, Galgotia	Computer Science Press

Website References:

Sl.	Web Link	Remarks
01	https://www.tutorialspoint.com/data_structures_algorithms	
02	https://www.*programiz.com* › dsa	

03	https://www.w3schools.in/data-structures	
04	https://www.google.com	
05	https://www.youtube.com/watch?v=90rqSv6K72k&list=PLdl6zXgLsy3w1m6Hl5g2wfCJOLhBR8bg_	
06	https://www.youtube.com/watch?v=zg9ih6SVACc	

Subject Code	Subject Name	Period/Week		Credit
28543	Computer Peripherals and Interfacing	T	P	C
		3	3	4

Rationale	Peripherals are a generic name for any device external to a computer, but still normally associated with its extended functionality. The purpose of peripherals is to extend and enhance what a computer is capable of doing without modifying the core components of the system. A printer is a good example of a peripheral. It is connected to a computer, extends its functionality, but is not actually part of the core machine. This necessitates the introduction of Computer Peripherals subject in the curriculum for Diploma in Engineering Course. The subject will enable the diploma engineers to identify keyboard, Mouse, Scanner, Plotter LED Monitor, Printers (LASER, Dot Matrix, Inkjet,POS), HDD, SDD, Multimedia Projector etc. The knowledge of Computer Peripherals is the pre-requisite for Computer Hardware Maintenance & Troubleshooting.
Learning Outcome (Theoretical)	**After undergoing the subject, students will be able to:** ▪ Describe basics of interfacing.. ▪ Explain operation of keyboard and mouse. ▪ Explain the basic operation of displays and adapters. ▪ Describe operation of inkjet printers. ▪ Mention the characteristics of special type i/o devices. ▪ Describe the operation of HDD and SSD drives. ▪ Describe the operation of special storage device & multimedia projector.
Learning Outcome (Practical)	**After undergoing the subject, students will be able to:** • Identify the external and internal parts and components of a Keyboard, Mouse and multimediaprojector. • Repair and / or replace external and internal parts and components of a scanners and printers, Plotters, OMR, OCR. • Repair and / or replace the mechanical assembly and the electronic part of a LED monitor.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Period	Marks
1	**BASICS OF INTERFACING** 1.1 Define peripheral and interfacing. 1.2 State the functions of interfacing. 1.3 State the necessity of interfacing. 1.4 State the Categories of interface. 1.5 State the function of each category of interface. 1.6 Mention the methods of peripheral interfacing. 1.7 State the steps of analog and digital interfacing in a computer system. 1.8 State the elements of interface. 1.9 Describe the function of a general purpose parallel interface with block diagram.	**4**	**8**
2	**OPERATION OF SERIAL INTERFACES** 2.1 State the necessity of serial interfacing. 2.2 Mention the asynchronous character and synchronous block data format for a serialinterface. 2.3 Describe the operation of asynchronous serial interface with block diagram (UART). 2.4 Describe the operation of synchronous serial interface with block diagram. 2.5 Distinguish the Characteristics of asynchronous and synchronous serial interface. 2.6 Describe the operation of an USART with block diagram. 2.7Describe the operation of RS 232.C/v.24 standard serial interface with block diagrams.	**5**	**9**
3	**OPERATION OF KEYBOARD AND MOUSE** 3.1 Mention the types of keyboard switch. 3.2Describe the construction and operation of mechanical, membrane, capacitive and Hall Effect key switches. 3.3 Mention the desirable quality of key switches. 3.4 Describe the operation of keyboard encoder with block diagrams. 3.5 State the terms: bouncing, n-key rollover and n-key lockout. 3.6 Explain the flowchart for scanning the keyboard. 3.7 Describe the principle of hardware de-bouncing. 3.8 Describe the operation of an opt-mechanical mouse. 3.9 Describe the working principle of an optical mouse. 3.10 Describe the operation of wireless keyboard & wireless mouse.	**5**	**9**
4	**OPERATION OF DISPLAYS AND ADAPTERS** 4.1 Classify display devices. 4.2 State pixel, Horizontal and Vertical scanning, interlace and non-interlace scanning, composite video signal, Raster and VRAM. 4.3 Prepare the specification of a LED monitor. 4.4 Describe the operation of a LED. 4.5 Describe the principle of producing color pixel on LED screen. 4.6 Describe the operation of a color monitor using block diagrams. 4.7 Describe the general structure of a modern graphics adapter. 4.8 Describe the principle of producing a character on a LED displays.	**5**	**9**
5	**CONSTRUCTIONAL AND OPERATIONAL FEATURE OF DOT MATRIX PRINTERS** 5.1 Classify printers. 5.2 State the feature of a dot-matrix printer. 5.3 List the Major parts and components of a dot matrix printer. 5.4 Describe the operation of a dot matrix printer. 5.5 Describe the operation of the head driving circuit in a dot matrix printer. 5.6 Mention the advantages and disadvantages of dot matrix printers. 5.7 Prepare the specification of a dot matrix printer.	**4**	**8**

6	**CONSTRUCTIONAL AND OPERATIONAL FEATURE OF PLOTTERS** 6.1 State the features of plotter. 6.2 List the uses of plotter. 6.3 Classify plotters. 6.4 List the Major parts and components of a plotter. 6.5 Describe the operation of a plotter. 6.6 Mention the advantages and disadvantages of plotters. 6.7 Prepare the specification of a plotter.	**3**	**5**
7	**OPERATION OF INKJET PRINTERS** 7.1 State the principle of inkjet and bubble jet formation for printing. 7.2 Describe the operation of an inkjet printer. 7.3 List the Major parts and components of an inkjet printer. 7.4 Mention the advantages and disadvantages of an inkjet printer. 7.5 Prepare the specification of an inkjet printer.	**3**	**6**
8	**OPERATION OF LASER PRINTERS** 8.1 State the meaning of LASER. 8.2 Describe the operation of a LASER printer. 8.3 List the Major parts and components of a LASER printer. 8.4 State the function of each part and components of a LASER printer 8.5 Mention the advantages and disadvantages of an LASER printer. 8.6 Prepare the specification of a LASER printer. 8.7 Mention the steps of data exchange via parallel interface.	**4**	**7**
9	**FEATURE AND OPERATIONAL OF POS** 9.1 State the meaning of POS. 9.2 List the uses of POS. 9.3 List the Major parts and components of POS. 9.4 Prepare the specification of a LASER printer.	**2**	**4**
10	**CHARACTERISTICS OF SPECIAL TYPE I/O DEVICES** 10.1 List the special types of I/O devices. 10.2 State the characteristics of joy-stick and digitizer. 10.3 Describe the working principle of light pen. 10.4 Define scanner. 10.5 Classify scanner. 10.5 Describe the operation of a flatbed scanner. 10.6 State the uses of hand held scanner.	**3**	**5**
11	**CHARACTERISTICS OF OPTICAL I/O DEVICES.** 11.1 Define OMR, OCR, ICR and MICR. 11.2 Describe the characteristics of OMR, OCR, ICR and MICR. 11.3 Describe the advantages and limitations of MICR. 11.4 Prepare the specification of a Multimedia Projector. 11.5 Classify Multimedia Projector. 11.6 Describe the operation of a Multimedia Projector. 11.7 List the major parts and components of Multimedia Projector.	**3**	**6**
12	**OPERATION OF HDD AND SSD DRIVES** 12.1 Mention the data storage layout of a disk. 12.2 Describe the operation of a hard disk controller with block diagram. 12.3 Describe the operation hard disk drive. 12.4 Describe the recording principle in a hard disk. 12.5 Describe the operation of a SSD drives. 12.6 State the features of a SSD drives.	**3**	**6**

13	**OPERATION OF SPECIAL STORAGE DEVICES.** 13.1 State the methods of data recording (punch card/paper tape, magnetic tape,magnetic disk and optical) for Micro-Computer systems with example. 13.2 State the features of a flash memory as a secondary storage device. 13.3 Mention the data storage layout of a disk. 13.4 Describe the recording principle in a CD and DVD. 13.5 Describe the operation of optical disk drive (CD drive) and DVD drives. 13.6 State the features of a re-writable optical disk. 13.7 Describe the operation of USB devices.	**4**	**8**
	Total	**48**	**90**

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Marks
1	**Disassemble and reassemble a LED monitor/display unit** 1.1 Choose a place and clean the place 1.2 Collect a LED monitor 1.3 Collect the tools 1.4 Unscrew/unlock the monitor 1.5 Open the back cover 1.6 Identify and separate the components 1.7 Reassemble the monitor 1.8 Clean the workplace	**1**	**2**
2	**Troubleshoot and replace the defective parts of a LED monitor/display unit.** 2.1 Choose a place and clean the place 2.2 Collect a faulty LED monitor 2.3 Collect the tools 2.3 Unscrew/unlock the monitor 2.4 Open the back cover 2.5 Find out the faulty parts and replace 2.6 Reassemble the monitor 2.7 Clean the workplace	**1**	**2**
3	**Install and configure printers(Laser, Dot matrix, Inkjet, POS printers)** 3.1 Collect a specific printer 3.2 Connect the power cable to power line 3.3 Connect data cable to the computer 3.4 Plug and power on computer and printer 3.5 Install the printer from PnP features or manually 3.6 Configure the printer and print a test page 3.7 Clean the workplace	**1**	**2**
4	**Repair and / or replace mechanical assembly unit of laser printer** 4.1 Choose a place and clean the place 4.2 Collect a faulty Laser printer 4.3 Collect the tools 4.4 Unscrew/unlock the printer 4.5 Open the cover	**2**	**2**

	4.6 Find out the mechanical assembly unit 4.7 Replace the faulty parts or replace the unit 4.8 Reassemble the printer 4.9 Clean the workplace		
5	**Repair and / or replace Fixing unit and scanning/optical unit of laser printer** 5.1 Choose a place and clean the place 5.2 Collect a faulty printers 5.3 Disassemble the Printer 5.4 Clean the fixing unit and scanning/optical unit 5.5 Repair/replace the fixing unit or scanning/optical unit 5.6 Reassemble and test the printer 5.7 Clean the workplace	**2**	**2**
6	**Repair and / or replace power supply unit of printers(Laser, Dot & Inkjet printer)** 6.1 Choose a place and clean the place 6.2 Collect a faulty printers 6.3 Disassemble the Printer 6.4 Clean the power supply unit 6.5 Identify the damaged parts/components 6.6 Replace the parts/component 6.7 Reassemble the power supply unit 6.8 Reassemble the printer 6.9 Clean the workplace	**2**	**2**
7	**Repair and / or replace the mechanical assembly o f dotmatrix and inkjet printer** 7.1 Choose a place and clean the place 7.2 Collect a faulty Laser printer 7.3 Collect the tools 7.4 Unscrew/unlock the printer 7.5 Open the cover 7.6 Find out the faulty parts o mechanical portion 7.7 Replace the faulty parts mechanical portion 7.8 Reassemble and test the printer 7.9 Clean the workplace	**2**	**3**
8	**Repair and / or replace the formatter/motherboard o f dotmatrix and inkjet printer** 8.1 Choose a place and clean the place 8.2 Collect a faulty printer 8.3 Collect the tools 8.4 Unscrew/unlock the printer 8.5 Open the cover 8.6 Find out the faulty parts 8.7 Replace/repair the faulty parts 8.8 Reassemble and test the printer 8.9 Clean the workplace	**1**	**2**

9	**Install and perform operation of OMR and OCR devices.** 9.1 Collect OMR and OCR devices 9.2 Connect the power cable to power line 9.3 Power on of OMR/OCR devices 9.4 Connect OMR/OCR to the computer 9.5 Install the OMR/OCR from PnP features or manually 9.6 Configure and test the of OMR/OCR devices 9.7 Clean the workplace	**1**	**2**
10	**Disassemble, identify the internal parts and reassemble a multimedia projector(DLP & LCD types)** 10.1 Choose a place and clean the place 10.2 Collect a multimedia projector 10.3 Collect the tools 10.4 Unscrew/unlock the multimedia projector 10.5 Open the cover 10.6 Identify the types multimedia projector(DLP & LCD) 10.7 Identify and separate the components 10.8 Reassemble and test the multimedia projector(DLP & LCD) 10.9 Clean the workplace	**1**	**2**
11	**Disassemble, identify the internal components and repair/replace the defective parts of a flat bed scanner** 11.1 Choose a place and clean the place 11.2 Collect a Flat bed scanner 11.3 Collect the tools 11.4 Unscrew/unlock the flat bed scanner 11.5 Open the cover 11.6 Identify and separate the components 11.7 Find out the faulty parts and replace 11.8 Reassemble and test the flat bed scanner 11.9 Clean the workplace	**1**	**2**
12	**Disassemble, identify the internal components and repair/replace the defective parts of a plotter** 12.1 Choose a place and clean the place 12.2 Collect a plotter 12.3 Collect the tools 12.4 Unscrew/unlock the plotter 12.5 Open the cover 12.6 Identify and separate the components of the plotter 12.7 Find out the faulty parts and replace 12.8 Reassemble and test the plotter 12.9 Clean the workplace	**1**	**2**
	Total	**16**	**25**

References:

SL	Book Name	Writers Name
1	Computer Peripherals	Barry Wilkinson, David Horroks
2	Computer Peripherals	Leo F. Doyle

3	Computer Peripherals and Interfacing	Jyoti Snehi
4	Computer Peripherals	Barry M. Cook and Neil M. White
5	Computer Peripherals	D. J. Herda

SL	**Web Link**	**Remarks**
01	https://quicklearncomputer.com	All Accessories
02	https://www.bhphotovideo.com/c/browse/computer-peripherals/ci/22339	Peripherals
03	https://optics.fujifilm.com/projector/en/spec/manual/fp-z5000/about_this_product/parts/	Multimedia Projector

Subject Code	Subject Name	Period per Week		Credit
28544	Web Design and Development -1	T	P	C
		1	6	3

Rationale	This is an occupational specific subject in the curriculum for diploma in Engineering courses required to enable the graduates to use and work with ICT competently. It includes web technology and industry requirement, UI/UX and markup language, Responsive website and framework, Client-side scripting language, server-side scripting language, Data manipulation. This course also enables a graduate to adopt further study in upper level courses using IT and other sectors. This course is designed emphasizing on teaching and learning practical aspect rather than theory.
Learning Outcome (Theoretical)	**After undergoing the subject, students will be able to:** ▪ Describe web technology and industry requirement ▪ Describe UI/UX and markup language ▪ Describe Responsive website and framework ▪ Describe Client-side scripting language ▪ State server-side scripting language ▪ Explain Data manipulation
Learning Outcome (Practical)	After undergoing the subject, students will be able to: • Interpret web technology and industry requirement • Convert UI/ UX to markup language • Develop responsive website using framework • Develop website using client side scripting language • Develop website using server-side scripting language • Manipulate data using data layer

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	**WEB TECHNOLOGY AND INDUSTRY REQUIREMENT** 1.1 State web technology and web development. 1.2 Explain front end, back end and full stack developer. 1.3 Describe the roles of a web developer. 1.4 State the Trends of IT enabled industries. 1.5 Describe the career opportunities of a web developer. 1.6 Describe the website design standards and conventions recommended from W3C (www.w3school.org). 1.7 Describe the URL	**2**	**4**
2	**UI / UX AND MARKUP LANGUAGE** 2.1 State UI and UX design. 2.2 Differentiate between UX and UI. 2.3 State the Markup Language. 2.4 List the different types of Markup language. 2.5 Explain Markup Language structures according to W3C markup language coding guidelines and conventions. 2.6 State the tags and attributes of Markup language.	**2**	**4**
3	**RESPONSIVE WEBSITE AND FRAMEWORK** 3.1 State Responsive Website. 3.2 Explain Framework. 3.3 Mention the types of fronted framework. 3.4 Explain CSS structures according to W3C CSS coding guidelines and conventions. 3.5 Interpret syntax and variations of using CSS element tags and attributes. 3.6 Mention the uses of CSS in inline, internal, embedded or external way.	**3**	**4**
4	**CLIENT-SIDE SCRIPTING LANGUAGE** 4.1 State the Client Side Scripting language. 4.2 Explain structured of JavaScript. 4.3 Explain jQuery structures. 4.4 Describe JavaScript element tags and attributes. 4.5 List the common tools to develop JavaScript codes. 4.6 Describe jQuery built- in functions.	**3**	**4**
5	**SERVER-SIDE SCRIPTING LANGUAGE (PHP)** 5.1 Define Different type of server-side Scripting Language. 5.2 State PHP. 5.3 Explain variables and data types in PHP. 5.4 Explain Arrays in PHP. 5.5 Describe the different type of operators PHP. 5.6 Define control structure of PHP. 5.7 Describe If, If…else, Nested if…else, Switch, For loop, While loop, Foreach loop of control structure. 5.8 Explain Break and continue statement. 5.9 Explain Include and require of PHP.	**3**	**8**

	5.10 Describe built-in and user defined functions of PHP. 5.10 Explain Cookie and Session.		
6	**DATA MANIPULATION** 6.1 Explain AJAX and JSON code. 6.2 Define Third party API. 6.3 Describe Weather, Rapid, Any, Firebase, AWS of Third-party API. 6.4 State Hypertext Transfer Protocol (HTTP). 6.5 Describe Post, Get, Put, Patch, Delete method of HTTP. 6.6 Describe CRUD operations.	**3**	**6**
	Total	**16**	**30**

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Continuous Marks
1	**INTERPRET WEB TECHNOLOGY AND INDUSTRY REQUIREMENT** 1.1 Follow OSH practices 1.1.1 Safe work practices are observed as according to workplace procedures. 1.1.2 OSH hazards and incidents are reported to appropriate personnel according to workplace procedures. 1.1.3 Turn on your PC properly. 1.2 Interpret web technology Follow OSH practices 1.2.1 Web technology, web development is interpreted. 1.2.2 Front end and back end, full stack developer is stated. 1.2.3 UI/UX design layout is interpreted. 1.2.4 Roles of web developer is stated. 1.3 Identify career opportunities 1.3.1 Personal strengths and weaknesses are identified and analyzed. 1.3.2 Personal strengths and weaknesses are mapped according to purpose and objectives. 1.3.3 Trends of IT industry - its past, present and future are identified. 1.3.4 Career opportunities of a web developer are identified. Career Opportunities: Web developer, Web designer, Full stack web developer, Frontend developer, Backend developer 1.4 Perform requirement analysis for setting development 1.4.1 IT infrastructure and e-mail is ensured. IT infrastructure: Workstation, Power, Data Center, Internet facilities 1.4.2 Operating system is selected. Operating System: Windows, Linux, Mac 1.4.3 Version control software is installed as required. Version Control software: GIT, TFS, SVN 1.4.4 Web server tools and web server is installed. Web server tools: XAMPP, WAMP, LAMP Web server: IIS, Apache, Tomcat 1.4.5 Browser and browser extension are selected and IDE	**4**	**5**

	(Integrated Development Environment) is ensured. Browser: Google Chrome, EDGE, Firefox, Safari, Opera, Microsoft EDGE Browser Extension: Web developer (GC), Json Formatter, MOZ, Wappalyzer IDE: Visual Studio Code, Eclipse, WebStorm, PhpStrom Text Edition: Sublime Text, Notepad, 1.4.6 Task management tools are selected and ensured as per job requirement Task management tools: Jira, Trello, Asana 1.4.7 Communication channel are identified and used as per customer requirement. Communication channel: Skype, Slack 1.4.8 Test is performed to ensure all the setup is work effectively.		
2	**CONVERT UI/UX TO MARKUP LANGUAGE** 2.1 Plan a website 2.1.1 Purpose and intended audience of the website are identified. 2.1.2 Design requirements and constraints of using provided templates are identified. 2.1.3 Required design is collected or selected. 2.2 Convert UI/UX to markup language 2.2.1 Given UI/UX design template is converted into required format. Format: Figma File, XD File, Image, Text, Design specification 2.2.2 Website layout is developed as per job requirement. 2.2.3 File and folder are named properly and saved in a proper location. 2.2.4 Appropriate markup language is selected. Markup language: HTML, XML 2.2.5 Web content is placed into the right position by using markup language tags. Contents: Graphic media, Table, List, Form & button, Text formatting, Website content typography, Site map, Hyperlink titles. Markup language tags: P, Div, Heading, Image and video tags, Table, List, Form & button, Anchor tag, Meta. 2.2.6 Content is formatted properly by maintained standards and following legislation issues. Legislation: Copyright Act, National Cyber Policy, Intellectual Property Rights law, Subsequent amendments. 2.2.7 Hyperlinks are added to allow successful navigation between pages of website. 2.3 Test website 2.3.1 Website is tested to ensure functionality, correct any errors and log in according to testing procedures as per plan. Plan Includes requirements, purpose, specifications and/or features to develop an interactive and responsive web site which may be modified during any new creation or changes. Depending on assessment context, plan may include:	**6**	**10**

	key milestone outcomes how resources such as time, expertise and materials (and finance, if appropriate) will be used to achieve outcomes of each milestone. How consultation with stakeholders will be carried out to ensure that all constraints and requirements are met. 2.3.2 Website is opened in a variety of common browsers and check for accessibility, readability, legibility and presentation in accordance with client requirements. Accessibility: Cultural awareness, Physical impairments, Remote locations 2.3.3 Website is evaluated for fitness purpose in terms of purpose, target audience and specifications of client requirements.		
3	DEVELOP RESPONSIVE WEBSITE USING FRAMEWORK 3.1 Determine purpose and accessibility 3.1.1 Purpose of markup language document is identified. 3.1.2 Accessibility options are identified and determine for visually, physically or otherwise impaired persons. Accessibility: Cultural awareness, Physical impairments, Remote locations. 3.2 Set styles 3.2.1 CSS (Cascading Style Sheets) to markup language documents is linked and verified. 3.2.2 Appropriate styles that are to be controlled by CSS are identified as per responsive design. 3.2.3 Styles are defined and documented in accordance with established design principles. 3.3 Create CSS using framework 3.3.1 Frontend framework is identified. Frontend framework: Bootstrap, Tailwind CSS, Foundation zurb 3.3.2 CSS is created using determined styles by maintain standards and be aware of legislation. Legislation: Copyright Act, National Cyber Policy, Intellectual Property Rights law, Subsequent amendments 3.3.3 CSS is edited as per client requirement. 3.3.4 Changes are confirmed in linked markup language document. 3.3.5 CSS is tested/validated according to established design principles required website or browsers. Website: https://jigsaw.w3.org/css-validator Browsers: Google Chrome, EDGE, Mozilla Firefox, Opera, Safari, Microsoft EDGE	**6**	**10**
4	DEVELOP WEBSITE USING CLIENT SIDE SCRIPTING LANGUAGE 4.1 Plan features 4.1.1 Purpose and intended audience of the website are identified. 4.1.2 Design requirements and constraints are identified. 4.1.3 Conceptual idea is developed.	**4**	**10**

	4.1.4 Necessary software is installed and checked for functionality . 4.2 Apply JavaScript 4.2.1 JavaScript elements are added, and attributes are assigned to meet client requirements. 4.2.2 Interactivity is added, edited and formatted to the website in accordance with client requirements. 4.2.3 Markup content is rendered via JavaScript. 4.2.4 JavaScript variable, conditions, loop, array, and functions are stated. 4.3 Apply jQuery 4.3.1 jQuery built- in functions are interpreted. jQuery built- in functions: Hide, Show, Remove, Slide Up, Slide down, Fade in, Append, Fade out, Add class, Remove class, Animate 4.3.2 jQuery is added and attributes are assigned to meet client requirements. 4.3.3 Interactivity is added, edited and formatted to the website in accordance with client requirements. 4.3.4 Content is added in every page, if required, in accordance with client requirements. 4.3.5 jQuery plug in is installed and used as per plug in configuration. jQuery plug in: Slick slider, Light box, Filter, Cycle slider, wow.js, motion-ui, Bootstrap component jQuery or relevant, Chart.js 4.4 Perform website test 4.4.1 Website is tested according to the testing criteria. Testing criteria: Compatibility, Functionality, Any errors, Log in 4.4.2 Website is opened in a variety of common browsers. Browsers: Google Chrome, EDGE, Mozilla Firefox, Opera, Safari, Microsoft EDGE. 4.4.3 Accessibility, readability, legibility and appearance are checked in accordance with client requirements. 4.4.4 Website is evaluated for suitability as per client requirement. Suitability: Purpose, Target audience, Specifications.		
5	**DEVELOP WEBSITE USING SERVER-SIDE SCRIPTING LANGUAGE** 4.1 Plan features 4.1.1 Purpose and intended audience of the website are identified. 4.1.2 Design requirements and constraints are identified. 4.1.3 Necessary software is installed and checked for functionality. 4.2 Apply PHP 4.2.1 PHP scripts to handle HTML forms are performed. 4.2.2 Regular expressions including operators are performed. 4.2.3 PHP variable, conditions, loop, array, and functions are interpreted 4.2.4 PHP built- in functions are interpreted. PHP built- in functions: echo() , count() , die() , empty() , ceil() , exit() , file_get_contents() , file_put_contents() , getenv() ,	**6**	**10**

	header() , htmlentities() , include() , ini_set() , isset() , mail() , md5() , mkdir() , phpinfo() , preg match() , print_r() , rand() , require() , str_replace() , strlen() , trim() , addslashes , chunk_split() , crypt() , explode() , implode() , str_repeat , str_replace() , str_split , str_shuffle , str_split , str_word_count , strip_tags , stripslashes , strlen() , strops , strstr , ucfrist , ucwords , wordwrap . 4.2.5 PHP cookie and session are interpreted. 4.3 Perform website test 4.3.1 Website is tested according to the testing criteria. Testing criteria: Compatibility, Functionality, Any errors, Log in 4.3.2 Website is opened in a variety of common browsers Browsers: Google Chrome, EDGE, Mozilla Firefox, Opera, Safari, Microsoft EDGE 4.3.3 Accessibility, readability, legibility and appearance are checked in accordance with client requirements. 4.3.4 Website is evaluated for suitability as per client requirement. Suitability: Purpose, Target audience, Specifications		
6	**MANIPULATE DATA USING DATA LAYER** 6.1 Plan data layer 6.1.1 Purpose and intended audience of the website are identified. 6.1.2 Design requirements and constraints are identified. 6.1.3 A conceptual design is developed. 6.1.4 Necessary software installed and check all requirement. Software: Operating system, Application server, FTP client software 6.2 Implement ajax and json 6.2.1 Configure embedded ajax and json as required. 6.2.2 Content are added to the site via ajax. 6.2.3 Content are formatted in accordance with client requirements following legislation issues. 6.2.4 Ajax and json functionality are tested. 6.3 User third party API 6.3.1 Third party API (Application Programming Interface) data is manipulated by using HTTP (Hypertext Transfer Protocol) methods. Third party API: Weather API, Rapid API, Any API, Firebase, AWS API HTTP methods: Post, Get, Put, Patch, Delete 6.3.2 Data from third party API is tested. 6.4 Implement database 6.4.1 DB and table are created, and data is inserted. 6.4.2 CRUD operation is performed. CRUD: Create, Retrieve, Update, Delete 6.4.3 Last ID is retrieved. 6.4.4 Multiple data are inserted. 6.4.5 Data is limited. 6.4.6 Table relation is performed.	**6**	**5**

	6.5 Test data layer 6.5.1 Data layer is tested according to testing criteria. Testing criteria: Compatibility, Functionality, Any errors, Log in 6.5.2 Data layer is evaluated for ***suitability*** as per client requirement. Suitability: Purpose, Target audience, Specifications		
	Total	**32**	**50**

Necessary Resources (Tools, equipment's and Machinery):

Sl	Item Name	Quantity
01	PC with internet connection with necessary software. Web browser, HTML, Visual studio code/ Netscape	1 set per students

Recommended Books:

Sl	Book Name	Writer Name	Publisher Name & Edition
01	HTML and CSS: Design and Build Websites	Jon Duckett	
02	JavaScript and JQuery: Interactive Front-End Web Development	Jon Duckett	
03	Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5	Robin Nixon	
04	হাতে কলমে জাভাস্ক্রিপ্ট	জুনায়েদ আহমেদ	
05	ওয়েভ ডিজাইন এন্ড ডেভেলপমেন্ট	মাহাবুবুর রহমান (আইসিটি)	

Website References:

Sl	Web Link	Remarks
01	https://www.codecademy.com/	
02	https://www.w3schools.com/	
03	https://www.freecodecamp.org/	
04	https://www.javatpoint.com/	
05	https://www.geeksforgeeks.org/	
06	http://www.trainingwithliveproject.com/	
07	https://www.webcoachbd.com/	
08	https://www.tutorialspoint.com/	
09	https://www.guru99.com/	
10	https://www.stackoverflow.com	

Subject Code	Subject Name	Period/Week		Credit
26841	Digital Electronics – II	T	P	C
		2	3	3

Rationale	Diploma in Engineering Level students are required to acquire the knowledge and skill on concept of Digital counters , shift registers, memory, ADC, DAC, PLD, PLA , PAL, GAL, SAP-1 and 8085 microprocessor which are used in about all digital system and the foundation of advanced microprocessor, microcontroller and PLC.
Learning Outcome (Theoretical)	After Completing the subject, students will be able to: • Explain register and counter • Use Memory • Describe ADC and DAC • State programmable logic Devices • Describe simple computer • Explain Program 8085 microprocessor
Learning Outcome (Practical)	After undergoing the subject, students will be able to: • Verify the operation of shift register. • Verify the operation of binary counter. • Verify the operation of ring and Johnson counter. • Perform read & write operation of an EPROM. • Verify the operation of DAC. • Verify the operation of ADC. • Observe the operation of programmable logic device (PLD). • Test program to add two 8-bit numbers using 8085 microprocessor. • Test program to subtract two 8-bit numbers using 8085 microprocessor. • Test program to multiply two 8-bit numbers using 8085 microprocessor.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	**REGISTER** 1.1 Define register and shift register. 1.2 Mention types of shift registers. 1.3 Describe the operation of buffer register. 1.4 Explain the operation of SISO, SIPO, PISO and PIPO shift register with logic diagram. 1.5 Describe the operation of left shift, right shift and universal shift register with logic diagram. 1.6 List the different types of common shift register IC chips. 1.7 Mention the uses of shift registers.	3	6
2	**COUNTER** 2.1 Define binary counter, modulus of counter and divided by N counter. 2.2 Classify counter. 2.3 Differentiate between asynchronous and synchronous counter. 2.4 Describe the operation of 4-bit binary up, binary down, and binary Up-Down counter with timing diagram. 2.5 Describe the operation of MOD-10 counter. 2.6 Explain the operation of ring & Johnson counter with logic circuit and timing diagram. 2.7 Describe the operation of digital clock.	3	8
3	**MEMORY** 3..1 Define memory. 3..2 Classify memory. 3..3 Describe ROM, PROM, EPROM and EEPROM. 3..4 Describe the logic circuit of RAM and Flash RAM. 3..5 Explain the architecture of static RAM (SRAM) and dynamic RAM (DRAM). 3..6 Describe the read and write operation of memory. 3..7 Differentiate between RAM and ROM. 3..8 Distinguish between SRAM and DRAM.	3	6
4	**ANALOG TO DIGITAL CONVERTER (ADC) AND DIGITAL TO ANALOG CONVERTER (DAC)** 4.1 Define ADC and DAC. 4.2 Mention the steps to convert analog signal to digital signal. 4.3 Describe the operation of sample and hold circuit. 4.4 Mention the types of ADC and DAC. 4.5 Explain the conversion process of 3-bit parallel ADC. 4.6 Describe the operation of successive approximation and dual slope ADC. 4.7 Discuss the operation of a binary weighted and R-2R ladder DAC. 4.8 State resolution, percentage of resolution, accuracy of ADC and DAC. 4.9 List the ICs used as ADC and DAC.	3	8
5	**PROGRAMMABLE LOGIC DEVICES (PLDs)** 5.1 Defines PLD, AND array and OR Array.	4	5

	5.2 Mention the advantages of PLD. 5.3 Classify PLD. 5.4 Describe the logic structure of PLA, PAL and GAL. 5.5 Interpret standard PAL and GAL numbering. 5.6 Describe the programming process of SPLD. 5.7 Discuss the block diagram of CPLD. 5.8 Discuss the block diagram of FPGA. 5.9 List the Application of PLDs, CPLD and FPGA.		
6	**SIMPLE AS POSSIBLE (SAP)-1 COMPUTER** 5.1 State the meaning of SAP. 5.2 Describe the function of each stage of SAP-1 with block diagram. 5.3 State the function of control signals. 5.4 Explain each instruction of SAP-1 with binary code. 5.5 Write simple program using SAP-1 Instruction and show the instruction in memory with mentioning memory address. 5.6 State the concept of machine cycle, fetch cycle, execution cycle and Instruction cycle. 5.7 Describe the timing diagram of LDA, ADD and SUB Instructions. 5.8 Describe the methods of micro programming.	4	8
7	**FEATURES OF MICROPROCESSOR** 7.1. Define Microprocessor and microcomputer. 7.2. List 8-bit, 16-bit, 32 bit and 64-bit Microprocessors. 7.3. Describe the architecture of 8085 microprocessor. 7.4. Describe the pin diagram and function of each pin of Intel 8085 microprocessors. 7.5. Describe the software model of Intel 8085 microprocessors.	4	8
8	**PROGRAMMING OF 8085 MICROPROCESSORS** 8.1. Define assembly language and assembler. 8.2. Describe the fields of assembly language program. 8.3. Define instruction and instruction set. 8.4. Describe the instruction set of 8085 microprocessors. 8.5. Explain the addressing modes of Intel 8085 microprocessors. 8.6. Write programs using 8085 instructions.	4	7
9	**8085 MICROPROCESSOR BASED SYSTEM** 9.1 Define microprocessor based system. 9.2 Describe the block diagram of a microprocessor based system. 9.3 Define Bus multiplexing. 9.4 Explain the process of multiplexing bus using latch. 9.5 Describe the technique of generate control signals. 9.6 Differentiate between memories mapped I/O and standard I/O. 9.7 Describe the block diagram of 8255 programmable peripheral Interface (PPI). 9.8 Discuss the function of Programmable Interval Timer.	4	4
	Total	**32**	**60**

Detailed Syllabus (Practical)

Unit	Experiment name with procedure	Class (1 Period)	Continuous Marks
1	**VERIFY THE OPERATION OF SHIFT REGISTER.** 1.1 Select a SIPO & PISO shift register IC.	2	3

	1.2 Construct the SIPO & PISO shift register circuits diagram on Trainer Board. 1.3 Apply clock input pulse to the circuit and observe the operation. 1.4 Connect the PISO shift register according to circuits diagram on Trainer Board. 1.5 Apply clock input pulse to the circuit and observe the operation. 1.6 Maintain the record of performed task.		
2	**VERIFY THE OPERATION OF BINARY COUNTER.** 2.1 Select 4-Bit ripple counter IC. 2.2 Connect the Up /Down ripple counter circuit on Digital Trainer Board. 2.3 Apply clock input pulse to the circuit and observe the operation of up-counting and down counting. 2.4 Select MOD-10 counter IC. 2.5 Connect the Decade counter circuit on Digital Trainer Board. 2.6 Apply clock input pulse to the circuit and observe the Decade operation. 2.7 Maintain the record of performed task.	2	3
3	**VERIFY THE OPERATION OF RING AND JOHNSON COUNTER.** 3.1 Select ring counter IC. 3.2 Construct the Ring counter circuit on Digital Trainer Board. 3.3 Apply clock input pulse to the circuit and observe the operation of up-counting and down counting. 3.4 Select Johnson counter IC. 3.5 Construct the Decade counter circuit on Digital Trainer Board. 3.6 Apply clock input pulse to the circuit and observe the Decade operation. 3.7 Maintain the record of performed task.	2	2
4	**PERFORM READ & WRITE OPERATION OF AN EPROM.** 4.1 Select an EPROM IC. 4.2 Connect EPROM Chip with programmer. 4.3 Write/Burn data to the EPROM Chip. 4.4 Observe the written data from **EPROM.** 4.5 Maintain the record of performed task.	2	2
5	**VERIFY THE OPERATION OF DAC.** 5.1 Select a DAC IC. 5.2 Construct DAC IC circuit on Digital Trainer Board. 5.3 Apply input data and clock pulses to the different input of the circuit. 5.4 Observe the operation of the circuit and detect the output result of DAC. 5.5 Maintain the record of performed task.	1	3
6	**VERIFY THE OPERATION OF ADC.** 6.1 Select an A/D converter IC. 6.2 Connect an A/D converter IC according to circuit on Digital Trainer Board. 6.3 Apply input data and clock pulses to the different input of the circuit. 6.4 Observe the operation of the circuit and detect the output result of A/D converter. 6.5 Maintain the record of performed task.	1	2
7	**PERFORM THE WRITE OPERATION OF PLD** 7.1 Select appropriate PLD IC. 7.2 Select a logic equation. 7.3 Write the equation by a EPROM programmer. 7.4 Construct the circuit on Digital Trainer Board.	1	3

	7.5 Apply input data and clock pulses to the different input of the circuit. 7.6 Observe the operation of the circuit and detect the output result PLD. 7.7 Maintain the record of performed task.		
8	**TEST PROGRAM TO PERFORM 8-BIT ARITHMETIC OPERATION OF 8085 MICROPROCESSOR.** 8.1 Select 8085 microprocessor trainer board/Simulator. 8.2 Write assembly language program. 8.3 Run the program. 8.4 Observe the result. 8.5 Maintain the record of performed task.	1	3
9	**TEST PROGRAM TO PERFORM SELECTION/BRINCHING OPERATION OF 8085 MICROPROCESSOR.** 9.1 Select 8085 microprocessor trainer board/Simulator. 9.2 Write assembly language program. 9.3 Run the program. 9.4 Observe the result. 9.5 Maintain the record of performed task.	2	2
10	**TEST PROGRAM TO PERFORM REPEATION/LOOPING OF 8085 MICROPROCESSOR.** 10.1Select 8085 microprocessor trainer board/Simulator. 10.2Write assembly language program. 10.3Run the program. 10.4Observe the result. 10.5Maintain the record of performed task.	2	2
	Total	**16**	**25**

Necessary Resources (Tools, Equipment and Machinery):

Sl. No.	Item Name	Quantity
1	DC power Supply	10 Nos
2	Function generator	10 Nos
3	Oscilloscope	10 Nos
4	Digital Electronics Trainer	10 Nos
5	Power project board/ bread board,	20 Nos
6	8085 Microprocessor Trainar.	10 Nos
7	8085 Simulatore program.	
8	IC No: 74164, 74165, 7494, 7495, 7490, 7493, 74181, 74191, ADC0804, DAC0800, 74189, 2732.	10 Nos each
9	7-segment Display Module, 555IC	10 Nos each
10	Soldering Iron	20 Nos
11	Resin, Soldering lead, Soldering trip, Fixable wire, Wire Brush,	As required

Recommended Books:

Sl No.	Book Name	Writer Name	Publisher Name & Edition
1	A Text Book of Digital Electronics	R. S. Sedha	Chand Publication
2	Digital Computer Electronics	Albert P. Malvino	McGraw-Hill
3	Digital Fundamentals	Thomas L. Floyd	Prentice Hall
4	Digital Electronics	D. R. Kaushik	Dhanpat Rai Publication Company

Website References:

Sl. No.	Web Link	Remarks
1	https://www.tutorialspoint.com/	**Search the**

2	https://www.electronics-tutorials.ws/	**links**
3	https://www.youtube.com/channel/	
4	https://youtu.be/qsWkA-5grogo	
5	https://youtu.be/eXyGIPrD5Qk	
6	https://you.be/f-WiulYIrow	

Subject Code	Subject Name	Period per Week		Credit
29061	Environmental Studies	T	P	C
		2	3	3

Rationale	**The need for sustainable environmental development is critical for the future of the world and mankind. The excess demand of natural resources is creating obstacles to sustain life on earth. The continuing problems of pollution have made everyone aware of environmental issues. Different industrial sectors have direct impact on the environment and are responsible for air, water, soil, noise, marine, nuclear, and biological pollution. The knowledge of environmental studies is the prerequisite for the control of these pollutions. In this present scenario, fundamental knowledge of environmental studies is necessary for a Diploma in Engineering Course to understand the root causes of pollution and enable them to control industrial pollution through maintaining the raw materials, processes, and technology.** **The subject covers the basic knowledge about key environmental issues, different types of pollution, their effects, control measures, and remedies in their respective fields. This will enable them to be responsible professionals and contribute to sustainable development for the benefit of all.** **This module is designed with hands on practical approach which includes practical activity to identify common pollutants and data collection for resource consumption.**
Learning Outcome (Theoretical)	**After undergoing the subject, students will be able to:** 1. Describe the environment and environmental pollution. 2. Explain ecology and ecosystems. 3. Identify major environmental risks and challenges. related to industrial operation, production, and agriculture. 4. Identify ways to mitigate negative effects on the environment. 5. State Legislative measures and requirements to protect the environment.
Learning Outcome (Practical)	**After undergoing the subject, students will be able to:** 1. Analyze the water and wastewater quality parameters. 2. Demonstrate the air quality measures. 3. Estimate the noise level and acoustic zone mapping. 4. Collect data for resource consumption and waste generation. 5. Observe operations of an Effluent water treatment plant (ETP).

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	**INTRODUCTION TO ENVIRONMENTAL STUDIES** 1.1 Define nature, environment & environmental studies. 1.2 Mention the components of the environment. 1.3 Define pollution, pollutant & contaminant. 1.4 Classify different types of pollution. 1.5 Differentiate between natural and man-made environments. 1.6 Define climate change. 1.7 Mention the impact of climate change.	**2**	**4**
2	**ECOLOGY & ECOSYSTEM** 2.1 Define ecology & eco-system. 2.2 Illustrate the water cycle. 2.3 Illustrate the carbon cycle. 2.4 Illustrate the nitrogen cycle. 2.5 Illustrate the oxygen cycle. 2.6 Define food chains and food webs. 2.7 Define Biodiversity, biomass, bioconcentration and bio magnification. 2.8 Describe Terrestrial and Aquatic ecosystem. 2.9 Define ecologically critical area (ECA), threatened species, endanger species, extinct species, and exotic species. 2.10 List the ecologically critical areas of Bangladesh.	**2**	**4**
3	**GLOBAL AND NATIONAL ENVIRONMENTAL ISSUES** 3.1. Define Greenhouse effect, global warming & Ozone depleting substances (ODS). 3.2. Mention the causes of global warming. 3.3. List the greenhouse gases. 3.4. State the contribution of greenhouse gases to the greenhouse effect. 3.5. Discuss the effects of global warming on the environment and human life. 3.6. Define acid rain and impact on the environment. 3.7. Describe the importance of the ozone layer and the effects of ozone depletion. 3.8. Mention different types of natural disaster. 3.9. Discuss the Flood, Cyclone & Earthquake disaster management system of Bangladesh.	**3**	**6**
4	**WATER AND WASTEWATER MANAGEMENT** 4.1 Define water pollution, water pollutants and pollution sources. 4.2 Mention the sources of water pollution. 4.3 Mention the quality standards of drinking water and wastewater. 4.4 Define wastewater management. 4.5 Explain effluents, influent and methods of effluent treatment. 4.6 Draw different schematic diagrams of effluent treatment methods. 4.7 Explain the effects of water pollution on human health and the	**5**	**10**

	environment. 4.8 Discuss the importance of water conservation.		
5	**AIR POLLUTION, ENERGY AND CARBON FOOTPRINT** 5.1 Describe the sources, production, and consumption of energy. 5.2 Describe air pollution and sources of air pollution. 5.3 Define Carbon Footprint. 5.4 Define GHG emission and contribution to the greenhouse effect. 5.5 Discuss the effects of energy consumption on Climate Change. 5.6 Explain the concept of energy efficiency. 5.7 Discuss Carbon Footprint calculation methods. 5.8 Discuss the importance of reducing Carbon Footprint. 5.9 Discuss the effect of air pollution on human health, vegetation, and animals.	**5**	**8**
6	**NOISE POLLUTION** 6.1 Define sound & sound wave. 6.2 Mention the scale of measuring sound intensity. 6.3 Define sound pressure & sound power. 6.4 Describe the sound intensity and loudness. 6.5 Define noise pollution. 6.6 Mention the sources of noise pollution. 6.7 Mention the effect of noise pollution on human health. 6.8 Explain the methods for noise prevention in the industry.	**2**	**4**
7	**SOIL POLLUTION** 7.1. Define soil pollution and soil degradation. 7.2. Classify different types of soil pollution. 7.3. Mention the sources of soil pollution. 7.4. List the main pollutants in soil. 7.5. Describe the impacts of soil pollution on the food chain and ecosystem. 7.6. Describe the methods of soil pollution controlling. 7.7. List the agro-ecological zones of Bangladesh.	**2**	**4**
8	**SOLID WASTE MANAGEMENT** 8.1 Define solid waste. 8.2 Identify the sources of solid waste. 8.3 Categorize different types of solid waste. 8.4 Discuss the solid waste collection methods. 8.5 Describe 3R and 4R methods of solid waste management. 8.6 Describe the potential method of disposal of solid waste. 8.7 Mention the waste management strategies in Bangladesh. 8.8 Discuss the impact of solid waste on environment and human health.	**3**	**6**
9	**CHEMICAL MANAGEMENT** 9.1 Define Chemical hazard. 9.2. Discuss different types of chemical hazard and toxicity. 9.3 State the benefits of chemical management. 9.4 Describe basic concepts of chemical segregation and storage. 9.5. Describe chemical label and safety data sheet (SDS) 9.6. Discuss different hazard pictogram and safety signs. 9.7 Describe chemical pesticides.	**4**	**7**

	9.8. Describe the mitigation and control measures of chemical exposure.		
10	**REGULATORY ISSUES OF ENVIRONMENT** 10.1 Mention environmental act & legislations prescribed for air, noise, water, soil & wildlife protection in Bangladesh. 10.2 Discuss International protocols and agreements related to environmental issues. 10.3 Define environmental impact assessment (EIA). 10.4 Describe the environmental framework in Bangladesh. 10.5 Describe environmental conservation act 1995 in Bangladesh. 10.6 Describe the environment conservation rule 1997 in Bangladesh. 10.7 Discuss the steps required to obtain Environmental Clearance certificate in Bangladesh.	**4**	**7**
	Total	**32**	**60**

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Total Marks
1	**Determine physical water quality of water sample.** 1.1 Measure temperature, color, odor & taste. 1.2 Measure turbidity of water. 1.3 Measure total suspended solids (TSS) present in water sample. 1.4 Maintain the record of performed job.	1	5
2	**Determine chemical water quality of water sample.** 2.1 Measure pH level in water sample. 2.2 Measure Hardness in water sample. 2.3 Maintain the record of performed job.	1	5
3	**Measure total dissolved solids (TDS) present in water sample.** 3.2 Prepare TDS meter & necessary accessories. 3.2 Read the value of TDS meter. 3.3 Maintain the record of performed job.	1	5
4	**Determine Iron (Fe) & Arsenic (As) level in water sample.** 4.1 Prepare Iron & Arsenic test kit bottles. 4.2 Measure Iron (Fe) level in water sample. 4.3 Measure Arsenic level in water sample. 4.4 Maintain the record of performed job.	1	5
5	**Determine dissolved oxygen (DO), Chemical oxygen demand (COD), biochemical oxygen demand (BOD) in wastewater sample.** 5.1 Prepare DO meter and necessary accessories. 5.2 Measure dissolved oxygen (DO) level present in water. 5.3 Measure biochemical oxygen demand (BOD) in water. 5.4 Prepare required apparatus for Chemical oxygen demand **(**COD) test. 5.5 Prepare reagents for COD test. 5.6 Observe COD test readings and calculate result.	1	5

	5.7 Maintain the record of performed job.		
6	**Measure Air Quality** 6.1 Prepare air quality meter and necessary accessories. 6.2 Measure air quality, CO_2 level in the air. 6.3 Maintain the record of performed job.	1	5
7	**Control of air dust by cyclone separator** 7.1 Prepare cyclone separator. 7.2 Observe the reading of cyclone separator. 7.3 Remove the dust from cyclone separator. 7.4 Maintain the record of performed job.	1	5
8	**Measurement of noise level in different places** 8.1 Prepare noise meter. 8.2 Observe the reading of noise level meter. 8.3 Measure the noise level in different working area. 8.4 Maintain the record of performed job.	1	5
9	**Calculate Energy consumption.** 9.1 Collect the data. 9.2 Compute energy consumption in KWH. 9.3 Maintain the record of performed job.	1	5
10	**Perform a field visit on Effluent treatment plant (ETP)** 10.1 Observe the ETP plant. 10.2 Collect the relative data. 10.3 Prepare the diagram of observed ETP plant. 10.4 Maintain the record of performed job.	1	5
	Total	**10**	**50**

Necessary Resources (Tools, equipment's, and Machinery):

Sl	Item Name	Quantity
01	Turbidity meter	5 set
02	P^H meter	5 set
03	TDS meter	5 set
04	Noise Level Meter	5 set
05	DO meter	5 set
06	Cyclone Separator(high sampler)	5 set
07	Iron & Arsenic test kit box	5 set
08	Incubator	1 set
09	Water Bath	1 set
10	Glassware	5 set
11	Thermometer	5 set
12	Ultraviolet–visible Spectrophotometer	1 set
13	Energy meter	1 set
14	Bill or data for electricity bill, gas bill, liquid gas bill, gasoline bill	5 sets for each class
15	AMP meter	5 set
16	High volume sampler	1 set
17	Oven	1 set
18	Measurement scales up to 4 digits	5 set
19	COD reactor	5 sets
20	Chemicals reagents and stabilizing chemicals	2 liters

21	Hardness meter	5 sets
22	Hardness kit box	5 sets
23	Filter paper	10 packets
24	Air Quality meter	5 sets

Recommended Books:

Sl	Book Name	Writer Name	Publisher Name & Edition
01	Pollution control in process industries	S. P. Mahajan	McGraw Hill Education 2017
02	Environmental Policy and Public Health: Air Pollution, Global Climate Change, and Wilderness	William N. Rom	Jossey-Bass
03	Air pollution Fundamentals of Air Pollution, Fourth Edition	Daniel A. Vallero	Elsevier Publications
04	Industrial Noise Control	Bruce Fader	John Wiley & Sons
05	পরিবেশ দূষণ (১ম ও ২য় খন্ড)	আবদুল মালেক ভুঁইয়া	
06	পরিবেশ দূষণ	গৌতম পাল	
07	Sustainability Indicators	By Simon Bell, Stephen Morse	Routledge, London, 2001.
08	Down to Earth. Applying Business Principles to Environmental Management.	F. L. Reinhardt	Harvard Business School, Boston 2000, ISBN 1-57851-192-5.
09	Industrial Wastewater Treatment.	Patwardhan	2nd revised edition. PHI Learning. ISBN:8120353323; 2017
10	Industrial Wastewater Treatment, Recycling and Reuse.	Ranade &; Rhandari	Butterworth-Heinemann. ISBN: 9780080999685 2014
11	Energy, Resources and Environment	Alan Reddish and John Blunden	Hodder Education, 2nd edition
12	Exploring Environmental Issues-An integrated approach	David D. Kemp	Routledge, London

Website References:

Sl	Web Link	Remarks
01	http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/155eebe8_0092_4653_907d_421dc0890e6d/aian%20sonkolon%20fff-1-100.pdf	
02	http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/155eebe8_0092_4653_907d_421dc0890e6d/aian%20sonkolon%20fff-101-200.pdf	
03	http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/155eebe8_0092_4653_907d_421dc0890e6d/aian%20sonkolon%20fff-201-366.pdf	
04	Environmental Protection Agency https://www.epa.gov/laws-regulations	
05	Woodard &; AMP: Industrial Waste Treatment Handbook, 2nd Edition (2006) Chapters available for free download on https://www.sciencedirect.com/book/9780750679633/industrial-waste-treatment-handbook	