Siliguri Institute Of Technology

Department of Computer Science & Engineering

DATA STRUCTURE AND ALGORITHM

PCC-CS301 & PCC-CS391

2020-21

Course Description File on Data structure and Algorithm
2nd YEAR, 1st Semester

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION OF THE INSTITUTE:

To be a recognized institution offering high quality education, opportunities to students to become globally employable Engineers/Professionals in best ranked industries and research organization.

MISSION OF THE INSTITUTE:

To impart quality technical education for holistic development of students who will fulfill the needs of the industry/society and be actively engaged in making a successful career in industry/research/higher education in India & abroad.

VISION OF THE DEPARTMENT:

To be a nationwide recognized department that produces versatile computer engineers, capable of adapting to the changing needs of computer and related industry.

MISSION OF THE DEPARTMENT:

To impart quality technical education with skills, knowledge and attitude to succeed in Computer Science & Engineering careers.
To provide knowledge of emerging trends in computer and related industry and foster environment of lifelong learning.
To develop graduate engineers who investigate research, design and find workable solutions to complex engineering problems with awareness and concern for society and environment.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary

environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. **PSO1:** Apply probability, statistics, mathematics through differential and integral calculus, sciences including applications appropriate to the Computer Science & Engineering topics.

2. **PSO2:** Use algorithms, data structures/management, software design, concepts of programming languages and computer organization & architecture.

PROGRAM EDUCATION OBJECTIVE (PEO):

The graduates of Computer Science & Engineering will:

1. Competent professionals with knowledge of Computer Science & Engineering to pursue variety of careers/higher education.
2. Proficient in successfully designing innovative solutions to real life problems that are technically sound, economically viable and socially acceptable.
3. Efficient team leaders, effective communicators and capable of working in multi-disciplinary environment following ethical values.
4. Capable of adapting to new technologies and constantly upgrade their skills with an attitude towards lifelong learning.

Course Title: DATA STRUCTURE AND ALGORITHM

Code: PCC-CS301 & PCC-CS391

YEAR: 2ND

Semester: 1ST SEMESTER

Name of the Faculty: Prof. Sutapa Bhattacharya

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Class Schedule

Dept./Day	Monday	Wednesday	Thursday	Friday
CSE(B)	10:50AM–11:40AM	12:30PM-1:20PM	-------	3:50PM-4:40PM

Lab Schedule

Hours for meeting students:

Monday	14.10 -15.00 pm
Tuesday	14.10 -15.00 pm
Friday	14.10 -15.00 pm
Or by appointment	

i) Course Objective

Students will be capable to demonstrate the basic concept of data structures and implement it through C programming language and compute asymptotic notations of an algorithm to analyze the consumption of resources (time/space).

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
PCC-CS301.1	**Describe** concepts of data structures, pseudo-code and define asymptotic notations to analyze the performance of algorithms. **(BT-LEVEL 2)**	Students will attain 60% marks
PCC-CS301.2	**Implement** various operations onarray and linked list data structures. **(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301.3	**Solve** different problems involving stack and queue data structures as well as problems of recursive nature. **(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301.4	**Utilize** the knowledge of non-linear data structures like trees and graphs to design algorithms for various applications .**(BT-LEVEL 3)**	Students will attain 60% marks
PCC-CS301.5	**Verify** various algorithms for Sorting, Searching and Hashing. **(BT-LEVEL 5)**	Students will attain 60% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

SN	QUESTION	CO
1.	**Define** linear and non-linear data structure.	1
2.	**Describe** briefly about asymptotic notations.	1
3.	How do you **implement** the linked list data structure?	2
4.	How to **solve** the problem of singly linked list?	2
5.	How do you **implement** stack using array and linked list?	3
6.	How do you **implement linear** queue using array and linked list?	3
7.	How do you **implement** linear queue using array and linked list?	3
8.	How to **calculate** Balance factor in AVL tree?	4
9.	How can implement a non-linear data structure?	4
10.	What is the technique to **detect** worst time complexity in quick sort?	5
11.	How to **verify** complexity of sorting algorithm**?**	5

iii) Topic/Unit/Chapter Layout

SN	Unit Mapping	CONTENT	Lecture Required
1	**Unit-I**	**Introduction(2L)** Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.	2

2	**Unit-II**	**Array (2L)** Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.	2
3	**Unit-III**	**Linked List (4L)** Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.	4
4	**Unit-IV**	**Stack and Queue (5L)** Stack and its implementations (using array, using linked list), applications. Queues, circular queue, Priority Queue .Implementation of queue- both linear and circular (using array, using linked list), applications.	5
5	**Unit-V**	**Recursion (2L)** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	2
6	**Unit-VI**	**Nonlinear Data structures Trees (9L)** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only). B+ Tree: definitions, algorithms and analysis	9
7	**Unit-VII**	**Nonlinear Data structures Trees Graphs (6L)**: Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	6
8	**Unit-VIII**	**Sorting (5L)** Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort (concept of max heap, application – priority queue), radix sort and their complexity analysis.	5
9	**Unit-IX**	**Searching (2L)** Sequential search, Binary search and their complexity analysis.	2

10	**Unit-X**	**Hashing (3L)** Hashing functions, collision resolution techniques.	3

iv) Text& Reference books

Text Books:

1) Data Structure and Algorithms , Seymour Lipschutz, TMH Publications
2) Data Structures using C and C++ by Langsam, Tenenbaum, PHI publications

Reference Books:

1) "Fundamentals of Data Structures of C" by Ellis Horowitz, SartajSahni, Susan Anderson-freed

2) Data structures through C language by Samiran Chattopadhyay

v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

* The Internal assessment will be determined through the continuous assessment (CA) which is needed to be submitted 4 times in a semester based on performance of the students assessed as per academic calendar published by the University. The 4 no's of CAs will be based on test/ viva/ quiz/ presentation/seminar/ GD etc. out of which 2 no's preferably would be tests.

Schedule for Continuous Assessment (CA):

CA Description	Schedule
Quiz – 1	As per Institute Academic Calendar
1st Internal Examination	
Quiz – 2	
Assignment	
2nd Internal Examination	

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2
Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Course Target for the university examination = 60% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality

this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1	PO12	PSO1	PSO2
PCC-CS301.1	1	1	--	--	--	--	--	--	--	--	--	--	1	1
PCC-CS301.2	2	2	--	--	2	--	--	--	2	--	--	--	1	1
PCC-CS301.3	2	2	--	--	2	--	--	--	2	--	--	1	1	1
PCC-CS301.4	2	2	--	--	2	--	--	--	2	--	--	1	--	1
PCC-CS301.5	3	3	--	--	2	--	--	--	2	--	--	1	--	1
PCC-CS301	**2**	**2**	--	--	**2**	--	**--**	--	**2**	--	--	**1**	**1**	**1**

1 = courses in which the student will be exposed to a topic
2 = courses in which students will gain competency in that area
3= courses in which students will master that skill

(vii) Assessment Methodology

Outcome	Assessment Tool
PCC-CS301.1	Internal Test, Quiz, University Exam, PPT Presentation
PCC-CS301.2	
PCC-CS301.3	
PCC-CS301.4	
PCC-CS301.5	

(VIII)Weekly Lesson Plan

Week	Lectures	Planned Date	Execution Date	Laboratory	Assignment/Quiz
1	Discussion on course outcome and program outcome **Introduction:** Remembering C programming language. Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.	17/08/2020	17/08/2020	Array	**Assignment1**
	Algorithms and programs, basic idea of pseudo-code. Basic idea of pseudo-code, Algorithm efficiency and analysis **Linear Data Structure: Array-** Insertion, Deletion, Traversing, Row Major, Column Major	19/08/2020	19/08/2020		
	Linear Data Structure: Singly Linked List-Definitions, Operations- Create, Traverse	21/08/2020	21/08/2020		
2	**Singly Linked List**- Insertion ,Deletion Algorithm	24/08/2020	24/08/2020	Singly Linked list	**Assignment1**
	Singly Linked List- Reverse, Traverse(in reverse order),Sorting, Searching Algorithm	26/08/2020	26/08/2020		
	Linear Data Structure: Stack- Definitions, operations (push, pop, traverse). Implementations stack using array and linked list	31/08/2020	31/08/2020		
3	Polish notations Conversion -infix to postfix, Evaluation of postfix	02/09/2020	02/09/2020	Singly Linked list	**Assignment1**
	Principles of recursion – use of stack, differences between recursion and iteration, tail recursion, Applications - The Tower of Hanoi	04/09/2020	04/09/2020		

	Linear queue -(Definition, implementation using array and Linked List)	07/09/2020	07/09/2020		
4	**Circular queue-**(Definition, implementation using array) and Linked List)	09/09/2020	09/09/2020	Stack	**Quiz 1**
	Circular queue-implementation using Linked List	10/09/2020	10/09/2020		
	Priority Queue-- Operations, Algorithms and their analysis.	14/09/2020	14/09/2020		
5	**Nonlinear Data structures- Trees :**Basic terminologies, forest, tree representation (using array and linked list)	20/09/2020	20/09/2020	Linear Queue	**Assignment2**
	Binary trees - binary tree traversal (pre-, in-, post- order)	21/09/2020	21/09/2020		
	Binary search tree-Definition and operations (create, insert, traverse, search)	23/09/2020	23/09/2020		
6	BST Deletion	25/09/2020	25/09/2020	Circular Queue	**Assignment2**
	Expression tree, Threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree	27/09/2020	27/09/2020		
	Height balanced binary tree – AVL tree (insertion, deletion with examples only).	29/09/2020	29/09/2020		
7	Height balanced binary tree – AVL tree (insertion, deletion with examples only)—Continued..	30/09/2020	30/09/2020	Recursion	**Assignment2**
	B- Trees – operations (insertion, deletion with examples only).	05/10/2020	05/10/2020		
	B+- Trees – operations (insertion, deletion with examples only).	07/10/2020	07/10/2020		

8	**Sorting Algorithms :** Bubble sort and its optimizations, Insertion sort and analysis of time complexity	12/10/2020	12/10/2020	BST	**Assignment2**
	Selection sort and analysis of time complexity	02/11/2020	02/11/2020		
	Merge sort and analysis of time complexity	04/11/2020	04/11/2020		
9	Quick sort and analysis of time complexity	09/11/2020	09/11/2020	Sorting	**Quiz 2**
	Heap sort (concept of max heap) and analysis of time complexity	04/12/2020	04/12/2020		
	Shell sort, Radix sort and analysis of time complexity	11/12/2020	11/12/2020		
10	**Searching :** Sequential , Binary search and its time complexity	14/12/2020	14/12/2020	Sorting	**Assignment2**
	Doubly Linked List and its operations	18/12/2020	18/12/2020		
	Circular Linked List and its operations	21/12/2020	21/12/2020		
11	Polynomial and Applications using array and linked list	06/01/2021	06/01/2021	Searching and Double linked list	**Assignment2**
	Non-linear Data structure: Graphs- definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, and complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism)	08/01/2021	08/01/2021		
	Graphs: Definitions (Graph representations storage implementations – adjacency matrix, adjacency list, adjacency multi-list.**,** connectivity – Depth-first search (DFS)	13/01/2021	13/01/2021		

12	Breadth-first search (BFS) – concepts of edges used in DFS and BFS, applications.	15/01/2021	15/01/2021	Circular Linked List	**Quiz 2**
	Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	18/01/2021	18/01/2021		
	Hashing : Hashing functions, collision resolution techniques	20/01/2021	20/01/2021		
13	Eight Queen Puzzle Problem, Sparse Matrix	22/01/2021	22/01/2021	Polynomial Addition ,Multiplication	
	Discussion on Previous Question Paper on WBUT	25/01/2021	25/01/2021		
	Revision Lesson 1	27/01/2021	27/01/2021		
14	Revision Lesson 2	29/01/2021	29/01/2021	Hash table implementation	

B. Daily Lesson Plan (Repeat format for each unit)

UNIT: 1 **Title : <u>Introduction</u>** **Day:1**
CONTENTS 1)Discussion on program outcome ,Introduction to C programming language with example 2)Definethe Data structure 3) Classify Data Structure 4) Explain Algorithm with example
Unit Objectives: Student can able to recall C programming. Broad Objectives of the unit are: 1. Concepts ofusingpointer function and structure. 2.Data structure definition and classifications.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Describe** function, structure? (Level 2) 2. What do you **understand** by Data Structure? (Level 2) 3. **Classify** data structure with examples. (Level 5) 4. **Describe** characteristics of algorithms. (Level 2) 5. **Compare** between linear and non linear data structure. (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. What is the utilization of the following program? main() {

```
int a[]={0,1,2,3,4};
int  k, *p;
for(p=a, k=0;p+k<=a+4; p++, k++)
printf("  %d " , *(p+k));

}
```

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1)…… function of C is used to allocate a block of memory.
a)malloc() b)calloc()
c)free() d)realloc()

UNIT: 2
Title :**Array and Its Operation**
Day:2

CONTENTS

1) Define Array data structure.
2) Insert an element in to Array.
3) Delete an element from Array.
4)Memory representation: row major and column major

Topic/Unit/Chapter Objectives: Student can able to understand about linear data structure.
Broad Objectives of the chapter/topic are:
1. Concepts of linear data structure.
2. Implementthe algorithm to insert and deletean element from array.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Describe** array? (Level 1)
2. **Explain**thealgorithm for insert and delete operation on array data structure. (Level 4)
3. **Explain**with example on row major and column major. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1) Let A be a two dimensional array declared as A [1….10][1….15] of integer. Assuming that each integer takes one memory locations the array is stored in row major order and the first element of the array is stored at location 100, what is the address of the element A[i][j]?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1) The number of elements n is called the length ---------- of the array.
a) Upper Bound c) Lower Bound
b) Size d)Variable

2) Arrays are best data structures
a) for relatively permanent collections of data
b) for the size of the structure and the data in the structure are constantly changing
c) for both of above situation
d) for none of above situation

LABORATORY EXPERIMENT: related to the Topic objective and outcome
1) Insert one element into array and delete one element from array.

UNIT: 3
Title:**SingleLinked List**
Day:3

1) Definition of Linked list and its types.
2) Representation of linked list.
3)Operationsof Single Linkedlist(Create,Traverse,Insertion)

Unit Objectives: Student can able to understand about single linked list.
Broad Objectives of the chapter/topic are:
1. Student can able to **understand** linked list. (Level 2)

2. How to **create** a single linked list? (Level 6) 3. **Compare**between array and linked list. (Level 4)
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Explain**an algorithm for Creation of single linked list. (Level 4) 2.**Explain** the algorithm of Traversal of single linked list .(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Draw a single link list which has 5 nodes.
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1) Implement the following operation of linked list a)Create list b)Traversal c)Insert first d)insert last e)Insert Anywhere

UNIT: 3 Title: **Single Linked List** **Day:4**
CONTENTS OperationsofSingleLinkedlist.(Deletion,Searching,Sorting, Reversing)
Unit Objectives: Student can able to **understand** about operation of single linked list Broad Objectives of the chapter/topic are: 1. Student can able to **understand** single linked list. (Level 2) 2. Howto**explain** the algorithm to Insert and Delete an element from a single linked list? (Level 4)
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Explain** an algorithm for Insertion and deletion of single linked list. (Level 4) 2. **Explain** the algorithm of searching the element from single linked list. (Level 4) 3. **Explain** an algorithm for Sorting of single linked list. (Level 4) 4. **Explain** to Reverse single linked list. (Level 4) 5. **Explain** to traverse linked list in reverse order. (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Write an algorithm of finding the middle node form a single linked list. 2. Binary search is possible or not to find a node from a linked list.
LABORATORY EXPERIMENT: related to the Topic objective and outcome. 1) Implement the following operation of single linked list a)Delete first b)delete last c)Delete anywhere d)Sorting e)Reversing f)Traverse(in reverse order) g)Search the element from list

UNIT:3 Title : Linear Data Structure(Stack) **Day:5**
CONTENTS 1)STACK-Definitions, operations 3)Implementations using array 4)Implementations using linked list 5)Application of Stack 6)Arithmetic notation(prefix, postfix, infix)
Unit Objectives: Student can able to **understand** about operation of stack Broad Objectives of the chapter/topic are: 1. Able to **understand** about Stack Data Structure 2. Student can able to **understand** stack operation (PUSH and POP) 3. Able to understand about how to represent prefix, postfix, and infix notation

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. What do you **understand** by push and pop operation in Stack? (Level 2)
2. **Finding**the over flow and under flow condition for Stack? (Level 4)
3. **Explaining** the real life example of stack? (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. A single array A[1….MAXSIZE] is used to implement stacks. Two stacks grow from opposite ends of the array. Variable Top1 and Top2 (Top1<Top2) point to the location of the topmost element in each stacks .if the space is to be used efficiently .so what is the STACK FULL condition?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. Stack is also called as
   a) Last in first out
   b) First in last out
   c) Last in last out
   d) First in first out

2. Inserting an item into the stack when stack is not full is called ……. Operation and deletion of item form the stack, when stack is not empty is called ……..operation.
   a) push, pop
   b) pop, push
   c)insert, delete
   d) delete, insert

LABORATORY EXPERIMENT: related to the Topic objective and outcome.

1. Implement Stack Operation in C programming language using array and linked list.

UNIT: 4
Title : Linear Data Structure(STACK)
Day:5

CONTENTS

1)Convert infix to post fix expression(with examples)
2)Evaluation of post fix expression

Topic/Unit/Chapter Objectives: Student can able to understand stack data structure
Broad Objectives of the chapter/topic are:

1. Student can able to understand how to convert infix to post fix expression
2. Student can able to understand how to evaluate post fix expression

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Describe** polish notation? (Level 2)
2. What do you **understand** by reverse polish notation? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Translating the following infix expression into post fix expression
   A+(B*C – (D/(E+F))*G)*H
2. Evaluate the following Post fix expression (with single digit operand).
   8 2 3 ^ / 2 3 * + 5 1 * -
   Identify the Top two elements of the stack after the first * (operator) is evaluated.

UNIT: 5
Title : Recursion
Day:6

CONTENTS

1) Recursion.
2) Types of Recursion.
3) Tower of Hanoi.
4) Eight Queen Puzzle Problem.

Unit Objectives: Student can able to **understand** about recursion and its classification.
Broad Objectives of the chapter/topic are:

1. Student can able to understand How to apply recursion technique in real life application.
2. Student can able to understand how to draw recursive tree.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Compare** between Recursion Vs Iteration. (Level 4)
2. **Describe** Tail recursion? (Level 2)
1. **Explain** the algorithm of Tower of Hanoi. (Level 4)
2.**Outline**a recursive Tree for Tower of Hanoi for n =3. (Level 4)
3. **Explain** the algorithm of 8 queen puzzle problem. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

```
1) int ABC( int n  , int  m )
     {
          if(n==0)
           return(m+1);
else  if (m==0 &&n>0)
     return  ABC(n-1,1);
else   return   ABC(n-1,ABC(n,m-1));
     }
```

2) Draw a recursive Tree for Tower of Hanoi for n =4

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
NA

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Construct C programming language for GCD of two number recursive techniques.
2. Construct C programming language for Fibonacci series of two number using recursion.
3. Construct C programming language for tower of Hanoi in recursive technique.
4. Construct C programming language for eight queen puzzle problem in recursive technique.

UNIT: 4
Title : Linear Data Structure(Linear QUEUE)
Day:7

CONTENTS

1)Linear Queue-Definitions
2)Operation of Queue(insert at front ,delete at rear)
3)Implementation using array and linked list

Topic/Unit/Chapter Objectives: Student can able to understand queue data structure
Broad Objectives of the chapter/topic are:
1. Able to understand about linear queue Data Structure
2. Student can able to understand linear queue operation (insert at front ,delete at rear)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Discuss** the operation in queue? (Level 2)
2. **Explain** the over flow and under flow condition for Queue data structure? (Level 4)
3.Whatdo you **understand by** the real life example of queue? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. What is the difficulties of linear queue and how overcome it?

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. Which data structure allows deleting data elements front and inserting at rear?

A. Stack
B. Queues
C. Tree
D. Linked List

2. A ..... is a data structure that organizes data similar to a line in the supermarket, where the first one in line is the first one out.

A. Queue
B. Stacks
C. Both of them
D. Neither of them

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement Linear Queue Operation in C programming language using array and linked list.

UNIT:4

Title Linear Data Structure(Circular QUEUE)

Day:7

CONTENTS

1)CIRCULAR Queue
2)Operation of CURCULAR Queue(insert at front ,delete at rear ,traverse)
3)Implementation using array and linked list

Unit Objectives: Student can able to understand Circular queue data structure

Broad Objectives of the chapter/topic are:

1. Able to understand about circular queue Data Structure
2. Student can able to understand circular queue operation (insert at front ,delete at rear)
3. Student can able to know how it use full in real life.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Discuss** the operation in Circular queue? (Level 2)
2. **Describe** the over flow and under flow condition for Circular Queue data structure? (Level 2)
3. **Outline** the real life example of queue. (Level 4

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1.Take a circular queue **CQ** which is allocated 5 memory cells starting from **CQ[0] to CQ[4].**Perform the following operations one by one on it and write down **front** and **rear** value in each and every step.

(i)Insert 23,12,45,33 (ii) Delete two elements (iii) Insert 43, 56 (iv) Delete one element (v) Insert 10

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. Let queue be a circular array having size 5. Now front=5 and rear=5 indicates that the queue----------

(a)is empty (b)is full (c) contains only one element (d)none of these

2. A linear list in which elements can be added or removed at either end but not in the middle, is known as

(a) Queue (b) Deque (c) Stack (d) Tree

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement Circular Queue Operation in C programming language using array

UNIT: 3

Title : Linear Data Structure(Circular Linked List)

Day:8

CONTENTS

1) Circular Linkedlist. (Definition)
2) Operation of circular linked list.
3) Double Linkedlist.(Definition)
4) Operation of Double linked list (Create,Traverse)

Topic/Unit/Chapter Objectives: Student can able to understand Operation of De Queue data structure

Broad Objectives of the chapter/topic are:

1. Student can able to **understand** Circular linked list.
2. How to create, traverse a circular linked list.
3. How to Insert and Delete an element from a circular linked list?
4. Student can able to **understand** double linked list.
5. **How** to Create and traverse the double linked list?
6. Write down the advantages of doubly linked list over singly linked list.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Explain** an algorithm for Creation and traversal of Circular linked list. (Level 4)
2. **Explain** the algorithm for insertion and deletion of Circular linked list. (Level 4)
3.**Explain**an algorithm for Creation and traversal (forward and back word direction) of Double linked list. (Level 4)
4. **Compare** between singly linked list and doubly linked list. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1) Draw circular linked lists which have 5 nodes.
2) Draw a double linked list which has 5 nodes.

QUIZ: related to Topic objective and outcome (new quiz with real world examples)

1. The disadvantage in using a circular linked list is.....
   A. It is possible to get into infinite loop B. Last node points to first node.
   C. Time consuming D. Requires more memory space

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement the following operation of circular linked list

a)Create b)Traverse c)Insert first d)insert last
e)Delete first f)delete last

TOPIC/UNIT/ CHAPTER: 3
Title: Doubly linked list
Day:6

CONTENTS

Operations of Doubly linked list(Insert, Delete)

Topic/Unit/Chapter Objectives: Student can able to **understand** about Circular linked list and its operation.
Broad Objectives of the chapter/topic are:
1. How to Insert and Delete an element from a double linked list.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Explain** an algorithm for insertion of Double linked list. (Level 4)
2. **Explain** an algorithm for deletion of Double linked list. (Level 4)

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1)Implement the following operation of double linked list
a)Create b)Traverse
c)Insert first d)insert last
e)Insert at specified position f)Delete first g)Delete at specified position
h)delete last

UNIT: 3
Title: Linear Data Structure(Application of linked list)
Day:7

CONTENTS

1.Representation of Polynomial expression using array
2. Representation of Polynomial expression using linked list
3.Polynomial addition using linked list
4.Polynomial multiplication using linked list

Topic/Unit/Chapter Objectives: Student can able to **understand** about double linked list and its operation.
Broad Objectives of the chapter/topic are:

1. Student can able to **understand** polynomial addition.
2. Student can able to **understand** polynomial multiplication.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Explain** an algorithm for Polynomial addition. (Level 4) 2. **Explain** an algorithm for Polynomial multiplication. (Level 4)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1. Implement the following operation of linked list a. Polynomial addition. b. Polynomial multiplication

UNIT: 6 Title : NON -Linear Data Structure(Tree) **Day:8**
CONTENTS 1.Define Tree and its terminology 2.Definition of binary tree with examples 3.Types of Tree(complete , strictly , extended) 4.Expression Tree
Topic/Unit/Chapter Objectives: Student can able to **understand** about operation of double linked list Broad Objectives of the chapter/topic are: 1. Student can able to **understand** Tree. 2.Concepts of binary tree
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. What do you **understand** by complete binary tree? (Level 2) 2. **Describe** the following terms : Degree , terminal ,root node, height , child (Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria NA 1) Prove that $n_o = n_2+1$ where no is the terminal and n2 is non terminal node degree 2.
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.In array representation of binary tree, if the index number of a child node is 6 then the index number of its parent node is (a) 2 (b) 3 (c) 4 (d) 5

UNIT: 6 Title : NON -Linear Data Structure(BST) **Day:9**
CONTENTS 1.Definitions of BST 2. Construct BST from in order, pre order and post order traversal. 3.BST operations using algorithms[Create,Traverse(Recursive and non-recursive)]
Topic/Unit/Chapter Objectives: Student can able to **understand** about application of link list Broad Objectives of the chapter/topic are: 1. Student can able to know the operation of binary search tree. 2. Student can able to know how to construct BST from pre order, post order and in order.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1**. Explain** the Algorithm for finding number of node from a BST.(Level 4) 2. **Explain** an algorithm for finding in order predecessor of root node from non- empty BST.(Level 4) 3. **Describe** BST. (Level 2) 4. **Write** an algorithm for create and traverse BST. (Level 1)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Write an algorithm inorder traversal of BST in non-recursive way.

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement the following BST Operation
   a)Create b)Traverse(preorder, in order, post order in recursive way)
   c)Traverse(preorder, in order in non- recursive way)

UNIT: 6
Title : NON -Linear Data Structure(BST)
Day:10

CONTENTS

BST operations using algorithms(Insertion)

Topic/Unit/Chapter Objectives: Student can able to **understand** about nonlinear data structure like Tree and its terminology.
Broad Objectives of the chapter/topic are:
1.How to insert a node in recursive as well as non-recursive way in a BST?

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Explain** the Algorithm to insert a node in a BST.(Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1.Insert following elements in BST:44,12,34,78,90,6,22,87

1. Implement the following BST Operation
   a) Insert the node using recursive and non-recursive way

UNIT: 6
Title : NON -Linear Data Structure(BST)
Day:11

CONTENTS

BST operations using algorithms(Deletion)

Topic/Unit/Chapter Objectives: Explanation of operation of binary search tree.
Broad Objectives of the chapter/topic are:
1**. Able to understand** the Algorithm for deleting node from a BST.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1**. Explain** the Algorithm for deleting node from a BST.(Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1. Write an Algorithm for finding in order successor of root node.

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1. Implement the following BST Operation
   Delete the node

UNIT: 6
Title : NON -Linear Data Structure(Threaded Binary Tree)
Day:12

CONTENTS

1.Threaded Binary Tree
2. Classification of Threaded Binary Tree.
3. Traversal of Threaded Binary tree.

Topic/Unit/Chapter Objectives: Explanation of operation of threaded binary tree.
Broad Objectives of the chapter/topic are:.
1. Student can able to **understand** about threaded binary tree.
2. Student can able to know the classification of Threaded Binary tree

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. Whatdo you **understand** by Threaded Binary tree? (Level 2)
2. **Implement**an algorithm for In order Traverse of Threaded Binary Tree? (Level 3)
3. **Compare** the efficiency between threaded binary tree and BST? (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Draw a Full Threaded Binary Tree which has seven nodes.

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1.If a binary tree is threaded for inorder traversal a right NULL link of any node is replaced by the address of its
(a) successor (b) predecessor (c)root (d)own

UNIT: 6
Title:NON -Linear Data Structure (AVL tree)
Day:13

CONTENTS

1. AVL Tree-Definitions
2. Balance Factor
3. Operation of AVL Tree(Single rotations, Double rotations)

Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure than binary search tree.
Broad Objectives of the chapter/topic are:
1. Student can able to **understand** about AVL tree.
2. Student can able to know the Operation of AVL tree.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. What do you **understand** by AVL tree? (Level 2)
2. **Complete** the full form of AVL? (Level 3)
3. **Compare** BST and AVL tree.(Level 4)
4. What do you **understand** by pivot node in AVL tree? (Level 2)
5. What do you **understand** by Balance factor? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Draw all the general form of rotation for insert in an AVL tree.
2. Insert the following keys in AVL tree and show the rotations.
   8, 12, 9, 11, 7, 6,66,2,1,44

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
12. A binary search tree whose left subtree and right subtree differ in hight by at most 1 unit is called ……
A. AVL tree B. Red-black tree
C. Lemma tree D. None of the above

TOPIC/UNIT/ CHAPTER: 6
Title : NON -Linear Data Structure(AVL Tree)
Day:14

CONTENTS

Explain Ro R1 R-1 rotation for delete an element

Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure than binary search tree. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** about rotation for delete a node from AVL tree
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Evaluate** the time complexity of AVL Tree? (Level 5)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw all the general form of rotation for delete an element from an AVL tree

TOPIC/UNIT/ CHAPTER: 6 Title: NON -Linear Data Structure(B Tree) Date: 27/10/21 Day: Wesnesday
CONTENTS **1.** Explain B Tree. **2.** Operation of B tree with example
Topic/Unit/Chapter Objectives: Explanation of deletion of element form B tree. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** about B Tree. 2. Student can able to **know** the Operation of B tree.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1. **Describe** B Tree tree?(Level 2) 2.**Discuss** the element is to be insert into B- Tree? .(Level 2) 3. **Describe** an element is to be Deleted from B- Tree? (Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Insert The following element in to B Tree of order 4 : 4,7,1,4,22,9,11,55,33,88,77 2. Delete The following element in to B Tree of order 4 : 4,7,1,4,22,9,11,55,33,88,77

UNIT: 1 Title : **Algorithm efficiency and analysisand Sorting** **Day:15**
CONTENTS 1) Define asymptotic notation. 2) Demonstrate the classification of asymptotic notation.
Topic/Unit/Chapter Objectives: Explanation of more efficient Data structure Broad Objectives of the chapter/topic are: 1. Student can able to relate about Big O, Theta and Omeganotation. 2. Student can able to find complexity of an algorithm.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Explain** Big O , Theta, Omega notation.(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Prove that $3n^2 + 7n = O(n^2)$ 2. Prove that $3n^2 + 7n = \Omega(n^2)$ 3. Prove that $3n^2 + 7n = \Theta(n^2)$ 4. Short notes on asymptotic notations.
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.Which of the following shows the correct relationship among some of the more common computing times for algorithm?

(a)O (log n) <O (n) <O (n*log n) <O (2^n) <O (n^2)
(b)O (n) <O (log n) <O (n* log n) <O (2^n) <O (n^2)
(c)O (n) < O (log n) <O (n* log n) <O (n^2) <O (2^n)
(d) O (log n) <O (n) <O (n*log n) <O (n^2) <O (2^n)

UNIT: 9
Title : Searching
Day:16

CONTENTS

1)Searching- Linear Search, Binary search, Interpolation search
2)Time complexity of Linear Search, Binary search, Interpolation search

Topic/Unit/Chapter Objectives: Explanation of Sorting
Broad Objectives of the chapter/topic are:

1. Student can able to understand about linear searching and its time complexity
2. Student can able to understand about binary searching and its time complexity
3. Student can able to understand about interpolation searching and its time complexity

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Describe** searching? (Level 2)
2. **Compare**Best, average and worst case time complexity of linear search. (Level 4)
3.**Compare**Best, average and worst case time complexity of binary search. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1)Search an smallest element from a matrix

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1.The worst case time complexity of binary search is
(a)O (n^2) (b) O (n) (c) O (log n) (d) O (n*log n)

LABORATORY EXPERIMENT: related to the Topic objective and outcome

1) Implement linear search, binary search and interpolation search in C programming language

UNIT: 9
Title :Sorting
Day:17

CONTENTS

1. Bubble, Insertion sort
2. Time Complexity Analysis

Topic/Unit/Chapter Objectives: Student can able to understand about algorithm and how analyze time complexity of an algorithm.
Broad Objectives of the chapter/topic are:
1. **Explain**Bubble, Insertion sort algorithm. (Level 4)
2. **Explain** the time complexity analysis. (Level 4)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):

1. **Classify** the best, worst and average case time complexity of bubble sort. (Level 2)
2. **Classify** the best ,worst and average case time complexity of insertion sort ?(Level 2)
3. **Describe** modified bubble sort?(Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1.Draw the step of Bubble sort for the following data element : 5,1,7,2,4,8
2.Draw the step of Insertion sort for the following data element : 5,1,7,2,4,8

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1.The best case time complexity of the bubble sort technique is

(a) O (n) (b)O(n^2) (c)O(nlogn) (d)O(logn) 2.The worst case time complexity of the insertion sort technique is (a) O (n) (b)O(n^2) (c)O(nlogn) (d)O(logn)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1. Implement program for following sorting algorithm a)Bubble sort. b)Insertion sort

UNIT: 8 Title: Sorting **Day:18**
CONTENTS 1.Selection Sort, Merge sort 2. Time Complexity Analysis
Topic/Unit/Chapter Objectives: Student can able to understand about searching algorithm. Broad Objectives of the chapter/topic are: 1. **Explain** selection and merge sort algorithm. (Level 4) 2. **Explain** the time complexity analysis. (Level 4)
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): **1.Classify** the best ,worst and average case time complexity of selection sort ?(Level 2) 2.**Classify** the best ,worst and average case time complexity of selection sort ?(Level 2)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Selection sort for the following data element : 15,1,70,2,41,87 2.Draw the step of Insertion sort for the following data element : 5,11,7,12,47,8
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The best case time complexity of the merge sort technique is (a) O (n) (b)O(n^2) (c)O(nlogn) (d)O(logn)
LABORATORY EXPERIMENT: related to the Topic objective and outcome 2. Implement program for following sorting algorithm a)Selection sort a)Merge sort

UNIT: 8 Title :Sorting **Day:19**
CONTENTS 1.Quick sort algorithm and time complexity analysis
Topic/Unit/Chapter Objectives: student can able to understand about sorting and its time complexity Broad Objectives of the chapter/topic are: 1. Student can able to **understand** the algorithm of Quick sort 2. student can able to **understand** Time complexity of Quick sort
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Compare** the best ,worst and average case time complexity of Quick Sort ?(Level 4) 2. **Find** the strategy which is used to implement Quick sort?(Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1. Draw the step of Quick sort for the following data element : 5,1,7,2,4,8,9,11,6
QUIZ: related to Topic objective and outcome (new quiz with real world examples) 1.The best case time complexity of the quick sort technique is (a) O (n) (b)O(n^2) (c)O(nlogn) (d)O(logn)

LABORATORY EXPERIMENT: related to the Topic objective and outcome 1.Implement program for following sorting algorithm a)Quick sort

UNIT:8 Title: Sorting **Day:20**
CONTENTS **1.** Shell sort and Radix sort **2.** Time complexity analysis
Topic/Unit/Chapter Objectives: student can able to understand about more efficient sorting Algorithm and its time complexity. Broad Objectives of the chapter/topic are: 1. Student can able to **understand** Shellsort. **2.** Student can able to **understand** Radix sort.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): **1. Implement** the algorithm of Shell Sort. **2. Implement** the algorithm of Radix Sort?
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Shell sort for the following data element : 511,100,79,24,402,801,319,101,604.666,222,873,471,902,184 2.Draw the step of Radix sort for the following data element : 511,100,79,24,402,801,319,101,604.666,222,873,471,902,184
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1.Implement program for following sorting algorithm a)Shell sort b)Radix sort

UNIT: 8 Title Sorting **Day:21**
CONTENTS 1)Algorithm for Heap sort 2)Construction of Heap tree 3)Time complexity analysis
Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of merge sort. Broad Objectives of the chapter/topic are: 3. Student can able to **understand** the algorithm of heap sort
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): 1.**Compare**the best ,worst and average case time complexity of Heap Sort ?(Level 4) 2. **Explain** the Heap sort algorithm? (Level 4)
HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria 1.Draw the step of Heap sort for the following data element : 5,1,7,2,4,8,9,11,6
LABORATORY EXPERIMENT: related to the Topic objective and outcome 1.Implement program for following sorting algorithm a)Heap sort

UNIT: 5 Title : NON -Linear Data Structure(Graph) **Day:22**

CONTENTS

1)Graph definition
2)Types of Graph: Directed, undirected, complete graph
3)Definitions- weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism

Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of Heap sort.
Broad Objectives of the chapter/topic are:
1.Able to understand definition of graph.
2.Able to learn deferent terminology of graph
3. Able to understand different types of graph?

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. **Describe** the definition of graph? (Level 2)
2. **Identify** directed or undirected graph?(Level 4)
3. **Describe** the definition of different types of graphs? (Level 2)
4. **Identify** isomorphism of graph? (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1.Drawan un directed graph which have 8 vertex and represent it using array.

QUIZ: related to Topic objective and outcome (new quiz with real world examples)
1.The vertex, removal of which makes a graph disconnected, is called
(a)pendant vertex (b)bridge (c)articulation point (d)none of these

UNIT: 4
Title : NON -Linear Data Structure(Graph)
Day:23

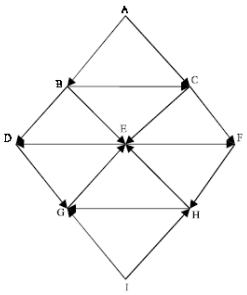
CONTENTS

1) Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list.
2)Graph Traversal-BFS and DFS (algorithms with examples)

Topic/Unit/Chapter Objectives: student can know the algorithm and complexity analysis of Radix sort.
Broad Objectives of the chapter/topic are:
1. Able to understand adjacency matrix and list.
2. Able to understand BFS and DFS traversal of graphs
3. Comparison study about BFS and DFS

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1. How to **construct** adjacency matrix of a graph? (Level 6)
2. How to **construct** a graph using linked list? (Level 6)
3. Explain DFS with example. (Level 4)
4. Describe the data structure need to develop DFS? (Level 2)
5. Explain BFS with example. (Level 4)
6. Describe the data structure need to develop BFS? (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria
1. Traverse the following Graph using DFS and BFS



TOPIC/UNIT/ CHAPTER: 5
Title : NON -Linear Data Structure(Graph)
Day:24

CONTENTS

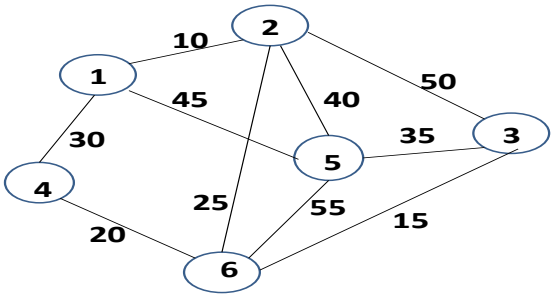
1)Spanning Tree
2) Minimum Spanning Tree
3)Prim's algorithm.

Topic/Unit/Chapter Objectives: how to define graph and how to represent graph
Broad Objectives of the chapter/topic are:
1.Able to know about spanning tree.
2.Able to understand minimum spanning tree.
3.Able to know about Prim's algorithm with example.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1.**Describe**minimum spanning tree? (Level 2)
2. **Explain** prim's algorithm with example. (Level 4)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Using Prim's Algorithm to find the minimum spanning tree (MST) of the given graph.



UNIT: 10
Title :**Hashing**
Day:25

CONTENTS

1)Definition of Hashing
2)Different types of Hashing
3)Collision Resolution techniques

Topic/Unit/Chapter Objectives: student can able to relate how sparse matrix can utilize for space optimization in memory
Broad Objectives of the chapter/topic are:
1. Student can able to understand hashing.
2. Student can able to understand how many types of hashing techniques are there?
3. Student can able to understand about collision resolution techniques.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy):
1.**Describe**Hashing .(Level 2)
2.**Describe** the utilization of different types of hashing?(Level 2)
3.**Describe**different types of collision resolution techniques. (Level 2)

HOME WORK: related to Topic objective and outcome as expressed in terms of indicators/criteria

1. Calculate load factor.

TOPIC/UNIT/ CHAPTER:
Title **:WBUT QUESTION ANSWER SESSION**
Day:26

CONTENTS
Last 5 years university question paper.
Topic/Unit/Chapter Objectives: student can able to relate how sparse matrix can utilize for space optimization in memory Broad Objectives of the chapter/topic are: 1. They are able to explain to analyze, investigate and evaluate. 2. They are able to judge how to apply theory.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities (Performance Criteria/Indicators with Levels of Bloom's Taxonomy): **Discussion most of the university questions in last 5 years.**

a) Teaching Strategy/Method (describe instructional methods, usage of ICT, efficient and engaging instructions and display the best practices on institutional website)

1) To give Assignments
2) By giving more interesting examples
3) Giving lectures in power point presentation

b) Strategy to support weak students

1) To engage the weak students in habit of studying, I give him some easy questions in regular basis.
2) Some weak students also have a problem that they forget what they learn. In my class I always give some tips on how to recall and how to write systematically.
3) Weak students need special attention even after college hours. I always give some extra hours to a weak student.

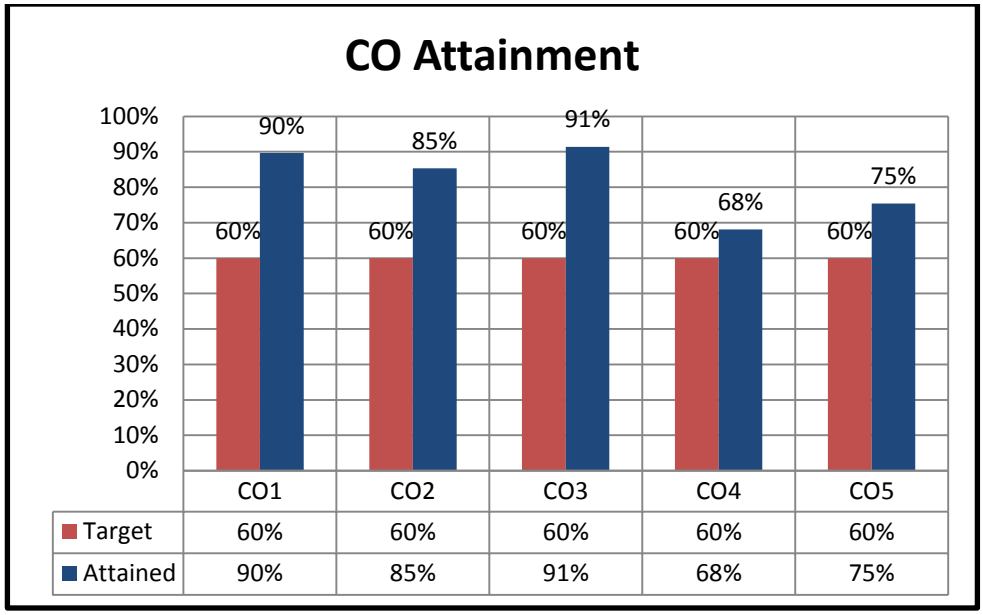
c) Strategy to encourage bright students

1) Have an extra challenge ready that allows the student to go deeper into the subject, learn a little more, or apply a skill he has just learned in a new way.
2) Some students are engaged with the final year students for their final project.

d) Efforts to keep students engaged

1) Regular basis Home Work.
2) 5-10 minutes spend in an every class for question answer session.
3) Quiz in regular basis.
4) Some technical assignments in group wise.

e) Analysis of Students performance in the course (internal) (labs, seminars, tests, assignments, quiz, exam etc)



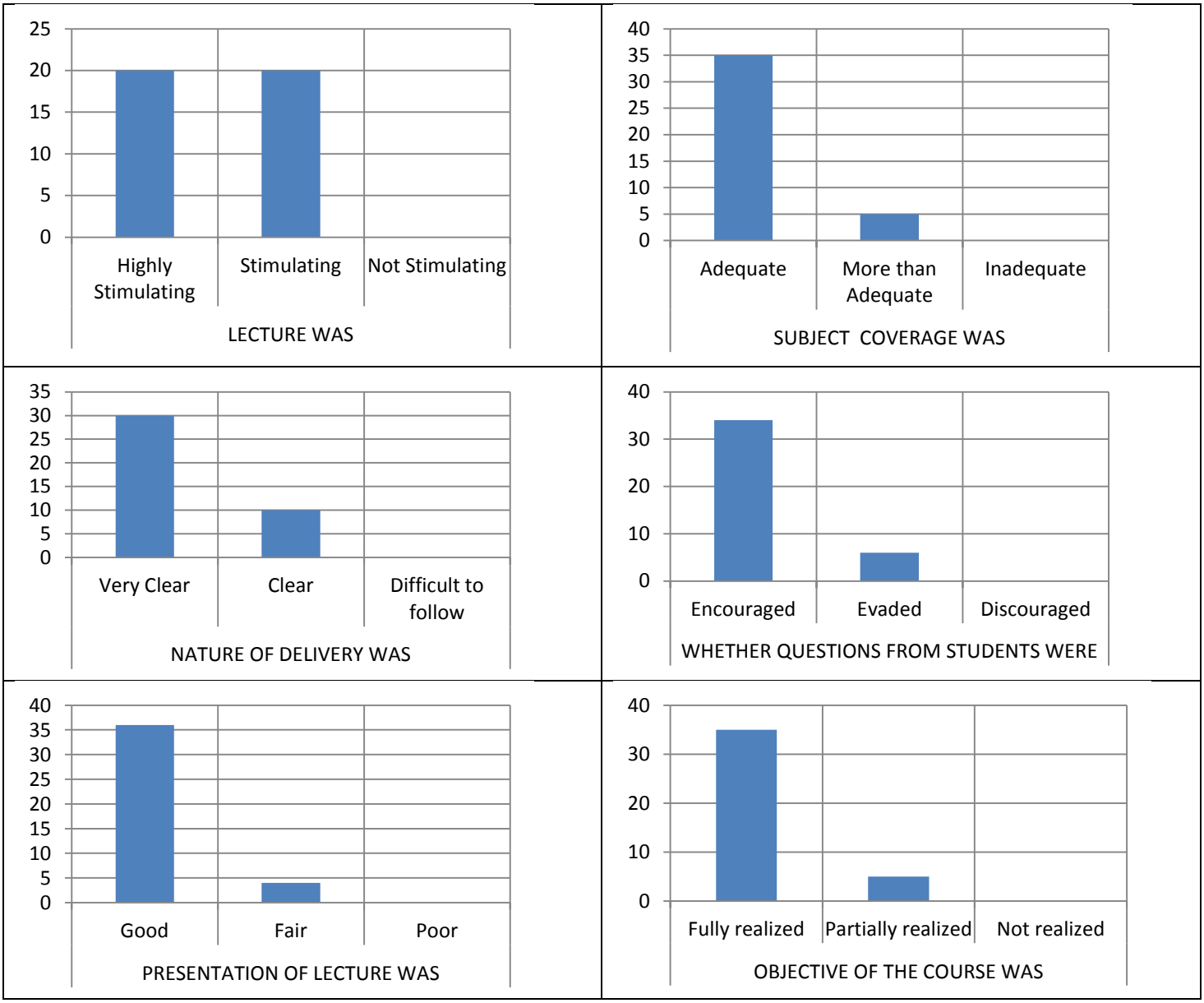
Comments:

- 90% students have attained the set target of 60% marks for CO1
- 85% students have attained the set target of 60% marks for CO2
- 91% students have attained the set target of 60% marks for CO3
- 68% students have attained the set target of 60% marks for CO4
- 75% students have attained the set target of 60% marks for CO5

f) Analysis of Students performance in the course (university results)

	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME
University Result	**60%**	**58**	**36**	**62%**

g)Student Feedback



h)Teacher Self-Assessment (at the completion of course)

At the completion of course I have understood that CO1 and CO5has reached the attainment levels but not satisfactorily.That'swhy more assignments and quiz questions should be provided.

i) Recommendations/Suggestions for improvement by faculty

Text books are available in the library but in previous edition. That's why books should be updated.

Paper Code: PC-CS 301

FACULTY NAME :**Ms.SUTAPA BHATTACHARYA** **YEAR: 2020**

STREAM: **B.TECH[CSE]** YEAR: **2ND** SEMESTER: **IST** SECTION: **B**

SN	ROLL NO.	NAME	ATTENDANCE [5 MARKS]		MARKS IN INTERNAL EXAM[15 MARKS]			QUIZ [10 MARKS] MARKS=[((I+II)/30)*100]/10			TOTAL [30 MARKS]
			TOTAL %	MARKS	I	II	AVG	Q-I [15]	Q-II [15]	MARKS	
1	11900119049	PAWAN KUMAR SAH	89	5	27	28	14	8	13	7	26
2	11900119050	AJAY SHIL	75	4	27	28	14	14	11	8	26
3	11900119051	SOMESH KUMAR THAKUR	95	5	27	27	14	9	8	6	25
4	11900119052	AMAN RAZA	76	4	28	27	14	13	13	9	27
5	11900119053	ABHILASHA GUPTA	76	5	17	27	11	13	7	7	23
6	11900119054	PANAKJ KUMAR	80	3	24	20	11	11	13	8	22
7	11900119055	ALOK KUMAR	95	4	23	18	10	9	7	5	19
8	11900119056	PIYUSH PRAKASH	95	5	23	29	13	10	14	8	26
9	11900119057	ANOUSHKA GHOSH	95	5	26	29	14	9	7	5	24
10	11900119058	RAUSHAN KUMAR	95	5	29	28	14	14	10	8	27
11	11900119059	DIVYANGANA GANGULY	75	5	27	28	14	13	13	9	28
12	11900119060	SUMIT KUMAR	82	4	27	22	12	13	8	7	23
13	11900119061	AGNIVA SENGUPTA	96	5	27	26	13	15	14	10	28
14	11900119062	ASHUTOSH SHARAN SINGH	80	4	23	29	13	8	7	5	22

15	11900119063	SANGITA MALLICK	85	4	19	22	10	10	6	5	19
16	11900119064	BIKASH KUMAR SINGH	75	5	10	22	8	7	6	4	17
17	11900119065	AABHASH JAIN	95	5	24	26	13	14	10	8	26
18	11900119066	CHINMOY BISWAS	85	4	25	21	12	15	10	8	24
19	11900119067	DEEPSIKHA ROY	85	4	23	24	12	12	8	7	23
20	11900119068	AKSHAT KUMAR GUPTA	96	5	9	22	8	11	11	7	20
21	11900119069	HARSH VARDHAN	89	4	21	20	10	12	8	7	21
22	11900119070	SATISH KUMAR	75	5	29	28	14	10	14	8	27
23	11900119071	RIYA CHATTERJEE	95	5	25	24	12	12	14	9	26
24	11900119072	ROHAN MUKHERJEE	10	3	AB	AB	AB	AB	AB	AB	12
25	11900119073	SOUMYA MAJUMDER	76	5	16	22	10	14	10	8	23
26	11900119074	SHREYA	80	4	26	9	9	10	11	7	20
27	11900119075	ADITYA SINGH	95	5	28	25	13	15	10	8	26
28	11900119076	TANIBHA MAJUMDER	95	4	29	17	12	7	7	5	21
29	11900119077	SAUMYODIP CHATTERJEE	95	5	25	15	10	11	6	6	21
30	11900119078	SAYANTAN BHOWMICK	95	5	24	24	12	13	10	8	25
31	11900119079	TANIYA GHOSH	75	4	24	29	13	15	10	8	25
32	11900119080	RITIKA MUKHERJEE	82	4	15	24	10	9	12	7	21

33	11900119081	SABARNA BISWAS	96	5	21	18	10	8	5	5	20
34	11900119082	SHIVAM TALUKDAR	80	3	10	11	5	12	8	7	15
35	11900119083	DEBASMITA TALUKDAR	85	5	14	21	9	10	5	5	19
36	11900119084	TANMAY SEN	75	5	10	9	5	9	11	7	17
37	11900119085	SAYANBRATA SAHA	95	3	12	13	6	11	6	6	15
38	11900119086	KESHAV KUMAR	85	5	17	29	12	15	13	9	26
39	11900119087	ASHISH GUPTA	85	4	10	29	10	15	10	8	22
40	11900119088	KESHAV AGARWAL	96	3	14	18	8	9	8	6	17
41	11900119089	SUBHADIP SARKAR	89	3	10	11	5	8	5	4	12
42	11900119090	UTPAL KUMAR	75	4	12	21	8	15	8	8	20
43	11900119091	PRITAM PAUL	95	4	17	9	7	10	5	5	16
44	11900119092	KUNDAN KUMAR	76	3	10	13	6	9	8	6	15
45	11900119093	AMISHA SINGH	76	4	14	17	8	10	14	8	20
46	11900120092	**SubhankarSaha**	95	4	10	9	5	9	8	6	15
47	11900120093	**BishalSaha**	75	4	12	13	6	10	11	7	17
48	11900120094	**Pinki Deb**	82	4	17	17	9	13	12	8	21
49	11900120095	**SristiTalapatra**	96	5	17	14	8	14	9	8	21
50	11900120096	**Didhitiraj Chakraborty**	80	5	17	17	9	11	5	5	19
51	11900120097	**Ushna Roy**	89	5	27	28	14	8	13	7	26
52	11900120098	**Sandip Deb**	75	4	27	28	14	14	11	8	26
53	11900120099	**Indranil Roy**	95	5	27	27	14	9	8	6	25

54	11900120100	**Debopriyo Sarkar**	76	4	28	27	14	13	13	9	27
55	11900120101	**Nayan Kumar Sinha**	76	5	17	27	11	13	7	7	23
56	11900120102	**Tuhin Ghosh**	80	3	24	20	11	11	13	8	22
57	11900120103	**Arnab Saha**	95	4	23	18	10	9	7	5	19
58	11900120104	**Ishani Singh**	95	5	23	29	13	10	14	8	26

Siliguri Institute of Technology
LIST OF PRACTICAL'S
Paper Name: Data Structure& Algorithm
Paper Code PCC- CS 391

SN	Details of Experiment(s)	Hours Allotted
1	Implement the following Operation of Array data structure : 1) Insert and delete an element in to an Array. 2) Traverse the array.	3 HRS
2	Implement the following Operation of Single linked list : 1) Create and Traverse a single linked list. 2) Insert and delete an element from a list 3) Reverse a single list. 4)Searching the element from the list 5)Sorting the node values in ascending order	3 HRS
3	1) Implement The following Stack Operation using Array and Linked List : a)PUSH() b)POP() c) Traversal 2)Write a program to implement Tower of Hanoi and 8 queen puzzle problem using recursion	3 HRS
4	1)Implement The following linear Queue Operation using Array and Linked list : a)Enqueue() b)Dequeue() c) Traversal 2)Implement The following Circular Queue Operation using Array : a)Enqueue() b)Dequeue() c) Traversal	3 HRS
5	Implement The following Double ended Queue Operation using Array : a)Insert left() b)Insert right() c) Delete left() d) Delete right() e)Traversal()	3 HRS
6	Implement the following Operation of Double linked list : 1) Create and Traverse a double linked list. 2) Insert and delete an element from a list.	3 HRS
7	Implement the following Operation of Circular linked list : 1) Create and Traverse a double linked list. 2) Insert and delete an element from a list.	3 HRS

8	Write a program to implement polynomial addition and multiplication using linked list.	3 HRS
9	Implement The following Binary search Tree operation : a) Insert an element b) Delete an element c) Search an element	3 HRS
10	Develop the following sorting algorithm: a)Bubble sort b)Selection sort c) Insertion Sort d)Merge sort	3 HRS
11	Develop the following sorting algorithm: a)Quick sort b)Heap sort c)Shell sort	3 HRS
12	Develop the following searching algorithm: Linear Search, Binary Search and Interpolation search	3 HRS

Siliguri Institute of Technology
SESSIONAL/PRACTICAL PERFORMANCE RECORD
Paper Name: Data Structure and Algorithm Lab
Paper Code: PCC-CS391

FACULTY NAME :**Ms SUTAPA BHATTACHARYA** **YEAR: 2020**

STREAM: **B.TECH[CSE]** YEAR: **3RD** SEMESTER: **IST** SECTION:**B**

SN	ROLL NO	NAME	Lab_A1(P1,P2,P6, P7,P8)Marks:16	Lab_A2(P3,P4 ,P5)Marks:9	Lab_A3(P 9) Marks:4	Lab_A4(P10, P11,P12) Marks:11	TOTAL[40]
1	11900119049	PAWAN KUMAR SAH	15	8	4	9	**36**
2	11900119050	AJAY SHIL	14	9	4	11	**38**
3	11900119051	SOMESH KUMAR THAKUR	14	9	4	11	**38**
4	11900119052	AMAN RAZA	13	9	4	11	**37**
5	11900119053	ABHILASHA GUPTA	7	5	4	8	**24**
6	11900119054	PANAKJ KUMAR	10	6	4	9	**29**
7	11900119055	ALOK KUMAR	9	6	4	9	**28**
8	11900119056	PIYUSH PRAKASH	14	9	4	11	**38**
9	11900119057	ANOUSHKA GHOSH	12	9	4	11	**36**
10	11900119058	RAUSHAN KUMAR	14	9	4	11	**38**
11	11900119059	DIVYANGANA GANGULY	7	7	2	4	**21**
12	11900119060	SUMIT KUMAR	13	8	4	10	**35**

13	11900119061	AGNIVA SENGUPTA	14	9	4	11	**38**
14	11900119062	ASHUTOSH SHARAN SINGH	13	9	4	11	**37**
15	11900119063	SANGITA MALLICK	13	8	4	11	**36**
16	11900119064	BIKASH KUMAR SINGH	11	8	4	9	**32**
17	11900119065	AABHASH JAIN	14	9	4	11	**38**
18	11900119066	CHINMOY BISWAS	13	8	4	11	**36**
19	11900119067	DEEPSIKHA ROY	13	9	4	9	**35**
20	11900119068	AKSHAT KUMAR GUPTA	11	8	4	9	**32**
21	11900119069	HARSH VARDHAN	11	9	4	11	**35**
22	11900119070	SATISH KUMAR	12	8	4	11	**36**
23	11900119071	RIYA CHATTERJEE	11	8	3	8	**30**
24	11900119072	ROHAN MUKHERJEE	14	9	4	11	**38**
25	11900119073	SOUMYA MAJUMDER	14	7	4	10	**35**
26	11900119074	SHREYA	8	6	3	7	**24**
27	11900119075	ADITYA SINGH	14	8	4	10	**36**
28	11900119076	TANIBHA MAJUMDER	11	7	4	10	**32**
29	11900119077	SAUMYODIP CHATTERJEE	13	9	4	9	**35**
30	11900119078	SAYANTAN BHOWMICK	13	9	4	11	**37**
31	11900119079	TANIYA GHOSH	14	9	4	11	**38**
32	11900119080	RITIKA MUKHERJEE	13	8	4	10	**35**
33	11900119081	SABARNA BISWAS	11	9	4	9	**33**
34	11900119082	SHIVAM TALUKDAR	8	6	2	8	**24**
35	11900119083	DEBASMITA TALUKDAR	8	6	2	6	**22**
36	11900119084	TANMAY SEN	11	6	3	9	**29**
37	11900119085	SAYANBRATA SAHA	11	6	3	9	**29**
38	11900119086	KESHAV KUMAR	13	9	4	11	**37**
39	11900119087	ASHISH GUPTA	13	9	4	10	**36**
40	11900119088	KESHAV AGARWAL	12	9	4	11	**35**
41	11900119089	SUBHADIP SARKAR	15	8	4	9	**36**
42	11900119090	UTPAL KUMAR	14	9	4	11	**38**
43	11900119091	PRITAM PAUL	14	9	4	11	**38**
44	11900119092	KUNDAN KUMAR	13	9	4	11	**37**
45	11900119093	AMISHA SINGH	7	5	4	8	**24**
46	11900120092	**SubhankarSaha**	10	6	4	9	**29**
47	11900120093	**BishalSaha**	9	6	4	9	**28**
48	11900120094	**Pinki Deb**	14	9	4	11	**38**
49	11900120095	**SristiTalapatra**	12	9	4	11	**36**
50	11900120096	**Didhitiraj**	14	9	4	11	**38**

		Chakraborty					
51	11900120097	**Ushna Roy**	7	7	2	4	**21**
52	11900120098	**Sandip Deb**	13	8	4	10	**35**
53	11900120099	**Indranil Roy**	14	9	4	11	**38**
54	11900120100	**Debopriyo Sarkar**	13	9	4	11	**37**
55	11900120101	**Nayan Kumar Sinha**	13	8	4	11	**36**
56	11900120102	**Tuhin Ghosh**	11	8	4	9	**32**
57	11900120103	**Arnab Saha**	14	9	4	11	**38**
58	11900120104	**Ishani Singh**	13	8	4	11	**36**

CERTIFICATE
I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	**Semester**	**Subject with Code**	**Total Chapters**	**Remarks**
1.	3rd	Data Structure& Algorithm (PCC-CS301) Data Structure & Algorithm Lab (PCC-CS 391)	10	

Date :	**Signature of Faculty**

Submitted to HOD
Certificate by HOD
I, the undersigned, certify that **Prof. SutapaBhattacharya**has completed the course work allotted to him satisfactorily / not satisfactorily.

Date :	**Signature of HOD**

Submitted to Director

Date :	**Signature of Director**

SILIGURI INSTITUTE OF TECHNOLOGY

INFORMATION TECHNOLOGY

COURSE FILE

5TH SEM, 3RD YEAR, 2020

SEC – ALL

PAPER DESCRIPTION : Compiler Design

PAPER CODE : PCC CS 501

Course File

Course Title : Compiler Design

Code : PCC CS 501

Semester ___5TH_ Year Third

Name of the Faculty: Mrs. Sampa Das

Internet Homepage:

E-mail : sampa.sit@gmail.com

Class Schedule				
Lecture			Tutorial	Practical
MON 10:00 AM TO 10:50AM	MON 02:00 AM TO 03:00AM	FRI 11:40 AM TO 12:30PM	NA	NA

Hours for meeting students:	
MONDAY	04:40 TO 05:15
WEDNESDAY	04:40 TO 05:15
THRUSHDAY	04:40 TO 05:15

i) Course Objective

To provide a thorough understanding of the internals of Compiler Design.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
PCC-CS501.1	Understand given grammar specification develop the lexical analyzer.	60%
PCC-CS501.2	Design a given parser specification design top-down and bottom-up parsers.	60%
PCC-CS501.3	Develop syntax directed translation schemes.	60%

PCC-CS501.4	Develop algorithms to generate code for a target machine.	60%

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform / demonstrate the following:

Sl.	Question	CO
1.	What do you **understand** by Formal Language / Finite State Machine?	CO 1
2.	What are the **analytic** issues of finite language?	CO 1
3.	**Conversion** between NFA to DFA.	CO1
4.	**Application** of Arden's Theorem.	CO3
5.	How to **design** a DFA / NFA?	CO2
6.	**What** is the difference between deterministic finite automata and non-deterministic finite automata?	CO1
7.	**Implement** a SLR parser for the given CFG**.**	CO 4

iii) Topic/Unit/Chapter Layout

SN	Unit Mapping	CONTENT	Lecture Required
1	**Unit-I**	**Introduction to Compiling [3L]** Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	3
2	**Unit-II**	**Lexical Analysis [6L]** The role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).	6
3	**Unit-III**	**Syntax Analysis [9L]** The role of a parser, Context free grammars, writing a grammar, Top down Parsing, Non recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	9
4	**Unit-IV**	**Syntax directed translation [5L]** Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.	5
5	**Unit-V**	**Type checking [4L]** Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions	4
6	**Unit-VI**	**Run time environments [5L]** Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	5
7	**Unit-VII**	**Intermediate code generation [4L]** Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	4
8	**Unit-VIII**	**Code optimization [5L]** Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.	5
9	**Unit-IX**	**Code generations [4L]** Issues in the design of code generator, a simple code generator, Register allocation & assignment.	4

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours
Unit - I	3
Unit -II	6
Unit -III	9
Unit - IV	5
Unit - V	4
Unit - VI	5
Unit - VII	4
Unit - VIII	5
Unit - IX	4
Total	45 Hrs.

iv)Textbooks

1. Aho, Sethi, Ullman - "**Compiler Principles, Techniques and Tools**" - Pearson Education.

b) Reference Books:

2. Holub - "**Compiler Design in C**" - PHI

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70

Total	100

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	40% of the students have attained more than the target level of that CO
Attainment Level 2	50% of the students have attained more than the target level of that CO
Attainment Level 3	60% of the students have attained more than the target level of that CO

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
PCC-CS501.1	2	2	-	-	-	-	2	-	-	-	2	2	2	-
PCC-CS501.2	2	-	-	-	-	1	1	-	-	-		1	2	-
PCC-CS501.3	2	1	-	-	-	3	3	-	-	-		2	2	-
PCC-CS501.4	2	2	-	-	-	3	3	-	-	-		1	1	-
PCC-CS501	2.0	1.8	2.0			2.3	2.4				2.0	1.4	2.0	

1 = courses in which the student will be exposed to a topic (BT level 1& 2)
2 = courses in which students will gain competency in that area (BT level 3-4)
3= courses in which students will master that skill (BT level 5-6)

(vii) Assessment Methodology

Outcome	Assessment Tool
PCC-CS501.1	Internal Test, Quiz, University Exam, Term Paper, Mini Project, PPT Presentation
PCC-CS501.2	
PCC-CS501.3	
PCC-CS501.4	

(VIII) A. Weekly Lesson Plan

Week	Lectures	Assignment
1	Compilers, Analysis of the source program, The3phases of the compiler, Cousins of the compiler.	
2	The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata,	
3	From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex)	
4	The role of a parser, Context free grammars, Writing a grammar, Top down Parsing,	
5	Non-recursive Predictive parsing(LL), Bottom up parsing, Handles, Viable prefixes,	
6	Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	
7	Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions	
8	L attributed definitions, Bottom-up evaluation of inherited attributes.	
9	Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions	
10	Source language issues (Activation trees, Control stack, scope of declaration, Binding of names),Storage organization(Subdivision of run-time memory, Activation records), Storage allocation strategies	
11	Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	

12	Intermediate languages, Graphical representation, Three-address code,	
13	Implementation of three address statements(Quadruples, Triples, Indirect triples)	
14	Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.	
15	Issues in the design of code generator, a simple code generator, Register allocation & assignment.	

(VIII) B. COMBINED DAILY LESSON PLAN & EXECUTION REPORT

CHAPTER / UNIT	Topic Description (to be quoted from syllabus)	No. of Lectures	Plan Date(s)	Execution Date(s)	Tick if completed YES/NO	HomeWork/ Assignment/ Quiz
I	**Introduction to Compiling [3L]**					
UNIT -I	Compilers, Analysis of the source program with example.	1	18/08/20	21/08/20		
	The phases of the compiler. Example	1	18/08/20	21/08/20		Homework
	Cousins of the compiler.	1	18/08/20	21/08/20		
	Assessment on this CHAPTER - I	--				Quiz
II	**Lexical Analysis [6L]**					
U N	The role of the lexical analyser with example. Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens.	1	21/08/21	24/04/20		
	Finite automata, From a regular expression to an NFA, Examples.	1	24/04/20	25/08/21		Homework

	From a regular expression to NFA, Examples.	1	25/08/20	28/08/20		
	From a regular expression to DFA, Examples.	1	28/08/21	31/08/20		
	Design of a lexical analyser generator (Lex).	1	01/08/21	04/09/20		
	Example using LEX Tool.	1	04/09/20	07/09/20		
	Assessment on this CHAPTER - II	--				Assignment
III	**Syntax Analysis [9L]**					
UNIT - II	The role of a parser, Context free grammars, writing a grammar, Examples.	1	07/09/20	08/09/20		
	Top down Parsing, Non recursive Predictive parsing (LL) with example.	1	07/09/20	11/09/20		
	Case study on LL Parser with examples.	1	14/09/20	15/09/20		
	Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR)	1	15/09/20	18/09/20		
	Case study on SLR Parser with examples.	1	18/09/20	21/09/20		Homework
	Case study on LALR Parser with examples.	1	21/09/20	22/09/20		
	Parser generators (YACC) with example.	1	22/09/20	25/09/20		
	Example using YACC Tool.	1	28/09/20	29/09/20		
	Error Recovery strategies for different parsing techniques.	1	29/09/20	05/10/20		Assignment
	Assessment on this CHAPTER - III	--	05/10/20	05/10/20		Assignment
IV	**Syntax directed translation [4L]**					
	Syntax director definitions, Construction of syntax trees, Examples.	1	05/10/20	06/10/20		
	Bottom-up evaluation of S attributed definitions, Examples.	1	06/10/20	09/10/20		
	L attributed definitions, Examples.	1	05/10/20	12/10/20		Homework
	Bottom-up evaluation of inherited attributes. Examples.	1	12/10/20	06/11/20		
	Assessment on this CHAPTER - IV	--	16/10/20	09/11/20		Quiz
V	**Type checking [2L]**					
UNIT	Type systems, Specification of a simple type checker, Examples.	1	19/10/20	17/11/20		

	Equivalence of type expressions, Type conversions, Examples.	**1**	20/10/20	23/11/20		
	Assessment on this CHAPTER - V	--				Quiz
VI	**Run time environments [5L]**					
UNIT -II	Source language issues (Activation trees, Control stack, scope of declaration, Binding of names)	**1**	03/11/20	24/11/20		
	Storage organization (Subdivision of run-time memory, Activation records)	**1**	06/11/20	04/01/21		
	Storage allocation strategies,	**1**	09/11/20	07/01/21		
	Parameter passing (call by value, call by reference, copy restore, call by name),	**1**	10/11/20	08/01/21		Homework
	Symbol tables, dynamic storage allocation techniques.	**1**	13/11/20	08/01/21		
	Assessment on this CHAPTER - VI	--		08/01/21		Quiz
VII	**Intermediate code generation [4L]**					
UNIT-III	Intermediate languages, Graphical representation, Three-address code.	**1**	17/11/20	24/11/20		
	Three-address code with different examples.	**1**	23/11/20	04/01/21		Homework
	Implementation of three address statements (Quadruples, Triples, Indirect triples).	**1**	24/11/20	07/01/21		Homework
	Assessment on this CHAPTER - VII	--				Quiz
VIII	**Code optimization [4L]**					
UNIT - V	Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Examples.	**1**	27/11/20	08/01/21		
	Dag representation of basic blocks with examples.	**1**	04/01/21	12/01/21		
	The principle sources of optimization, Loops in flow graph,	**1**	05/01/21	15/01/21		Homework
	Peephole optimization.	**1**	08/01/21	18/01/21		
	Assessment on this CHAPTER - VIII	--	15/01/21	25/01/21		Quiz
IX	**Code generations [4L]**					

UNIT -IX	Issues in the design of code generator, a simple code generator, Example.	**1**	11/01/21	29/01/21		
	Register allocation & assignment. Examples.	**1**	12/01/21	01/02/21		Homework
	Assessment on this CHAPTER - IX	--				Quiz
Last 5 years question paper discussion						

(IX) Teaching Strategy / Method

1. Detailed use of blackboard
2. Good oratory skill with clearly audible volume of lecture
3. Interactive classroom
4. Always encouraging the students to ask questions
5. Use of practical examples or similar models to illustrate the topics.

(IXA) Strategy to support weak students

1. Paying attention to their problems in understanding the subject
2. Encouraging them to express their point of trouble
3. Allotting extra time beyond schedules class hours to help them understand the topics
4. Suggesting them different ways (as found suitable depending upon the case) to overcome their problem.

(IXB) Strategy to encourage bright students

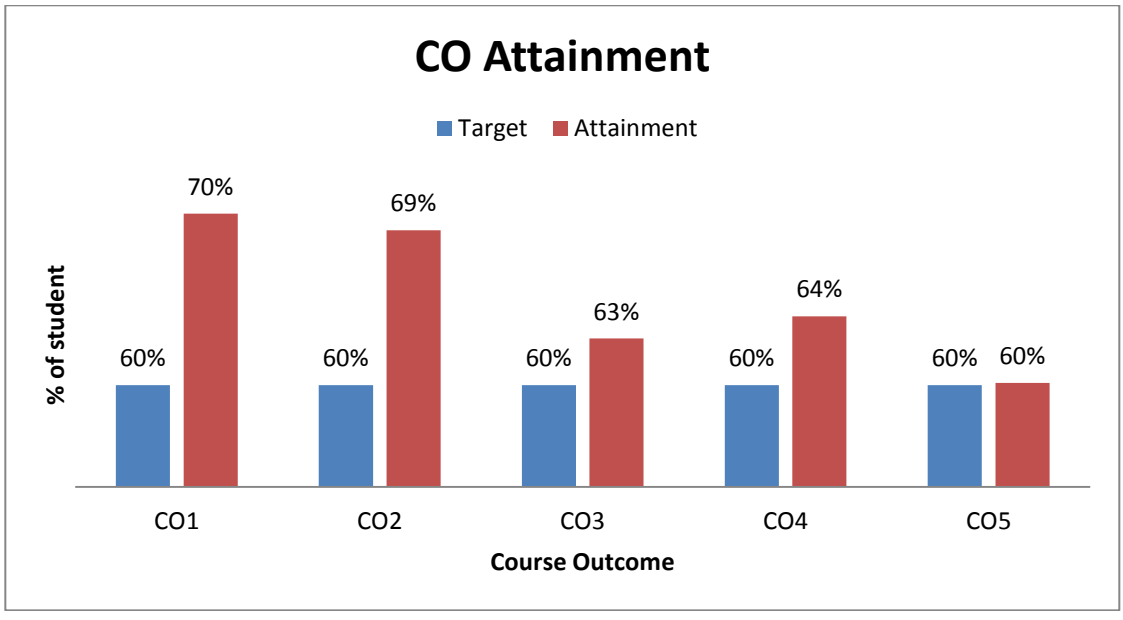
1. Try to encourage them to study beyond the syllabus
2. Ask them to develop the habit of reading anything good and rich in content
3. Advise them to try and solve higher level engineering numerical problems.

(IXC) Efforts to keep students engaged

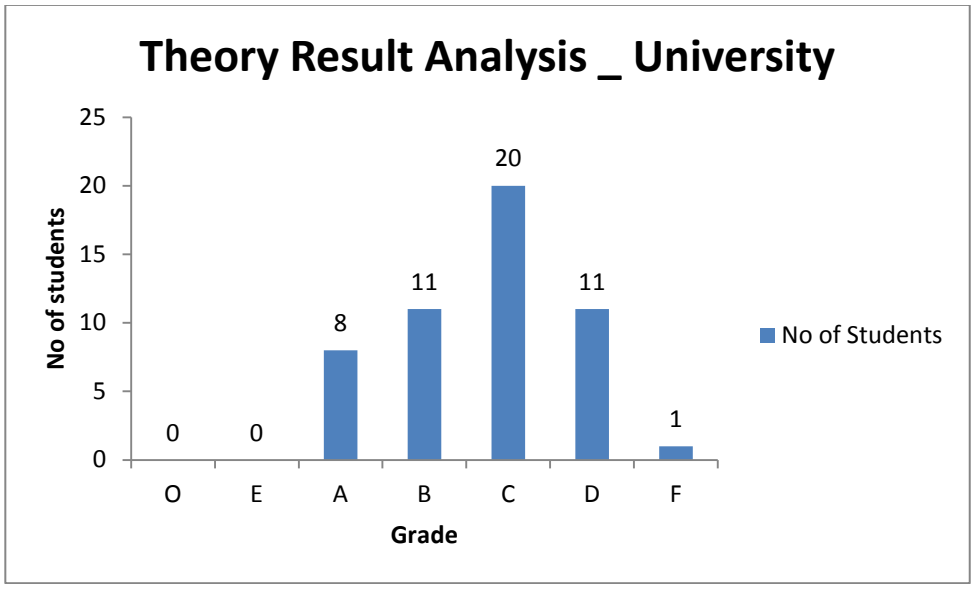
1. During class to avoid monotony some aptitude problems are given to solve.
2. Asking random questions to the students from the topic
3. Sometimes different tricks or techniques are shown to them to make the lecture interesting.
4. Informal technical quiz is also held.

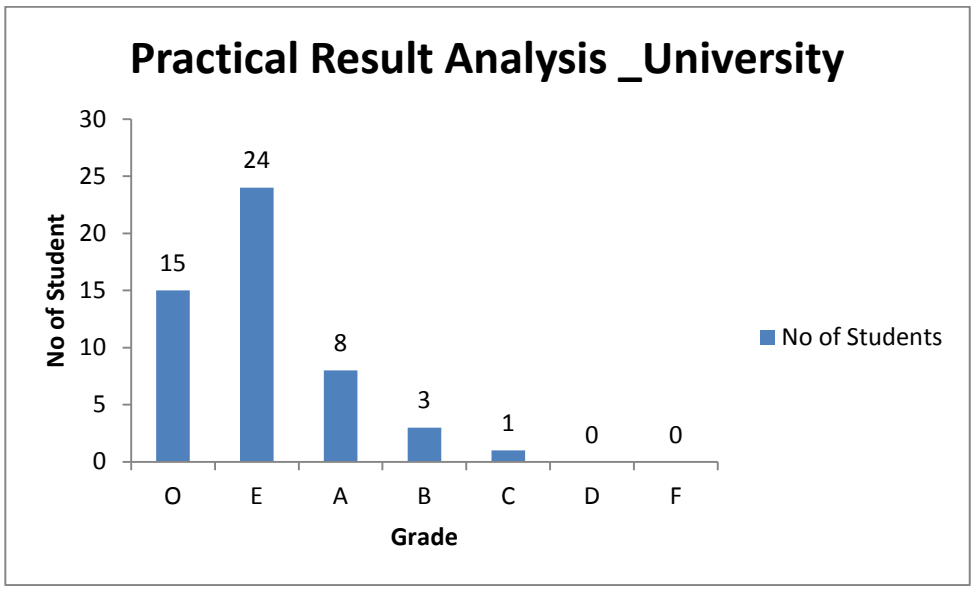
(X) Analysis of Students performance in the course

INTERNAL ASSESSMENT

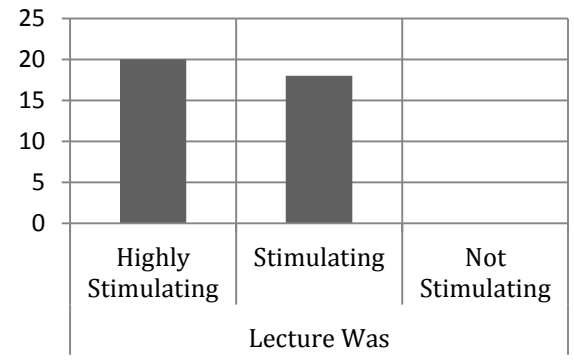


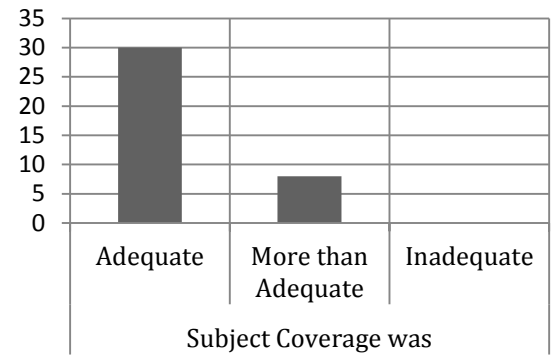
UNIVERSITY EXAMINATION

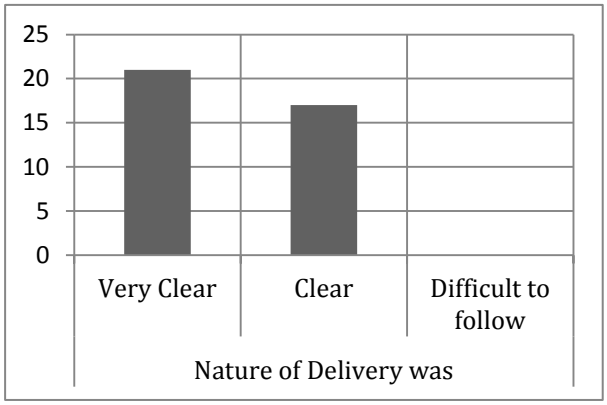


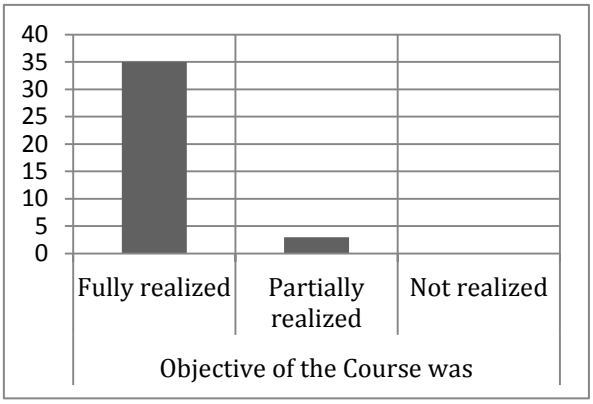


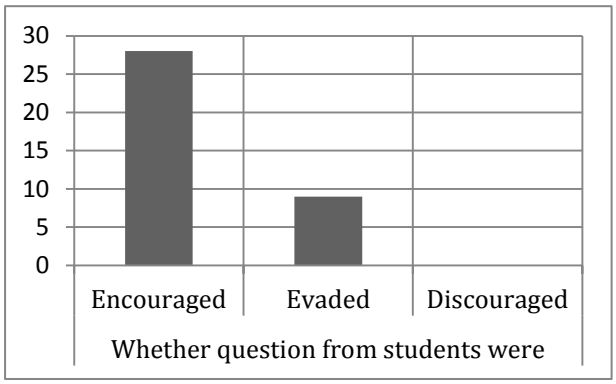
(XI) Analysis of Student Feed Back

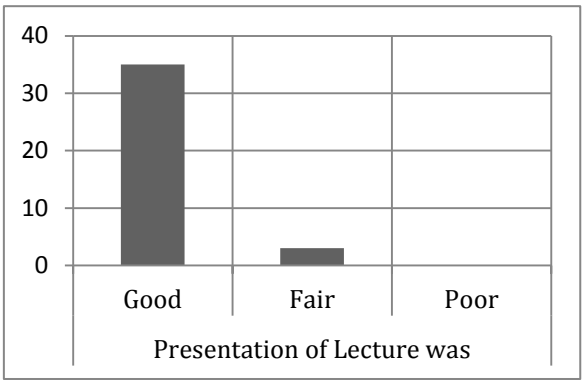












(XII) Teacher Self-Assessment (at the completion of course)

From the analysis of the results obtained it can be seen that set targets for the course outcome have been achieved successfully by the students..

(XIV) Recommendations/Suggestions for improvement by faculty

During the execution of course I felt there is a need regular tutorials to substantiate the theoretical lectures hence I recommit tutorial may be incorporated in the syllabus.

INTERNAL ASSESMENT RECORD

Subject with code:_____PCC-CS501_____ Section:__ALL___

Semester :___5TH___ Discipline:__IT_____

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
1	11900218001	Ujjwal Jha	30	5	11	12	11.5	9	25.5
2	11900218002	Tejoshmoy Dutta	25	5	5	11	8	9	22
3	11900218003	Sudeshna Pan	26	5	14	15	14.5	9	28.5
4	11900218004	Subrata Roy	30	5	9	14	11.5	9	25.5
5	11900218005	Subhankar Maji	32	5	12	14	13	9	27
6	11900218006	Subhajit Mandal	35	5	15	14	14.5	9	28.5
7	11900218007	Sourik Basu	33	5	10	12	11	9	25
8	11900218008	Sonu Kumar	31	5	6	13	9.5	9	23.5
9	11900218010	Shubham Kumar	31	5	14	13	13.5	9	27.5
10	11900218011	Shivam Raj	32	5	12	13	12.5	9	26.5
11	11900218012	Shivam Kumar Mishra	34	5	15	12	13.5	9	27.5
12	11900218013	Saumya Sagar	22	5	11	12	11.5	9	25.5
13	11900218014	Sahil Pal	20	5	13	11	12	9	26
14	11900218015	Sagar Prasad	15	5	10	10	10	9	24
15	11900218016	Sagar Lama Tamang	24	5	10	10	10	9	24
16	11900218017	Sagar Dutta	25	5	10	10	10	9	24
17	11900218018	Roshan Darnal	22	5	11	9	10	9	24
18	11900218019	Ratnadeep Shome	26	5	9	9	9	9	23
19	11900218020	Raktimabho Ghosh	28	5	8	14	11	9	25
20	11900218021	Rakesh Ghosh	28	5	7	12	9.5	9	23.5
21	11900218022	Rajoshree Saha	28	5	8	8	8	9	22
22	11900218023	Raja Sah	29	5	8	8	8	9	22
23	11900218024	Rahul Raj	11	3	8	12	10	9	22
24	11900218025	Rahul Deb Barman	15	5	14	13	13.5	9	27.5
25	11900218026	Rahul Biswas	28	5	14	11	12.5	9	26.5
26	11900218027	Pritish Jha	29	5	14	13	13.5	9	27.5
27	11900218028	Prithvi Raj	27	5	14	11	12.5	9	26.5
28	11900218029	Pritam Sharma	25	5	14	12	13	9	27
29	11900218030	Pragya Jaiswal	33	5	15	12	13.5	9	27.5
30	11900218031	Nipu Chandra Das	34	5	12	9	10.5	9	24.5
31	11900218032	Muskan Bansal	21	4	1	9	5	9	18
32	11900218033	Kush Ojha	25	5	11	11	11	9	25
33	11900218034	Jaydeep Das	26	5	12	10	11	9	25
34	11900218036	Harshita Richa	25	5	12	10	11	9	25
35	11900218037	Esha Das	25	5	13	12	12.5	9	26.5
36	11900218038	Diptiman Majumdar	2	5	11	13	12	9	26
37	11900218039	Deepraj Pradhan	5	5	14	12	13	9	27
38	11900218040	Deepjoy Sarkar	2	5	15	11	13	9	27
39	11900218041	Debashis Mishra	25	5	12	11	11.5	9	25.5
40	11900218042	Buddhadeb Jena	22	5	1	9	5	9	19

41	11900218043	Brijesh Kumar Choudhury	9	2	11	9	10	9	21
42	11900218044	Avrojyoti Dhar	8	1	12	8	10	9	20
43	11900218045	Ashutosh Kumar	21	5	12	8	10	9	24
44	11900218046	Arnab Roy	22	5	13	12	12.5	9	26.5
45	11900218047	Arghadip Bagchi	24	5	11	13	12	9	26
46	11900218048	Apu Sarkar	24	5	14	14	14	9	28
47	11900218049	Anjay Kant Jha	2	1	15	15	15	9	25
48	11900218050	Anindita Saha Pramanik	28	5	12	11	11.5	9	25.5
49	11900218051	Amelia Dutta	29	5	1	15	8	9	22
50	11900218052	Abhishikta Biswas	27	5	11	14	12.5	9	26.5
51	11900219001	ABHIJIT DAS	25	5	12	14	13	9	27
52	11900219062	MADHURIMA DAS	33	5	12	15	13.5	9	27.5
53	11900219063	ALIVEA HAZRA	34	5	13	12	12.5	9	26.5
54	11900219064	PRANALI GIRI	21	5	11	14	12.5	9	26.5
55	11900219065	ANNYESHA BANERJEE	25	5	14	14	14	9	28

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks
1	5th	PCC-CS 501	9	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that…Sampa Das….has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

INFORMATION TECHNOLOGY

COURSE FILE

2021

Course File

Course Title/Code: Design and Analysis of Algorithm/PCC-CS-404

Semester:- 4th Year:-2nd

Name of the Faculty: **Prof. Moumita Ghosh**
E-mail : **mou2005be@@gmail.com**

Class Schedule:

Day	Monday [L]	Tuesday [L]	Wednesday	Thursday [L]	Friday [L]
Timing	**12:30 pm – 1:20 pm**	**11:40 am-12.30pm**	**----**	**----**	**10:50 am– 11:40 am**

Laboratory Schedule:

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Group A1	---	---	**2**	---	**2:10 pm – 4:40 pm - -**
Group A2	---	---	---	**10:00am-12:30 pm**	---

Hours of Meeting Students:- Tuesday & Wednesday (3:00 PM – 4:30PM) /By an Appointment

i) Course Objective:

Students will be able to apply different programming design paradigm to develop new algorithms and also analyze the efficiency of its algorithm.

ii) Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

a) The Students will be able to:

Course Outcomes	Targets
1. Memorize the fundamental principles of basic algorithms. (**BT-Level 1**)	60% marks
2. Describe the notion of NP-completeness. (**BT-Level 2**)	60% marks
3. Use the Asymptotic notations as well as Recurrences on simple algorithms, including those algorithms that are using complex loops and recursions. (**BT-Level 3**)	60% marks
4. Estimate the time and space complexity of a given algorithm. (**BT-Level 4**)	60% marks
5. Experiment and analysis on various algorithms on graph data structures as well as basic graph algorithms. (**BT-Level 5**)	60% marks
6. Implement different known algorithms with the help of different programming design paradigm like divide & conquer, greedy method, dynamic programming , backtracking etc. (**BT-Level 6**)	60% marks

b) Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

SN	QUESTION	BT- LEVEL
1.	**What** do you understand by an algorithm?	1
2.	**What** are the analytic issues of an algorithm?	1
3.	**Write** an algorithm to find the **maximum number among three numbers** and also calculate the running time complexity**.**	1
4.	**Write** an algorithm to calculate the **sum of two matrices** and also calculate the running time complexity.	1
5.	**Define Cook's** theorem. Prove that **3-SAT** is NP- Complete.	2
6.	**Find** out the Recurrence relation of recursive **Tower of Hanoi** problem and solve it for the input size n.	3
7.	**Solve** the following recurrence using iteration method. 1. $T(n)=2T(n/2) + O(n)$	3
8.	**Solve** the following recurrence using master method. 1. $T(n)=2T(n/2) + O(n)$ 2. $T(n)=4T(n/2) + O(n)$ 3. $T(n)=T(n/2) + O(n)$	3
9.	**Show** that the following equation is correct: $33n^2 + 4n = \Omega(n^2)$	3
10.	**Solve** $T(n) = aT(n/b) + O(n^k)$ where $a > 1$ and $b \geq 1$.	3
11.	**Find** out the running time complexity of the **Quick sort** algorithm in Best, Worst and Average cases.	4
12.	**Find** out the running time complexity of the **N-Queen** problem.	4
13.	**Implement** adjacent matrix and adjacent list of a given graph and also conclude which representation is better**.**	5
14.	**Implement** graph traversal techniques like **BFS** and **DFS**.	5
15.	**Implement Binary Search** with the help of **Divide & Conquer** strategy.	6
16.	**Implement** shortest path using **Dijkstra's** algorithm with the help of dynamic programming strategy**.**	6

Design & Analysis of Algorithm syllabus [in Chapters]
Code:
Contact: 3L

CHAPTER-1

Complexity Analysis: [4L]

Time and Space Complexity, Different Asymptotic notations – their mathematical significance

CHAPTER-2

Heap Sort and its complexity [2L]

CHAPTER-3

Divide and Conquer: [3L]

Basic method, use, following case studies with proper analysis.

1) Binary Search.
2) Merge Sort.
3) Quick Sort and their complexity.

CHAPTER-4

Dynamic Programming: [4L]

Basic method, use, following case studies with proper analysis.

1) Matrix Chain Multiplication.
2) All pair shortest paths
    a. Floyd-Warshall Algorithm.
3) Single source shortest path.
    a. Dijkstra's Algorithm.
    b. Bellmanford Algorithm.

CHAPTER-5

Backtracking: [2L]

Basic method, use, following case studies with proper analysis.

1) n queens problem.
2) Graph coloring problem.

CHAPTER-6

Greedy Method: [4L]

Basic method, use, ,following case studies with proper analysis.

1) Knapsack problem.
2) Job sequencing with deadlines.
3) Minimum cost spanning tree
    a. Prim's Algorithm.
    b. Kruskal's Algorithm.

CHAPTER-7

Lower Bound Theory: [1L]

Prove O(nlg(n)) bound for comparison sort .

CHAPTER-8

Disjoint set manipulation: [1L]

Set manipulation algorithm like UNION-FIND, union by rank.

CHAPTER-9

Graph traversal algorithm: [3L]

1) Breadth First Search(BFS)
2) Depth First Search(DFS)
3) Classification of edges - tree, forward, back and cross edges – complexity and comparison

CHAPTER-10

String matching problem: [2L]

Different techniques Naive algorithm, string matching using finite automata, and Knuth, Morris, Pratt (KMP) algorithm with their complexities.

CHAPTER-11

Amortized Analysis: [2L]

Aggregate, Accounting, and Potential Method.

CHAPTER-12

Network Flow: [3L]

Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration)

CHAPTER-13

Matrix Manipulation Algorithm: [3L]

Strassen's matrix manipulation algorithm; application of matrix multiplication to solution of simultaneous linear equations using LUP decomposition, Inversion of matrix and Boolean matrix multiplication.

CHAPTER-14

Notion of NP-completeness: [4L]

P class, NP class, NP hard class, NP complete class – their interrelationship, Satisfiability problem, Cook's theorem (Statement only), and Clique decision problem.

CHAPTER-15

Approximation Algorithms:[1L]

Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes, vertex cover problem, travelling salesman problem.

c) Chapter Layout

Chapter No.	Chapter	Lecture Hours	Tutorials	Laboratory hours
Chapter - 1	Complexity Analysis	4 HRS	1	6 HRS
Chapter – 2	Heap Sort and its complexity	2 HRS	1	3 HRS
Chapter – 3	Divide and Conquer	3 HRS	1	3 HRS
Chapter – 4	Dynamic Programming	4 HRS	1	6 HRS
Chapter – 5	Backtracking	2 HRS		3 HRS
Chapter – 6	Greedy Method	4 HRS	1	3 HRS
Chapter – 7	Lower Bound Theory	1 HRS		
Chapter – 8	Disjoint set manipulation	1 HRS	1	
Chapter – 9	Graph traversal algorithm	3 HRS	1	3 HRS
Chapter – 10	String matching problem	2 HRS	1	3 HRS

Chapter – 11	Amortized Analysis	2 HRS		
Chapter – 12	Network Flow:	3 HRS	1	
Chapter – 13	Matrix Manipulation Algorithm	3 HRS	1	
Chapter – 14	Notion of NP-completeness	4 HRS	1	
Chapter - 15	Approximation Algorithms	1 HRS		
Total		39 HRS	11	30 HRS

d) Textbooks:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein , "Introduction to Algorithms"
2. Aho, J. Hopcroft and J. Ullman "The Design and Analysis of Algorithms" D. E. Knuth "The Art of Computer Programming", Vol. 3
3. Jon Kleiberg and Eva Tardos, "Algorithm Design"

e) Reference Books:

1. K. Mehlhorn , "Data Structures and Algorithms" - Vol. I & Vol. 2.
2. S. Baase "Computer Algorithms"
3. E. Horowitz and Shani "Fundamentals of Computer Algorithms"

f) Evaluation Scheme:

1) THEORY

Evaluation Criteria	Marks
First & Second Internal Exam*	15
Quiz/ Assignments	10
Attendance	5
University Exam	70
Total	100

*Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

2) LABORATORY

Evaluation Criteria	Marks

Internal Exam*	40
University Exam	60
Total	100

***** Internal Evaluation will be based on daily lab performance as per the following schedule:

g) Laboratory Evaluation:

Expt. No.	Experiment Name	Schedule	Marks
P1	Experiment on different **Searching** Techniques and also judge the running time complexity. List of Experiments --- **1) Linear Search** **2) Binary Search**	3 HRS	2 + 2
P2	Experiment on different **Sorting** techniques and also judge the running time complexity. List of Experiments --- **3) Merge Sort** **4) Quick Sort**	3 HRS	2 + 2
P3	Experiment on different **Sorting** techniques and also judge the running time complexity. List of Experiments --- **5) Heap Sort** **6) Counting Sort**	3 HRS	2 + 2
P4	Experiment on some **recursion** problems also judge the running time complexity as well as plot the graph. List of Experiments --- **7) Calculate x^y** **8) N^{th} Fibonacci Number** **9) Tower of Hanoi etc and**	3 HRS	1+1+2
P5	Experiment on **Dynamic Programming** algorithm strategy and also judge the running time complexity. **10) Matrix Chain Multiplication.**	3 HRS	4
P6	Experiment on **Dynamic Programming** algorithm strategy and also judge the running time complexity. **11) Floyd's Algorithm**	3 HRS	4
P7	Experiment on **Backtracking** algorithm strategy and also judge the running time complexity. List of Experiments --- **12) 4 Queen** **13) Graph Coloring**	3 HRS	2+2

P8	Experiment on **Minimum Spanning Tree** and also judge the running time complexity. (Any one) List of Experiments --- **14) Prim's Algorithm** **15) Kruskal's Algorithm**	3 HRS	4
P9	Experiment on **Graph Traversal Techniques** and also judge the running time complexity. List of Experiments --- **16) BFS** **17) DFS**	3 HRS	2 + 2
P10	Experiment on **String Matching** Algorithm and also judge the running time complexity. **18) KMP**	3 HRS	4

Overall Course Attainment Target

Attainment Level	Inference	Marks
Attainment Level 1	40% of the students have attained more than the target level of that CO	1
Attainment Level 2	50% of the students have attained more than the target level of that CO	2
Attainment Level 3	60% of the students have attained more than the target level of that CO	3

(70% of university and 30% of the internal exam) will be = **Attainment Level 2**

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

h) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes (PO's)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CS404.1	1	1	1	-	-	-	-	-	-	-	-	-	1	1
CS404.2	1	2	2	-	-	--	-	-	-	-	-	-	2	-
CS404.3	1	1	2	-	-	-	-	-	-	-	-	-	2	-
CS404.4	2	2	2	-	-	--	-	-	-	-	-	-	2	1
CS404.5	1	2	2	-	-	-	-	-	1	-	-	-	-	2
CS404.6	1	3	2	-	-	-	-	-	1	-	-	-	-	2
CS404	1	2	2	-	-	-	-	-	1	-	-	-	2	2

- CS404.1 to CS404.3 & CS404.5 to CS404.6 minimally satisfies where as CS404.4 partially satisfies the application of knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems. (PO1)
- CS404.1, CS404.3 minimally satisfies, CS404.2, CS404.4, CS404.5 partially satisfies where as CS404.6 fully satisfies the ability of the student to identify, formulate, and analyze engineering problems to arrive at substantiated conclusions. (PO2)
- CS501.1 minimally satisfies where as CS404.2 to CS404.6 partially satisfies design solutions for complex engineering problems. (PO3)
- CS404.5 & CS404.6 minimally satisfies the student's ability to function effectively as an individual and as a member in a team (PO9).
- CS404.1 to CS404.4 satisfies application of knowledge of mathematical foundations, programming skills and algorithm. (PSO1).
- CS404.4 to CS404.6 satisfies Data Structures. (PSO2)

Outcome	Method	Supporting Tools	Demonstration
CS 404.1	Structured (partially supervised)	Blackboard	Describe the basic algorithm.
CS 404.2	Structured (partially supervised)	Blackboard , PPT , NPTEL	Describe the basic concept of NP.
CS 404.3	Structured (partially supervised)	Blackboard + C Programming	Calculate Asymptotic notations & Recurrences
CS 404.4	Structured (partially supervised)	Blackboard , NPTEL	Judge the efficiency of a given algorithm.
CS 404.5	Structured (partially supervised)	Blackboard + C Programming	Implement different graph traversal algorithms.
CS 404.6	Structured (partially supervised)	Blackboard + C Programming	Implement basic algorithm with the help of different programming design paradigm.

i) Delivery Methodology:

j) Assessment Methodology:

Assessment Tool	Outcomes						Specific Question/activity aligned to the Outcome
	CS404.1	CS404.2	CS404.3	CS404.4	CS404.5	CS404.6	
FIRST INTERNAL	√	--	√	√	√	√	First Internal Question Paper
SECOND INTERNAL	√	--		√	√	√	Second Internal Question Paper
ASSIGNMENT	√	--	√	√	√	√	First, Second Assignment
QUIZ	√	√	√	√	√	√	Quiz –(Q1, Q2, Q3)
LABORATORY	--	--	√	√	√	√	LAB Assignments

k) A. Weekly Lesson Plan

Week	Lecture	Plan date	Execution date	SOME TOPICS	Laboratory	Assignment/Quiz
1	Complexity Analysis.	15.1.2021, 18.1.2021 19.1.2021 22.1.2021		Linear/Non Linear Data Structures.	Review on basic algorithms.	---
2	Heap Sort.	25.1.2021 29.1.2021 1.2.2021		Asymptotic Notations & Recurrences	Recursion	Assignment - I
3	Binary Search, Merge Sort, Quick Sort.	2.2.2021 5.2.2021 8.2.2021 9.2.2021		Heap Sort & Binary Search.	Linear & Binary Search	---
4	Matrix Chain Multiplication. Single Source Shortest Path. (Dijkstra's & Bellman Ford)	12.2.2021 15.2.2021 19.2.2021 22.2.2021 23.2.2021		Binary Search, Merge Sort & Quick Sort.	Sorting	Assignment - II
5	All Pair Shortest Path (Floyd's Algorithm). N-Queen, Graph Coloring.	26.2.2021 1.3.2021 2.3.2021 5.3.2021 8.3.2021		Matrix Chain Multiplication & Shortest Path Problem.	Sorting	Quiz – I (Q1)
6	Knapsack problem. Kruskal's Algorithm. Prim's Algorithm.	9.3.2021 12.3.2021 15.3.2021		Floyd's algorithm.	Matrix Chain	---
7	Job Sequencing with deadline. Lower Bound Theory. Disjoint set manipulation.	16.3.2021 19.3.2021 22.3.2021		Knapsack Problem & Job Sequencing.	Floyd's	
8	Graph traversal algorithm (BFS & DFS)	23.3.2021 26.3.2021		MST.	N-Queen & Graph Coloring	Quiz – II (Q2)

9	String Matching.	30.3.2021 5.4.2021		BFS & DFS.	Prim's & Kruskal's	---
10	Amortized Analysis Approximation Algorithms.	6.4.2021 9.4.2021		-----	BFS & DFS	---
11	Network Flow, Ford- Fulkerson algorithm.	12.4.2021 16.4.2021		-----		---
12	System of Linear Equations Solve by LUP. Strassen's Matrix Multiplication. Matrix Inversion & Boolean Matrix Multiplication.	19.4.2021 20.4.2021 23.4.2021 26.4.2021 27.4.2021		Network Flow.	KMP	---
13	Notion of NP-completeness.	30.4.2021 3.5.2021 4.5.2021 7.5.2021 10.5.2021 11.5.2021 17.5.2021		LUP. Matrix Inversion.	---	Quiz – III (Q3)

B. Daily Lesson Plan (Repeat format for each chapter)

CHAPTER: 1 Title: **Time & space complexity**
CONTENTS Asymptotic notations & other mathematical preliminaries with examples.
Chapter Objectives: They are capable to make a decision what are the actual ways to judge the efficiency of an algorithm. **Broad Objectives of the chapter are:** 1. To able how to judge the efficiency of an algorithm in **worst** case. 2. To able how to judge the efficiency of an algorithm in **best** case. 3. To able how to judge the efficiency of an algorithm in **average** case.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: 1. **What** is asymptotic notation? (Level 1) 2. **Different** types of asymptotic notations. (Level 2) 3. **Explain** Big 'O' notation with example. (Level 4) 4. **Explain** Big 'Ω' notation with example. (Level 4) 5. **Explain** Big 'Θ' notation with example. (Level 4) 6. **Prove** that $2n^2 + 5n + 4 = O(n^2)$/ $\Omega(n^2)$/ $\Theta(n^2)$ (Level 5)
HOME WORK: 1. Prove that $3n^2 + 7n = O(n^2)$ (Like Question No. 6) 2. Prove that $3n^2 + 7n = \Omega(n^2)$ (Like Question No. 6) 3. Prove that $3n^2 + 7n = \Theta(n^2)$ (Like Question No. 6) 4. Short notes on asymptotic notations. (Like Question No. 1-5)

CHAPTER: 1 Title: **Time & space complexity**
CONTENTS Recursion & iteration, design of recursive algorithms, tower of Hanoi, tail recursion

Chapter Objectives: They are capable to make a decision what are the actual ways to judge the efficiency of an algorithm.

Broad Objectives of the chapter are:

1. To able to write an iterative algorithm.
2. To able to write a recursive algorithm.
3. To able how to judge the efficiency of an iterative algorithm.
4. To able how to judge the efficiency of a recursive algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. How to write an iterative algorithm. (Level 2)
2. How to write recursion algorithm. (Level 2)
3. How to judge the efficiency of an iterative algorithm. (Level 2)
4. How to judge the efficiency of a recursive algorithm. (Level 2)
5. Write an algorithm on Tower of Hanoi problem. (Level 1)
6. What is tail recursion with example? (Level 1)

HOME WORK:

1. Write an iterative algorithm on n^{th} Fibinacci number & calculate the running time complexity. (Like Question No. 1&3)
2. Write a recursive algorithm on n^{th} Fibinacci number & calculate the running time complexity. (Like Question No. 2 & 4)
3. Short notes on Tower of Hanoi problem. (Like Question No. 5,6)

CHAPTER: 1

Title: **Time & space complexity**

CONTENTS

Substitution Method with examples, Iteration Method with examples Master Method with examples.

Chapter Objectives: They are capable to make a decision what are the actual ways to judge the efficiency of an algorithm.

Broad Objectives of the chapter are:

1. They are able, how to judge efficiency of an algorithm using substitution method.
2. They are able, how to judge efficiency of an algorithm using iteration method.
3. They are able, how to judge efficiency of an algorithm using master method.

Once the student has completed this topic/ chapter he/she will be able to answer following

questions/perform the following activities with Levels of Bloom's Taxonomy:

1. How to solve substitution method with example. (Level 6)
2. How to solve iteration method with example. (Level 6)
3. How to solve master method with example. (Level 6)

HOME WORK:

1. Solve the following recurrence using substitution method (Like Question No. 1)
    a. T(n)=2T(n/2) + O(n)
2. Solve the following recurrence using iteration method (Like Question No. 2)
    a. T(n)=2T(n/2) + O(n)
3. Solve the following recurrence using master method (Like Question No. 3)
    a. T(n)=2T(n/2) + O(n)
    b. T(n)=4T(n/2) + O(n)
    c. T(n)=T(n/2) + O(n)
4. Short notes on Recurrences. (Like Question No. 1-3)

CHAPTER: 1

Title: **Time & space complexity**

CONTENTS

Different algorithms for a problem, example study – Fibonacci numbers using recursion & iteration with complexity

Chapter Objectives: They are capable to make a decision what are the actual ways to judge the efficiency of an algorithm.

Broad Objectives of the chapter are:

1. They are able to judge the efficiency of an algorithm in **worst** case with case study.
2. They are able to judge the efficiency of an algorithm in **best** case with case study.
3. They are able to judge the efficiency of an algorithm in **average** case with case study.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. How to judge the efficiency of an algorithm in **worst** case with case study. (Level 5)
2. How to judge the efficiency of an algorithm in **best** case with case study. (Level 5)
3. How to judge the efficiency of an algorithm in **average** case with case study. (Level 5)

HOME WORK:

1. Write an iterative algorithm on sum of n numbers & calculate the running time complexity. (Like Question No. 1, 2 & 3)
2. Write a recursive algorithm on sum of n numbers & calculate the running time complexity. (Like Question No. 1, 2 & 3)

LABORATORY EXPERIMENT: (P4)

1. WAP to find out nth Fibonacci number using recursion as well as tail recursion and calculate the running time complexity also plot the curve between certain ranges.
2. WAP to solve Tower of Hanoi problem using recursion.
3. WAP to compute x^y.

CHAPTER: 2

Title: **Heap Sort and its complexity**

CONTENTS

Discuss on Heap, Types of heap, how to create heap with examples.

Chapter Objectives: They are capable to make a heap as well as heap sort and judge the efficiency of this algorithm.

Broad Objectives of the chapter are:

1. They are able to describe what is heap.
2. They are able to know types of heap.
3. They are able to create a heap.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. **What** is heap? (Level 1)
2. **Different** types of heap. (Level 2)
3. **Create** a heap for some certain data. (Level 6)

HOME WORK:

1. Create a heap (max/min) with the following data 33, 25, 67, 89, 12, 55, 3, 67. (Like Question No. 3)
2. Short notes on heap. (Like Question No. 1-3)

CHAPTER: 2

Title: **Heap Sort and its complexity**

CONTENTS

Heap sort with example. Analysis of heap as well as heap sort.

Chapter Objectives: They are capable to make a heap as well as heap sort and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain heap sort algorithm with some example.
2. They are able to solve the efficiency of heap sort algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the heap sort algorithm with example? (Level 1)
2. Short notes on heap sort. (Level 2)
3. What is the time complexity of a heap? (Level 1)
4. Establish the time complexity of a heap sort. (Level 4)

HOME WORK:

1. Create a heap (max/min) with the following data 33, 25, 67, 89, 12, 55, 3, 67. And sort the data in ascending and descending order. (Like Question No. 1)
2. Short notes on heap sort. (Like Question No. 1-4)

LABORATORY EXPERIMENT:

1. WAP to implement Heap sort. Estimate the running time complexity.

Tutorial 2

Title: **Asymptotic Notations & Recurrences**

1. Prove that $3n^2 + 7n = O(n^2)$
2. Prove that $3n^2 + 7n = \Omega(n^2)$
3. Prove that $3n^2 + 7n = \Theta(n^2)$
4. Solve the following recurrence using substitution method.
   a. $T(n)=2T(n/2) + O(n)$
5. Solve the following recurrence using iteration method.
   a. $T(n)=2T(n/2) + O(n)$
6. Solve the following recurrence using master method.
   a. $T(n)=2T(n/2) + O(n)$
   b. $T(n)=4T(n/2) + O(n)$
   c. $T(n)=T(n/2) + O(n)$

CHAPTER: 3

Title: **Divide & Conquer**

CONTENTS

Basic idea on divide & conquer (D&C) method: case study - Binary Search

Chapter Objectives: They are capable to make an algorithm on the basis of D&C strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain D&C algorithm strategy with some example.
2. They are able to explain binary search algorithm with some example.
3. They are able to solve the efficiency of binary search algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the binary search algorithm with example? (Level 1)
2. What is BST? (Level 1)
3. What is the time complexity of binary search algorithm? (Level 4)
4. Establish the time complexity of a binary search algorithm. (Level 4)

HOME WORK:

1. Create a binary search tree (BST) with the following data 33, 25, 67, 89, 12, 55, 3, 67. (like question no. 2)
2. Short notes on binary search technique. (like question no. 1,3,4)
3. Explain binary search algorithm with an example. (like question no. 1)

LABORATORY EXPERIMENT:

1. WAP to implement binary search iterative as well as recursive method. Establish the running time complexity for both the cases.

CHAPTER: 3

Title: **Divide & Conquer**

CONTENTS

Divide & conquer method: (contd.) case study - Merge Sort .

Chapter Objectives: They are capable to make an algorithm on the basis of D&C strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain merge sort algorithm with some example.
2. They are able to solve the efficiency of merge sort algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the merge sort algorithm with example? (Level 1)
2. What is the time complexity of merge sort algorithm? (Level 4)
3. Establish the time complexity of a merge sort algorithm. (Level 4)

HOME WORK:

1. Short notes on merge sort. (like question no 1-3)
2. Explain merge sort algorithm with an example. (like question no. 1)

LABORATORY EXPERIMENT:

1. WAP to implement merge sort using divide & conquer strategy. Establish the running time complexity.

CHAPTER: 3

Title: **Divide & Conquer**

CONTENTS

Divide & conquer method: (contd.) case study - Quick Sort .

Chapter Objectives: They are capable to make an algorithm on the basis of D&C strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain quick sort algorithm with some example.
2. They are able to solve the efficiency of quick sort algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the quick sort algorithm with example? (Level 1)
2. What is the time complexity of quick sort algorithm? (Level 4)
3. Establish the time complexity of a quick sort algorithm. (Level 4)

HOME WORK:

1. Short notes on quick sort. (like question no 1-3)
2. Explain quick sort algorithm with an example. (like question no. 1)

LABORATORY EXPERIMENT:

1. WAP to implement quick sort using divide & conquer strategy. Establish the running time complexity.

Tutorial: 3

Title: **Heap Sort**

1) Create a binary heap (max/min) with the following data 33, 25, 67, 89, 12, 55, 3, 67. And sort the data in ascending and descending order.

2) Create a Fibonacci heap with the following data 33, 25, 67, 89, 12, 55, 3, 67.

CHAPTER: 4

Title: **Dynamic Programming**

CONTENTS

Dynamic programming: case study –Matrix Chain Multiplication with example

Chapter Objectives: They are capable to make an algorithm on the basis of Dynamic Programming strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain matrix chain multiplication algorithm with some example.
2. They are able to solve the efficiency of matrix chain multiplication algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the matrix chain multiplication algorithm with example? (Level 1)
2. Write the optimal parenthesis algorithm with example? (Level 1)
3. What is the time complexity of matrix chain multiplication algorithm? (Level 1)
4. Establish the time complexity of a matrix chain multiplication algorithm. (Level 4)

HOME WORK:

1. Short notes on matrix chain multiplication. (like question no 1,3,4)
2. Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is⟨5,10,3,12,5⟩. (like question no. 1)

LABORATORY EXPERIMENT:

1. WAP to multiply a chain of matrices optimally whose sequence of dimensions is <10, 20, 50, 1, 100>.

CHAPTER: 4

Title: **Dynamic Programming**

CONTENTS

Dynamic programming: case study – Single Source shortest paths with example. (Dijkstra's Algorithm)

Chapter Objectives: They are capable to make an algorithm on the basis of Dynamic Programming strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

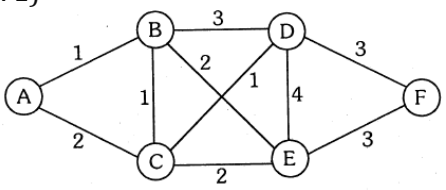
1. They are able to clarify the actual need of single source shortest path problem with an example.
2. They are able to explain Dijkstra's algorithm with some example.
3. They are able to solve the efficiency of Dijkstra's algorithm with different data structure.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the Dijkstra's algorithm of single source shortest path problem with an example? (Level 1)
2. Establish the time complexity of a Dijkstra's algorithm of single source shortest path algorithm. (Level 4)

HOME WORK:

1. Short notes on single source shortest path problem. (like question no 1,2)
2. Find out the shortest path between Vertex 'A' to Vertex 'F' using Dijkstr's algorithm where Vertex 'A' is the start Vertex. (like question no. 1)



LABORATORY EXPERIMENT:

1. WAP to implement Dijkstra's algorithm for single source shortest path. (**if required**)

CHAPTER: 4

Title: **Dynamic Programming**

CONTENTS

Dynamic programming: case study – Single Source shortest paths with example.
(Bellman ford Algorithm)

Chapter Objectives: They are capable to make an algorithm on the basis of Dynamic Programming strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

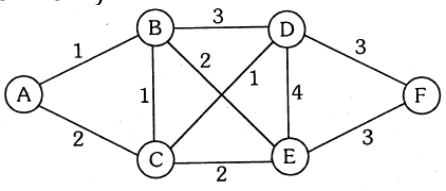
1. They are able to clarify the actual need of single source shortest path problem with an example.
2. They are able to explain Bellman ford algorithm with some example.
3. They are able to solve the efficiency of Bellman ford algorithm with different data structure.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the Bellman ford algorithm of single source shortest path problem with an example? (Level 1)
2. Establish the time complexity of a Bellman ford algorithm of single source shortest path algorithm. (Level 4)
3. Compare between Dijkstra's and Bellman ford algorithm.(Level 4)

HOME WORK:

1. Short notes on single source shortest path problem. (like question no 1,2)
2. Find out the shortest path between Vertex 'A' to Vertex 'F' using Bellman ford algorithm where Vertex 'A' is the start Vertex. (like question no. 1)



3. Write some difference between Dijkstra's and Bellman ford algorithm.

LABORATORY EXPERIMENT:

2. WAP to implement Dijkstra's algorithm for single source shortest path. (**if required**)

Tutorial: 4

Title: **Binary Search, Merge Sort & Quick Sort**

1) Create a binary search tree (BST) with the following data 33, 25, 67, 89, 12, 55, 3, 67 and also find out the results in different traversal techniques

2) Illustrate the operation of PARTITION on the following sequence of keys.
   a. 2, 3, 18, 17, 5, 1

3) Show how Quick sort works for the following sequence of keys.
   a. 2, 3, 18, 17, 5, 1

4) Use Merge sort algorithm to sort the following elements.
   a. 15, 10, 5, 20, 25, 30, 40, 35

5) Show that merging two sorted sequences S_1 and S_2 takes $O(n_1 + n_2)$ time, where n_1 is the size of S_1 and n_2 is the size of S_2.

CHAPTER: 4

Title: **Dynamic Programming**

CONTENTS

Dynamic programming: case study – All pair shortest paths with example. (Floyd's Algorithm)

Chapter Objectives: They are capable to make an algorithm on the basis of Dynamic Programming strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to clarify the actual need of all pair shortest path problem with an example.
2. They are able to explain Floyd's algorithm with some example.
3. They are able to solve the efficiency of Floyd's algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the Floyd's algorithm for all pair shortest path problem with an example? (Level 1)
2. Establish the time complexity of a Floyd's algorithm of single source shortest path algorithm. (Level 4)

HOME WORK:

1. Short notes on all pair shortest path problem. (like question no 1,2)
2. Find out the shortest path between all pair using Floyd's algorithm. (like question no. 1)

0	7	5	∞
∞	0	7	6
∞	∞	0	∞
4	1	11	0

3. Write some difference between single source and all pair shortest path..

LABORATORY EXPERIMENT:

1. WAP to find the shortest path between all pairs of vertices of a given graph using Floyd's algorithm.

0	7	5	∞
∞	0	7	6
∞	∞	0	∞
4	1	11	0

CHAPTER: 5

Title: **Backtracking**

CONTENTS

Basic idea on backtracking strategy. Case study – n queen problem

Chapter Objectives: They are capable to make an algorithm on the basis of Backtracking strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to clarify the actual need of backtracking strategy.
2. They are able to explain 'n' queen problem with an example.
3. They are able to solve the efficiency of 'n' queen problem.
4. They are able to know the actual need of state space tree of n queen problem.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the short notes on 'n' queen problem. (level 1)
2. Write the 'n' queen algorithm with an example? (Level 1)
3. Establish the time complexity of 'n' queen algorithm. (Level 4)
4. How to draw the state space tree? (Level 2)

HOME WORK:

1. Short notes on n queen problem. (like question no 1,2,3)
2. Find out the one solution for the given 4 queen problem. (like question no. 2)

-	Q	-	-
-	-	-	-
-	-	-	-
-	-	-	-

3. Draw the state space tree for 4 queen problem. (like question no. 4)

LABORATORY EXPERIMENT:

1. WAP to implement 4-Queen problem using backtracking strategy.

CHAPTER: 5

Title: **Backtracking**

CONTENTS

Basic idea on backtracking strategy. Case study – graph coloring problem

Chapter Objectives: They are capable to make an algorithm on the basis of Backtracking strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

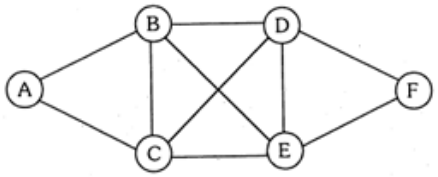
1. They are able to explain graph coloring problem with an example.
2. They are able to solve the efficiency of graph coloring algorithm.
3. They are able to know the actual need of state space tree of graph coloring problem.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the short notes on graph coloring problem. (level 1)
2. Write the 'graph coloring algorithm with an example? (Level 1)
3. Establish the time complexity of graph coloring algorithm. (Level 4)
4. How to draw the state space tree? (Level 2)

HOME WORK:

1. Short notes on graph coloring problem. (like question no 1,2,3)
2. Find how many distinct colors are required for the given graph.(like question no. 2)



3. Draw the state space tree for 3-coloring problem. (like question no. 4)

LABORATORY EXPERIMENT:

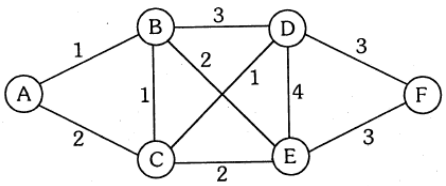
1. WAP to implement graph coloring problem using backtracking strategy.

Tutorial: 5

Title: **Matrix Chain Multiplication & Shortest Path Problem**

1) Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is⟨5,10,3,12,5⟩.

2) Find out the shortest path between Vertex 'A' to Vertex 'F' using Dijkstr's / Bellman Ford algorithm where Vertex 'A' is the start Vertex.



CHAPTER: 6

Title: **Greedy Method**

CONTENTS

Basic idea on Greedy Method: case study - Knapsack Problem with example.

Chapter Objectives: They are capable to make an algorithm on the basis of Greedy strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to clarify the actual need of greedy strategy with an example.
2. They are able to explain greedy knapsack problem with an example.

3. They are able to solve the efficiency of greedy knapsack algorithm with different data structure.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the greedy knapsack algorithm with an example? (Level 1)
2. Establish the time complexity of a greedy knapsack algorithm. (Level 4)

HOME WORK:

1. Short notes on greedy knapsack problem. (like question no 1,2)
2. Find an optimal solution to the knapsack instance n=7, m=15, (v1, v2, v3, . . , v7) = (10, 5, 15, 7, 6, 18, 3), and (w1, w2, w3, . . . , w7) = (2, 3, 5, 7, 1, 4, 1).(like question no 1)

CHAPTER: 6

Title: **Greedy Method**

CONTENTS

Greedy Method: Minimum spanning trees(MST): Kruskal's algorithm with example.

Topic/Unit/Chapter Objectives: They are capable to make an algorithm on the basis of Greedy strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter/topic are:

1. They are able to explain Kruskal's algorithm with an example.
2. They are able to solve the efficiency of Kruskal's algorithm with set data structures.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the Kruskal's algorithm with an example? (Level 1)
2. Establish the time complexity of Kruskal's algorithm. (Level 4)

HOME WORK:

1. Short notes on Kruskal's algorithm. (like question no 1,2)
2. Find out the minimum spanning tree for the following graph (adjacent matrix with weight) using Kruskal's algorithm.(like question no 1)

-	1	∞	4	∞	∞	∞
1	-	2	6	4	∞	∞
∞	2	-	∞	5	6	∞
4	6	∞	-	3	∞	4
∞	4	5	3	-	8	7
∞	∞	6	∞	8	-	3
∞	∞	∞	4	7	3	-

LABORATORY EXPERIMENT:

1. WAP to implement MST of a given graph using Kruskal's algorithm. Check your program on a graph whose length matrix is given in (Home Work Question no 2)

CHAPTER: 6

Title: **Greedy Method**

CONTENTS

Greedy Method: Minimum spanning trees(MST): Prim's algorithm with example.

Chapter Objectives: They are capable to make an algorithm on the basis of Greedy strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to clarify minimum spanning tree with an example.
2. They are able to explain Prim's algorithm with an example.
3. They are able to solve the efficiency of Prim's algorithm with different data structures.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the Prim's algorithm with an example? (Level 1)
2. Establish the time complexity of Prim's algorithm. (Level 4)
3. What is minimum spanning tree with an example.(Level 2)

HOME WORK:

1. Short notes on minimum spanning tree. (like question no 1,2)
2. Find out the minimum spanning tree for the following graph (adjacent matrix with weight) using Prim's algorithm. (like question no 1)

-	1	∞	4	∞	∞	∞
1	-	2	6	4	∞	∞
∞	2	-	∞	5	6	∞
4	6	∞	-	3	∞	4
∞	4	5	3	-	8	7
∞	∞	6	∞	8	-	3
∞	∞	∞	4	7	3	-

LABORATORY EXPERIMENT:

2. WAP to implement MST of a given graph using Prim's algorithm. Check your program on a graph whose length matrix is given in (Home Work Question no 2)

Tutorial: 6

Title: **All pair Shortest Path Problem**

1) Find out the shortest path between all pair using Floyd's algorithm. (like question no. 1)

0	7	5	∞
∞	0	7	6
∞	∞	0	∞
4	1	11	0

2) Find out the total number of operations for the above problem.

CHAPTER: 6

Title: **Greedy Method**

CONTENTS

Greedy Method: case study - Job Sequencing with Deadline with example.

Chapter Objectives: They are capable to make an algorithm on the basis of Greedy strategy and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to clarify the actual need of job sequencing with deadline with an example.
2. They are able to explain job sequencing problem with an example.
3. They are able to solve the efficiency of job sequencing with deadline.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the job sequencing with deadline algorithm with an example? (Level 1)
2. Establish the time complexity of job sequencing with deadline algorithm. (Level 4)

HOME WORK:

1. Short notes on job sequencing with deadline problem. (like question no 1,2)
2. Using greedy strategy, schedule the following jobs within deadline so as to maximize the profit. Deadline and profits are mentioned as follows. (like question no 1)

Job i	1	2	3	4
Deadline d_i	3	2	3	1
Profit g_i	9	7	7	2

CHAPTER: 7

Title: **Lower Bound Theory**

CONTENTS

Lower bound theory, necessity of lower bounds. Lower bound theory: lower bound of the sorting problem with example.

Topic/Unit/Chapter Objectives: They are capable to judge the lower bound of an algorithm.

Broad Objectives of the chapter/topic are:

1. They are able to explain Lower bound theory.
2. They are able to clarify the lower bound of the sorting problem.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Justify what is the lower bound of an algorithm? (Level 5)
2. How to design decision trees for sorting algorithms. (Level 6)
3. Establish the lower bound for worst case of comparison based sorting technique. (Level 5)

HOME WORK:

1. Short notes lower bound theory. (like question no 1,2,3)
2. Draw the decision tree for a sorting algorithm where number of element is 4. (like question no 2)

CHAPTER: 8

Title: **Disjoint set manipulation**

CONTENTS

Disjoint set manipulation: UNION-FIND, Union by Rank, Path Compression with example.

Topic/Unit/Chapter Objectives: They are competent how to manipulate disjoint sets data structure.

Broad Objectives of the chapter/topic are:

1. They are able to explain disjoint set data structure.
2. They are able to explain Union, Find algorithms.
3. They are able to know path compression with example.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write Union, Find algorithm with an example? (Level 2)
2. What is path compression, explain with an example. (Level 1)
3. Establish the running time complexity for Union, Find algorithms. (Level 5)
4. Prove the theorem every node has rank at most $\lfloor \lg(n) \rfloor$. (Level 5)
5. Prove the lemma for all tree roots x, size(x) $\geq 2^{rank[x]}$. (level 5)

HOME WORK:

1. Short notes on disjoint set manipulation. (like question no 1,2,3)

Tutorial: 7

Title: Knapsack Problem

1) Find an optimal solution to the knapsack instance n=7, m=15, (v1, v2, v3, . . , v7) = (10, 5, 15, 7, 6, 18, 3), and (w1, w2, w3, . . . , w7) = (2, 3, 5, 7, 1, 4, 1).

2)

CHAPTER: 9

Title: **Graph traversal algorithm**

CONTENTS

Graphs, properties of graphs, representation of graphs with examples.

Chapter Objectives: They are capable to make an algorithm and also explain properties of a graph on the basis of graph traversal techniques and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

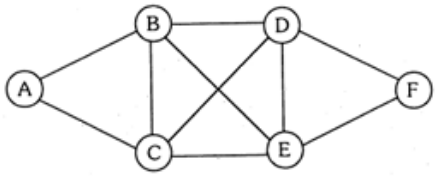
1. They are able to clarify the actual need of graph and also explain graph properties.
2. They are able how to represent a graph in computer memory.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the graph representation algorithm with an example? (Level 1)
2. Establish the time complexity of graph representation. (Level 4)

HOME WORK:

1. Short notes on graph. (like question no 1,2)
2. Write the adjacent matrix and adjacent list for the given graph.



3. Prove that a complete graph has at least n(n-1)/2 number of edges.

CHAPTER: 9

Title: **Graph traversal algorithm**

CONTENTS

Graph traversal algorithms: BFS with example.

Chapter Objectives: They are capable to make an algorithm and also explain properties of a graph on the basis of graph traversal techniques and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

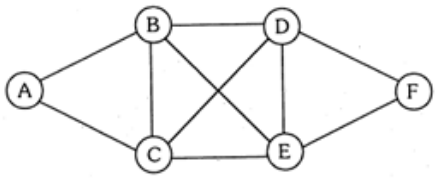
1. They are able to clarify the BFS algorithm with an example.
2. They are able to solve the efficiency of BFS algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the BFS algorithm with an example? (Level 1)
2. Establish the time complexity of BFS algorithm. (Level 4)

HOME WORK:

1. Short notes on BFS. (like question no 1,2)
2. Find out the BFS tree for the given graph. (like question no. 1)



3. Establish the running time for the BFS algorithm.(like question no. 2)

LABORATORY EXPERIMENT:

1. WAP to implement BFS on a given graph(in Home Work Question no 2) where the graph is represented as a adjacent list.

CHAPTER: 9

Title: **Graph traversal algorithm**

CONTENTS

Graph traversal algorithms: DFS with example.

Chapter Objectives: They are capable to make an algorithm and also explain properties of a graph on the basis of graph traversal techniques and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

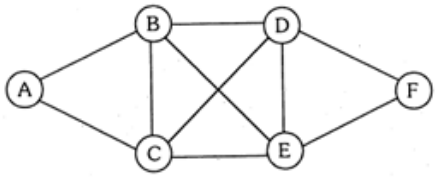
1. They are able to clarify the DFS algorithm with an example.
2. They are able to solve the efficiency of DFS algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the DFS algorithm with an example? (Level 1)
2. Establish the time complexity of DFS algorithm. (Level 4)
3. Comparative study between DFS and BFS.

HOME WORK:

1. Short notes on DFS. (like question no 1,2)
2. Find out the DFS tree for the given graph. (like question no. 1)



3. Establish the running time for the DFS algorithm.(like question no. 2)
4. Difference between DFS and BFS.(like question no. 3).
5. Short notes on Graph traversal techniques. (like question 1,2,3)

LABORATORY EXPERIMENT:

1. WAP to implement DFS on a given graph (in Home Work Question no 2) where the graph is represented as a adjacent list.

CHAPTER: 9

Title: **Graph traversal algorithm**

CONTENTS

Graph traversal algorithms: Classification of edges with example.

Chapter Objectives: They are capable to make an algorithm and also explain properties of a graph on the basis of graph traversal techniques and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

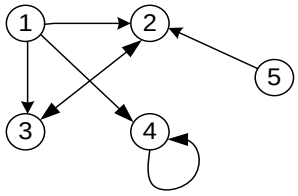
1. They are able to classify the edges in DFS tree.
2. They are able to know different types of edges.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the definition of different types of edges with examples. (Level 1)
2. How to classify the edges give an example. (Level 3)

HOME WORK:

1. Find out the DFS tree and classified the edges for the following Graph where start vertex is '1'.



Tutorial: 8

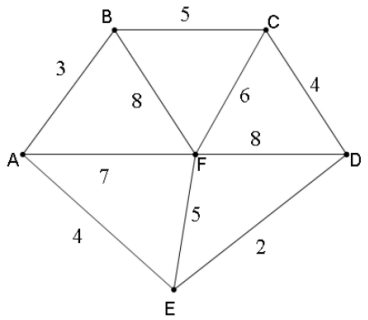
Title: Minimum Spanning Tree

1) Find out the minimum spanning tree for the following graphs (adjacent matrix with weight) using Prim's / Krukal's algorithm.

i)

-	1	∞	4	∞	∞	∞
1	-	2	6	4	∞	∞
∞	2	-	∞	5	6	∞
4	6	∞	-	3	∞	4
∞	4	5	3	-	8	7
∞	∞	6	∞	8	-	3
∞	∞	∞	4	7	3	-

ii)



CHAPTER: 10

Title: **String Matching**

CONTENTS

Basic idea on String Matching algorithm: naïve string matching algorithm

Topic/Unit/Chapter Objectives: They are capable to make an algorithm on the basis of string matching and judge the efficiency of the algorithm.

Broad Objectives of the chapter/topic are:

1. They are able to explain what is string algorithm matching with an example.
2. They are able to explain naïve string matching algorithm with example.
3. They are able to find out the running time complexity of naïve string matching algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the naïve string matching algorithm with an example. (Level 2)
2. Establish the running time complexity of naïve string matching algorithm. (Level 4)

HOME WORK: Not Required.

CHAPTER: 10

Title: **String Matching**

CONTENTS

Basic idea on String Matching algorithm: Knuth-Moris-Prat [KMP] string matching algorithm with example.

Topic/Unit/Chapter Objectives: They are capable to make an algorithm on the basis of string matching and judge the efficiency of the algorithm.

Broad Objectives of the chapter/topic are:

1. They are able to explain KMP algorithm with example.
2. They are able to find out the running time complexity of KMP algorithm.
3. They are able to know what is suffix and prefix with example.
4. They are able to know how to calculate the prefix function.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Write the KMP algorithm with an example. (Level 2)
2. Establish the running time complexity of KMP algorithm. (Level 4)
3. Give an example on prefix calculation.(Level 3)

HOME WORK:

1. Write the KMP algorithm with an example.(like question no. 1)
2. Compute the prefix function π for the pattern ababbabbabbababbabb where the alphabet is Σ = {a,b}. (like question no. 3)

LABORATORY EXPERIMENT:

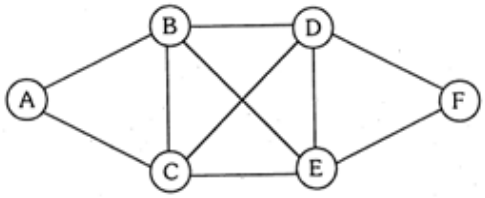
1. WAP to implement KMP algorithm for pattern matching.

Tutorial: 9

Title: **BFS & DFS**

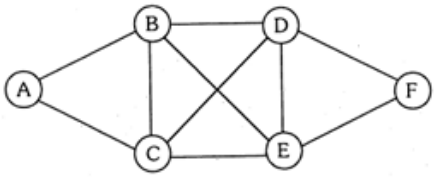
1) Find out the BFS tree for the given graph.

1.

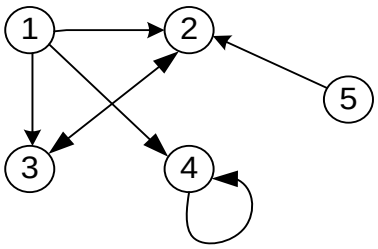


2) Find out the DFS tree for the given graph.

1.



3) Find out the DFS tree and classified the edges for the following Graph where start vertex is '1'.



CHAPTER: 11 Title: **Amortized Analysis**
CONTENTS Discuss short notes on Amortized Analysis.
Chapter Objectives: They are capable to judge the efficiency of the algorithm on average running time over per operation cost. **Broad Objectives of the chapter are:** 1. They are able to explain average running time per operation cost. 2. They are able to know the actual meaning of amortized analysis.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: 1. What is the actual meaning of amortized analysis? (Level 2)

CHAPTER: 11 Title: **Amortized Analysis**
CONTENTS Different techniques used in Amortized Analysis.
Chapter Objectives: They are capable to judge the efficiency of the algorithm on average running time over per operation cost. **Broad Objectives of the chapter are:** 1. They are able to classify different techniques used in amortized analysis. 2. They are able to explain different techniques with an example.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: 1. Describe aggregate analysis with an example? (Level 2) 2. Describe accounting method with an example? (Level 2) 3. Describe potential method with an example? (Level 2)
HOME WORK:

1. Write short notes on Amortized analysis.(like question no. 1,2,3)

CHAPTER: 15

Title: **Approximation Algorithm**

CONTENTS

Approximation algorithms: Only Short Notes.

Chapter Objectives: They are capable to understand the notion of Approximation algorithm.

Broad Objectives of the chapter are:

1. They are able to explain actual meaning of approximation algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Short notes on Approximation algorithm. (Level 4)

CHAPTER: 12

Title: **Network Flow**

CONTENTS

Basic idea on Network Flow with examples.

Chapter Objectives: They are capable to explain network flow and also measure the total flow of a network.

Broad Objectives of the chapter are:

1. They are able to explain about flow networks.
2. They are able to explain certain properties of a flow network.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. What is maximum flow network?
2. Describe three properties of a flow network with examples.

HOME WORK:

1. Write short notes on flow network.(like question no. 1,2)
2. What is the meaning of maximal flow problem?(like question no. 1)

CHAPTER: 12

Title: **Network Flow**

CONTENTS

Ford Fulkerson Algorithm with example.

Chapter Objectives: They are capable to explain network flow and also measure the total flow of a network.

Broad Objectives of the chapter are:

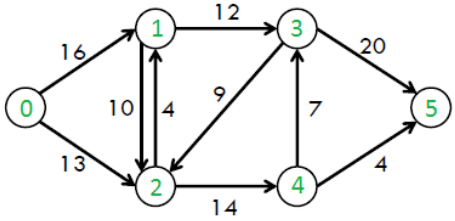
1. They are able to explain Residual network, Augmenting path, Cuts.
2. They are able to explain Ford Fulkerson algorithm of a flow network.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Explain Residual network, augmenting path and cuts with example.(Level 4)
2. Write Ford Fulkerson algorithm on network flow with example. (Level 2)

HOME WORK:

1. Short notes on Ford Fulkerson algorithm.
2. Find out the total flow for the given network using Ford Fulkerson.



CHAPTER: 12

Title: **Network Flow**

CONTENTS

Discuss on Max Flow Min cut Theorem and illustrate some examples.

Chapter Objectives: They are capable to explain network flow and also measure the total flow of a network.

Broad Objectives of the chapter are:

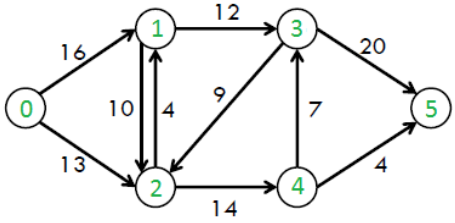
1. They are able to explain Residual network, Augmenting path, Cuts.
2. They are able to explain Max flow Min cut theorem with example.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Explain Residual network, augmenting path and cuts with example.(Level 4)
2. Write Max flow Min cut theorem with example. (Level 3)

HOME WORK:

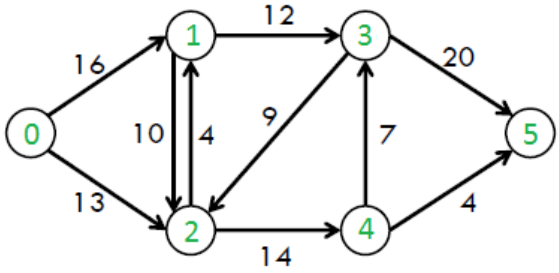
1. State Max flow Min cut theorem with example.
2. Use the Ford-Fulkerson algorithm to find the maximum flow for the following network. (Source : 0 & Sink: 5) and also find the cuts.



Tutorial: 10

Title: **Network Flow**

1) Use the Ford-Fulkerson algorithm to find the maximum flow for the following network. (Source : 0 & Sink: 5) and also find the cuts.



CHAPTER: 13

Title: **Matrix Manipulation Algorithm**

CONTENTS

Algorithms for solution of simultaneous equations using LUP decomposition.

Chapter Objectives: They are capable to make an algorithm on the basis of matrix manipulation and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain the computational procedure of LU decomposition.
2. They are able to explain LUP algorithm with examples.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Solve the equation by LUP decomposition. (Level 5)

$$\begin{bmatrix}1 & 5 & 4\\ 2 & 0 & 3\\ 5 & 8 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}12\\ 9\\ 5\end{bmatrix}$$

2. Write LUP algorithm with example. (Level 3)

HOME WORK:

1. Solve the equation by LUP decomposition. (like question no. 1)

$$\begin{bmatrix}1 & 5 & 4\\ 2 & 0 & 3\\ 5 & 8 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}12\\ 9\\ 5\end{bmatrix}$$

2. Solve the equation by LUP decomposition. (like question no. 1)

$$\begin{bmatrix}1 & 0 & 0\\ 4 & 1 & 0\\ -7 & 6 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}3\\ 14\\ -7\end{bmatrix}$$

CHAPTER: 13

Title: **Matrix Manipulation Algorithm**

CONTENTS

Inversion of Matrix with example.

Chapter Objectives: They are capable to make an algorithm on the basis of matrix manipulation and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to find out the inverse of a matrix using Gauss-Jordan's rule.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Find out inverse of a matrix using Gauss-Jordan's rule. (Level 5)

$$\begin{bmatrix} 1 & 5 & 4 \\ 2 & 0 & 3 \\ 5 & 8 & 2 \end{bmatrix}$$

HOME WORK:

1. Find out inverse of a matrix using Gauss-Jordan's rule. (like question no. 1)

$$\begin{bmatrix} 1 & 5 & 4 \\ 2 & 0 & 3 \\ 5 & 8 & 2 \end{bmatrix}$$

2. Find out inverse of a matrix using Gauss-Jordan's rule. (like question no. 1)

$$\begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ -7 & 6 & 1 \end{bmatrix}$$

CHAPTER: 13

Title: **Matrix Manipulation Algorithm**

CONTENTS

Strassen's Matrix Multiplication algorithm with example and analysis.

Chapter Objectives: They are capable to make an algorithm on the basis of matrix manipulation and judge the efficiency of the algorithm.

Broad Objectives of the chapter are:

1. They are able to explain the computational procedure of Strassen's Matrix Multiplication algorithm with an example.
2. They are able to explain the running time complexity of Strassen's Matrix Multiplication algorithm.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Find C=AB. (Level 5)

$$A=\begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 5 & 6 & 7 \\ 2 & 1 & 4 & 1 \\ 5 & 1 & 1 & 1 \end{pmatrix} and\ B = \begin{pmatrix} 3 & 1 & 2 & 1 \\ 3 & 1 & 1 & 2 \\ 4 & 1 & 2 & 2 \\ 1 & 1 & 1 & 3 \end{pmatrix}$$

2. Write short notes on Strassen's Matrix Multiplication algorithm. (Level 2)

HOME WORK:

1. Find C=AB. (like question no. 1)

$$A=\begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 5 & 6 & 7 \\ 2 & 1 & 4 & 1 \\ 5 & 1 & 1 & 1 \end{pmatrix} and\ B = \begin{pmatrix} 3 & 1 & 2 & 1 \\ 3 & 1 & 1 & 2 \\ 4 & 1 & 2 & 2 \\ 1 & 1 & 1 & 3 \end{pmatrix}$$

2. Calculate the running time complexity of Strassen's Matrix Multiplication algorithm. (like question no. 2)

Tutorial: 11

Title: LUP & Matrix Inversion

1) Solve the equation by LUP decomposition.

$$\begin{bmatrix}1 & 5 & 4\\ 2 & 0 & 3\\ 5 & 8 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}12\\ 9\\ 5\end{bmatrix}$$

2) Solve the equation by LUP decomposition.

$$\begin{bmatrix}1 & 0 & 0\\ 4 & 1 & 0\\ -7 & 6 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}3\\ 14\\ -7\end{bmatrix}$$

3) Find out the A^{-1} for the given A.

$$A=\begin{bmatrix}1 & 5 & 4\\ 2 & 0 & 3\\ 5 & 8 & 2\end{bmatrix}$$

4) Show that $AA^{-1} = I$. (relative to Q3)

CHAPTER: 14

Title: **Notion of NP Completeness**

CONTENTS

Complexity theory : P, NP, NP-hard class, NP-complete class

Chapter Objectives: They are capable to understand the notion of NP Completeness.

Broad Objectives of the chapter are:

1. They are able to explain P, NP, NP hard, NP Complete class.
2. They are able to explain relation between P, NP, NP hard class, NP Complete class.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: 1. Explain P, NP, NP hard, NP Complete class.(Level 4) 2. Write deterministic algorithm (like linear search) with example. (Level 5) 3. Write non deterministic algorithm (like linear search) with example. (Level 5)
HOME WORK: 1. Write non deterministic algorithm on sorting technique with an example. (like question no. 3) 2. Draw a ven diagram on P, NP, NP hard, NP Complete class. (like question no 1)

CHAPTER: 14 Title: **Notion of NP Completeness**
CONTENTS Discuss on optimization problems and Decision problems and relation between them.
Chapter Objectives: They are capable to understand the notion of NP Completeness. **Broad Objectives of the chapter are:** 1. They are able to explain verification algorithm. 2. They are able to explain polynomial-time verification algorithm. 3. They are able to explain polynomial time reduction. 4. They are able to clarify optimization versus decision algorithm.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: 1. What is polynomial-time verification algorithm? (Level 1) 2. What polynomial time reduction? (Level 1) 3. Convert graph coloring decision problem to optimization problem and vice versa. (Level 4)
HOME WORK: 1. Convert K-clique decision problem to optimization problem and vice versa.

CHAPTER: 14 Title: **Notion of NP Completeness**
CONTENTS SAT, 3-SAT problems

Chapter Objectives: They are capable to understand the notion of NP Completeness.

Broad Objectives of the chapter are:

1. They are able to explain Cook's Theorem.
2. They are able to explain SAT problem.
3. They are able to proof 3-SAT is NP complete.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

1. Explain Cook's theorem? (Level 2)
2. Describe SAT problem? (Level 2)
3. Prove that 3-SAT is NP complete. (Level 5)

CHAPTER: 14

Title: **Notion of NP Completeness**

CONTENTS

Clique decision problem

Chapter Objectives: They are capable to understand the notion of NP Completeness.

Broad Objectives of the chapter are:

1. They are able to explain Cook's Theorem.
2. They are able to explain K-Clique problem.
3. They are able to proof Clique decision problem is NP complete.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy:

4. Explain Cook's theorem? (Level 2)
5. Describe K-Clique problem? (Level 2)
6. Prove that Clique decision problem is NP complete. (Level 5)

QUIZ: Not Required.

Title: **Discussion on University QP(Last 5 Years)**
CONTENTS Last 5 years university question paper.
Topic/Unit/Chapter Objectives: we provide discussion on university question paper so that our students can clear their concept and their answers can be to the point. **Broad Objectives of the chapter/topic are:** 1. They are able to explain to analyze, investigate and evaluate. 2. They are able to judge how to apply theory.
Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy: **Discussion most of the university questions in last 5 years.**

SILIGURI INSTITUTE OF TECHNOLOGY

INFORMATION TECHNOLOGY

COURSE FILE

1ST SEM, 3RD YEAR, 2020

SEC – A/B

PAPER DESCRIPTION : SOFTWARE ENGINEERING

PAPER CODE : ESC501

Course File

Course Title : Software Engineering

Code : ESC501

Semester : 1ST semester **Year : 3RD** , 2020

Name of the Faculty: **Prof. Subrata De**

Internet Homepage: NA

E-mail : subratade34@gmail.com

Class Schedule			
Lecture			**Tutorial**
Tuesday – 10.00 am – 10.50 am	Thursday – 10.00 am – 10.50 am	Friday – 02.10 pm – 03.00 pm	**NA**

Hours for meeting students:	
Monday	1.30 pm to 2.10 pm
Wednesday	1.30 pm to 2.10 pm
Other days	By appointment

i) Course Objective

Students will be able to design good Software life cycle model for any software project. They will also be able to design using traditional approach as well as Object Oriented approach. They will be able to perform different level of Testing on any developed software. They will be able to perform project scheduling using Gantt chart and Pert chart. Finally, they will be able to design different UML diagrams.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Outcomes		Target
CO1	**Discuss** different Life Cycle Model.	65% marks
CO2	**Discuss** System design and traditional and object-oriented approach for System design.	65% marks
CO3	**Discuss** different Testing strategy.	65% marks
CO4	**Discuss** Software Project Management- Project Scheduling, Quality Assurance.	65% marks
CO5	**Discuss** static and dynamic models, different UML diagrams.	65% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	**Discuss** the Waterfall model with a schematic diagram and mention the advantages & disadvantages of this model.	2
2.	**Discuss** the phases of Spiral Model with advantages and disadvantages.	2
3.	**Discuss** different types of feasibility study.	2
4.	**Explain** basic COCOMO model and its application.	4
5.	**Explain** the difference between white box testing and black box testing.	4
6.	**Differentiate** between Error, Fault and Failure.	2
7.	**Explain** top-down and bottom-up integration testing strategies.	4
8.	**Discuss** the Stubs and Drivers in Integration Testing.	2
9.	**Describe** the differentiation between Quality Assurance and Quality Control.	1
10.	**Explain** McCall's quality triangle.	4

Software Engineering
ESC501
Contracts: 3L
Credits- 3
44L

UNIT - 1 (10L)

Overview of System Analysis & Design ,
Business System Concept, System Development Life Cycle,
Waterfall Model , Spiral Model, Feasibility Analysis,
Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

UNIT – 2(5L):

System Design – Context diagram and DFD,
Problem Partitioning, Top-Down And Bottom-Up design;
Decision tree, decision table and structured English;
Functional vs. Object- Oriented approach.

UNIT – 3 (12L):

Coding & Documentation (4L):
Structured Programming, OO Programming,
Information Hiding, Reuse, System Documentation.

Testing (8L):
Levels of Testing, Integration Testing,
Test case Specification, Reliability Assessment,
Validation & Verification, Metrics, Monitoring & Control.

UNIT - 4 (7L):

Software Project Management (7L):
Project Scheduling, Staffing,
Software Configuration Management,
Quality Assurance, Project Monitoring.

UNIT - 5(10L):

Static and dynamic models, why modeling, UML diagrams (10L):
Class diagram, interaction diagram: collaboration diagram,
sequence diagram, state chart diagram,
activity diagram, implementation diagram.

iii) Topic/Unit/Chapter Layout

Unit	Lecture Hours
UNIT - 1	10 hrs
UNIT – 2	5 hrs
UNIT – 3	12 hrs
UNIT – 4	7 hrs
UNIT – 5	10 hrs
Total	44 hrs

iv) Textbooks

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)

Reference books :

1. **Sommerville, Software Engineering – Pearson**
2. **Martin L. Shooman, Software Engineering – TMH**

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15
Quiz / assignment	10
Attendance	5
University Exam/External Exam	70
Total	100

* Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	40% of the students have attained more than the target level of that CO
Attainment Level 2	50% of the students have attained more than the target level of that CO
Attainment Level 3	60% of the students have attained more than the target level of that CO

Overall Course Attainment Target = 70% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs		
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.	3.
CO1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1
CO2	0	0	0	0	2	0	0	0	0	0	0	1	1	1	1
CO3	0	0	2	0	3	0	0	0	1	0	0	0	1	2	2
CO4	0	0	2	0	3	0	0	0	1	0	0	0	2	3	2
CO5	0	0	2	0	2	0	0	0	1	0	0	0	2	3	2
	0.0	0.0	1.4	0.2	2.4	0.0	0.0	0.0	0.6	0.0	0.0	0.0	1.4	2.0	1.6

(vii) Assessment Methodology

Outcomes	Assessment Tool
CO1	✓ First Internal Exam ✓ Assignment
CO2	✓ First Internal Exam ✓ Assignment
CO3	✓ First Internal Exam ✓ Assignment
CO4	✓ Assignment ✓ End of Semester Test
CO5	✓ Assignment ✓ End of Semester Test

(VIII) A. Weekly Lesson Plan

Week	Lectures	Assignment
1,2,3	Overview of System Analysis & Design, Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, COCOMO model.	1. Describe Classical Waterfall model and its iterative version. 2. Describe Spiral model and mention for which type of projects Spiral model is used.
4,5	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object-Oriented approach.	1. What is module in traditional design approach and in object oriented design approach. 2. Describe structure chart.

6,7,8	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. [4L] Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification 12 Metrics, Monitoring & Control.	1. Discuss different types of System Testing. 2. Explain regression testing.
9,10,11	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.	1. Explain CMM model. 2. Differentiate between quality assurance and quality control.
12, 13,14	Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.	
15	**Revision and MAKAUT Question Answer discussion.**	

(VIII) B. COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY: SUBRATA DE	DEPARTMENT :IT	SUBJECT CODE: ESC501	SEMESTER : 5TH

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)
1	**Introduction**		**10**		
	1.1	Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model.	05	14.08.2020 18.08.2020 20.08.2020 21.08.2020 25.08.2020	20.08.2020 21.08.2020 25.08.2020 27.08.2020 28.08.2020
	1.2	Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.	05	27.08.2020 28.08.2020 01.09.2020 03.09.2020 04.09.2020	01.09.2020 03.09.2020 04.09.2020 08.09.2020 10.09.2020
2	**System Design**		**05**		
	2.1	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design;	03	08.09.2020 10.09.2020 11.09.2020	11.09.2020 15.09.2020 18.09.2020
	2.2	Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	02	15.09.2020 18.09.2020	22.09.2020 24.09.2020
3	**Coding & Documentation**		**12**		
	3.1	Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.	02	22.09.2020 24.09.2020	25.09.2020 29.09.2020
	3.2	Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification, Metrics, Monitoring & Control.	10	25.09.2020 29.09.2020 01.10.2020 06.10.2020 08.10.2020 09.10.2020 13.10.2020 15.10.2020 16.10.2020 27.10.2020	01.10.2020 06.10.2020 08.10.2020 09.10.2020 13.10.2020 15.10.2020 16.10.2020 27.10.2020 29.10.2020 03.11.2020
4	**Software Project Management**		**7**		
	4.1	Project Scheduling, Staffing, Software Configuration Management.	04	29.10.2020 03.11.2020 05.11.2020 06.11.2020	05.11.2020 06.11.2020 10.11.2020 12.11.2020
	4.2	Quality Assurance, Project Monitoring.	03	10.11.2020 12.11.2020 13.11.2020	13.11.2020 24.11.2020 26.11.2020
5		**Static and dynamic models**	**10**		

	5.1	Static and dynamic models, why modeling	02	24.11.2020 26.11.2020	27.11.2020 01.12.2020
	5.2	UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.	08	27.11.2020 01.12.2020 03.12.2020 04.12.2020 08.12.2020 10.12.2020 11.12.2020 15.12.2020	03.12.2020 04.12.2020 08.12.2020 10.12.2020 11.12.2020 15.12.2020 17.12.2020 18.12.2020
44					

(IX) Teaching Strategy / Method

- **Learning** is a **memorization** technique based on repetition. The idea is that one will be able to quickly recall the meaning of the material the more one repeats it.
- Taking interactive classes through Power Point Presentation.
- Conducting question answer session at the end of the class.
- Providing real life examples for their better understanding.

(IXA) Strategy to support slow learner students

- Learning carefully to their doubts.
- **Enhance students' self-belief.**
- Some weak students also have a problem that they forget what they learn. In my class I always give some tips on how to recall and how to write systematically.
- Weak students need special attention, merging of weak students with bright students to solve some assignments.

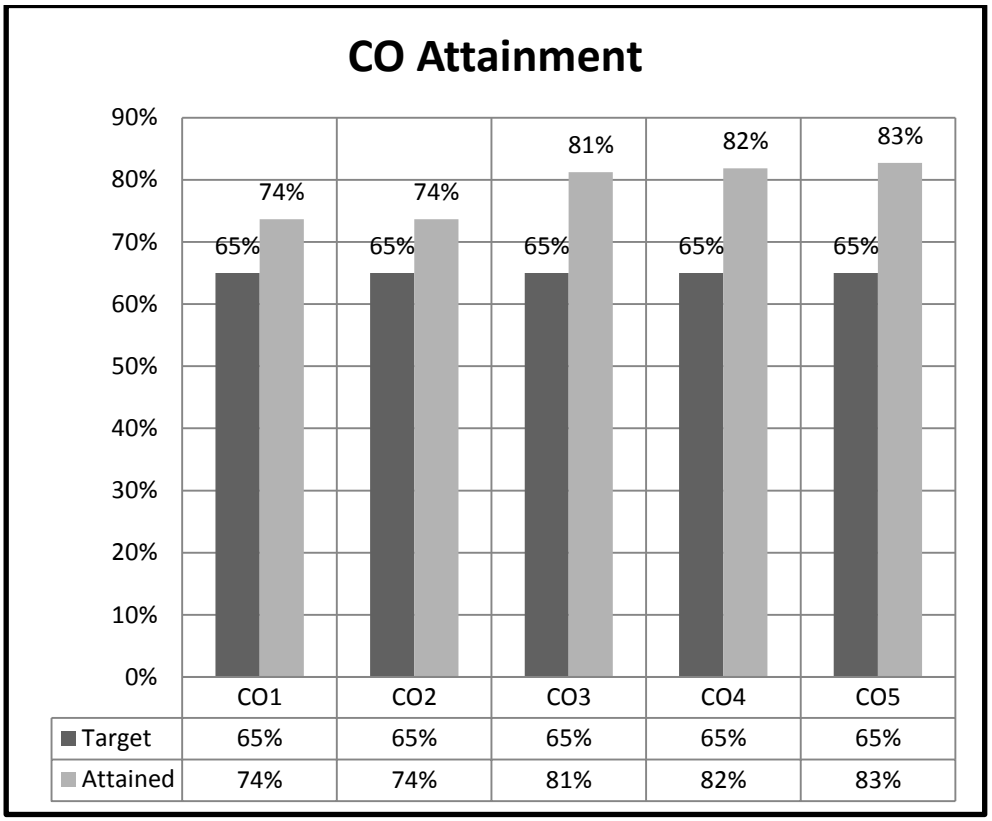
(IXB) Strategy to encourage bright students

1) Provide challenging problems to them.
2) Question answer session.
3) Motivate them to published research papers.

(X) Analysis of Students performance in the course

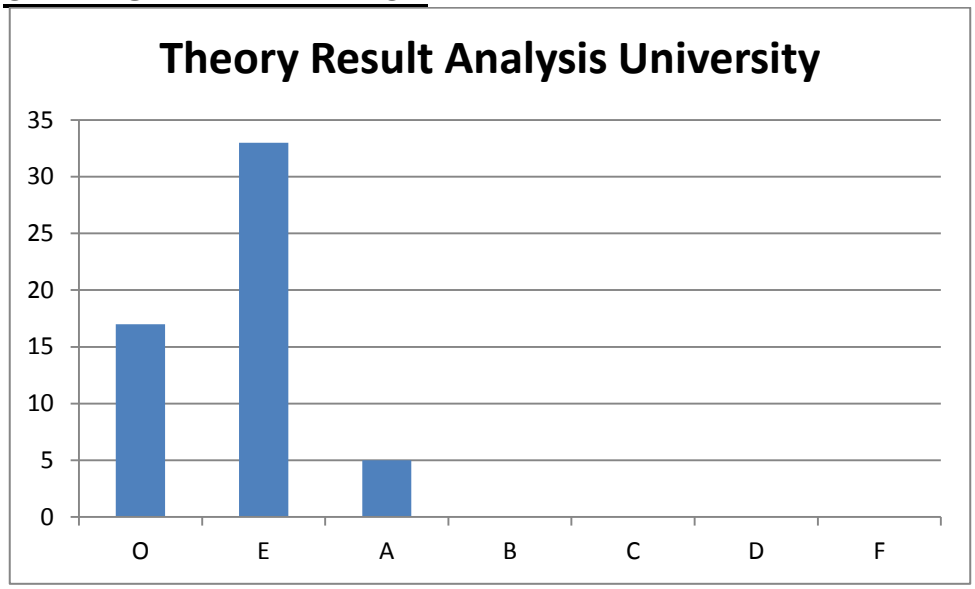
INTERNAL ASSESSMENT

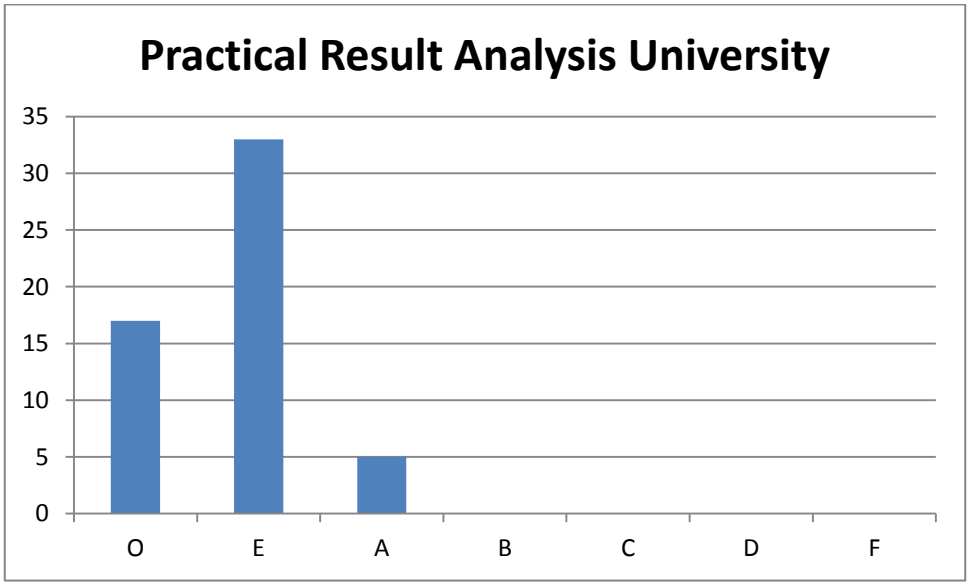
a) Analysis of Students performance in the course (internal) (seminars, tests, assignments, quiz, exam etc)



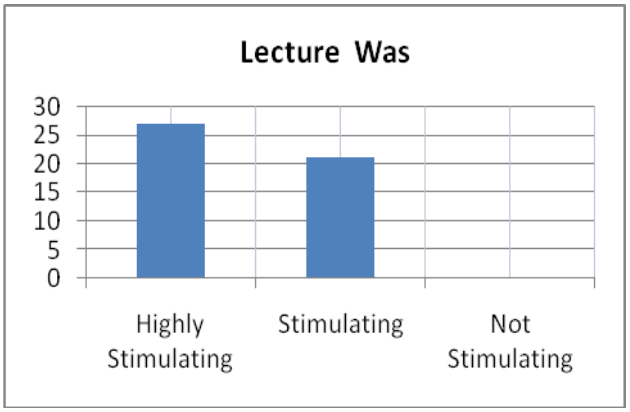
- 74% students have attained the set target of 65% marks for CO1
- 74% students have attained the set target of 65% marks for CO2
- 81% students have attained the set target of 65% marks for CO3
- 82% students have attained the set target of 65% marks for CO4
- 83% students have attained the set target of 65% marks for CO5

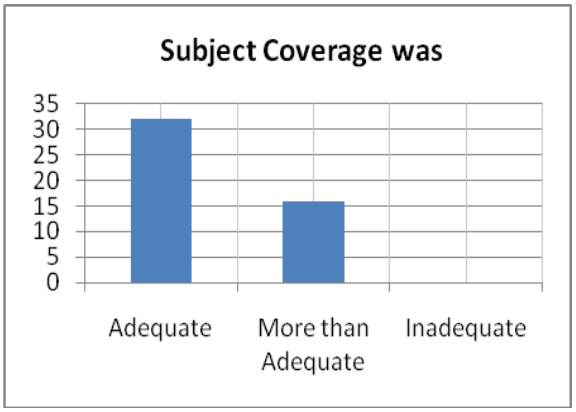
UNIVERSITY EXAMINATION

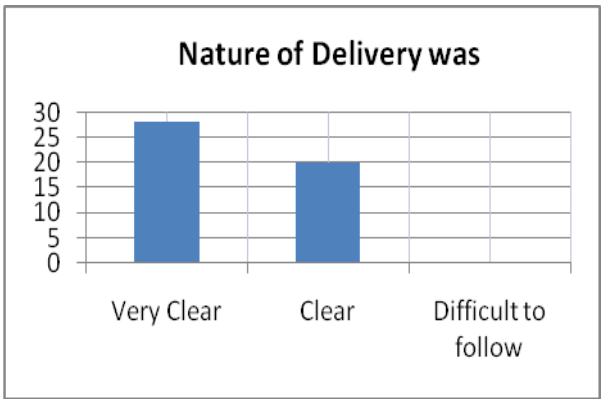


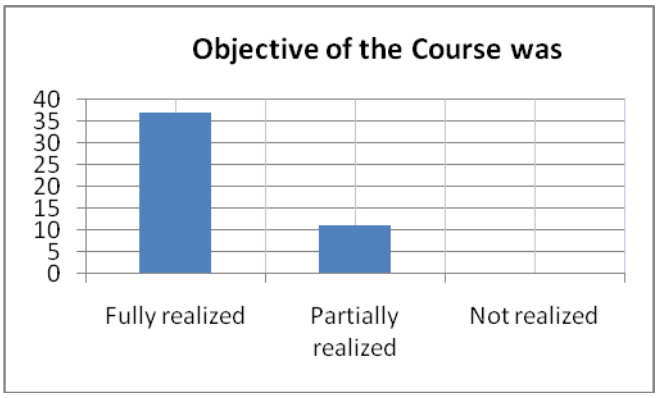


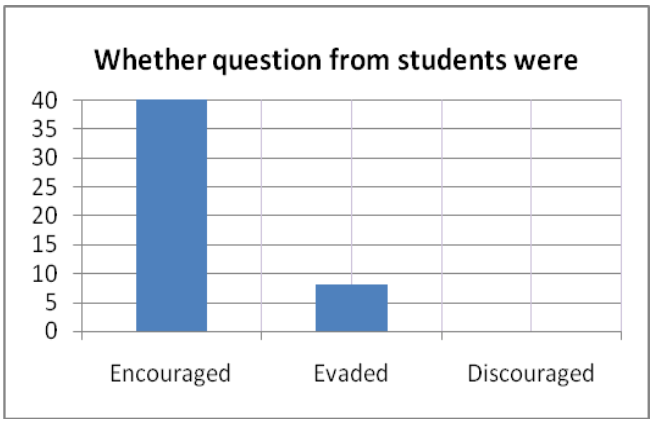
(XI) Analysis of Student Feed Back

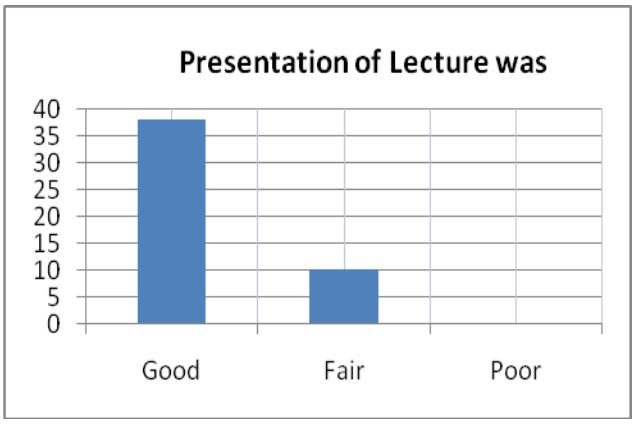












(XII) Teacher Self-Assessment (at the completion of course)

- All COs are successfully attained.
- Student performance is satisfactory.
- Students' feedback indicates that the course objective was adequate.

(XIII) Recommendations/Suggestions for improvement by faculty

CO2 should be focused in details. This portion has great impact in software industries.

INTERNAL ASSESMENT RECORD

Subject with code: Software Engineering (ESC501)
Section: A & B
Semester : 5 th
Discipline: INFORMATION TECHNOLOGY

SN	NAME	ROLL NO.	ATTENDANCE [5 MARKS]		MARKS IN INTERNAL EXAM [15]			ASSIGNMENT [10 MARKS] MARKS=[((I+II)/6]			TOTAL [30 MARKS]
			TOTAL %	MARKS	I	II	AVG/2	A-I [20]	A-II [40]	MARKS	
1	UJJWAL JHA	11900218001	91	4	22	23	11	16	36	9	24
2	TEJOSHMOY DUTTA	11900218002	82	3	24	20	11	14	30	7	21
3	SUDESHNA PAN	11900218003	82	3	11	10	5	11	26	6	14
4	SUBRATA ROY	11900218004	91	4	21	20	10	17	33	8	22
5	SUBHANKAR MAJI	11900218005	100	5	20	21	10	13	32	8	23
6	SUBHAJIT MANDAL	11900218006	91	4	23	22	11	18	29	8	23
7	SOURIK BASU	11900218007	100	5	26	26	13	17	32	8	26
8	SONU KUMAR	11900218008	100	5	20	22	11	12	36	8	24
9	SHUBHAM KUMAR	11900218010	82	3	23	24	12	16	31	8	23
10	SHIVAM RAJ	11900218011	82	3	20	18	10	13	33	8	21
11	SHIVAM KUMAR MISHRA	11900218012	82	3	22	24	12	18	34	9	24
12	SAUMYA SAGAR	11900218013	91	4	24	26	13	15	29	7	24
13	SAHIL PAL	11900218014	91	4	26	23	12	11	34	8	24
14	SAGAR PRASAD	11900218015	100	5	20	26	12	14	34	8	25
15	SAGAR LAMA TAMANG	11900218016	82	3	22	24	12	16	29	8	23
16	SAGAR DUTTA	11900218017	91	4	21	12	8	18	34	9	21
17	ROSHAN DARNAL	11900218018	82	3	12	9	5	9	22	5	13
18	RATNADEEP SHOME	11900218019	91	4	23	22	11	14	33	8	23
19	RAKTIMABHO GHOSH	11900218020	100	5	24	23	12	16	30	8	25
20	RAKESH GHOSH	11900218021	82	3	24	26	13	17	36	9	25
21	RAJOSHREE SAHA	11900218022	91	4	22	22	11	13	31	7	22
22	RAJA SAH	11900218023	91	4	21	18	10	17	27	7	21
23	RAHUL RAJ	11900218024	91	4	25	26	13	14	26	7	24
24	RAHUL DEB BARMAN	11900218025	91	4	24	19	11	16	27	7	22
25	RAHUL BISWAS	11900218026	82	3	18	24	11	15	25	7	21
26	PRITISH JHA	11900218027	91	4	17	18	9	14	32	8	21
27	PRITHVI RAJ	11900218028	82	3	24	16	10	20	31	9	22
28	PRITAM SHARMA	11900218029	82	3	23	27	13	17	32	8	24
29	PRAGYA JAISWAL	11900218030	82	3	24	24	12	16	26	7	22
30	NIPU CHANDRA DAS	11900218031	100	5	23	24	12	17	26	7	24
31	MUSKAN BANSAL	11900218032	82	3	9	8	4	9	18	5	12
32	KUSH OJHA	11900218033	82	3	19	18	9	13	31	7	19

INTERNAL ASSESMENT RECORD

Subject with code: Software Engineering (ESC501)
Section: A & B
Semester : 5 th
Discipline: INFORMATION TECHNOLOGY

SN	NAME	ROLL NO.	ATTENDANCE [5 MARKS]		MARKS IN INTERNAL EXAM [15]			ASSIGNMENT [10 MARKS] MARKS=[((I+II)/6]			TOTAL [30 MARKS]
			TOTAL %	MARKS	I	II	AVG/2	A-I [20]	A-II [40]	MARKS	
33	JAYDEEP DAS	11900218034	82	3	11	10	5	7	26	6	14
34	HARSHITA RICHA	11900218036	100	5	21	23	11	16	22	6	22
35	ESHA DAS	11900218037	100	5	19	26	11	17	34	9	25
36	DIPTIMAN MAJUMDAR	11900218038	91	4	23	24	12	10	27	6	22
37	DEEPRAJ PRADHAN	11900218039	91	4	22	22	11	15	26	7	22
38	DEEPJOY SARKAR	11900218040	91	4	22	22	11	17	28	8	23
39	DEBASHIS MISHRA	11900218041	82	3	22	26	12	15	24	7	22
40	BUDDHADEB JENA	11900218042	91	4	20	22	11	16	23	7	22
41	BRIJESH KUMAR CHOUDHURY	11900218043	82	3	7	10	4	11	20	5	12
42	AVROJYOTI DHAR	11900218044	82	3	20	24	11	18	29	8	22
43	ASHUTOSH KUMAR	11900218045	82	3	23	28	13	15	27	7	23
44	ARNAB ROY	11900218046	82	3	16	16	8	16	36	9	20
45	ARGHADIP BAGCHI	11900218047	100	5	22	23	11	18	26	7	23
46	APU SARKAR	11900218048	82	3	17	22	10	15	28	7	20
47	ANJAY KANT JHA	11900218049	82	3	12	7	5	9	14	4	12
48	ANINDITA SAHA PRAMANIK	11900218050	91	4	24	23	12	17	30	8	24
49	AMELIA DUTTA	11900218051	82	3	12	9	5	9	22	5	13
50	ABHISHIKTA BISWAS	11900218052	91	4	23	22	11	14	33	8	23
51	ABHIJIT DAS	11900219001	100	5	24	23	12	16	30	8	25
52	MADHURIMA DAS	11900219062	82	3	24	26	13	17	36	9	25
53	ALIVEA HAZRA	11900219063	91	4	22	22	11	13	31	7	22
54	PRANALI GIRI	11900219064	91	4	21	18	10	17	27	7	21
55	ANNYESHA BANERJEE	11900219065	91	4	25	26	13	14	26	7	24

ATTENDANCE SHEET (Lecture)

Subject with code: Software Engineering (ESC501) **Section:** A & B

Semester : 5th **Discipline:** INFORMATION TECHNOLOGY

Sl	Roll No.	Name	20.08.2020	21.08.2020	25.08.2020	27.08.2020	28.08.2020	01.09.2020	03.09.2020	04.09.2020	08.09.2020	10.09.2020	11.09.2020	15.09.2020	18.09.2020	22.09.2020	24.09.2020	25.09.2020	29.09.2020	01.10.2020	06.10.2020	08.10.2020	09.10.2020	13.10.2020	15.10.2020
1	11900218001	UJJWAL JHA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
2	11900218002	TEJOSHMOY DUTTA	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	11900218003	SUDESHNA PAN	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
4	11900218004	SUBRATA ROY	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
5	11900218005	SUBHANKAR MAJI	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1
6	11900218006	SUBHAJIT MANDAL	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0
7	11900218007	SOURIK BASU	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0
8	11900218008	SONU KUMAR	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1
9	11900218010	SHUBHAM KUMAR	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0
10	11900218011	SHIVAM RAJ	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1
11	11900218012	SHIVAM KUMAR MISHRA	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
12	11900218013	SAUMYA SAGAR	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
13	11900218014	SAHIL PAL	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
14	11900218015	SAGAR PRASAD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	11900218016	SAGAR LAMA TAMANG	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
16	11900218017	SAGAR DUTTA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	11900218018	ROSHAN DARNAL	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
18	11900218019	RATNADEEP SHOME	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
19	11900218020	RAKTIMABHO GHOSH	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	11900218021	RAKESH GHOSH	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
21	11900218022	RAJOSHREE SAHA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
22	11900218023	RAJA SAH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	11900218024	RAHUL RAJ	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
24	11900218025	RAHUL DEB BARMAN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	11900218026	RAHUL BISWAS	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
26	11900218027	PRITISH JHA	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
27	11900218028	PRITHVI RAJ	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	11900218029	PRITAM SHARMA	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0

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Sl	Roll No.	Name	20.08.2020	21.08.2020	25.08.2020	27.08.2020	28.08.2020	01.09.2020	03.09.2020	04.09.2020	08.09.2020	10.09.2020	11.09.2020	15.09.2020	18.09.2020	22.09.2020	24.09.2020	25.09.2020	29.09.2020	01.10.2020	06.10.2020	08.10.2020	09.10.2020	13.10.2020	15.10.2020
29	11900218030	PRAGYA JAISWAL	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
30	11900218031	NIPU CHANDRA DAS	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
31	11900218032	MUSKAN BANSAL	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	11900218033	KUSH OJHA	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
33	11900218034	JAYDEEP DAS	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	0
34	11900218036	HARSHITA RICHA	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
35	11900218037	ESHA DAS	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1
36	11900218038	DIPTIMAN MAJUMDAR	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1
37	11900218039	DEEPRAJ PRADHAN	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
38	11900218040	DEEPJOY SARKAR	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0
39	11900218041	DEBASHIS MISHRA	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	11900218042	BUDDHADEB JENA	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
41	11900218043	BRIJESH KUMAR CHOUDHURY	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
42	11900218044	AVROJYOTI DHAR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
43	11900218045	ASHUTOSH KUMAR	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
44	11900218046	ARNAB ROY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
45	11900218047	ARGHADIP BAGCHI	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
46	11900218048	APU SARKAR	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
47	11900218049	ANJAY KANT JHA	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	11900218050	ANINDITA SAHA PRAMANIK	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
49	11900218051	AMELIA DUTTA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
50	11900218052	ABHISHIKTA BISWAS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	11900219001	ABHIJIT DAS	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
52	11900219062	MADHURIMA DAS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
53	11900219063	ALIVEA HAZRA	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
54	11900219064	PRANALI GIRI	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
55	11900219065	ANNYESHA BANERJEE	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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Sl	Roll No.	Name	16.10.2020	27.10.2020	29.10.2020	03.11.2020	05.11.2020	06.11.2020	10.11.2020	12.11.2020	13.11.2020	24.11.2020	26.11.2020	27.11.2020	01.12.2020	03.12.2020	04.12.2020	08.12.2020	10.12.2020	11.12.2020	15.12.2020	17.12.2020	18.12.2020		TOTAL(%)
1	11900218001	UJJWAL JHA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
2	11900218002	TEJOSHMOY DUTTA	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
3	11900218003	SUDESHNA PAN	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
4	11900218004	SUBRATA ROY	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1		95
5	11900218005	SUBHANKAR MAJI	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1		82
6	11900218006	SUBHAJIT MANDAL	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1		91
7	11900218007	SOURIK BASU	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1		82
8	11900218008	SONU KUMAR	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1		86
9	11900218010	SHUBHAM KUMAR	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1		86
10	11900218011	SHIVAM RAJ	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1		82
11	11900218012	SHIVAM KUMAR MISHRA	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
12	11900218013	SAUMYA SAGAR	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1		95
13	11900218014	SAHIL PAL	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
14	11900218015	SAGAR PRASAD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
15	11900218016	SAGAR LAMA TAMANG	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1		91
16	11900218017	SAGAR DUTTA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
17	11900218018	ROSHAN DARNAL	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1		91
18	11900218019	RATNADEEP SHOME	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1		91
19	11900218020	RAKTIMABHO GHOSH	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		95
20	11900218021	RAKESH GHOSH	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1		86
21	11900218022	RAJOSHREE SAHA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
22	11900218023	RAJA SAH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
23	11900218024	RAHUL RAJ	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1		91
24	11900218025	RAHUL DEB BARMAN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
25	11900218026	RAHUL BISWAS	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1		91
26	11900218027	PRITISH JHA	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1		91
27	11900218028	PRITHVI RAJ	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		95
28	11900218029	PRITAM SHARMA	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1		86

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Sl	Roll No.	Name	16.10.2020	27.10.2020	29.10.2020	03.11.2020	05.11.2020	06.11.2020	10.11.2020	12.11.2020	13.11.2020	24.11.2020	26.11.2020	27.11.2020	01.12.2020	03.12.2020	04.12.2020	08.12.2020	10.12.2020	11.12.2020	15.12.2020	17.12.2020	18.12.2020		TOTAL(%)
29	11900218030	PRAGYA JAISWAL	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
30	11900218031	NIPU CHANDRA DAS	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
31	11900218032	MUSKAN BANSAL	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
32	11900218033	KUSH OJHA	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1		95
33	11900218034	JAYDEEP DAS	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1		82
34	11900218036	HARSHITA RICHA	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1		91
35	11900218037	ESHA DAS	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1		82
36	11900218038	DIPTIMAN MAJUMDAR	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1		86
37	11900218039	DEEPRAJ PRADHAN	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1		86
38	11900218040	DEEPJOY SARKAR	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1		82
39	11900218041	DEBASHIS MISHRA	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1		86
40	11900218042	BUDDHADEB JENA	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1		95
41	11900218043	BRIJESH KUMAR CHOUDHURY	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
42	11900218044	AVROJYOTI DHAR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
43	11900218045	ASHUTOSH KUMAR	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1		91
44	11900218046	ARNAB ROY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
45	11900218047	ARGHADIP BAGCHI	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1		91
46	11900218048	APU SARKAR	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1		91
47	11900218049	ANJAY KANT JHA	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		95
48	11900218050	ANINDITA SAHA PRAMANIK	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1		86
49	11900218051	AMELIA DUTTA	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1		82
50	11900218052	ABHISHIKTA BISWAS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
51	11900219001	ABHIJIT DAS	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1		91
52	11900219062	MADHURIMA DAS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		100
53	11900219063	ALIVEA HAZRA	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1		91
54	11900219064	PRANALI GIRI	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1		91
55	11900219065	ANNYESHA BANERJEE	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1		95

Records of Assignment

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Sl	Roll No.	Name	Assignment - I	Assignment - II
1	11900218001	UJJWAL JHA	1	1
2	11900218002	TEJOSHMOY DUTTA	1	1
3	11900218003	SUDESHNA PAN	1	1
4	11900218004	SUBRATA ROY	1	1
5	11900218005	SUBHANKAR MAJI	1	1
6	11900218006	SUBHAJIT MANDAL	1	1
7	11900218007	SOURIK BASU	1	1
8	11900218008	SONU KUMAR	1	1
9	11900218010	SHUBHAM KUMAR	1	1
10	11900218011	SHIVAM RAJ	1	1
11	11900218012	SHIVAM KUMAR MISHRA	1	1
12	11900218013	SAUMYA SAGAR	1	1
13	11900218014	SAHIL PAL	1	1
14	11900218015	SAGAR PRASAD	1	1
15	11900218016	SAGAR LAMA TAMANG	1	1
16	11900218017	SAGAR DUTTA	1	1
17	11900218018	ROSHAN DARNAL	1	1
18	11900218019	RATNADEEP SHOME	1	1
19	11900218020	RAKTIMABHO GHOSH	1	1
20	11900218021	RAKESH GHOSH	1	1
21	11900218022	RAJOSHREE SAHA	1	1
22	11900218023	RAJA SAH	1	1
23	11900218024	RAHUL RAJ	1	1
24	11900218025	RAHUL DEB BARMAN	1	1
25	11900218026	RAHUL BISWAS	1	1
26	11900218027	PRITISH JHA	1	1
27	11900218028	PRITHVI RAJ	1	1
28	11900218029	PRITAM SHARMA	1	1

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Subject with code: Software Engineering (ESC501) **Section:** A & B

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Sl	Roll No.	Name	Assignment - I	Assignment – II
29	11900218030	PRAGYA JAISWAL	1	1
30	11900218031	NIPU CHANDRA DAS	1	1
31	11900218032	MUSKAN BANSAL	1	1
32	11900218033	KUSH OJHA	1	1
33	11900218034	JAYDEEP DAS	1	1
34	11900218036	HARSHITA RICHA	1	1
35	11900218037	ESHA DAS	1	1
36	11900218038	DIPTIMAN MAJUMDAR	1	1
37	11900218039	DEEPRAJ PRADHAN	1	1
38	11900218040	DEEPJOY SARKAR	1	1
39	11900218041	DEBASHIS MISHRA	1	1
40	11900218042	BUDDHADEB JENA	1	1
41	11900218043	BRIJESH KUMAR CHOUDHURY	1	1
42	11900218044	AVROJYOTI DHAR	1	1
43	11900218045	ASHUTOSH KUMAR	1	1
44	11900218046	ARNAB ROY	1	1
45	11900218047	ARGHADIP BAGCHI	1	1
46	11900218048	APU SARKAR	1	1
47	11900218049	ANJAY KANT JHA	1	1
48	11900218050	ANINDITA SAHA PRAMANIK	1	1
49	11900218051	AMELIA DUTTA	1	1
50	11900218052	ABHISHIKTA BISWAS	1	1
51	11900219001	ABHIJIT DAS	1	1
52	11900219062	MADHURIMA DAS	1	1
53	11900219063	ALIVEA HAZRA	1	1
54	11900219064	PRANALI GIRI	1	1
55	11900219065	ANNYESHA BANERJEE	1	1

SILIGURI INSTITUTE OF TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

COURSE FILE

6TH SEM, 3RD YEAR, 2020

SEC – ALL

PAPER DESCRIPTION : DATA WAREHOUSING AND DATA MINING

PAPER CODE : PEC IT 602B

Course File

Course Title : DATAWARE HOUSING AND DATA MINING

Code : PEC CS 602B

Semester ___6TH_ Year Third

Name of the Faculty: Mrs. Sampa Das

Internet Homepage:

E-mail : sampa.sit@gmail.com

Lecture		
MON 12:30 PM TO 01:20PM	MON 12:00 PM TO 01:20PM	FRI 10:50 AM TO 11:40AM

Hours for meeting students:	
MONDAY	04:40 TO 05:15
WEDNESDAY	04:40 TO 05:15
THRUSHDAY	04:40 TO 05:15

i) Course Objective

To provide a thorough understanding of the internals of Compiler Design.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
PEC-IT602B.1	**Describe** the basic concept of data warehousing.(BT Level 1)	60% marks
PEC-IT602B.2	**Explain** data warehouse architecture and infrastructure.(BT Level 4)	60% marks
PEC-IT602B.3	**Identify** different data mining tools to analyze data.(BT Level 1)	60% marks
PEC-IT602B.4	**Make** decision from classified data .(BT Level 4)	60% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform / demonstrate the following:

Sl.	Question	CO
1.	**What** do you understand by Data warehouse?	CO 1
2.	How you **identify** the business requirements' of data warehouse?	CO 1
3.	**Explain** the architectural plan and architectural components of data warehouse?	CO1
4.	What do you **understand** about metadata?	CO3
5.	How to **create** different type of data design?	CO2
6.	**Compare** different types of data design?	CO1
7.	**Identify** different types of data extraction, transformation and loading?	CO 4
8.	**Explain** about data quality?	CO 4
9.	**Compare** between information from data warehouse verses operational system?	CO 4
10.	**Defining** information delivery process?	CO 1
11.	**Describing** and **comparing** about OLAP in data warehouse?	CO 2
12.	**Defining** about OLAP and WEB in data warehouse?	CO 2
13.	**Describe** about data mining?	CO 2
14.	How to **apply** data mining in data warehouse?	CO 3

iii) Topic/Unit/Chapter Layout

SN	Unit Mapping	CONTENT	Lecture Required
1	**Unit-I**	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods .	8
2	**Unit-II**	Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	8
3	**Unit-III**	Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis	9
4	**Unit-IV**	Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; modulation for communication, filtering, feedback control systems.	11
5	**Unit-V**	Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	9
6	**Unit-VI**	Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	5

iii) Topic/Unit/Chapter Layout

Chapter No.	Lecture Hours
Unit - 1	8HRS
Unit – 2	8 HRS
Unit – 3	8 HRS
Unit – 4	9 HRS
Unit – 5	11HRS
Unit – 6	9HRS
Total	49 HRS

iv)Textbooks

1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India

Reference Books:

1. Data Warehousing, Data Mining, & OLAP – Second Edit ion by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education

2. Data warehouse Toolkit by Ralph Kimball, Wiley India

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	40% of the students have attained more than the target level of that CO
Attainment Level 2	50% of the students have attained more than the target level of that CO
Attainment Level 3	60% of the students have attained more than the target level of that CO

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes (PO's)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEC IT602B.1	1	-	1	-	-	-	-	-	-	-	-	-	1	-
PEC IT602B..2	1	2	2	-	-	--	-	-	-	-	-	-	1	1
PEC IT602B..3	1	2	-	-	-	-	-	-	-	-	-	-	2	-
PEC IT602B..4	1	2	2	-	-	--	-	-	-	-	-	-	2	1
PEC-IT 602B	1	2	1.6	-	-	-	-	-	-	-	-	-	1.5	1

1 = courses in which the student will be exposed to a topic (BT level 1& 2)
2 = courses in which students will gain competency in that area (BT level 3-4)
3= courses in which students will master that skill (BT level 5-6)

(vii) Assessment Methodology

Outcome	Assessment Tool
PEC IT602B..**1**	Internal Test, Quiz, University Exam,

PEC IT602B..**2**	Term Paper, Mini Project, PPT Presentation
PEC IT602B..**3**	
PEC IT602B..**4**	

(VIII) A. Weekly Lesson Plan

Weeks	Lectures	Assignments/Quiz
1	Discussion on course outcome and program outcome, Overview of Data warehousing.	-----
2	Business requirements of Data warehousing.	--------
3	Data warehouse Architectural Types and their components.	Assignment-I
4	Infrastructure of data warehouse	Quiz-I
5	Metadata types and their functional areas	-------
6	Data Design in data warehouse.	--------
7	Dimensional modeling	----------
8	Different schema, Dimension Table and Fact Table.	Quiz-II
9	Data Quality	-----
10	Overall concept of Online Analytical Processing (OLAP).	Assignment-II
11	Data warehouse and web.	-----
12	Overview of Data mining and Data Mining Applications.	-- ----

(VIII) B. COMBINED DAILY LESSON PLAN & EXECUTION REPORT

CHAPTER / UNIT	Topic Description (to be quoted from syllabus)	No. of Lectures	Plan Date(s)	Execution Date(s)	Tick if completed YES/NO	HomeWork/ Assignment/ Quiz
I						
UNIT-I	Introduction to Data Warehousing;	**1**	12/04/21	21/04/21		
	Introduction to Data Mining	**1**	18/04/21	21/04/21		

	Mining frequent patterns	**1**	18/04/21	21/04/21		
	Mining frequent patterns		21/04/21	24/04/21		
	association and correlations		24/04/21	25/04/21		
	association and correlations		25/04/21	28/04/21		
	Sequential Pattern Mining concepts		2/08/21	24/04/21		
	primitives, scalable methods		24/04/21	25/04/21		
	Assessment on this CHAPTER - I	--	25/04/2	28/04/21		Quiz
II						
UNIT	Classification and prediction	**1**	28/04/21	31/04/21		
	Cluster Analysis – Types of Data in Cluster Analysis	**1**	03/05/21	04/05/21		Homework
	Partitioning methods	**1**	04/05/21	07/05/21		
	Partitioning methods		10/05/21	14/05/21		
	Hierarchical Methods		18/05/21	/04/21		
	Hierarchical Methods	**1**	03/05/21	04/05/21		
	Transactional Patterns and other temporal based frequent patterns	**1**	04/05/21	07/05/21		
	Transactional Patterns and other temporal based frequent patterns	**1**	11/05/21	14/05/21		
	Assessment on this CHAPTER - II	--				Assignment
III						
UNIT	Mining Time series Data	**1**	12/05/21	14/05/21		
	Mining Time series Data	**1**	18/05/21	18/05/21		
	Periodicity Analysis for time related sequence data		19/05/21	18/09/21		
	Periodicity Analysis for time related sequence data	**1**	21/04/21	25/04/21		
	Trend analysis	**1**	25/05/21	26/05/21		Homework

	Similarity search in Time-series analysis	**1**	26/05/21	28/05/21		
	Similarity search in Time-series analysis	**1**	26/05/21	28/05/21		
	Assessment on this CHAPTER - III	**--**				Assignment
IV						
UNIT	Mining Data Streams	**1**	01/06/21	02/06/21		
	Methodologies for stream data processing and stream data systems		02/06/21	04/06/21		
	Frequent pattern mining in stream data	**1**	08/06/21	09/06/21		
	Sequential Pattern Mining in Data Streams	**1**	09/06/21	11/06/21		
	Classification of dynamic data streams		15/06/21	18/06/21		
	Class Imbalance Problem		16/06/21	21/06/21		
	Graph Mining		18/06/21	22/06/21		
	Social Network Analysis		22/06/21	24/06/21		
	modulation for communication		24/06/21	28/06/21		
	filtering, feedback control systems		28/06/21	29/06/21		
	Assessment on this CHAPTER - IV	--				Quiz
V						
UNIT	Web Mining, documents and web usage mining;	**1**	29/06/21	01/07/21		
	Mining the web page layout structure,		01/07/21	05/07/21		
	mining web link structure,		05/07/21	06/07/21		
	mining web link structure,		06/07/21	08/07/21		

	mining multimedia data on the web,		08/07/21	15/07/21		
	Automatic classification of web documents and web usage mining		13/07/21	19/07/21		
	Automatic classification of web documents and web usage mining		15/07/21	20/07/21		
	Distributed Data Mining		19//07/21	22/07/21		
	Distributed Data Mining		20/06/21	26/07/21		
	Assessment on this CHAPTER - V	--				Quiz
VI						
UNIT	Recent trends in Distributed Warehousing and Data Mining,	**1**	22/07/21	27/07/21		
	Class Imbalance Problem;	**1**	26/07/21	29/07/21		
	Graph Mining;	**1**	27/07/21	02/08/21		
	Social Network Analysis	**1**	29/07/21	03/08/21		Homework
	Assessment on this CHAPTER - VI	--				Quiz
Last 5 years question paper discussion						

(IX) Teaching Strategy / Method

1. Detailed use of blackboard
2. Good oratory skill with clearly audible volume of lecture
3. Interactive classroom
4. Always encouraging the students to ask questions
5. Use of practical examples or similar models to illustrate the topics.

(IXA) Strategy to support weak students

1. Paying attention to their problems in understanding the subject
2. Encouraging them to express their point of trouble
3. Allotting extra time beyond schedules class hours to help them understand the topics
4. Suggesting them different ways (as found suitable depending upon the case) to overcome their problem.

(IXB) Strategy to encourage bright students

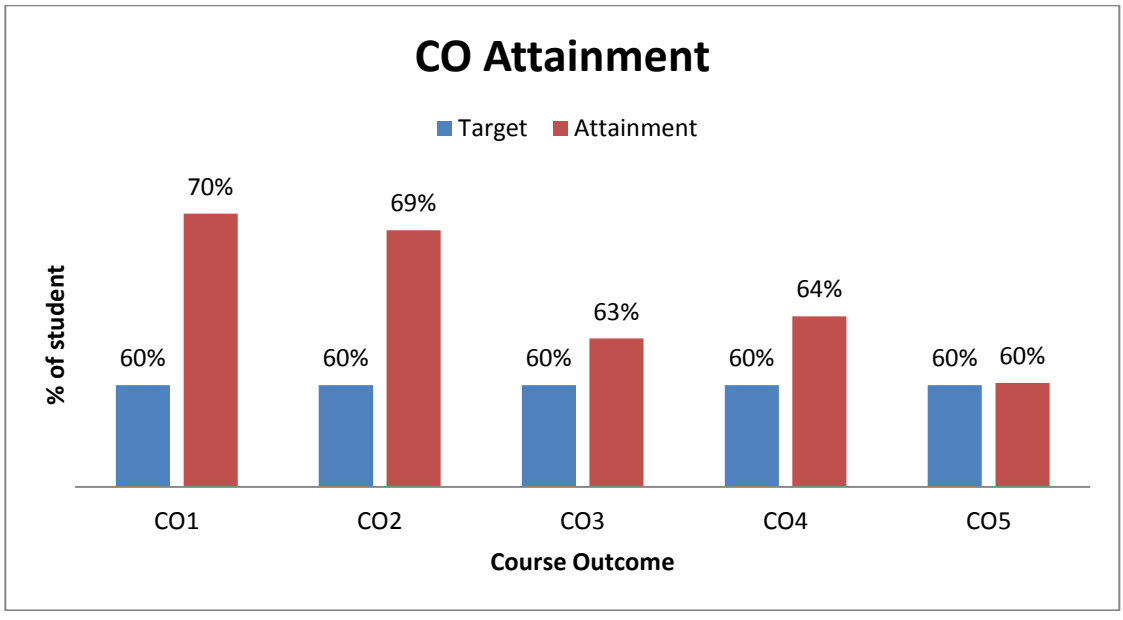
1. Try to encourage them to study beyond the syllabus
2. Ask them to develop the habit of reading anything good and rich in content
3. Advise them to try and solve higher level engineering numerical problems.

(IXC) Efforts to keep students engaged

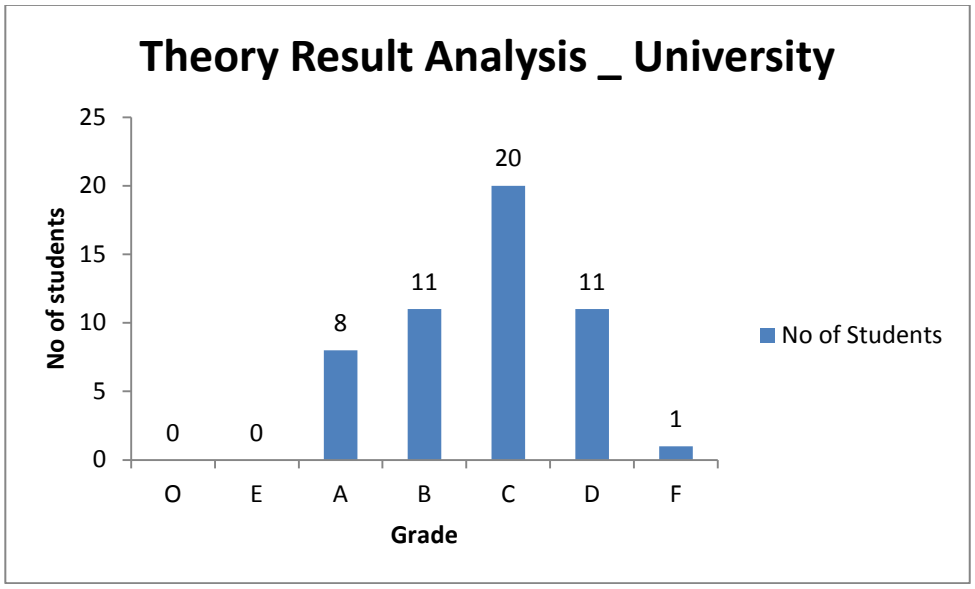
1. During class to avoid monotony some aptitude problems are given to solve.
2. Asking random questions to the students from the topic
3. Sometimes different tricks or techniques are shown to them to make the lecture interesting.
4. Informal technical quiz is also held.

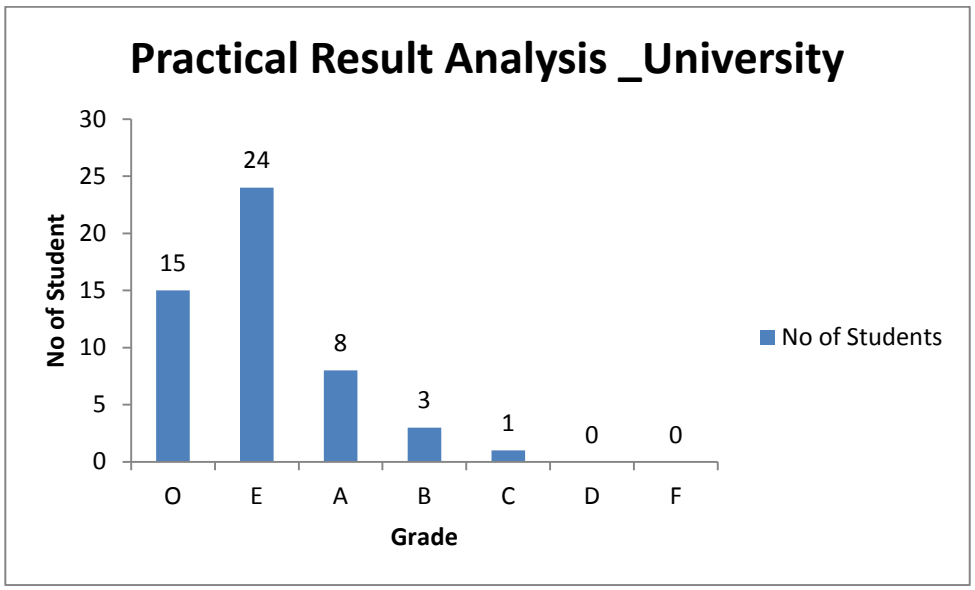
(X) Analysis of Students performance in the course

INTERNAL ASSESSMENT

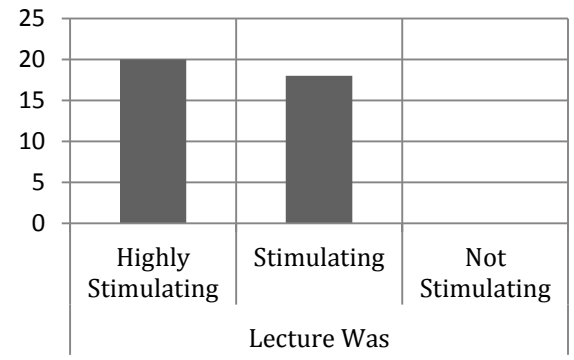


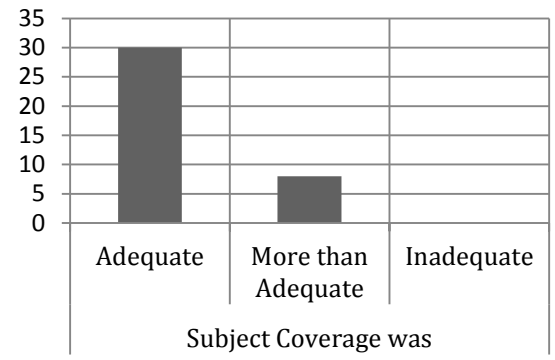
UNIVERSITY EXAMINATION

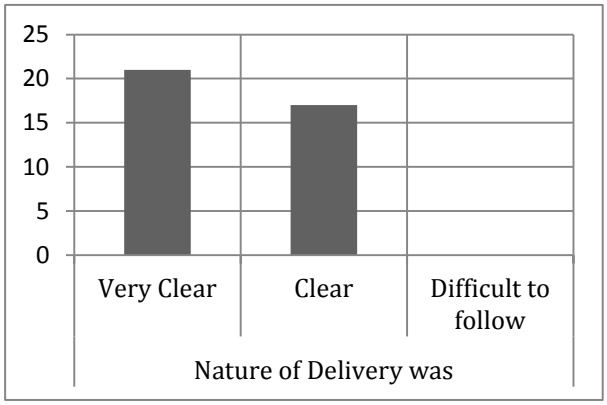


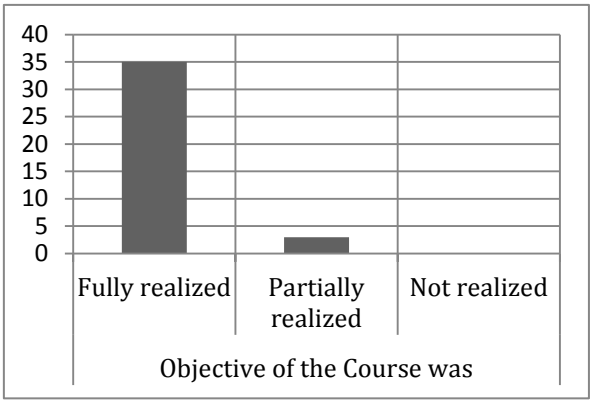


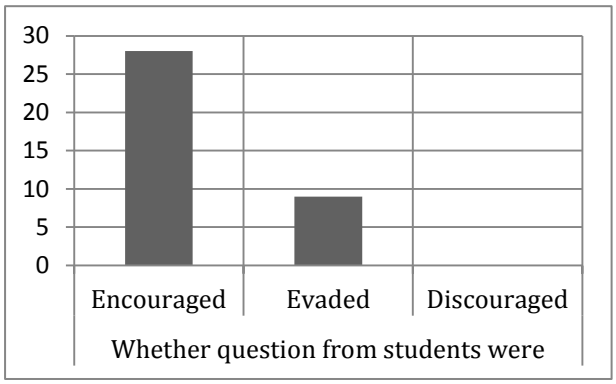
(XI) Analysis of Student Feed Back

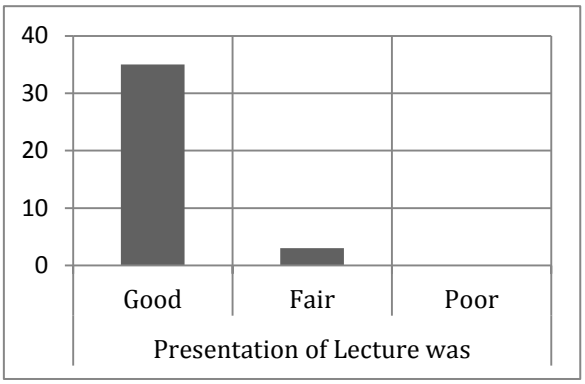












(XII) Teacher Self-Assessment (at the completion of course)

From the analysis of the results obtained it can be seen that set targets for the course outcome have been achieved successfully by the students..

(XIV) Recommendations/Suggestions for improvement by faculty

During the execution of course I felt there is a need regular tutorials to substantiate the theoretical lectures hence I recommit tutorial may be incorporated in the syllabus.

INTERNAL ASSESMENT RECORD

Subject with code:_____PEC-IT602B_____ Section:__SEC A___

Semester :___6TH___ Discipline:__CSE_____

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
1	11900118011	TUHIN MOHURY	30	5	11	12	11.5	9	25.5
2	11900118012	TIRTHA GHOSH	25	5	5	11	8	9	22
3	11900118013	SWETA KUMARI DAS	26	5	14	15	14.5	9	28.5
4	11900118014	SWARNALI CHAKRABORTY	30	5	9	14	11.5	9	25.5
5	11900118015	SWARAJ GUPTA	32	5	12	14	13	9	27
6	11900118016	SUBHAM KUMAR SAHANI	35	5	15	14	14.5	9	28.5
7	11900118017	SUSHANT SAH	33	5	10	12	11	9	25
8	11900118018	SURYA PRAKASH YADAV	31	5	6	13	9.5	9	23.5
9	11900118019	SUBHAM CHATTERJEE	31	5	14	13	13.5	9	27.5
10	11900118020	SUBHAM AGARWAL	32	5	12	13	12.5	9	26.5
11	11900118021	SUBHADEEP KUNDU	34	5	15	12	13.5	9	27.5
12	11900118022	SOUVIK ROY	22	5	11	12	11.5	9	25.5
13	11900118023	SOURAV BHOWMIK	20	5	13	11	12	9	26
14	11900118024	SOHAM MAJUMDAR	15	5	10	10	10	9	24
15	11900118025	SNEHASISH SAHA	24	5	10	10	10	9	24
16	11900118026	SHREYASHI MRIDHA	25	5	10	10	10	9	24
17	11900118027	SHREYASHI KAR	22	5	11	9	10	9	24
18	11900118028	SHREYA ACHARJEE	26	5	9	9	9	9	23
19	11900118029	SHIV GOPAL VERMA	28	5	8	14	11	9	25
20	11900118030	SHARLEE SAHA	28	5	7	12	9.5	9	23.5
21	11900118031	SAYANTAN GHOSH	28	5	8	8	8	9	22
22	11900118032	SAURAV SUMAN	29	5	8	8	8	9	22
23	11900118034	SAPTARSHI ROY	11	3	8	12	10	9	22
24	11900118035	SALINEE AICH	15	5	14	13	13.5	9	27.5
25	11900118036	SAIDURZZAMAN MONDAL	28	5	14	11	12.5	9	26.5
26	11900118037	SAHIL PRADHAN	29	5	14	13	13.5	9	27.5
27	11900118038	SAHELI DAS	27	5	14	11	12.5	9	26.5
28	11900118039	SAGAR SARKAR	25	5	14	12	13	9	27
29	11900118040	RUPANKAR CHAKRABORTY	33	5	15	12	13.5	9	27.5
30	11900118041	ROHIT GOYAL	34	5	12	9	10.5	9	24.5
31	11900118042	ROHAN KUMAR SHAH	21	4	1	9	5	9	18
32	11900118043	RISHABH KUMAR	25	5	11	11	11	9	25
33	11900118044	RANJAN KUMAR	26	5	12	10	11	9	25

34	11900118045	RAKESH RANJAN	25	5	12	10	11	9	25
35	11900118046	RAHUL SINGH	25	5	13	12	12.5	9	26.5
36	11900118047	RAHUL CHAKRABORTY	2	5	11	13	12	9	26
37	11900118048	PULAK KUMAR ROY	5	5	14	12	13	9	27
38	11900118049	PRITAM KUMAR MONDAL	2	5	15	11	13	9	27

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks
1	6th	PEC-IT 602B	6	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that…Sampa Das….has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY
COMPUTER SCIENCE & ENGINEERING

COURSE FILE

2ND SEM, 3RD YEAR, 2020

SEC – B

PAPER DESCRIPTION : Database Management System

PAPER CODE : CS 601 & CS 691

Course File

Course Title: Database Management System

Code : CS 601 & CS691

Semester:- 6th **Year:-** 3rd

Name of the Faculty: Prof. Jayashree Singha

Internet Homepage:

E-mail : jaysin31m85@gmail.com

Class Schedule				
Lecture				Practical
Monday 10:50 AM – 11:40 AM	**Wednesday** 10:00 AM – 10:50 AM	**Thursday** 11:40 AM - 12:30 PM	**Friday** 2.10 PM -3.00 PM	**Monday** 2:10 PM – 4:40 PM (B1) **Wednesday** 2:10 PM – 4:40 PM (B2)

Hours for meeting students:
Monday to Friday 4.40 PM -5.30 PM

i) Course Objective

Students will be able to design normalized database and apply it to build secure and efficient applications.

ii) Course Outcomes

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

		Target
CS 601.1	Understand the fundamental concepts of database system and Entity-Relationship (E-R) model and relate an E-R schema to relation schema. [BT - Level – 2]	60% Marks
CS 601.2	Identify query processing methodologies of Relational Algebra, Relational Calculus and query optimization techniques and apply them to write optimal queries. [BT - Level – 3]	60% Marks
CS 601.3	Construct simple and moderately advanced database queries using SQL and PL/SQL blocks for ensuring data integrity and security. [BT - Level –4]	60% Marks
CS 601.4	Understand the concepts of normalization and apply such knowledge to the normalization of a database; and be able to identify basic database storage structures and access techniques. [BT - Level – 3]	60% Marks

CS 601.5	Explain the basic issues of transaction processing, concurrency control and recovery mechanisms in applications. [BT - Level – 2]	60% Marks

i. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform / demonstrate the following:

Sl.	Question	CO
1.	What do you understand by database and database management system?	1
2.	Explain the 3-schema architecture of DBMS. How are these different schema layers related to the concepts of logical and physical data independence?	1
3.	What do you understand by physical and logical data independence and why are they important?	1
4.	Describe the role of DBA.	1
5.	Explain the following terms briefly: attribute, domain, entity, relationship, entity set, relationship set, one-to-many relationship, many-to-many relationship, participation constraint, overlap constraint, covering constraint, weak entity set, specialization, generalization, aggregation, and role indicator.	1
6.	Describe a banking system database with the help of suitable ERD.	1
7.	Use mathematical notations of relational algebra to express a database query. Consider the following tables: SUPPLIER (SUPPLIER _ID, SUPPLIER_NAME, SUPPLIER_ADDRESS) PARTS (PART_ID, PART_NAME, COLOR) CATALOG (SUPPLIER_ID, PART_ID, COST) Write the following queries in Relational Algebra based on above mentioned tables: a. Find names of the suppliers who supply 'YELLOW' parts. b. Find names of the suppliers who supply both 'BLUE' and 'RED' parts. c. Find name of the supplier who supply all parts.	2
8.	Use mathematical notations of relational calculus to express a database query. Consider the following tables: EMPLOYEE (EMPLOYEE_NO, EMPLOYEE_NAME, CITY) WORKS (EMPLOYEE_NO, COMPANY_NAME, SALARY) Write the following query in Tuple and Domain Relational Calculus: Find the name and city of residence of all employees who work for TCS Company.	2
9.	Construct simple and nested queries on a given database system using SQL. Consider the following tables: EMPLOYEE (EMP_CODE, EMP_NAME, DESIGNATION, HEAD, DOJ, BASIC, DEPT_CODE) DEPARTMANT (DEPT_CODE, DEPT_NAME, LOCATION) Write the following queries in SQL	3

	a. List the names of the employees who are earning more than the lowest salary of an employee in department 30. b. List of only those DEPT_CODE where the total salary is greater than 20000. c. List the names of those employees whose names either starts or ends with 'S'. d. List the names of the employees along with the name of the people under whom they are working.	
10.	Explain the concepts of functional dependency, multivalued dependency and join dependency.	4
11.	Find the closure of the following set F of functional dependencies for the relation schema R. R=(A, B, C, D,E); F={ A→BC, CD→E, B→D, E→A}	4
12.	Consider the relation schema R(A, B, C) with a set of functional dependencies F={A→BC, B→C, A→B, AB→C}. Find the irreducible set for F.	4
13.	Consider a relation schema R(A, B,C, D, E, F) with set of functional dependencies F = {A→BCDEF, BC→ADEF, B→F, D→E }. i) Find the candidate keys for R. ii) Decompose R to 3NF. iii) If another functional dependency D→B is introduced, what will be the resulting decomposed relation schema? iv) Is the decomposition lossless ?	4
14.	Describe each of the following indexing techniques with suitable example: primary, secondary and clustered indexing.	4
15.	Compare and contrast between: i) B-tree and B^+ tree organization	4
16.	Construct a B^+ tree for the following set of key values: [5, 10, 15, 20, 25, 30, 35, 40, 50, 55, 65,70, 75, 80, 90, 95] when the number of pointers that will fit in one node is: 5 i. Insert 60 ii. Delete 15, 75	4
17.	Discuss the ACID properties of database.	5
18.	Write the differences among 2PL and Strict 2PL? Which one is advantageous and why?	5
19.	Determine whether the following schedule S is conflict or serial? S: [R3(y); R3(z); R1(x); W1(x); W3(z); W3(y); R2(z); R1(y); W1(y); R2(y); W2(y); R2(x); W2(x)] If conflict then, find the equivalent serial schedule.	5
20.	Describe log-based and non-log based recovery techniques.	5

iii) Topic/Unit/Chapter Layout

Chapter No.	Topic/Unit/Chapter	Lecture Hours	Tutorials	Laboratory hours
Chapter - 1	Introduction	4 HRS	NOT APPLICABLE	
Chapter – 2	Entity-Relationship Model	6 HRS		
Chapter – 3	Relational Model	5 HRS		
Chapter – 4	SQL and Integrity Constraints	8 HRS		26 HRS
Chapter – 5	Relational Database Design	9 HRS		2 HRS
Chapter – 6	Internals of RDBMS	7 HRS		
Chapter – 7	File Organization & Index Structures	6 HRS		2HRS
	Total	**45 HRS**		**30 HRS**

iv)Textbooks

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing Company.

Reference books :

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

* The Internal assessment will be determined through the continuous assessment (CA) which is needed to be submitted 4 times in a semester based on performance of the students assessed as per academic calendar published by the University. The 4 no's of CAs will be based on test/ viva/ quiz/ presentation/seminar/ GD etc. out of which 2 no's preferably would be tests.

Schedule for Continuous Assessment (CA):

CA Description	Schedule
Quiz – 1	As per Institute Academic Calendar
1st Internal Examination	
Quiz – 2	
Assignment	
2nd Internal Examination	

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2
Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Course Target for the university examination = 60% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes (PO's)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CS 601.1	2	2	2	--	--	--	--	--	--	--	--	--	1	2
CS 601.2	2	3	1	1	--	--	--	--	--	--	--	--	3	2
CS 601.3	2	2	2	--	1	--	--	--	1	--	--	1	2	3
CS 601.4	2	2	2	--	--	--	--	--	--	--	--	--	--	3
CS 601.5	2	2	2	--	--	--	--	--	--	--	--	--	--	3
CS 601	2	2	2	1	1	--	--	--	1	--	--	1	2	3

1 = courses in which the student will be exposed to a topic
2 = courses in which students will gain competency in that area
3 = courses in which students will master that skill

(vii) Assessment Methodology

Outcome	Assessment Tool
CS 601.1	Internal Test, Quiz, Assignment, University Exam
CS 601.2	
CS 601.3	
CS 601.4	
CS 601.5	

(VIII) Weekly Lesson Plan

CHAPTER / UNIT	Topic Description (to be quoted from syllabus)	No. of Lectures	Plan Date(s)	Execution Date(s)	Homework/ Assignment/ Quiz
I	**Introduction**				
Unit-I	Overview of DBMS: Definition, Application, File & Database Concepts	1	20.1.20		
	3 Schema architecture, Data Abstraction, Data Independence	1	21.1.20		
	Database Users, Database Administrator, Concepts of Instances and Schemas, Metadata, Data Dictinoary, Data Models	1	24.1.20		
	Assessment on this CHAPTER - I	--			Quiz

II	**Entity-Relationship Model**				
Unit II	ERD: Basic concepts, Degree and Cardinaliity of relationship, Types of attributes, Mapping Cardinalities	1	27.1.20		
	Keys: (super, candidate, primary, alternate, foreign) keys, Intigrity Constraints	1	28.1.20		
	Weak Entity sets, Participation constraints, ERD example	1	31.1.20		Homework
	Specialization and Generalization and the Constraints on them, Aggregation	1	3.2.20		Homework
	ERD example	1	4.2.20		Homework
	Design of RDBMS from ERD	1	6.2.20		Homework
	Assessment on this CHAPTER - II	--			Assignment
IV	**SQL and Integrity Constraints**				
Unit-IV	SQL: Data Languages-Procedural & Non-Procedural, Basic SQL commands: CREATE, ALTER, DROP, TRUNCATE, RENAME, Constraints: PRIMARY KEY, REFERENCIAL KEY, CHECK , NOT NULL, UNIQUE, DEFAULT	1	7.2.20		
	SQL commands: INSERT, UPDATE, DELETE, SELECT, WHERE, DISTINCT, AND,OR, NOT, BETWEEN, IN, LIKE,ORDER BY,	1	10.2.20		
	Aggregate Functions, GROUP BY, HAVING, UNION, INTERSENCT, MINUS/EXCEPT	1	11.2.20		
	Nested sub queries using Comparison operators, IN, NOT IN, EXISTS, NOT EXISTS, ALL, SQL Queries with example	1	13.2.20		
	SQL Queries with example practice	1	14.2.20		
	Assessment on this CHAPTER - IV	--			Assignment, Quiz
III	**Relational Model**				
Unit-III	Relational Algebra Operations: select, project, Cartesian product, union, intersect, set difference	1	17.2.20		
	Join: inner join, outer join, assignment, rename	1	18.2.20		Homework
	Generalized projection, Aggregate functions, Modifications of database: insert, update, delete	1	20.2.20		
	Division, Relational algebra Queries with example	1	21.2.20		
	Relational algebra Queries with example,	1	24.2.20		Homework
	Relational Calculus: Tuple Relational Calculus with example	1	25.2.20		

	Domain relational Calculus with example	1	2.3.20		
	Assessment on this CHAPTER - III	--			Assignment,
V	**Relational Database Design**				
Unit-V	FD with example	1	3.3.20		Homework
	Armstrongs axioms, Closure of F	1	5.3.20		
	Computing Closure of F examples	1	6.3.20		
	Attribute closure, Its Application, with examples	1	12.3.20		
	Minimal Cover theory	1	13.3.20		
	Minimal Cover example	1	16.3.20		
	Database Normalization : 1NF	1	17.3.20		
	2NF, 3NF, BCNF theory and example	1	19.3.20		
	Normalization example discussion	1	20.3.20		
	Normalization example discussion, Dependency Preservation Property and Lossless Join Decomposition theory and example	1	23.3.20		
	Lossless Join Decomposition example, MVD & 4NF theory and example	1	24.3.20		
	5NF theory and example	1	26.3.20		
	Assessment on this CHAPTER - V	--			Assignment, Quiz
VI	**Internals of RDBMS**				
Unit-VI	Transaction properties, states, operations, Schedule	1	27.3.20		
	Serializability, Test for Conflict serializability, Recoverable schedule, Cascadeless schedule	1	30.3.20		
	View serializability, Need for Concurrency Control	1	31.3.20		
	Concurrency Control Techniques: Locks, 2PL	1	2.4.20		
	Deadlock, Time Stamp Protocol	1	3.4.20		
	Log based Recovery Techniques,	1	6.4.20		
	Check Points, Non-log based Recovery Techniques	1	7.4.20		
	Query Optimization Steps, Operator Tree Construction	1	9.4.20		

	Assessment on this CHAPTER - VI	--			Quiz
VII	**File Organization & Index Structures**				
Unit-VII	Indexing Techniques: Primary , Clustered, Secondary	1	10.4.20		
	Multilevel Index, Problems on Indexing	1	13.4.20		
	B Tree Construction, Insertion, Deletion	1	16.4.20		
	B+ Tree Construction, Insertion, Deletion	1	17.4.20		
	Assessment on this CHAPTER - VII	--			Quiz

2) Laboratory

Expt. No.	Experiment Name	Schedule	Marks
P1	**1.** a)Create following tables– **Table Name: Department** **Col Name** **Type** **Width** **Constraint** DNO NUMBER 2 PRIMARY KEY DNAME VARCHAR2(10) 10 NOT NULL **Table Name: Employee** **Col Name** **Type** **Width** **Constraint** ENO NUMBER 2 PRIMARY KEY ENAME VARCHAR2(10) 10 NOT NULL DNO NUMBER 2 REFERENCES Department SALARY NUMBER 6 b) Insert the following data– **Table: Department** **DNO** **DNAME** 10 Admin 20 Accounts 30 Sales 40 Marketing 50 Purchasing **Table: Employee** **ENO** **ENAME** **DNO** **SALARY** 1 Amal 10 30000 2 Shyamal 30 50000 3 Kamal 40 10000 4 Nirmal 50 60000 5 Bimal 20 40000 6 Parimal 10 20000 c) Display all data from Department table. d) Display all data from Employee table.	3 HRS	3

<table>
<tr><td></td><td>e) Try to insert following value in Employee table(copy error message)
(1,akash,60,70000)

f) Try to insert following value in Employee table(copy error message)
(1,akash,60,70000)
g) Display name and salary of all employees whose department no is 10.

h) Display the name and salary of all employees who working in Accounts Department.</td><td></td><td></td></tr>
<tr><td>P2</td><td>2. a)Create following tables–
Table Name: Project
Col Name Type Width Constraint
PNO NUMBER 2
PNAME VARCHAR2(10) 10
LOCATION VARCHAR2(20) 20
Table Name: Work
Col Name Type Width Constraint
ENO NUMBER 2 REFERENCES Employee
PNO NUMBER 2
HOURS NUMBER 3
PLOCATION VARCHAR2(20) 20

b) Add a foreign key constraint on column ‘PNO’ in ‘Work’ table referencing column ‘PNO’ in table ‘Project’ and name the constraint as FK_PNO. (Copy the Error message)
c) Add a Primary Key on PNO in Project Table.
d) Add a Primary Key on Eno in Work Table.
e) Drop the Primary Key of the table Work.
f) Now add a composite Primary key on ENO,PNO in Work Table.
g) Try to add a foreign key constraint on column ‘PNO’ in ‘Work’ table referencing column ‘PNO’ in table ‘Project’ and name the constraint as FK_PNO.
h) Add a check constraint on ‘LOCATION’ column so that permissible value for ‘LOCATION’ attribute must be among ‘Kolkata’, ‘Mumbai’,’Chennai’,’Delhi’ and name the constraint as CHK_ENG.
i) Add a new column ‘MANAGER_No’ in table ‘Employee’. The data type is number and width is 3.
j) Change width of ‘MANAGER_NO’ column to 2.
k) Add a NOT NULL constraint on Pname in Project Table.
l) Drop column PLOCATION from Work Table.</td><td>3 HRS</td><td>3</td></tr>
<tr><td>P3</td><td>1. Insert appropriate data on Project table and Work table.
2. Update MANAGER_NO column with following data:-
ENO MANAGER_NO
1
2 1
3 4
4 5
5 2
6 1
3. Write queries using SQL:-
a. To list the name of all Employees.
b. Display data from table ‘Project’ with column heading PROJECT_NO,</td><td>3 HRS</td><td>3</td></tr>
</table>

	PROJECT_NAME. c. List the name of the Project in Mumbai. d. List employees having name starting with letter 'S'. e. List Employees where second character of name is 'a'. f. To list the Project name where the project locations are Kolkata and Delhi. g. List the name of all employees from where department no is 10 and salary above 50000. h. To sort the employee data in alphabetic order of employee name. i. To sort the employee data in descending order of salary.		
P4	**Q1. Write queries using SQL:-** a. Display the employee name, department name and project location of all employee. b. Display the employee name, project name, working hour of all employee. c. Display names of all employees who work more than 28 hours. d. Display the name of all employees who work in 'Kolkata' or 'Mumbai'. e. Display name of the employee, who work in same location as that of 'Shyamal'. f. List the name of employees who are working on more than one project. g. Write a query to select first two rows from employee table. h. Write a query to select last two rows from employee table. i. Display the name, salary, HRA of employees (HRA calculated as 15% of salary). j. Retrieve the maximum and minimum salary for each department. k. Display the employee name and their respective manager's name. l. Display the name of the employee who is earning second maximum salary. m. Display the name of the employee who is earning n^{th} highest salary. n. Display the name of the employees whose salary is greater than the salary of all the employee whose manager no is 2. o. Get the details of all employees whose salary is lesser than the average salary of the employees. p. Drop the primary key from Work table. q. Insert two duplicate row in work table. r. Delete duplicate rows from work table. s. Create a view that will show department name and total salary. The name of view will be account. t. Select the department names having total salary greater than 45000. i) Using account view ii) Using employee table. u. Write a query to retrieve Employee names from the Employee table and output will look like:- Mr. A	3 HRS	3
P5	**Q1. <u>Create following tables:-</u>** **HOTEL (HOTEL_NO, NAME, ADDRESS)** **ROOM(ROOM_NO, HOTEL_NO, TYPE, PRICE)**	3 HRS	3

	BOOKING(HOTEL_NO, GUEST_NO, DATE_FROM, DATE_TO, ROOM_NO) **GUEST(GUEST_NO, NAME, ADDRESS)** i. Where **HOTEL** contains hotel details and HOTEL_NO is the Primary Key. ii. **ROOM** contains room details for each hotel and **(HOTEL_NO,ROOM_NO)** forms the Primary key. **BOOKING** contains details of the bookings and the Primary Key comprises (**HOTEL_NO, GUEST_NO, DATE_FORM)** and **GUEST** contains guest details and **GUEST_NO** is the Primary key and mention the Foreign Key constraints. **Q2. <u>Write queries using SQL.</u>** i. List full details of hotels in Mumbai ii. List the name and addresses of all guests in New Delhi, alphabetically ordered by the name. iii. List all double or family rooms with a price below Rs. 800 per day, in ascending ordered. iv. List the bookings for which no date_to has been specified. v. What is the total daily revenue from all the double room? vi. How many different guests have made booking for august, 2015 vii. List the price and type of all rooms at the hotel Land Mark. viii. What is the total income from booking for the hotel Manor today. ix. Retrieve the Hotel name where double room price is above 5000 and single room price is below 2500.		
P6	Q1. Write a PL/SQL program to check the given number is even or odd. Q2. Write a program to check whether a given number is prime or not. Q3. Write a program to calculate the net salary of a employee where DA is 50%, HRA is 15% of salary. (use previous Employee table.).	3 HRS	3
P7	Q1. A HRD manager has decided to raise the salary for all the employees in department number 10 by 0.05, department number 20 by 0.08, department number 30 by 0.1 and other department by .03 . Whenever any such raise is given to employees an audit trail of the same is maintained in the EMP_RAISE table. The EMP_RAISE table holds the employee number, the date when the raise was given and the raise amount. Write a PL/SQL block to update the salary of each employee appropriately and insert a record in the EMP_RAISE table as well. Tables are as follows: EMP_RAISE(EMP_CODE, RAISE_AMOUNT, RAISE_DATE)	3 HRS	3
P8	Q1.a) Write a PL/SQL function, which returns maximum of the three numbers. b) Write a function, which returns net salary of a given employee where DA is 50%, HRA is 15% of salary. (use previous Employee table.). If employee No is not found then return False. c) Write a procedure to calculate sum of two numbers. d) Write a procedure, which returns net salary and department of a given employee where DA is 50%, HRA is 15% of salary. (use previous Employee table.)	3 HRS	3
P9	**Q7.** Create a transparent audit system for a table **Employee**. The system must keep track of the records that are being deleted or updated. The functionality being when a record is deleted or modified the original record details and the date of operations is stored in the audit-client table, the delete or update is allowed to go through.	3 HRS	3

	Write a trigger for the above problem. The Tables are as follows:- **AUDIT (EMP_NO, NAME, DEPT_NO, OPERATION,USER_ID,OP_DATE)** OPERATION : Operation performed on the client-master table OP_DATE : The date when the operation was performed. USER_ID : The name of the user performing the operation.		
P10	**Q1.** Create a unique index on ENO column of the table EMP. **Q2.** Make a group of 5 students. Open two terminals. From one terminal Login into the Oracle server with the user name FACULTY and password FACULTY. (This user has the ***CREATE USER*** system privilege. From the other terminal do the experiments with the newly created user. 1. Create a user **STUDENT** with following characteristics **a.** The password student123 **b.** Default tablespace **SYSTEM**, with a quota of 10 megabytes **c.** Temporary tablespace **TEMP** **d.** Access to the tablespace **SYSTEM**, with a quota of 5 megabytes **e.** Limits on database resources defined by the profile **DEFAULT** 2. After successfully creating this user, try to connect using this username and password. Note the error message and state the reason. 3. Grant the role ***Connect*** to the user with admin option. 4. Grant Resource and other necessary system privileges to this user. (e.g. Alter, Create, Insert, Delete, Grant etc.) 5. Now Create the Table Employee(Eno Number(2), EName Varchar2(15)). Insert 3 records. Try different DML operations.	3 HRS	3
Total (Implementation +Viva)			**30+10=40**
University Exams			**60**

(vii) Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
CS 601.1	Structured (partially supervised Whole Class- grouping)	Blackboard & Chalk, Lecture Notes	Representation of any database system with ERD design.
CS 601.2	Structured (partially supervised Whole Class- grouping)	Blackboard & Chalk, Lecture Notes	Express a database query using mathematical notations of relational algebra and relational calculus.
CS 601.3	Structured (partially supervised Whole Class- grouping and independent work)	Blackboard & Chalk, Lecture Notes	Construct simple and nested queries on a given database system using SQL, and write PL/SQL programs.
CS 601.4	Structured (partially supervised Whole Class- grouping)	GMEET , GOOGLE CLASS, Lecture Notes, PPT	Design normalized database and demonstrate data retrieval techniques.
CS 601.5	Structured (partially supervised Whole Class- grouping)	GMEET , GOOGLE CLASS, Lecture Notes, PPT	Demonstrate database transaction processing and recovery techniques.

B. Daily Lesson Plan

Lecture	TOPIC/UNIT/ CHAPTER	Plan date	Execution date	Details of home work/assignment/mini project/ICT used/other	Details of topics that are beyond syllabus (if any)	Remarks
1.	Overview of DBMS: Definition, Application, File & Database Concepts	20.1.20	27.01.20			
2.	3 Schema architecture, Data Abstraction, Data Independence	21.1.20	3.2.20			
3.	Database Users, Database Administrator, Concepts of Instances and Schemas, Metadata, Data Dictinoary, Data Models	24.1.20	5.2.20			
4.	ERD: Basic concepts, Degree and Cardinaliity of relationship, Types of attributes, Mapping Cardinalities	27.1.20	6.2.20			
5.	Keys: (super, candidate, primary, alternate, foreign) keys, Intigrity Constraints	28.1.20	7.2.20	1. Explain the distinctions among the terms primary key, candidate key and super key.		
6.	Weak Entity sets, Participation constraints, ERD example	31.1.20	10.2.20	1. Draw an ERD		
7.	Specialization and Generalization and the Constraints on them, Aggregation	3.2.20	13.2.20			
8.	ERD example	4.2.20	14.2.20	ASSIGNMENT-1*		
9.	Design of RDBMS from ERD	6.2.20	17.2.20	Convert the ER diagram of University Database Sytem into a relational database schema. Be certain to indicate primary keys and referential		

				integrity constraints.		
10.	SQL: Data Languages- Procedural & Non-Procedural, Basic SQL commands: CREATE, ALTER, DROP, TRUNCATE, RENAME, Constraints: PRIMARY KEY, REFERENCIAL KEY, CHECK , NOT NULL, UNIQUE, DEFAULT	7.2.20	19.2.20			
11.	SQL commands: INSERT, UPDATE, DELETE, SELECT, WHERE, DISTINCT, AND,OR, NOT, BETWEEN, IN, LIKE,ORDER BY	10.2.20	20.2.20	1. Consider the following tables: SALES_ORDER_DETAILS (ORDER_NO, PRODUCT_NO, QTY_ORDERED, QTY_DISPATCHED) SALES_ORDER (ORDER_NO, CLIENT_NO, ORDER_DATE) CLIENT _MASTER (CLIENT_NO, NAME, BALANCE_DUE) PRODUCT_MASTER (PRODUCT_NO, DESCRIPTION) Write the following queries in SQL d. Retrieve the PRODUCT_NO and the total QTY_ORDERED for products 'P001' and 'P004'. e. Retrieve all orders placed by a client named 'RAHUL DESAI'. f. Find out all products that are not being sold/ ordered. g. Retrieve the ORDER_NO, client NAME, their ORDER_DATE in 'DD/MM/YY' format and sorted in ascending order of ORDER_DATE.		
12.	Aggregate Functions, GROUP BY, HAVING, UNION, INTERSENCT, MINUS/EXCEPT	11.2.20	21.2.20			
13.	Nested sub queries using Comparison operators, IN, NOT IN, EXISTS, NOT EXISTS, ALL	13.2.20	24.2.20			
14.	SQL Queries with example	14.2.20	26.2.20			

15.	Relational Algebra Operations: select, project, Cartesian product, union, intersect, set difference	17.2.20	27.2.20			
16.	Join: inner join, outer join, assignment, rename	18.2.20	17.3.20			
17.	Generalized projection, Aggregate functions, Modifications of database: insert, update, delete	20.2.20	19.3.20			
18.	Division, Relational algebra Queries with example	21.2.20	20.3.20	SUPPLIER (SUPPLIER _ID, SUPPLIER_NAME, SUPPLIER_ADDRESS) PARTS (PART_ID, PART_NAME, COLOR) CATALOG (SUPPLIER_ID, PART_ID, COST) Write the following queries in Relational Algebra based on above mentioned tables: (Level 1) 1. Get the supplier who supply part id 'P2'. 2. Get the suppliers who supply at least all those part supplied by supplier 'S2'. 3. Get the color of parts supplied by supplier 'S1'. 4. Find the parts that are supplied by at least two different suppliers. 5. Find names of the suppliers who supply 'YELLOW' parts.		
19.	Relational algebra Queries with example,	24.2.20	23.3.20			

20.	Relational Calculus: Tuple Relational Calculus with example	25.2.20	24.3.20	EMPLOYEE (EMPLOYEE_NO, EMPLOYEE_NAME, CITY) WORKS (EMPLOYEE_NO, COMPANY_NAME, SALARY) 1. Write the following query in both Tuple and Domain Relational Calculus. (Level 1) • Find the name and city of residence of all employees who work for TCS Company. • Find the name of all employees who earn more than rupees 20000/- per month. • Find the name of the company for the employees of Bangalore city. Find the name of the employees who do not belong to Bangalore city.		
21.	Domain relational Calculus with example	2.3.20	26.3.20			
22.	FD with example	3.3.20	27.3.20			
23.	Armstrongs axioms, Closure of F	5.3.20	30.3.20			
24.	Computing Closure of F examples	6.3.20	31.3.20	1. Find the closure of the set of functional dependencies F. (Level 4) a. F= {A→BC, CD→E, B→D, E→A} b. F= { AB→C, A→DE, B→F, F→GH, D→IJ}} 2. R= [A, B, C, D, E] F= {A→B, AB→C, D→AC, D→E} E= {A→BC, D→AE} Are F and E equivalent?		
25.	Attribute closure, Its Application, with examples	12.3.20	2.4.20			
26.	Minimal Cover theory	13.3.20	3.4.20			
27.	Minimal Cover example	16.3.20	6.4.20			

28.	Database Normalization : 1NF	17.3.20	7.4.20			
29.	2NF, 3NF, BCNF theory and example	19.3.20	9.4.20	1. R= [A, B, C, D] F= {A→BC, B→C, A→B, AB→C, AC→D} Find whether F is irreducible.		
30.	Normalization example discussion	20.3.20	10.4.20	1. Patient{patient_id, patient_name, appointment_no, time, doctor} F= {patient_id→patient_name, {patient_id, appointment_no} →time, doctor, time→ appointment_no} Find the key of the relation Patient.		
31.	Normalization example discussion, Dependency Preservation Property and Lossless Join Decomposition theory and example	23.3.20	20.4.20			
32.	Lossless Join Decomposition example, MVD & 4NF theory and example	24.3.20	21.4.20			
33.	5NF theory and example	26.3.20	23.4.20			
34.	Transaction properties, states, operations, Schedule	27.3.20	24.4.20			
35.	Serializability, Test for Conflict serializability, Recoverable schedule, Cascadeless schedule	30.3.20	27.4.20			
36.	View serializability, Need for Concurrency Control	31.3.20	28.4.20			
37.	Concurrency Control Techniques: Locks, 2PL	2.4.20	4.5.20	1. Find out whether the following schedule S is conflict or serial? S: [R3(y); R3(z); R1(x); W1(x); W3(z); W3(y); R2(z); R1(y); W1(y); R2(y); W2(y); R2(x); W2(x)] If conflict then, find the equivalent serial schedule.		
38.	Deadlock, Time Stamp Protocol	3.4.20	5.5.20			
39.	Log based Recovery Techniques,	6.4.20	7.5.20			

40.	Check Points, Non-log based Recovery Techniques	7.4.20	8.5.20			
41.	Query Optimization Steps, Operator Tree Construction	9.4.20	11.5.20			
42.	Indexing Techniques: Primary , Clustered, Secondary	10.4.20	12.5.20			
43.	Multilevel Index, Problems on Indexing	13.4.20	14.5.20			
44.	B Tree Construction, Insertion, Deletion	16.4.20	15.5.20	1. Construct a B tree of order 3 for the following set of key values: [5, 10, 15, 20, 35, 40, 50,65,70, 75,90, 95] i. Insert 60 ii. Delete 15, 75		
45.	B+ Tree Construction, Insertion, Deletion	17.4.20	18.5.20			

*Details of Assignments are given later.

***ASSIGNMENTS**

Database Management System (CS 601)
Assignment 1
2020

1. Draw an ER diagram for the following application from the manufacturing industry: [CO1]
   - Each supplier has a unique name.
   - More than one supplier can be located in the same city.
   - Each part has a unique part number.
   - Each part has a color.
   - A supplier can supply more than one part.
   - A part can be supplied by more than one supplier.
   - A supplier can supply a fixed quantity of each part.
2. Consider a database used to record the marks that students get in different exams of different course offerings.
   a. Construct an E-R diagram that models exams as entities and uses a ternary relationship, for the above database. You can make appropriate assumptions to make the specification complete.
   b. Construct an alternative ER diagram that uses only a binary relationship between students and course offerings. Make sure that only one relationship exists between a particular student and course offering pair, yet you can represent the marks that a student gets in different exams of a course offering.
3. Design an ER diagram for keeping track of the exploits of your favourite sports team. You should store the matches played, the scores in each match, the players in each match and individual player's statistics for each match. Summary statistics should be modeled as derived attribute.
   Extend the ER diagram to track the same information for all terms in a league.
4. Suppose you are given the following requirements for a simple database for the National Hockey League (NHL):
   - the NHL has many teams,
   - each team has a name, a city, a coach, a captain, and a set of players,
   - each player belongs to only one team,
   - each player has a name, a position (such as *left wing* or *goalie*), a skill level, and a set
   - of injury records,
   - a team captain is also a player,
   - a game is played between two teams (referred to as host_team and guest_team) and
   - has a date (such as *May 11th, 1999*) and a score (such as *4 to 2*).

   Construct a clean and concise ER diagram for the NHL database using the Chen notation as in your textbook. List your assumptions and clearly indicate the cardinality mappings as well as any role indicators in your ER diagram.

5. Consider the following schema: [CO2, CO3]
Suppliers (*sid:* integer, *sname:* string, *address:* string)
Parts (*pid:* integer, *pname:* string, *color:* string)
Catalog (*sid:* integer, *pid:* integer, *cost:* real)
The key fields are underlined, and the domain of each field is listed after the field name. Therefore *sid* is the key for Suppliers, *pid* is the key for Parts, and *sid* and *pid* together form the key for Catalog. The Catalog relation lists the prices charged for parts by Suppliers.
Write the following queries in relational algebra, tuple relational calculus and domain relational calculus:
   a. Get the supplier who supply part id 'P2'.
   b. Get the name of the suppliers who supply at least one 'RED' part. (some red part)
   c. Find the *sid*s of suppliers who supply some red part or are at 221 Packer Street.

d. Find name of the supplier who supply all parts.
e. Get the suppliers who supply at least all those part supplied by supplier ‘S2’.
f. Get the supplier who do not supply part id ‘P2’.
g. Get the total quantity total quantity of part ‘P1’ supplied by supplier ‘S1’.
h. Get the color of parts supplied by supplier ‘S1’.
i. Get the name of the suppliers who supply every ‘BLUE’ part.
j. Find the parts that are supplied by at least two different suppliers.
k. Find names of the suppliers who supply both ‘BLUE’ and ‘RED’ parts.
l. Find names of the suppliers who supply only ‘RED’ parts.
m. Find names of the suppliers who supply ‘YELLOW’ parts.
n. Get the name of the suppliers who supply at least one ‘RED’ part.

(x) Teaching Strategy / Method

1) Taking interactive classes through different examples.
2) Conducting Question – answer session at the end of the class.
3) Real life application for better understanding.

(xa) Strategy to support weak students

1) To engage the weak students in habit of studying, I give them some easy questions in regular basis.
2) Some weak students also have the problem of forgetting what they have learnt. In my class I always give some tips on how to recall and how to write systematically.
3) Weak students need special attention even after college hours. I always give some extra hours to weak students.

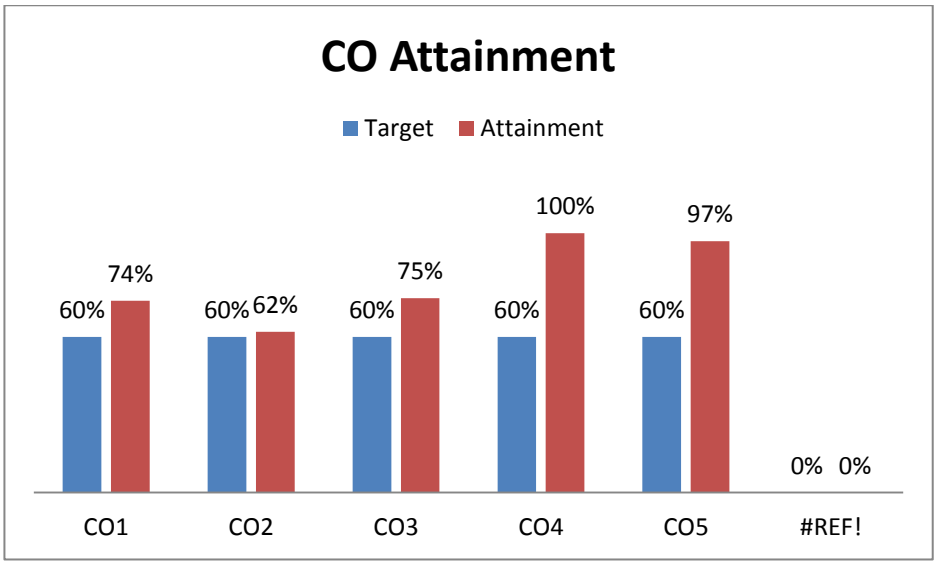
(xb) Strategy to encourage bright students

1) Have an extra challenge ready that allows the student to go deeper into the subject, learn a little more, or apply a skill he has just learned in a new way.
2) Some students are engaged with the final year students for their final projects.

(xc) Efforts to keep students engaged

1) Regular basis Home Work.
2) 5-10 minutes spent in an every class for question answer session.
3) Quiz on regular basis.
4) Some technical assignments are given group wise.

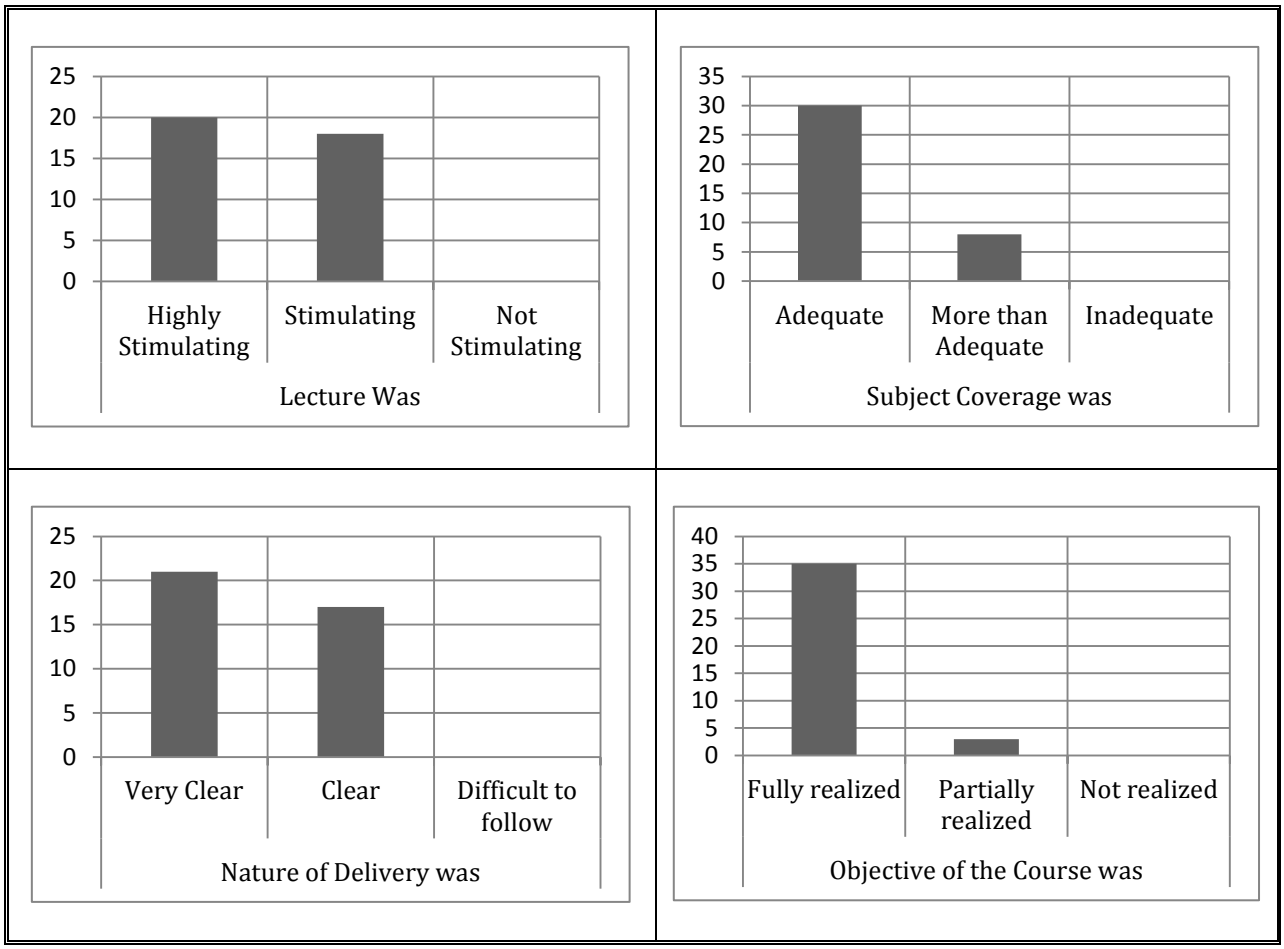
(xi) Analysis of Students performance in the course

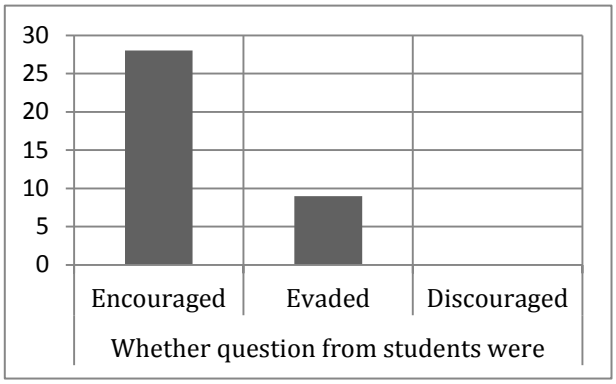


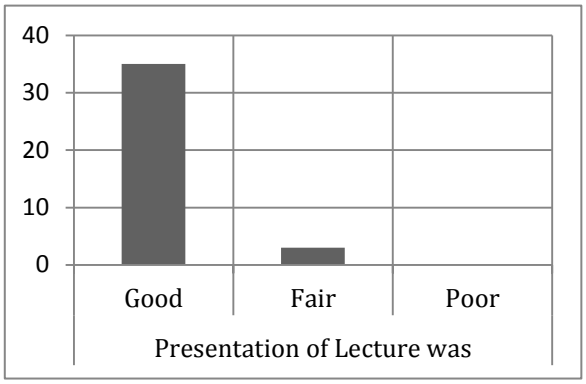
(xii) Analysis of Students performance in the course (university results)

	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME
University Result	**60%**	**50**	**50**	**100**

(xiii) Analysis of Student Feed Back







(xiv) Teacher Self-Assessment (at the completion of course)

From the analysis of the results obtained it can be seen that set targets for the course outcome have been achieved partially by the students. More emphasis should be given for Data Models, Relational Algebra and Calculus and Query Optimization Techniques.

(xiv) Recommendations/Suggestions for improvement by faculty

- More emphasis should be given to clear the concepts of ERD concepts and Relational Algebra and Calculus.
- Tutorials must be incorporated in the syllabus.
- Increase the total contact hours for theory to 48 hrs.

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz
			Total	Marks	1st	2nd	Avg.	
1	11900117055	KOUSHIK SHIL	75	3	16	25	20.5	6
2	11900117056	KIRAN KUMARI	83	4	21	28	24.5	9
3	11900117057	KAUSHIK DEY	78	3	22	27	24.5	9
4	11900117058	KARAN AGARWAL	99	5	27	24	25.5	10
5	11900117059	JAYA BANIK	79	3	23	26	24.5	8
6	11900117060	HIMANISH BHATTACHARYA	79	3	20	24	22	10
7	11900117061	GUNJAN ROY	86	4	22	23	22.5	7
8	11900117062	DIPIKA SARKAR	93	5	17	25	21	8
9	11900117063	DIPANNITA KUNDU	91	5	18	23	20.5	7
10	11900117064	DIBYA JYOTI GHOSH	75	3	18	23	20.5	8
11	11900117065	DEBRUPA BHATTACHARYA	98	5	28	24	26	10
12	11900117066	DEBALINA LAHA	79	3	19	25	22	7
13	11900117067	DEB PRAMANIK	86	4	20	22	21	10
14	11900117068	BRAJESH KUMAR MANDAL	79	3	24	24	24	8
15	11900117069	BISHAL DHAIR	98	5	20	23	21.5	10
16	11900117070	BHASKAR RAY	95	5	14	25	19.5	10
17	11900117071	BARSHAN PAL	91	5	15	25	20	10
18	11900117072	AYITIK SHOME	79	3	17	25	21	8
19	11900117073	AVISHEK ROY	84	4	15	26	20.5	8
20	11900117074	ARSALAN UMER SHAH	81	4	14	23	18.5	9
21	11900117075	ARPITA SAHA KUNDU	93	5	24	25	24.5	10
22	11900117076	ARNAB SHARMA	84	4	28	27	27.5	10
23	11900117077	ARNAB BAURI	79	3	24	28	26	5
24	11900117078	ARITRA SINHA	93	5	16	28	22	9

25	11900117079	ARITRA SAHA	91	5	28	22	25	9
26	11900117080	ARGHYA MITRA	76	3	27	23	25	9
27	11900117081	ANISH KUMAR JHA	84	4	23	27	25	7
28	11900117082	ANINDITA KAR	81	4	15	26	20.5	9
29	11900117083	ANIKET SHAW	93	5	25	24	24.5	9
30	11900117084	AMRIT RAJ	91	5	22	26	24	10
31	11900117085	AMIT BHAGAT	98	5	23	22	22.5	9
32	11900117086	AKASH KRISHNA KOLEY	86	4	24	28	26	7
33	11900117087	ADITYA SINGH	91	5	15	25	20	10
34	11900117088	ADHIRAJ PAL	84	4	22	27	24.5	7
35	11900117089	ABHISHEK SINHA	81	4	22	26	24	9
36	11900117090	ABHISHEK SHARMA	84	4	22	22	22	7
37	11900117091	ABHISHEK PRASAD	81	4	28	23	25.5	9
38	11900117092	ABHISHEK KUMAR	88	4	19	25	22	8
39	11900117093	ABHISHEK DEB	86	4	15	23	19	9
40	11900117094	ABHINAV KUMAR	91	5	28	25	26.5	9
41	11900117095	AASHUTOSH SINHA	76	3	23	22	22.5	7
42	11900118002	SUDHIR KUMAR	84	4	24	26	25	10
43	11900118003	SUBHAM NANDI	81	4	22	25	23.5	7
44	11900118004	SANCHITA DAS	93	5	27	23	25	9
45	11900118005	RIMLI SARKAR	91	5	20	22	21	8
46	11900118006	NUTAN DASGUPTA	98	5	15	25	20	7
47	11900118007	NIKITA PRASAD	86	4	18	24	21	7
48	11900118008	KRITIKA SHRESTHA	86	5	26	23	24.5	7
49	11900118009	DIPANKAR KARJEE	83	5	21	24	22.5	10
50	11900118010	ARIT MAJUMDAR	80	5	22	24	23	8

RECORDS OF ASSIGNMENTS/~~QUIZ~~
Paper Name: DATABASE MANAGEMENT SYSTEM
Paper Code: CS 601

Sl.	Roll No.	Name	A1			Sl.	Roll No.	Name	A1		
1	11900117055	KOUSHIK SHIL	1			25	11900117079	ARITRA SAHA	1		
2	11900117056	KIRAN KUMARI	1			26	11900117080	ARGHYA MITRA	1		
3	11900117057	KAUSHIK DEY	1			27	11900117081	ANISH KUMAR JHA	1		
4	11900117058	KARAN AGARWAL	1			28	11900117082	ANINDITA KAR	1		
5	11900117059	JAYA BANIK	1			29	11900117083	ANIKET SHAW	1		
6	11900117060	HIMANISH BHATTACHARYA	1			30	11900117084	AMRIT RAJ	1		
7	11900117061	GUNJAN ROY	1			31	11900117085	AMIT BHAGAT	1		
8	11900117062	DIPIKA SARKAR	1			32	11900117086	AKASH KRISHNA KOLEY	1		
9	11900117063	DIPANNITA KUNDU	1			33	11900117087	ADITYA SINGH	1		
10	11900117064	DIBYA JYOTI GHOSH	1			34	11900117088	ADHIRAJ PAL	1		
11	11900117065	DEBRUPA BHATTACHARYA	1			35	11900117089	ABHISHEK SINHA	1		
12	11900117066	DEBALINA LAHA	1			36	11900117090	ABHISHEK SHARMA	1		
13	11900117067	DEB PRAMANIK	1			37	11900117091	ABHISHEK PRASAD	1		
14	11900117068	BRAJESH KUMAR MANDAL	1			38	11900117092	ABHISHEK KUMAR	1		
15	11900117069	BISHAL DHAIR	1			39	11900117093	ABHISHEK DEB	1		
16	11900117070	BHASKAR RAY	1			40	11900117094	ABHINAV KUMAR	1		
17	11900117071	BARSHAN PAL	1			41	11900117095	AASHUTOSH SINHA	1		
18	11900117072	AYITIK SHOME	1			42	11900118002	SUDHIR KUMAR	0		
19	11900117073	AVISHEK ROY	1			43	11900118003	SUBHAM NANDI	1		
20	11900117074	ARSALAN UMER SHAH	1			44	11900118004	SANCHITA DAS	1		
21	11900117075	ARPITA SAHA KUNDU	1			45	11900118005	RIMLI SARKAR	1		
22	11900117076	ARNAB SHARMA	1			46	11900118006	NUTAN DASGUPTA	1		
23	11900117077	ARNAB BAURI	1			47	11900118007	NIKITA PRASAD	1		
24	11900117078	ARITRA SINHA	1			48	11900118008	KRITIKA SHRESTHA	1		
						49	11900118009	DIPANKAR KARJEE	1		
						50	11900118010	ARIT MAJUMDAR	1		

Sessional/Practical Performance Record

Paper Name: DATABASE MANAGEMENT SYSTEM LAB
Paper Code: CS 691

Sl	Roll No.	Name	Marks in experimentation										Total (30)	Viva (10)	Total out of 40
			1	2	3	4	5	6	7	8	9	10			
1	11900117055	KOUSHIK SHIL	3	3	3	2	3	3	2	3	2	3	27	5	32
2	11900117056	KIRAN KUMARI	3	3	3	3	3	3	3	3	2	3	29	8	37
3	11900117057	KAUSHIK DEY	3	3	3	3	2	3	3	2	2	3	27	8	35
4	11900117058	KARAN AGARWAL	3	3	3	3	3	3	2	2	1	2	25	9	34
5	11900117059	JAYA BANIK	3	3	2	2	2	3	2	2	2	1	22	9	30
6	11900117060	HIMANISH BHATTACHARYA	3	3	2	3	2	3	2	2	2	3	25	7	32
7	11900117061	GUNJAN ROY	3	3	3	3	3	3	2	2	1	2	25	8	35
8	11900117062	DIPIKA SARKAR	3	3	3	3	2	3	3	2	2	3	27	7	37
9	11900117063	DIPANNITA KUNDU	3	3	3	3	3	2	3	3	2	3	28	8	35
10	11900117064	DIBYA JYOTI GHOSH	3	3	3	3	3	3	3	3	2	3	29	10	37
11	11900117065	DEBRUPA BHATTACHARYA	3	3	2	2	3	3	3	3	2	2	26	7	36
12	11900117066	DEBALINA LAHA	3	3	3	1	1	1	1	1	1	1	16	8	25
13	11900117067	DEB PRAMANIK	3	3	3	2	3	3	2	2	2	2	25	8	34
14	11900117068	BRAJESH KUMAR MANDAL	3	3	2	2	2	2	2	2	2	3	23	9	33
15	11900117069	BISHAL DHAIR	3	3	2	3	2	2	2	2	2	2	23	9	30
16	11900117070	BHASKAR RAY	2	2	2	2	3	3	3	3	2	3	25	10	35
17	11900117071	BARSHAN PAL	3	3	3	3	3	3	2	2	1	2	25	7	32
18	11900117072	AYITIK SHOME	3	3	3	3	2	3	3	2	2	3	27	8	37
19	11900117073	AVISHEK ROY	3	3	2	2	3	3	3	3	2	3	27	7	35
20	11900117074	ARSALAN UMER SHAH	3	3	2	3	2	2	2	2	2	3	24	7	31
21	11900117075	ARPITA SAHA KUNDU	3	3	3	2	3	3	2	2	2	2	25	9	34
22	11900117076	ARNAB SHARMA	3	3	3	3	2	3	3	2	2	3	27	9	34
23	11900117077	ARNAB BAURI	3	3	3	2	3	3	1	2	1	2	23	7	32
24	11900117078	ARITRA SINHA	3	3	3	3	2	3	3	2	2	3	27	10	36

Sessional/Practical Performance Record

Paper Name: DATABASE MANAGEMENT SYSTEM LAB
Paper Code: CS 691

Sl	Roll No.	Name	Marks in experimentation										Total	Viva	Total out of 40
			1	2	3	4	5	6	7	8	9	10			
25	11900117079	ARITRA SAHA	2	2	3	3	3	3	3	3	3	3	28	8	36
25	11900117079	ARITRA SAHA	3	2	3	2	3	2	3	2	2	3	25	7	34
26	11900117080	ARGHYA MITRA	3	3	3	2	2	1	2	2	1	2	21	9	30
27	11900117081	ANISH KUMAR JHA	3	3	3	3	2	3	3	2	2	3	27	7	37
28	11900117082	ANINDITA KAR	2	2	3	2	3	2	3	3	2	3	25	9	34
29	11900117083	ANIKET SHAW	3	3	3	3	2	3	3	3	2	3	28	9	38
30	11900117084	AMRIT RAJ	3	3	3	3	3	3	3	3	2	3	29	7	37
31	11900117085	AMIT BHAGAT	3	3	3	3	3	3	3	3	2	3	29	10	39
32	11900117086	AKASH KRISHNA KOLEY	3	3	2	3	3	2	2	2	2	2	24	10	33
33	11900117087	ADITYA SINGH	3	3	3	2	2	3	3	2	2	3	26	8	35
34	11900117088	ADHIRAJ PAL	3	3	2	2	2	2	2	2	2	2	22	9	31
35	11900117089	ABHISHEK SINHA	3	2	2	3	2	2	2	2	2	2	22	10	32
36	11900117090	ABHISHEK SHARMA	2	2	2	3	3	2	3	3	2	3	25	7	34
37	11900117091	ABHISHEK PRASAD	2	2	1	2	1	2	2	2	2	2	18	9	27
38	11900117092	ABHISHEK KUMAR	3	3	2	3	2	2	2	2	2	2	23	8	30
39	11900117093	ABHISHEK DEB	3	3	2	3	2	3	3	2	2	2	25	7	33
40	11900117094	ABHINAV KUMAR	2	2	2	2	2	2	2	2	2	2	20	7	28
41	11900117095	AASHUTOSH SINHA	2	2	2	2	2	3	2	2	2	1	20	10	29
42	11900118002	SUDHIR KUMAR	3	3	2	3	2	3	2	2	2	3	25	7	35
43	11900118003	SUBHAM NANDI	3	3	3	3	3	3	2	2	1	2	25	8	35
44	11900118004	SANCHITA DAS	3	3	3	3	2	3	3	2	2	3	27	7	35
45	11900118005	RIMLI SARKAR	3	3	3	3	3	2	3	3	2	3	28	5	33
46	11900118006	NUTAN DASGUPTA	3	3	3	3	3	3	3	3	2	3	29	8	38
47	11900118007	NIKITA PRASAD	3	3	2	2	3	3	3	3	2	2	26	7	34
48	11900118008	KRITIKA SHRESTHA	3	3	3	2	3	3	2	2	2	2	25	9	32
49	11900118009	DIPANKAR KARJEE	3	3	3	1	1	1	1	1	1	1	16	5	21
50	11900118010	ARIT MAJUMDAR	3	3	3	3	3	3	3	3	2	3	29	8	37

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY			
Sl.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
1	11900117055	KOUSHIK SHIL	Doubt Clearing Classes Taken
2	11900118009	DIPANKAR KARJEE	

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that……..has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

ELECTRONICS & COMMUNICATION ENGINEERING

COURSE FILE

7TH SEM, 4TH YEAR, 2020

PAPER DESCRIPTION : EMBEDDED SYSTEM

PAPER CODE : EC 704B

Course File

Course Title : Embedded System

Code : EC 704B

Semester : 7 th semester **Year :** 4th Year

Name of the Faculty: Prof. Subhamay Sarker

Internet Homepage: NA

E-mail : Subhamay.gemini@gmail.com

Class Schedule			
Lecture		Tutorial	Practical
Monday – 2.10pm – 3.00pm	Thursday – 3.00pm – 3.50 pm & 3.50 pm - 4.40pm	NA	NA

Hours for meeting students:	
Tuesday	1.30 pm to 2.10 pm
Thursday	1.30 pm to 2.10 pm
Other days	By appointment

i) Course Objective

Students will be able to describe the definition of Embedded System and its various components like, devices and communication buses, Program Modelling Concepts and the concept of Real Time Operation Systems. They will also be able to use various Embedded C Compilers, IDEs and simulators for programming popular microcontrollers used in Embedded System design.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
CO1	**Describe** the concept of Embedded System, **Identify** the differences between Embedded system Vs General computing systems & Microprocessor and Microcontroller. [B.T. LEVEL 1]	65% marks
CO2	**Discuss** the architecture of Embedded System. **Understand** the operation of various Devices and Communication Buses used in Embedded System. [B.T. LEVEL 2]	65% marks
CO3	**Discuss** the Program Modelling Concepts and Real Time Operation Systems used in Embedded System. [B.T. LEVEL 2]	65% marks
CO4	**Use** various Embedded C Compilers, IDEs and simulators for programming popular microcontrollers used in Embedded System design. [B.T. LEVEL 3]	65% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	**Define** Embedded System?	1
2.	**Identify** the differences between Embedded system & General computing systems.	1
3.	**Describe** the hardware architecture of the real time systems.	1
4.	**Discuss** watchdog timer, real time clock.	2
5.	**Discuss** the parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. List the ideal characteristic of op-amp.	2
6.	**Discuss** various examples of Embedded System like Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc	2
7.	**Use** MPLAB IDE to create & build an LED Blinking program using PIC microcontroller.	3

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours
1. Introduction to Embedded System	5
2. Devices and Communication Buses	10
3. Program Modelling Concepts	5
4. Real Time Operating Systems	8
5. Examples of Embedded System	6
6. Programming concepts and embedded programming in C, C++, JAVA.	4

iv)Textbooks

1. Embedded System : Rajkamal (TMH)
2. Introduction to Embedded System : Shibu K. V. (TMH)

Reference books :

1. Embedded System : L. B. Das (Pearson).
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded System design : S. Heath (Elsevier)
6. Embedded microcontroller and processor design: G. Osborn (Pearson)

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15
Quiz / assignment	10
Attendance	5
University Exam/External Exam	70
Total	100

* Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	50% of the students have attained more than the target level of that CO
Attainment Level 2	60% of the students have attained more than the target level of that CO
Attainment Level 3	70% of the students have attained more than the target level of that CO

Overall Course Attainment Target = 70% of the students will get “A” Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
CO1	1	1	0	0	0	0	0	0	0	0	0	0	1	1
CO2	1	1	0	0	1	0	0	0	0	0	0	0	1	1
CO3	1	1	1	0	1	0	0	0	0	0	0	0	1	2
CO4	2	2	2	0	3	0	0	0	1	0	0	0	2	3
	1.3	1.3	1.5	0.0	1.7	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.3	1.8

1 = courses in which the student will be exposed to a topic (BT level 1& 2)
2 = courses in which students will gain competency in that area (BT level 3-4)
3= courses in which students will master that skill (BT level 5-6)

CO1 to CO3 minimally & CO4 partially satisfies application of knowledge of mathematics and science in identifying and solving engineering problems. (PO1, PO2).

CO3 minimally and CO4 partially satisfies the condition of designing system components and solutions. (PO3).

CO2 to CO3 minimally and CO4 strongly satisfies the condition for the use of modern tool to Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Electronics & Communication engineering activities with an understanding of the limitations. (PO5).

CO4 minimally satisfies the condition for functioning effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. (PO9).

(vii) Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
EC704B.1	Structured (Supervised Whole-Class Grouping)	Blackboard & Chalk, PPT.	**Identify** the differences between Embedded system Vs General computing systems.
EC704B.2	Structured (Supervised Whole-Class Grouping)	Blackboard & Chalk, PPT.	**Understand** the architecture & operation of various Devices and Communication Buses.
EC704B.3	Structured (Supervised Whole-Class Grouping)	Blackboard & Chalk, PPT.	**Discuss** the Program Modelling Concepts and Real Time Operation Systems used in Embedded System.
EC704B.4	Structured (Partially Supervised Independent work)	Hardware & Software based Based, PPT, Video Lecture.	**Use** various Embedded C Compilers, IDEs and simulators for programming popular microcontrollers.

(viii) Assessment Methodology

Outcome	Assessment Tool	Specific Question/activity aligned to the Outcome
EC704B.1	Internal Exam	1. (a) What is the difference between an Embedded System & General purpose computing system. (b) Briefly describe the hardware architecture of a generalized 'Embedded System'.
	Quiz	1. A Microcontroller normally has which of the following devices on-chip? a) RAM b) ROM c) I/O Ports d) all of the above.
	University Exam	1. a) What is the difference between Neuman architecture and Harvard architecture ? b) Whatr do you mean by Memory Hierarchy in an embedded system ?
EC704B.2	Internal Exam	1. Describe the operation of an alphanumeric LCD interfacing using parallel port communication.
	Quiz	1. Data Transfer using Serial Peripheral Interface (SPI) is a _____ wire operation. a) 1

		b) 2 c) 3 d) None of these
	University Exam	1. Compare SPI, I 2C, USART stating the possible application areas. How to decide the clock source and the reference voltages for 16F877 AD module operation ?
EC704B.3	Internal Exam	1. Bring out the difference between 'Traditional Design flow' and 'Hardware/Software Co-design' with appropriate block diagram. Describe briefly what do you understand by ' Hardware Software Trade-off '. In context with Program Modeling concepts list out the various 'Program Models'.
	Quiz	1. Cyclic scheduling is best for which of the following tasks a) Aperiodic b) Sporadic c) Periodic d) None of these
	University Exam	1. a) What are the different utility in mail box, pipe and queue in RTOS ? b) What are the different management techniques adopted and why in real time OS ?
EC704B.4	Internal Exam	1. (a) What do you mean by Cross-Compiler? (b) Using a translation hierarchy diagram, describe the functions of Compiler, Assembler, Linker and Loader.
	Quiz	1. A thread is defined as a _____. a) ISR b) Process within process c) Process d) none of the above.
	University Exam	1. What do you mean by fixed point and floating point arithmetic in connection with embedded system computation? Discuss with example. 2. Define the terms 'Transducer' and 'Actuator' in connection with embedded system design.

(ix) A. Weekly Lesson Plan

Week	Lectures	Assignment
1,2	**Discussion of Course outcome and program outcome**. Introduction to Embedded System : Embedded system Vs General computing systems, History of Embedded System, Purpose of Embedded System, Microprocessor and Microcontroller, Hardware architecture of the real time systems.	1. Describe the Difference between Von-Neumann & Harvard architecture. 2. What does the term 'Embedded System' mean? Describe the architecture of an 'Embedded System' with a generalised block diagram. 3. Compare RISC vs. CISC Architecture.
3,4,5	Devices and Communication Buses: I/o types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.	1. Describe with appropriate connection diagram, the operation of a 3X3 keypad interfacing with a microcontroller using parallel port communication. 2. Explain Three modes of serial communication, 'synchronous' 'isosynchronous' and 'asynchronous' using serial devices with one example each. How do the following indicate the start and end of a byte or data frames? a) UART b) CAN c) USB
6,7	Program Modelling Concepts ; Fundamental issues in Hardware software co-design, Unified Modelling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.	What do you mean by hardware-software co-design ? Explain it with a suitable block diagram. What do you mean by Hardware Software trade-offs ?
8,9, 10,11, 12,13	Real Time Operating Systems : Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.	1. Explain Round robin scheduling algorithm in Embedded System. 2. With reference to the software architecture of Embedded System, describe 'Real-Time Operating Systems' (RTOS). What are its advantage & disadvantages?
14,15	Examples of Embedded System : Mobile phones, RFID, WISENET, Robotics, Biomedical Applications,	1. Write short notes on any three of the following:

	Brain machine interface etc. Popular microcontrollers used in Embedded System, sensors, actuators.	a) RFID. b) Unified Modelling Language (UML).
16,17, 18	Programming concepts and embedded programming in C, C++, JAVA.	3. What do you mean by Cross-Compiler ? What do you mean by BAUD RATE ? 4. Using a translation hierarchy diagram, describe the functions of Compiler, Assembler, Linker and Loader.

B. Daily Lesson Plan

Lecture	TOPIC/UNIT/ CHAPTER	Plan date with day	Execution date	Details of home work/assignment/mini project/ICT used/other	Details of topics that are beyond syllabus (if any)	Remarks
1	Introduction to Embedded System: Embedded system Vs General computing systems, History of Embedded System, Purpose of Embedded System.	24-08-2020 Thursday	24-08-2020 Thursday	1. What does the term 'Embedded System' mean? Describe the architecture of an 'Embedded System' with a generalised block diagram.		
2	Introduction to Embedded System: Von-Neumann Vs Harvard architechture, RISC Vs CISC.	27-08-2020 Thursday	27-08-2020 Thursday	1. a) What is the difference between an Embedded System & General purpose computing system. b) What is the difference between Von-Neumann & Harvard architecture.		
3	Introduction to Embedded System: Microprocessor and Microcontroller, Hardware architecture of the real time systems.	31-08-2020 Monday	7-09-2020 Monday			
4	Devices and Communication Buses: I/o types, serial and parallel communication devices.	3-09-2020 Thursday	10-09-2020 Thursday	1. Describe with appropriate connection diagram, the operation of a 3X3 keypad interfacing with a microcontroller using parallel port communication.		
5	Devices and Communication Buses: wireless communication devices.	7-09-2020 Monday	10-09-2020 Thursday			
6	Devices and Communication Buses: timer and counting devices,	10-09-2020 Thursday	14-09-2020 Monday	1. Why do we need at least one		

	watchdog timer, real time clock.			timer device in an embedded system **?**		
7	Devices and Communication Buses: timer and counting devices, watchdog timer, real time clock.	10-09-2020 Thursday	17-09-2020 Thursday	1. Write short notes on any three of the following: a) Watch Dog Timer (WDT)		
8	Devices and Communication Buses: serial bus communication protocols.	14-09-2020 Monday	21-09-2020 Monday	1. Explain Three modes of serial communication, 'synchronous' 'isosynchronous' and 'asynchronous' using serial devices with one example each.	Serial communication using PIC microcontroller.	
9	Devices and Communication Buses: serial bus communication protocols.	17-09-2020 Thursday	24-09-2020 Thursday	1. Write short notes on any three of the following: a) Serial Peripheral Interface (SPI). b) I^2C c) ISA	EEPROM interfacing using PIC microcontroller.	
10	Devices and Communication Buses: parallel communication network using ISA, PCI, PCT-X.	21-09-2020 Monday	28-09-2020 Monday	1. How do the following indicate the start and end of a byte or data frames? a) CAN b) USB		
11	Devices and Communication Buses: Internet embedded system network protocols, USB, Bluetooth.	24-09-2020 Thursday	01-10-2020 Thursday			
12	Program Modelling Concepts; Fundamental issues in Hardware software co-design	28-09-2020 Monday	05-10-2020 Monday	1. What do you mean by hardware-software co-design ? Explain it with a suitable block diagram.		
13	Program Modelling Concepts; Unified Modelling Language(UML)	01-10-2020 Thursday	08-10-2020 Thursday			
14	Program Modelling Concepts; Hardware Software trade-offs, DFG	05-10-2020 Monday	12-10-2020 Monday	1. What do you mean by Hardware Software trade-offs ?		

	model					
15	Program Modelling Concepts; State machine programming model, model for multiprocessor system.	08-10-2020 Thursday	15-10-2020 Thursday			
16	Real Time Operating Systems: Operating system basics.	12-10-2020 Monday	19-10-2020 Monday	1. Explain Round robin scheduling algorithm in Embedded System.		
17	Real Time Operating Systems: Tasks, Process and Threads.	15-10-2020 Thursday	22-10-2020 Thursday	1. With reference to the software architecture of Embedded System, describe 'Real-Time Operating Systems' (RTOS). What are its advantage & disadvantages?	RTOS development using embedded C.	
18	Real Time Operating Systems: Tasks, Process and Threads.	19-10-2020 Monday	26-10-2020 Monday	1. In connection with operating system define Process/Task & Thread; also describe Task Control Block (TCB) & its importance in context switching.		
19	Real Time Operating Systems: Multiprocessing and multitasking.	22-10-2020 Thursday	29-10-2020 Thursday	1. Differentiate between different types of multitasking systems.		
20	Real Time Operating Systems: Multiprocessing and multitasking	26-10-2020 Monday	02-11-2020 Monday			
21	Real Time Operating Systems: Multiprocessing and multitasking	29-10-2020 Thursday	05-11-2020 Thursday			
22	Real Time Operating Systems: task communication, task synchronization, qualities of good RTOS.	02-11-2020 Monday	9-11-2020 Monday	1. a) What is Round robin architecture? b) What are its drawbacks? c) How Round robin with interrupt can solve the problem?		
23	Real Time Operating Systems: task communication, task	05-11-2020 Thursday	12-11-2020 Thursday	1. What do you mean by RTOS?		

	synchronization, qualities of good RTOS.			Why do we need an RTOS in an advanced embedded system?		
24	Real Time Operating Systems: task communication, task synchronization, qualities of good RTOS.	9-11-2020 Monday	16-11-2020 Monday			
25	Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc.	12-11-2020 Thursday	19-11-2020 Thursday	1. Describe the operation of a WISENET.		
26	Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc.	16-11-2020 Monday	23-11-2020 Monday		Sensor interfacing. Ex. LM35	
27	Examples of Embedded System: Popular microcontrollers used in Embedded System, sensors, actuators.	19-11-2020 Thursday	26-11-2020 Thursday		Discussion on ARM Architecture & Arduino.	
28	Examples of Embedded System: Popular microcontrollers used in Embedded System, sensors, actuators.	23-11-2020 Monday	30-11-2020 Monday	1. Describe the architecture & features of PIC16F877A, AT89S52 and Intel 8051 microcontroller		
29	Programming concepts and embedded programming in C, C++, JAVA.	26-11-2020 Thursday	03-12-2020 Thursday	1. Write a program for PIC18f2550 to interface a 16x2 alphanumeric LCD. 2. Write a program for PIC18f2550 to interface a 3x3 matrix keypad. 3. Write a program for PIC18f2550 to interface an 8x8 LED matrix.		
30	Programming concepts and embedded programming in C, C++, JAVA.	30-11-2020 Monday	07-12-2020 Monday			
31	Programming concepts and embedded programming in C, C++, JAVA.	03-12-2020 Thursday	10-12-2020 Thursday			
32	Programming concepts and embedded programming in C, C++, JAVA.	07-12-2020 Monday	14-12-2020 Thursday			

(x) Teaching Strategy / Method

- Learning by demonstration and display of Block Diagrams & flowcharts.
- Students are made aware of the application of Embedded System through discussions about small projects.
- Making students aware of how to use modern software & hardware tools for designing Embedded System through PPTs & video lectures.
- Demonstration showing Embedded C programming using IDE.
- Verification of theoretical results with practical outputs through use of simulators.
- Interactive sessions.
- Question answer sessions for most of the classes were organised.

(xa) Strategy to support weak students

- Weak students are encouraged to ask questions and participate in all the discussions.
- In some cases specific groups are formed with a weak student and with a bright student.
- Special classes are arranged if required.

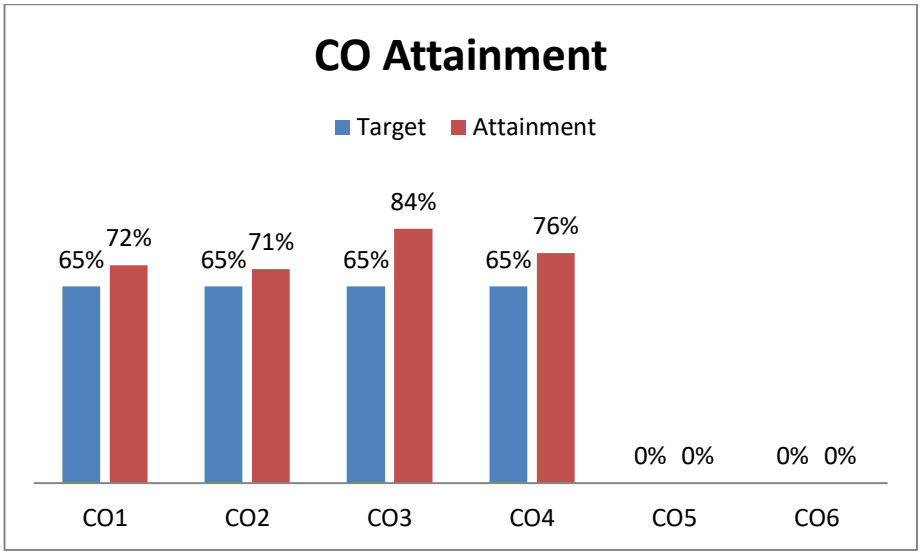
(xb) Strategy to encourage bright students

- Bright students are encouraged to discuss advanced topics related with the latest developments in the field of Embedded System.
- Such students are asked to write research papers on some specific topics.

(xc) Efforts to keep students engaged

- After discussing a topic, surprise quiz is floated on that topic in the next available class.
- Students are also encouraged to make practical circuits using the electronic components and showcase them in different technical fests.

(xi) Analysis of Students performance in the course (Internal Results)

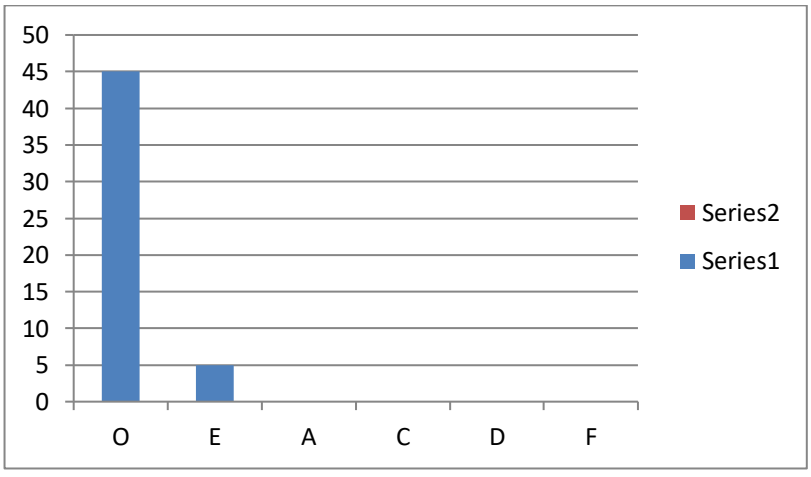


- 72% students have attained the set target of 65% marks for CO1
- 71% students have attained the set target of 65% marks for CO2
- 84% students have attained the set target of 65% marks for CO3
- 76% students have attained the set target of 65% marks for CO4

(xii) Analysis of Students performance in the course (university results)

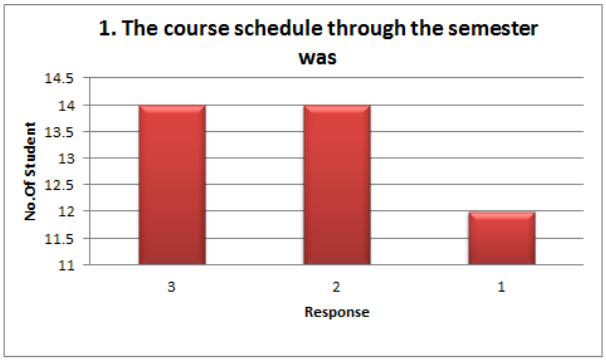
As per NBA SAR Example given in 3.2.2: Record of Attainment Level of A Course through University and Internal Assessments					
	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME	Attainment Level
Internals	65%	50	38	76%	3
University	70%	50	50	100%	3
Overall Attainment of Course Outcome=70% University +30% Internals					3.0

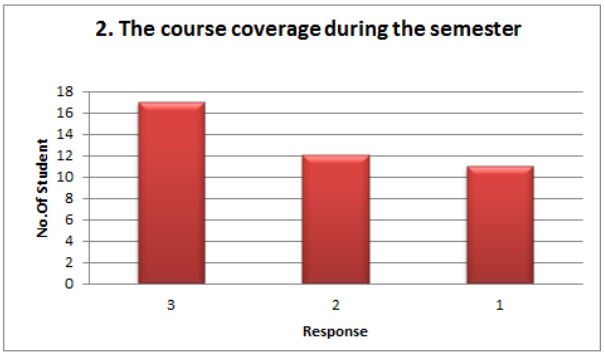
Theory Result Analysis _ University

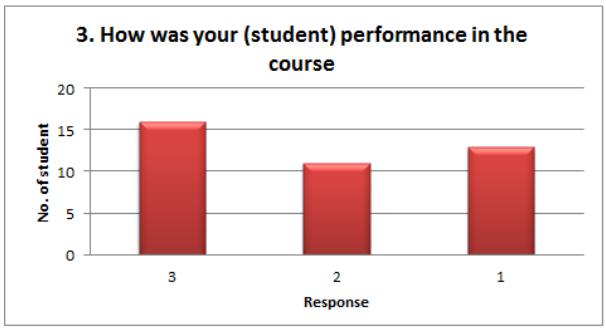


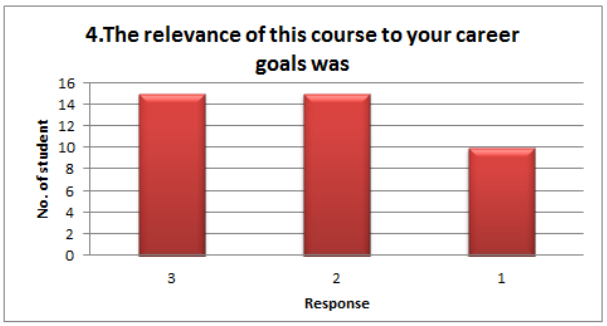
(xiii) Analysis of Student Feed Back

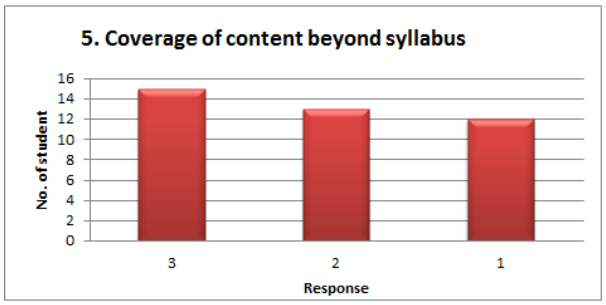
Feedback - CO based:

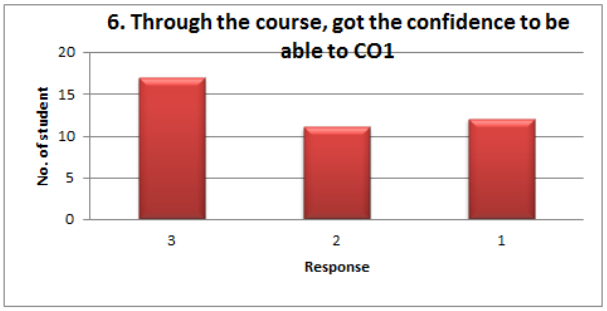


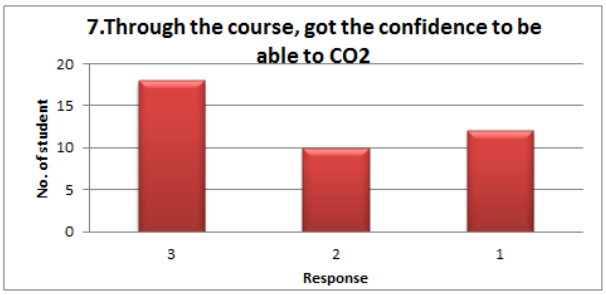


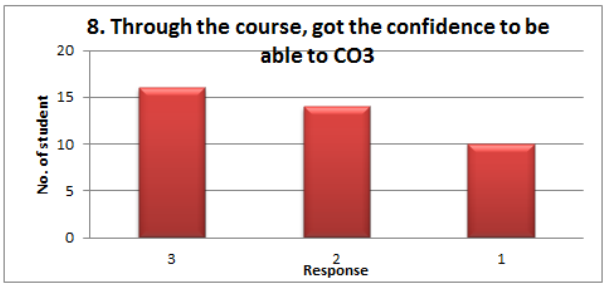


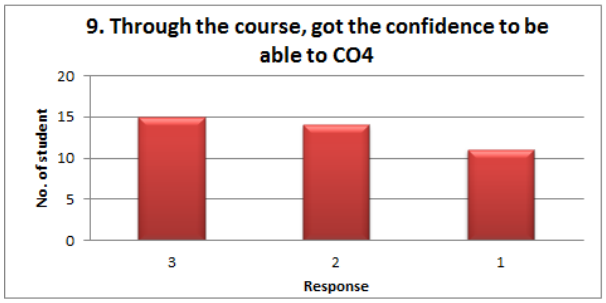


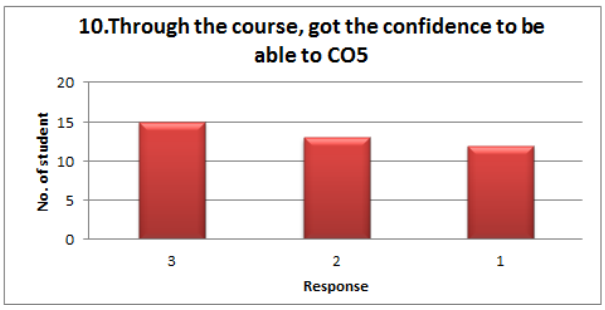


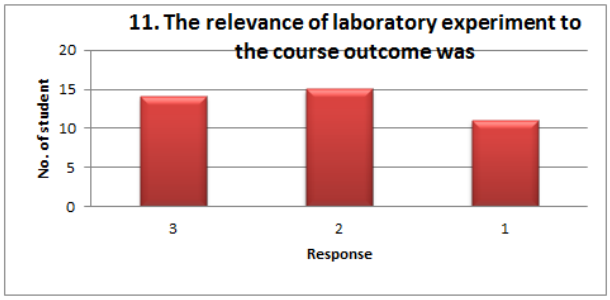


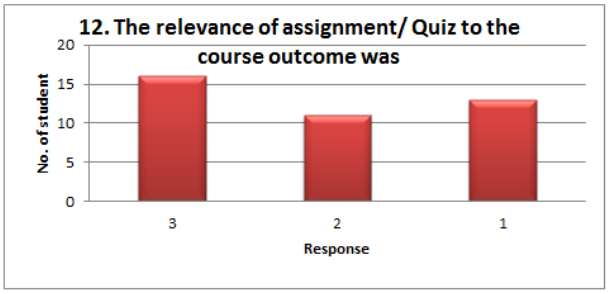


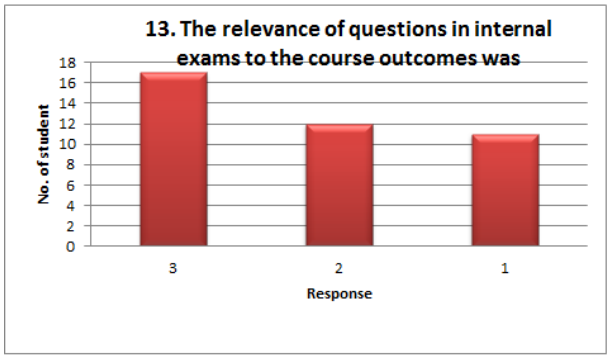


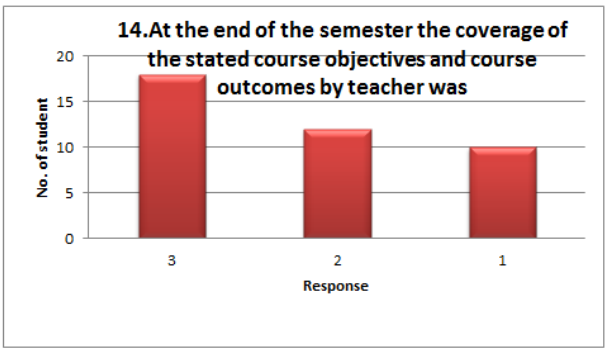


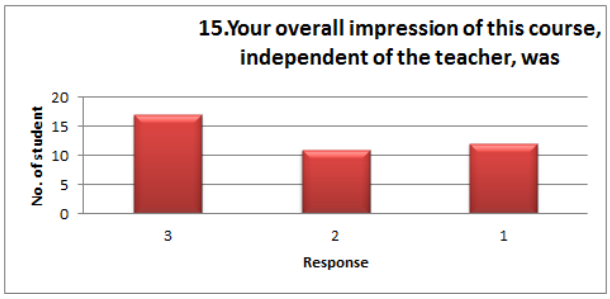


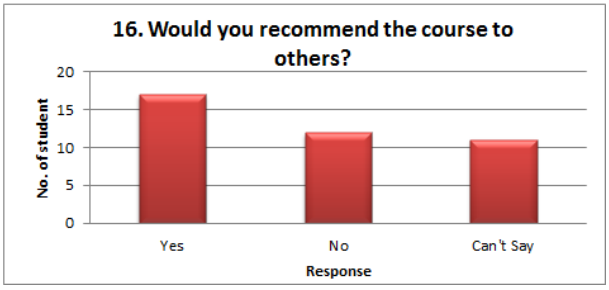












(xiv) Teacher Self-Assessment (at the completion of course)

From the graphical analysis of the results it is found that most of the course outcomes have been achieved successfully by the students. The set target for C04 and CO5 has not been achieved due to lack of practice and clarity of basic concepts. So, more stress is to be given on review based tutorials.

(xiv) Recommendations/Suggestions for improvement by faculty

The lecture should be slower so that the poor students can get time to listen and simultaneously take down notes.

INTERNAL ASSESMENT RECORD

Subject with code: Embedded System **(EC 704B)** Semester**: 7TH sem, 2020**

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
1	11900317004	Vivek Kumar Thakur	82%	4	19	25	11	8.0	23
2	11900317005	Vishal Choudhury	87%	4	24	24	12	8.0	24
3	11900317006	Tanmoy Bhowmick	79%	3	24	24	12	9.0	24
4	11900317007	Tamajit Das	95%	5	19	18	9.25	9.0	23
5	11900317008	Supratim Nag	79%	3	20	22	10.5	9.0	23
6	11900317011	Soumodeep Saha	76%	2	21	20	10.25	8.0	20
7	11900317012	Sooumodipta Basu Majumder	87%	4	16	21	9.25	9.0	22
8	11900317013	Sohini Sarkar	79%	3	21	23	11	9.0	23
9	11900317014	Sneha Chakraborty	79%	3	14	17	7.75	4.0	15
10	11900317015	Shraddha Das	79%	3	22	26	12	8.0	23
11	11900317016	Shalini Das	84%	4	16	22	9.5	7.0	21
12	11900317017	Samit Debnath	76%	2	23	23	11.5	6.0	20
13	11900317019	Rahul Biswas	95%	5	21	22	10.75	7.0	23
14	11900317020	Preety Prasad	76%	2	20	23	10.75	8.0	21
15	11900317021	Pratik Goutam	71%	1	18	19	9.25	7.0	17
16	11900317022	Pranab Singha	82%	4	19	20	9.75	8.0	22
17	11900317023	Parna Majumdar	87%	4	23	19	10.5	6.0	21
18	11900317024	Nitish Kumar Sah	74%	1	11	21	8	7.0	16
19	11900317025	Nitin Raj	95%	5	22	23	11.25	5.0	21
20	11900317026	Nibedita Banik	76%	2	19	25	11	6.0	19
21	11900317027	Lohit Sarkar	76%	2	23	26	12.25	8.0	22
22	11900317028	Komal Kanti Ganguly	82%	4	20	24	11	7.0	22
23	11900317029	Joy Sarkar	76%	2	19	25	11	7.0	20
24	11900317030	Jipsy Indra	95%	5	14	24	9.5	8.0	23
25	11900317031	Indrabati Chowdhury	76%	2	21	23	11	7.0	20
26	11900317032	Haimantika Mitra	74%	1	22	24	11.5	9.0	22
27	11900317033	Gourab Dewan	71%	1	25	24	12.25	8.0	21
28	11900317034	Gargi Karmakar	76%	2	18	22	10	9.0	21
29	11900317035	Eshita Roy	79%	3	19	23	10.5	10.0	24
30	11900317036	Dilip Kumar Sah	79%	3	21	23	11	9.0	23
31	11900317037	Dikhsha Deb	82%	4	22	23	11.25	10.0	25
32	11900317038	Dibyasree Pramanik	76%	2	23	21	11	6.0	19
33	11900317039	Debojit Ghosh	92%	5	23	20	10.75	7.0	23
34	11900317040	Debanjona Bhattacharjya	82%	4	14	21	8.75	10.0	23
35	11900317041	Budhaditya Dey	82%	4	25	20	11.25	8.0	23

36	11900317042	Brintik Majumder	76%	2	24	21	11.25	5.0	18
37	11900317043	Bidyut Kumar Barman	95%	5	19	19	9.5	8.0	23
38	11900317044	Avishekh Sutradhar	95%	5	14	24	9.5	8.0	23
39	11900317045	Ashu Prasad Shah	76%	2	21	23	11	7.0	20
40	11900317046	Arpan Banerjee	74%	1	22	24	11.5	9.0	22
41	11900317047	Arijit Ghosh	71%	1	25	24	12.25	8.0	21
42	11900317048	Aniket Chhetri	76%	2	18	22	10	9.0	21
43	11900317049	Amrita Ghosh	79%	3	19	23	10.5	10.0	24
44	11900317050	Aksheta Sarma	79%	3	21	23	11	9.0	23
45	11900317051	Abhradeep Das	82%	4	22	23	11.25	10.0	25
46	11900317052	Abhishek Aich	71%	1	22	20	10.5	8.0	20
47	11900317053	Prabir Paul	74%	1	20	21	10.25	6.0	17
48	11900318001	Debolina Chatterjee	76%	2	11	16	6.75	5.0	14
49	11900318002	Chirayata Sarkar	76%	2	24	20	11	8.0	21
50	11900318003	Ayush Chakraborty	74%	1	21	27	12	9.0	22

ATTENDANCE SHEET (Lecture)

Subject with code: Embedded System **(EC 704B)** Semester**: 7TH sem, 2020**

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

SL. No.	DATES																		
	MONTH	AUG								SEPT					OCT				
	Lectures	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
1	Vivek Kumar Thakur	2	0	2	2	1	2	1	2	1	0	1	0	1	2	1	2	1	
2	Vishal Choudhury	2	1	0	2	1	2	1	2	0	2	1	0	1	2	1	2	1	
3	Tanmoy Bhowmick	2	1	0	2	1	2	1	2	0	0	1	0	1	2	1	2	1	
4	Tamajit Das	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
5	Supratim Nag	2	1	2	0	1	2	1	2	1	2	1	0	1	2	0	2	0	
6	Soumodeep Saha	2	0	2	2	1	2	1	0	1	0	1	2	1	2	1	2	1	
7	Sooumodipta Basu Majumder	2	1	0	2	1	2	1	2	0	2	1	0	1	2	1	2	1	
8	Sohini Sarkar	2	1	0	2	1	2	1	2	0	0	1	0	1	2	1	2	1	
9	Sneha Chakraborty	2	1	2	0	1	2	1	2	1	2	1	0	1	2	0	2	0	
10	Shraddha Das	2	0	2	0	1	2	1	2	1	2	1	0	0	2	1	2	1	
11	Shalini Das	2	1	2	2	1	2	1	0	0	2	1	0	1	2	1	2	0	
12	Samit Debnath	2	1	2	2	1	2	1	0	1	2	1	2	0	0	1	0	1	
13	Rahul Biswas	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	

14	Preety Prasad	2	0	2	0	1	2	1	2	1	2	1	0	0	2	1	2	1	
15	Pratik Goutam	0	1	0	2	1	2	1	2	1	2	1	0	0	2	0	2	1	
16	Pranab Singha	0	1	2	2	1	2	1	2	1	2	0	2	1	2	0	2	1	
17	Parna Majumdar	2	1	0	2	1	2	1	2	0	2	1	0	1	2	1	2	1	
18	Nitish Kumar Sah	2	1	0	2	1	2	1	2	0	2	1	0	1	2	1	2	1	
19	Nitin Raj	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
20	Nibedita Banik	2	1	2	2	1	2	1	0	0	2	1	2	1	2	1	2	1	
21	Lohit Sarkar	2	0	2	2	1	2	1	0	1	2	1	0	1	2	1	2	1	
22	Komal Kanti Ganguly	2	1	0	2	1	2	1	0	0	2	1	0	1	2	1	2	1	
23	Joy Sarkar	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	
24	Jipsy Indra	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
25	Indrabati Chowdhury	2	0	2	0	1	2	1	2	1	2	1	0	0	2	1	2	1	
26	Haimantika Mitra	2	0	2	0	1	0	1	2	1	0	1	2	1	2	1	2	1	
27	Gourab Dewan	2	0	2	2	0	2	0	0	1	2	1	2	1	2	1	0	1	
28	Gargi Karmakar	0	1	2	2	1	2	1	2	1	2	0	0	0	2	0	2	1	
29	Eshita Roy	2	1	2	0	1	2	1	0	1	2	1	2	1	2	0	2	0	
30	Dilip Kumar Sah	2	1	2	2	1	2	1	2	1	2	1	2	0	0	1	0	1	
31	Dikhsha Deb	2	1	2	2	0	0	0	0	1	2	1	2	0	2	1	2	1	
32	Dibyasree Pramanik	2	1	2	0	1	2	1	2	1	0	1	0	1	2	1	2	1	
33	Debojit Ghosh	2	1	2	2	1	2	1	2	1	2	1	0	0	2	1	2	1	
34	Debanjona Bhattacharjya	2	1	2	2	1	2	1	0	1	0	1	2	1	2	1	2	0	
35	Budhaditya Dey	2	1	0	2	1	2	1	0	0	2	1	0	1	2	1	2	1	
36	Brintik Majumder	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	
37	Bidyut Kumar Barman	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
38	Avishekh Sutradhar	2	0	2	0	1	2	1	2	1	2	1	0	0	2	1	2	1	
39	Ashu Prasad Shah	2	0	2	0	1	0	1	2	1	0	1	2	1	2	1	2	1	
40	Arpan Banerjee	2	0	2	2	0	2	0	0	1	2	1	2	1	2	1	0	1	
41	Arijit Ghosh	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	

42	Aniket Chhetri	0	1	2	2	1	2	1	2	1	2	0	0	0	2	0	2	1	
43	Amrita Ghosh	2	1	0	2	1	2	1	0	0	2	1	0	1	2	1	2	1	
44	Aksheta Sarma	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	
45	Abhradeep Das	2	1	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	
46	Abhishek Aich	2	0	2	0	1	2	1	2	1	2	1	0	0	2	1	2	1	
47	Prabir Paul	2	0	2	0	1	0	1	2	1	0	1	2	1	2	1	2	1	
48	Debolina Chatterjee	2	0	2	2	0	2	0	0	1	2	1	2	1	2	1	0	1	
49	Chirayata Sarkar	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	
50	Ayush Chakraborty	2	1	0	2	1	2	1	0	1	0	1	2	1	2	1	2	1	

ATTENDANCE SHEET (Lecture)

Subject with code: Embedded System **(EC 704B)** Semester: **7TH sem, 2020**

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

SL. No.	DATES																		
	MONTH	NOV								TOTAL									
	Lectures	2	1	1	1					31	Percentage								
1	Vivek Kumar Thakur	2	0	1	0					24	77.42%								
2	Vishal Choudhury	2	1	1	1					26	83.87%								
3	Tanmoy Bhowmick	2	1	1	0					23	74.19%								
4	Tamajit Das	2	1	1	1					31	100.00%								
5	Supratim Nag	2	1	1	1					25	80.65%								
6	Soumodeep Saha	2	0	1	0					24	77.42%								
7	Sooumodipta Basu Majumder	2	1	1	1					26	83.87%								
8	Sohini Sarkar	2	1	1	0					23	74.19%								
9	Sneha Chakraborty	2	1	1	1					25	80.65%								
10	Shraddha Das	2	1	1	1					25	80.65%								
11	Shalini Das	2	1	1	1					25	80.65%								

12	Samit Debnath	2	1	1	1					24	77.42%							
13	Rahul Biswas	2	1	1	1					31	100.00%							
14	Preety Prasad	2	0	1	1					24	77.42%							
15	Pratik Goutam	2	1	1	1					23	74.19%							
16	Pranab Singha	2	1	0	1					26	83.87%							
17	Parna Majumdar	2	1	1	1					26	83.87%							
18	Nitish Kumar Sah	2	1	1	0					25	80.65%							
19	Nitin Raj	2	1	1	1					31	100.00%							
20	Nibedita Banik	0	1	1	1					26	83.87%							
21	Lohit Sarkar	2	0	1	0					24	77.42%							
22	Komal Kanti Ganguly	2	1	1	1					24	77.42%							
23	Joy Sarkar	2	1	0	0					23	74.19%							
24	Jipsy Indra	2	1	1	1					31	100.00%							
25	Indrabati Chowdhury	2	0	1	1					24	77.42%							
26	Haimantika Mitra	2	0	1	1					23	74.19%							
27	Gourab Dewan	2	1	1	1					24	77.42%							
28	Gargi Karmakar	2	1	1	1					24	77.42%							
29	Eshita Roy	2	1	1	1					25	80.65%							
30	Dilip Kumar Sah	2	1	0	1					25	80.65%							
31	Dikhsha Deb	2	1	1	1					24	77.42%							
32	Dibyasree Pramanik	2	1	1	0					24	77.42%							
33	Debojit Ghosh	2	1	1	1					28	90.32%							
34	Debanjona Bhattacharjya	2	1	0	0					24	77.42%							
35	Budhaditya Dey	2	1	1	1					24	77.42%							
36	Brintik Majumder	2	1	0	0					23	74.19%							
37	Bidyut Kumar Barman	2	1	1	1					31	100.00%							
38	Avishekh Sutradhar	2	0	1	1					24	77.42%							

39	Ashu Prasad Shah	2	0	1	1					23	74.19%							
40	Arpan Banerjee	2	1	1	1					24	77.42%							
41	Arijit Ghosh	2	1	0	0					23	74.19%							
42	Aniket Chhetri	2	1	1	1					24	77.42%							
43	Amrita Ghosh	2	1	1	1					24	77.42%							
44	Aksheta Sarma	2	1	0	0					23	74.19%							
45	Abhradeep Das	2	1	1	1					31	100.00%							
46	Abhishek Aich	2	0	1	1					24	77.42%							
47	Prabir Paul	2	0	1	1					23	74.19%							
48	Debolina Chatterjee	2	1	1	1					24	77.42%							
49	Chirayata Sarkar	2	1	0	0					23	74.19%							
50	Ayush Chakraborty	2	1	1	1					24	77.42%							

Records of Quiz

Subject with code: Embedded System **(EC 704B)** Semester**: 7TH sem, 2020**

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

Sl.	Roll No.	Name	CO1	CO2	CO3	Total (10)
1	11900317004	Vivek kumar Thakur	**3**	2	3	8
2	11900317005	Vishal Choudhury	2	3	3	8
3	11900317006	Tanmoy Bhowmick	3	3	3	9
4	11900317007	Tamajit Das	3	3	3	9
5	11900317008	Supratim Nag	3	2	4	9
6	11900317011	Soumodeep Saha	3	3	2	8
7	11900317012	Soumodipta Basu Mazumder	2	3	4	9
8	11900317013	Sohini Sarkar	2	3	4	9
9	11900317014	Sneha Chakraborty	1	1	2	4
10	11900317015	Shraddha Das	3	3	2	8
11	11900317016	Shalini Das	3	2	2	7
12	11900317017	Samit Debnath	1	2	3	6
13	11900317019	Rahul Biswas	1	3	3	7
14	11900317020	Preety Prasad	2	3	3	8
15	11900317021	Pratik Goutam	1	3	3	7
16	11900317022	Pranab Singha	2	3	3	8
17	11900317023	Parna Majumdar	1	2	3	6
18	11900317024	Nitish Kumar Sah	3	1	3	7
19	11900317025	Nitin Raj	3	1	1	5
20	11900317026	Nibedita Banik	1	3	2	6
21	11900317027	Lohit Sarkar	2	3	3	8
22	11900317028	Komal Kanti Ganguly	3	1	3	7
23	11900317029	Joy Sarkar	2	2	3	7
24	11900317030	Jipsy Indra	1	3	4	8
25	11900317031	Indrabati Chowdhury	2	2	3	7
26	11900317032	Haimantika Mitra	3	3	3	9
27	11900317033	Gourab Dewan	3	2	3	8

28	11900317034	Gargi Karmakar	3	3	3	9
29	11900317035	Eshita Roy	3	3	4	10
30	11900317036	Dilip Kumar Sah	3	2	4	9
31	11900317037	Dikhsha Deb	3	3	4	10
32	11900317038	Dibyasree Pramanik	1	3	2	6
33	11900317039	Debojit Ghosh	2	3	2	7
34	11900317040	Debanjona Bhattacharjya	3	3	4	10
35	11900317041	Budhaditya Dey	2	2	4	8
36	11900317042	Brintik Majumder	1	2	2	5
37	11900317043	Bidyut Kumar Barman	2	2	4	8
38	11900317044	Avishekh Sutradhar	2	3	3	8
39	11900317045	Ashu Prasad Shah	3	3	3	9
40	11900317046	Arpan Banerjee	3	1	4	8
41	11900317047	Arijit Ghosh	2	2	2	6
42	11900317048	Aniket chhetri	1	2	2	5
43	11900317049	Amrita Ghosh	2	2	4	8
44	11900317050	Aksheta Sarma	1	2	2	5
45	11900317051	Abhradeep Das	2	2	4	8
46	11900317052	Abhishek Aich	2	3	3	8
47	11900317053	Prabir Paul	3	3	3	9
48	11900318001	Debolina Chatterjee	3	1	4	8
49	11900318002	Chirayata Sarkar	2	2	2	6
50	11900318003	Ayush Chakraborty	1	2	2	5

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY			
Sl.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
1	11900317042	Brintik Majumder	• Additional doubt clearing sessions were taken after schedule lectures. • Providing extra Viva-Voce to students with poor attendance. • Guiding them through previous question year papers. • Highlighting important and frequently asked questions in the class. • Study materials were provided.
2	11900317050	Aksheta Sarma	
3	11900317025	Nitin Raj	
4	11900317014	Sneha Chakraborty	
5	11900317025	Nitin Raj	

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks
1.	7th	Embedded System, EC-704B	6	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that……..has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

ELECTRONICS & COMMUNICATION ENGINEERING

COURSE FILE

1ST SEM, 2ND YEAR, 2020

PAPER NAME : Signals and Systems

PAPER CODE : EC 303

Course File

Course Title: **Signals and Systems (EC303)**

Semester: **1st Year 2nd, 2020**

Name of the Faculty: **Prof. Jayati Routh**

E-mail:**jayatirouth@gmail.com**

Class Schedule (Group A):

Tuesday	10 am to 10.50 am
Thursday	11.40 pm to 1.20 pm
Friday	3 pm to 3.50 pm

Hours for meeting students:

Wednesday	**Saturday**	**Other Days**
1.20pm – 4 pm	1.20pm – 4 pm	1.30pm – 2pm or by appointment

i) Course Objective

Student will be able to describe the time-domain and frequency domain characteristics of different types of signals and analyse continuous and discrete time systems.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Outcomes		**Target**
EC303.1	**Describe** the basic concepts of systems and the way signals interact with the physical systems. [B.T. LEVEL 2]	60% marks
EC303.2	**Determine** the signal frequency content and the system representation in the frequency domain using Fourier Series / Transform. [B.T. LEVEL 2]	60% marks
EC303.3	**Implement** the Laplace Transform and Z-Transform for a determining the response of LTI systems. [B.T. LEVEL 3]	60% marks
EC303.4	**Analyse** sampling process and sampling of discrete time signals. [B.T. LEVEL 4]	60% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	**Discuss** the characteristics of Signal and Systems.	2
2.	**Summarize** the broad classification of signals & systems with suitable examples for each.	2
3.	**Calculate** the addition & multiplication of $x_1(n)$ ={1,2,3,1} & $x_2(n)$={3,2,1,1}	3
4.	**Compute** the Nyquist sampling rate and Nyquist sampling intervals for the following signals: (a) sinc(200πt)+3 sinc2(120πt) (b)sinc(100πt) sinc(200πt).	3
5.	For the system described by the given difference equation:y(n-2)+1.2y(n-1)+0.6y(n)=x(n); **calculate** the transfer function H(z)	3
6.	**Compute** the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the LTI system described by the difference equation: y(n) = x(n) + b. y(n-1)	3
7.	**Explain** the significance of ZT & LT in the computation of Transfer Function, Pole-zero-plot and stability of CTS and DTS.	2
8.	**Detect** the response of various CT & DT systems for an arbitrary input.	5
9.	**Check** the stability of various CT & DT systems.	5

iii) Unit Layout

Unit	Lecture Hours
I. Introduction to signal	6 HRS.
II. introduction to systems and its classification	6 HRS.
III. Analysis of signal and system in	8 HRS.

frequency domain using Fourier series and transform	
IV. Evolution of transforms- Laplace and Z transform.	8 HRS.
V. The sampling theorem and its implication	4HRS.

iv)Textbooks

1. A.V.Oppenheim, A.S.Willsky and S.H.Nawab-Signals & Systems, Pearson
2. S.Haykin & B.V.Veen, Signals and Systems- John Wiley
3. A.Nagoor Kani- Signals and Systems- McGraw Hill

Reference books :

1. J.G.Proakis & D.G.Manolakis- Digital Signal Processing Principles, Algorithms and Applications, PHI.
2. C T Chen- Signals and Systems- Oxford
3. E W Kamen &BS Heck- Fundamentals of Signals and Systems Using the Web and Matlab- Pearson
4. B.P.Lathi- Signal Processing & Linear Systems- Oxford
5. P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e, Scitech
6. M.J.Roberts, Signals and Systems Analysis using Transform method and MATLAB, TMH
7. S Ghosh, Signals and Systems- Pearson
8. M.H.Hays- Digital Signal Processing, Schaum's outlines, TMH
9. Ashok Ambardar, Analog and Digital Signal Processing- Thomson.
10. Phillip, Parr & Riskin- Signal, Systems and Transforms- Pearson

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15
Assignment	10
Attendance	5
University Exam	70
Total	100

* The Internal Marks will be determined through the continuous assessment (CA) which is needed to be submitted 4 times in a semester (CA1, CA2, CA3, CA4) based on performance of the students.

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	40% of the students have attained more than the target level of that CO	1
Attainment Level 2	50% of the students have attained more than the target level of that CO	2
Attainment Level 3	60% of the students have attained more than the target level of that CO	3

Overall Course Attainment Target (70% of university and 30% of the internal exam) will be =Attainment Level 3

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
EC 303.1	2	-	-	-	-	-	-	-	-	-	-	-	1	-
EC 303.2	3	1	-	-	-	-	-	-	-	-	-	-	2	-
EC 303.3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
EC 303.4	2	1	-	-	-	-	-	-	-	-	-	-	1	2
EC 303	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

- CO1&4 partially satisfies whereas CO 2 & 3 fully satisfies the application of knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems (PO1).
- CO2 & 4 minimally satisfies whereas CO 3 & 4 partially satisfies the abilty of the student to identify, formulate, and analyze engineering problems to arrive at substantiated conclusions (PO2).

(vii) Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
EC303.1	Structured (partially supervised whole class grouping)	Video Lecture, NPTEL materials, PPT, Class notes from various books	Basic concepts of signal and systems, their classification & characterization.
EC303.2	Structured (partially supervised whole class grouping)	Video Lecture, NPTEL materials, PPT, Class notes from various books	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series
EC303.3	Structured (Partially supervised whole class grouping)	Video Lecture, NPTEL materials, PPT, Class notes from various books	Evolution of Transforms: Fourier Transform, Laplace Transform , Z-transform (single sided and Double sided)
EC303.4	Structured (partially supervised whole class grouping)	Video Lecture, NPTEL materials, PPT, Class notes from various books	The Sampling Theorem and its implications- Spectra of sampled signals.

(viii) Assessment Methodology

Outcome	Assessment Tool	Specific Question / activity aligned to the Outcome
EC303.1	Internal Test	Check whether the following signals are periodic or not. If yes find out the fundamental period i) $x(t) = 3\cos(5t+\pi/6)$ ii) $x(t) = 5\cos 4\pi t+3\sin 8\pi t$
	University Exam	Check whether the following systems are time variant or not i) $y(t)= 2tx(t)$ ii) $y(t) = x(-t)$
EC303.2	Internal Test	State and prove the frequency shifting property of Fourier Transform
	Assignment	The differential equation for a causal LTI system is given by

		$\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 8y(t) = 2x(t)$
	University Exam	If the Fourier transform of x(t) is x(ω), Then calculate the Fourier transform of x(t-2)+x(t+2)
EC303.3	Internal Test	State and prove the initial value theorem.
	Assignment	Find the Z transform of $\Sigma\ \delta(n-k)$, where k ranges from [0-∞]
	University Exam	Find the Z-transform of x(n) = u(-n).
EC303.4	Internal Test	State and prove the sampling theorem
	University Exam	What is aliasing and how this effect can be avoided?

(IX)A. Weekly Lesson Plan

Week	Lectures	Assignments
1	Definition of signal, it's classification and different mathematical operations	Practice Problems on signals and systems
2	Classification and characterization of different types of systems. System representation through differential equations.	
3	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation tothe impulse response, Fourier series representation, the Fourier Transform,	Practice Problems on FT and DTFT.
4	convolution/multiplication	

	and their effect in the frequency domain, magnitude and phase response.	
5	The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.	
6	Laplace Transforms and its properties, region of convergence(ROC), pole –zero plotting, solution of differential equation and system behaviour using LT	Practice Problems on LT & ZT.
8	Concepts of Z transform, Region of convergence for different types of signals, properties	
9	Z domain analysis, eigen value, inverse Z transform.	
10	Sampling of signals and sampling theorem with proof. Types of sampling.	Power point presentation on sampling and reconstruction of signals.
11	Methods of signal reconstruction, aliasing, relationship between continuous and discrete time signal.	

(VIII) B. COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY : Jayati Routh	DEPARTMENT :ECE	SUBJECT: SIGNALS AND SYSTEM CODE : EC-303	SEMESTER :3RD

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
1	**Module 1**		**6**					
	1.1	Introduction to Signals and systems.	1	17.8.2020	17.8.2020			
	1.2	Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals.	2	18.8.2020-19.8.2020	18.8.2020-19.8.2020			
	1.3	System properties: linearity, shift invariance, causality.	2	21.8.2020-24.8.2020	21.8.2020-24.8.2020			
	1.4	System stability criteria, Operation on signals.	1	25.8.2020	26.8.2020			
2	**Module 2**		**6**					
	2.1	Linear shift invariant	1	26.8.2020	28.8.2020			

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
		(LSI)systems, impulse and step response.						
	2.2	Convolution, methods of convolution.	2	28.8.2020 - 31.8.2020	31.8.2020			
	2.3	Characterization of causality and stability of LSI systems,	1	1.9.2020	2.9.2020			
	2.4	System representation through differential equation	2	2.9.2020-4.9.2020	4.9.2020-7.9.2020			
3	**Module 3**		**8**					
	3.1	Periodic and semiperiodic inputs to an LSI system	1	7.9.2020	8.9.2020			
	3.2	Representation of Fourier Series, Fourier Coefficient of signals with symmetry	1	8.9.2020	9.9.2020			
	3.3	Fourier Transform, Convolution, multiplication and their effect on frequency domain.	2	9.9.2020	11.9.2020			
	3.4	Magnitude	1	11.9.2020	14.9.2020			

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
		and phase response, frequency domain duality.						
	3.5	Introduction to DTFT and DFT.	1	14.9 2020	15.9.2020			
	3.6	Parseval's theorem, the idea of signal space orthogonal basis.	1	15.9 2020	16.9.2020			
	3.7	Related numerical	1	16.9 2020	18.9.2020			
4		Module 4	8					
	4.1	Introduction to Laplace Transform		18.9.2020	21.9.2020			
	4.2	Notion of eigen function of LSI systems, a basis of eigen function.		21.9.2020	22.9.2020			
	4.3	Region of convergence, poles and zeros of system,		22.9.2020	23.9.2020			
	4.4	Solution to differential equation and system behaviour and system behaviour using Laplace Transform.		23.9.2020	28.9.2029			

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
	4.5	Z transform for discrete time signal and system, region of convergence		25.9.2020	29.9.2020			
	4.6	Properties of Z gtransform		28.9.2020	5.10.2020			
	4.7	Pole zero plot, Z domain analysis		29.9.2020	6.10.2020			
	4.8	Inverse z transform.		5.10.2020	7.10.2020			
5		Module 5	4					
	5.1	The sampling theorem and its implication-spectra of sampled signal.		5.10.2020	9.10.2020			
	5.2	Reconstruction of sampled signals		6.10.2020	13.10.2020			
	5.3	Aliasing and its effects		7.10.2020	15.10.2020			
	5.4	Relation between continuous and discrete time systems		9.10.2020	16.10.2020			

(IX) Teaching Strategy / Method

1. Detailed use of blackboard
2. Good oratory skill with clearly audible volume of lecture
3. Interactive classroom
4. Always encouraging the students to ask questions
5. Use of practical examples or similar models to illustrate the topics.

(IXA) Strategy to support weak students

1. Paying attention to their problems in understanding the subject
2. Encouraging them to express their point of trouble
3. Allotting extra time beyond schedules class hours to help them understand the topics
4. Suggesting them different ways (as found suitable depending upon the case) to overcome their problem.

(IXB) Strategy to encourage bright students

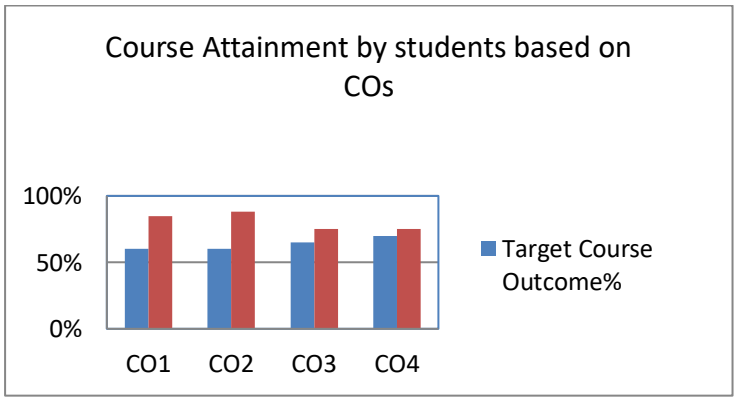
1. Try to encourage them to study beyond the syllabus
2. Ask them to develop the habit of reading anything good and rich in content
3. Advise them to try and solve higher level engineering numerical problems.

(IXC) Efforts to keep students engaged

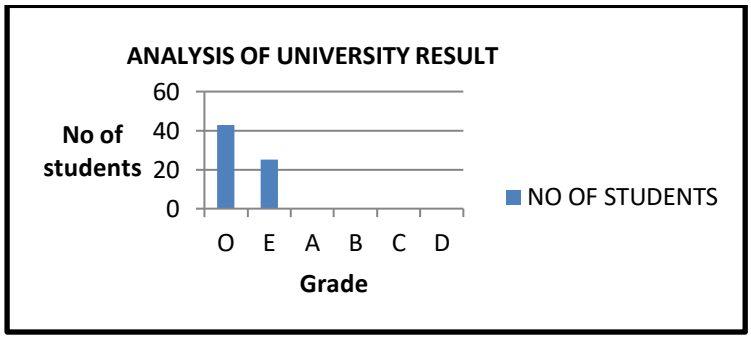
1. During class to avoid monotony some aptitude problems are given to solve.
2. Asking random questions to the students from the topic
3. Sometimes different tricks or techniques are shown to them to make the lecture interesting.
4. Informal technical quiz is also held.

X) Analysis of Students performance in the course

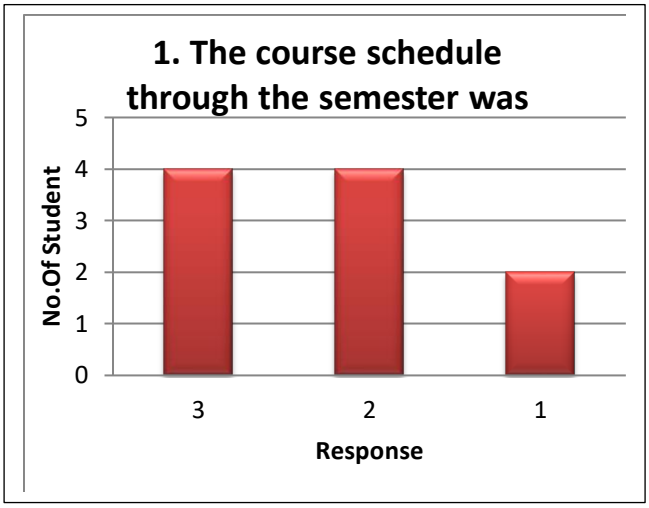
Course Attainment by Students Based on Cos:

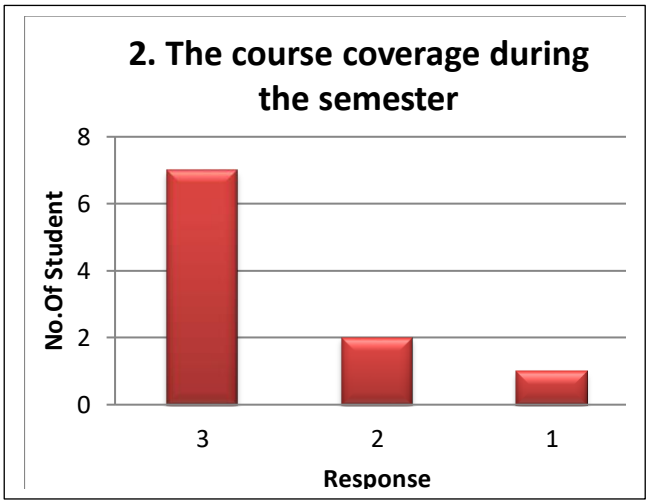


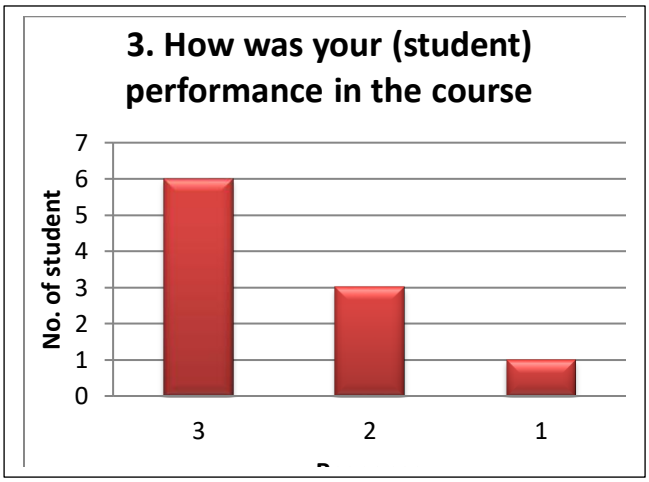
Analysis Based on University Result:

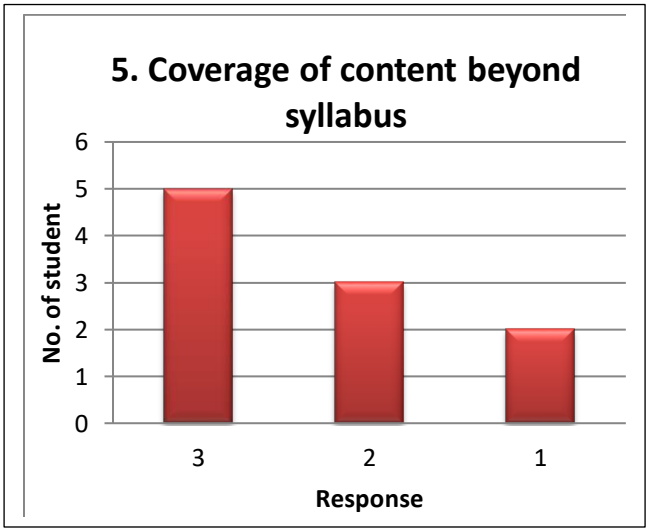


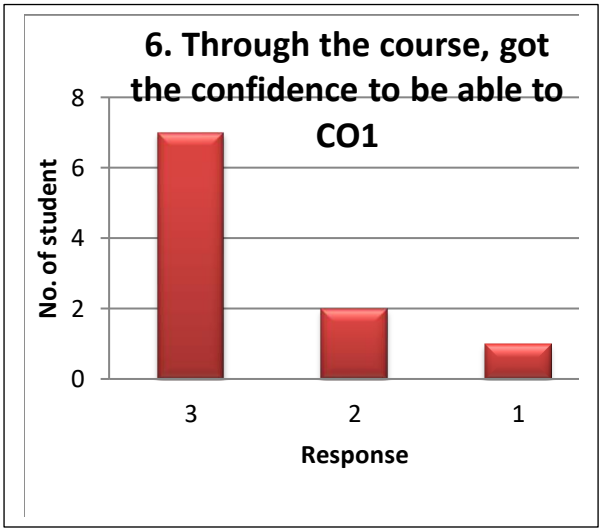
(XI) Analysis of Student Feed Back

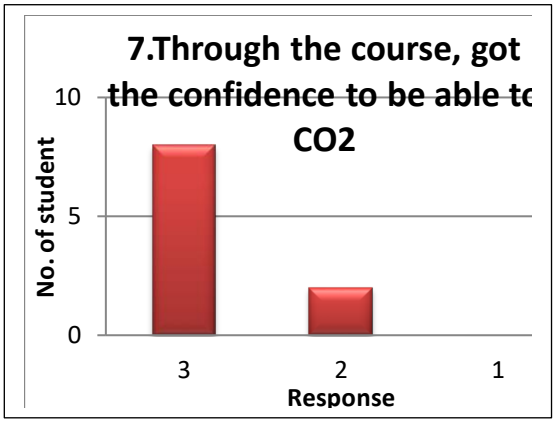


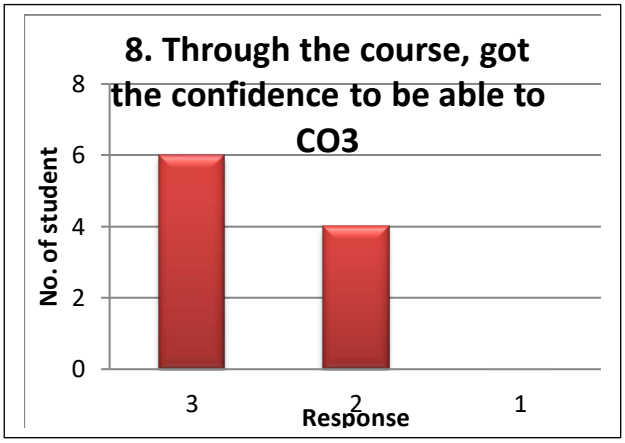


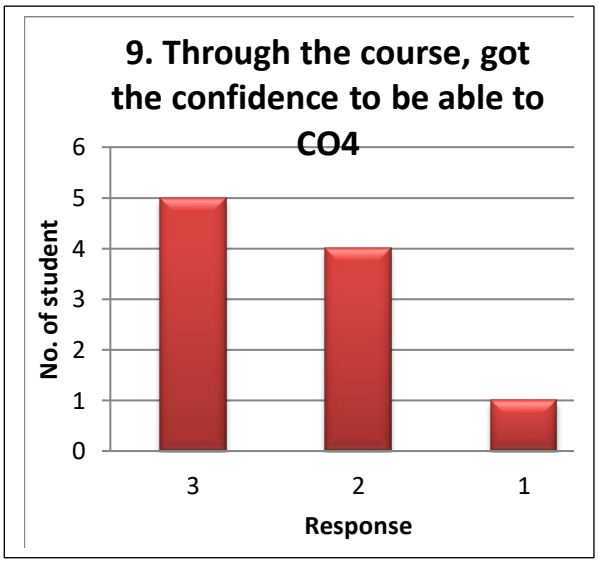


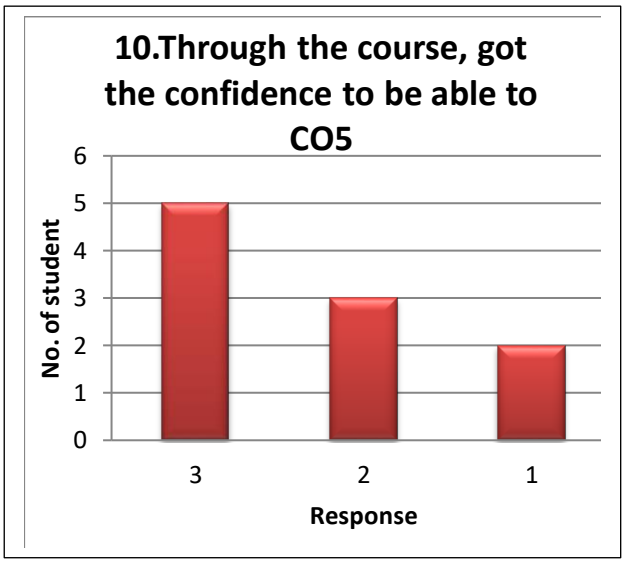


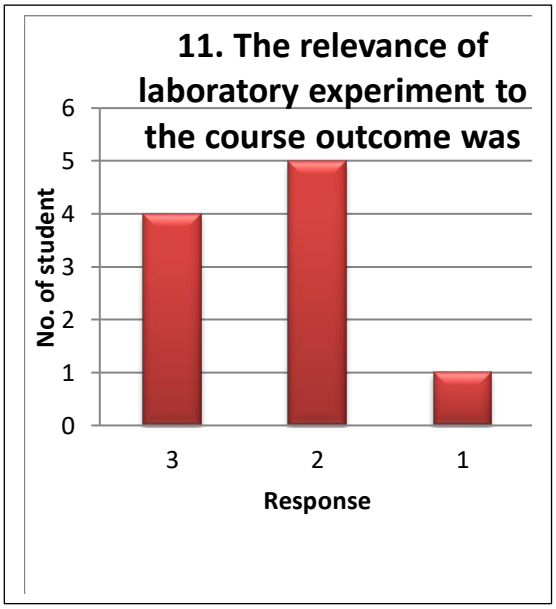


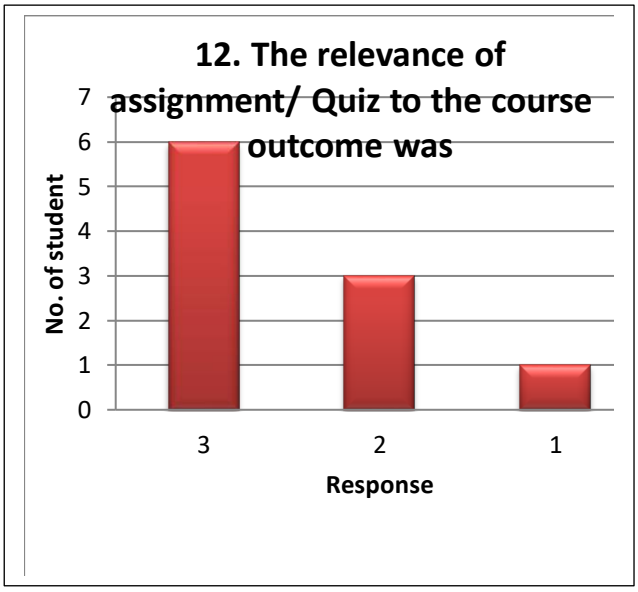

7.Through the course, got the confidence to be able to CO2
No. of student
10
5
0
3
2
1
Response

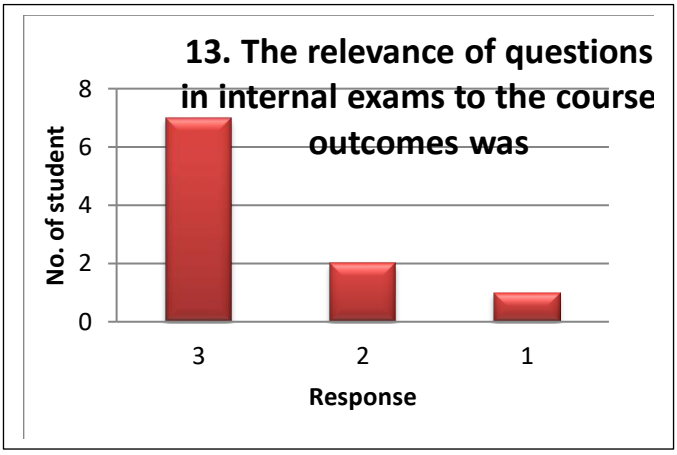

8. Through the course, got the confidence to be able to CO3
No. of student
8
6
4
2
0
3
2
1
Response

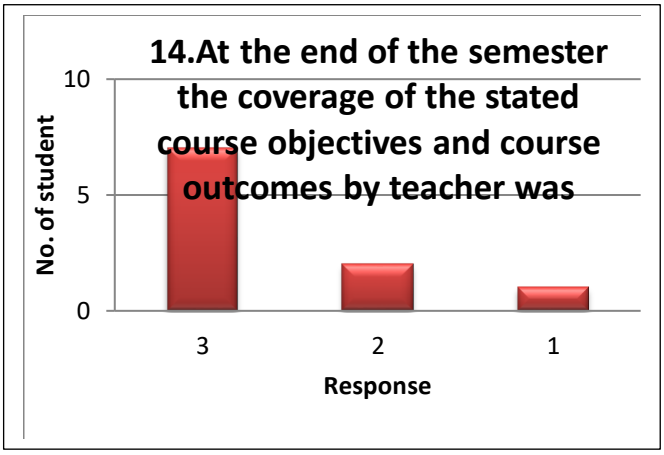

9. Through the course, got the confidence to be able to CO4
No. of student
6
5
4
3
2
1
0
3
2
1
Response

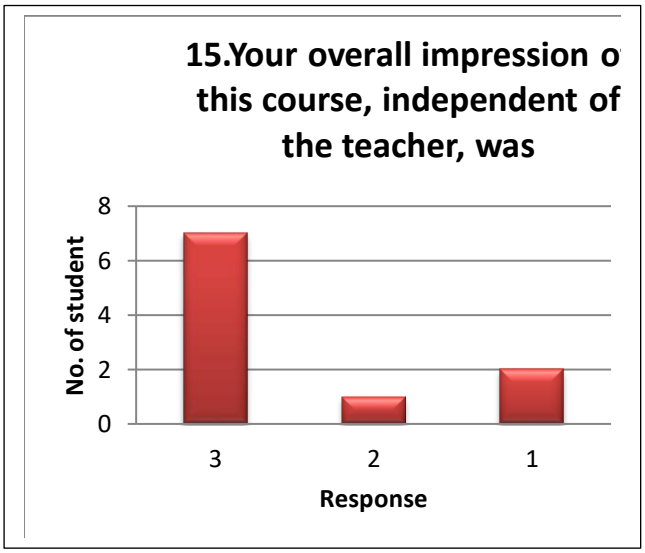

10.Through the course, got the confidence to be able to CO5
No. of student
6
5
4
3
2
1
0
3
2
1
Response


11. The relevance of laboratory experiment to the course outcome was
No. of student
6
5
4
3
2
1
0
3
2
1
Response


12. The relevance of assignment/ Quiz to the course outcome was
No. of student
7
6
5
4
3
2
1
0
3
2
1
Response


13. The relevance of questions in internal exams to the course outcomes was
No. of student
8
6
4
2
0
3
2
1
Response


14.At the end of the semester the coverage of the stated course objectives and course outcomes by teacher was
No. of student
10
5
0
3
2
1
Response


15.Your overall impression o this course, independent of the teacher, was
No. of student
8
6
4
2
0
3
2
1
Response


16. Would you recommend the course to others?
No. of student
8
7
6
5
4
3
2
1
0
Yes
No
Can't Say
Response

(XII) Teacher Self-Assessment (at the completion of course)

As the classes were conducted in online mode, Students' response in the class could not be monitored in a proper way. Performance of the students was judged by giving quiz and assignments through Google Classroom. Although attendance was improved due to home based classes (no transportation was needed).

(XIV) Recommendations/Suggestions for improvement by faculty

Students located in the rural areas or with a poor socio-economical background should be provided with online class facility.

INTERNAL ASSESMENT RECORD

Subject with code: Signals and System(EC 303)

Section: A

Semester : 3rd **Discipline: Electronics & Communication Engineering**

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
1	11900319001	ANIRBAN AIN	5	4	20	22	21	8	25
2	11900319002	ANIRUDDHA CHANDRA DAS	5	3	21	21	21	8	24
3	11900319003	SAURAV SINGH	5	3	23	22	22	7	26
4	11900319004	ANIRUDDHA DAS	5	3	22	23	22	9	25
5	11900319005	BIJAY KRISHNA MURMU	5	3	21	18	20	9	23
6	11900319006	DIPJYOTI PAUL	5	4	22	22	22	8	26
7	11900319007	JOYETA BARMAN	5	4	23	21	22	7	26
8	11900319008	ANIRUDRA PAUL	5	3	19	22	21	6	24
9	11900319009	KOUSTAV ROY	5	3	19	20	20	6	22
10	11900319010	ANWESHA SAHA	5	2	18	20	19	5	22
11	11900319011	Subhra sekhar Mohanta	5	3	20	20	20	6	23
12	11900319012	SUBHRAJIT ROY	5	4	21	22	22	7	26
13	11900319013	PIANTA SAHA	5	4	22	23	22	7	26
14	1190031901	MOHAMMAD	5	2	20	20	20	8	22

	4	NASIBUL AIN							
15	11900319015	BIPLAB SARKAR	5	3	21	22	21	8	24
16	11900319016	SAGAR DEBNATH	5	3	21	18	20	8	23
17	11900319017	ANUBHAB PAUL	5	3	21	22	22	8	26
18	11900319018	KESHER GUPTA	5	4	24	24	24	9	28
19	11900319019	Aman kumar	5	4	22	22	22	9	26
20	11900319020	PRITAM RAJA	5	4	23	23	23	9	27
21	11900319021	SAIKAT SARKAR	5	4	22	24	23	8	27
22	11900319022	SOURAV GHOSH	5	4	22	22	22	8	26
23	11900319023	NEHA	5	4	24	24	24	8	28
24	11900319024	SANTOSH KUMAR SHARMMA	5	1	18	18	18	7	19
25	11900319025	RITWIK CHOWDHURY	5	2	16	20	18	8	20
26	11900319026	RITIK JAISWAL	5	2	23	22	22	7	24
27	11900319027	SUVRANGSHU ROY	5	3	24	24	24	8	27
28	11900319028	SHUVADIP DAS	5	3	22	22	22	7	25
29	11900319029	Suvajit Gayen	5	3	23	23	23	7	26
30	11900319030	SOURAV BARMAN	5	3	22	24	23	8	26
31	11900319031	PINAKBRATA BISWAS	5	3	22	22	22	7	25
32	11900319032	AMIT KUMAR	5	3	24	24	24	6	27
33	11900319033	GOURAV KUMAR AGARWAL	5	2	22	22	22	7	24
34	1190032003	ARIJIT ROY	5	2	23	23	23	7	25
35	11900320039	SUJATA PAUL	5	4	22	24	23	8	27
36	11900320036	PAYEL RAJBANSHI	5	4	22	22	22	8	26
37	11900320035	ANINDYA DE	5	2	23	22	22	7	24
38	11900320037	SONI KUMARI	5	3	24	24	24	7	27
39	11900320038	JIT GHOSH	5	4	22	22	22	6	26
40	11900320040	Ruparna Dutta	5	4	23	23	23	7	27
41	11900320041	Tushar	5	4	22	24	23	7	27
42	11900320034	Afroja Akhtar	5	3	22	22	22	7	25

Records of Assignment

Subject with code: Signals and System(EC 303) Section: A

Semester :3RD Discipline: Electronics & Communication Engineering

Sl.	Roll No.	Name	Assignment / Quiz															
1	11900319001	ANIRBAN AIN	8															
2	11900319002	ANIRUDDHA CHANDRA DAS	8															
3	11900319003	SAURAV SINGH	7															
4	11900319004	ANIRUDDHA DAS	9															
5	11900319005	BIJAY KRISHNA MURMU	9															
6	11900319006	DIPJYOTI PAUL	8															
7	11900319007	JOYETA BARMAN	7															
8	11900319008	ANIRUDRA PAUL	6															
9	11900319009	KOUSTAV ROY	6															
10	11900319010	ANWESHA SAHA	5															
11	11900319011	Subhra sekhar Mohanta	6															
12	11900319012	SUBHRAJIT ROY	7															
13	11900319013	PIANTA SAHA	7															
14	11900319014	MOHAMMAD NASIBUL AIN	8															
15	11900319015	BIPLAB SARKAR	8															
16	11900319016	SAGAR DEBNATH	8															
17	11900319017	ANUBHAB PAUL	8															
18	11900319018	KESHER GUPTA	9															
19	11900319019	Aman kumar	9															
20	11900319020	PRITAM RAJA	9															
21	11900319021	SAIKAT SARKAR	8															
22	11900319022	SOURAV GHOSH	8															
23	11900319023	NEHA	8															

24	11900319024	SANTOSH KUMAR SHARMMA	7															
25	11900319025	RITWIK CHOWDHURY	8															
26	11900319026	RITIK JAISWAL	7															
27	11900319027	SUVRANGSHU ROY	8															
28	11900319028	SHUVADIP DAS	7															
29	11900319029	Suvajit Gayen	7															
30	11900319030	SOURAV BARMAN	8															
31	11900319031	PINAKBRATA BISWAS	7															
32	11900319032	AMIT KUMAR	6															
33	11900319033	GOURAV KUMAR AGARWAL	7															
34	1190032003	ARIJIT ROY	7															
35	11900320039	SUJATA PAUL	8															
36	11900320036	PAYEL RAJBANSHI	8															
37	11900320035	ANINDYA DE	7															
38	11900320037	SONI KUMARI	7															
39	11900320038	JIT GHOSH	6															
40	11900320040	Ruparna Dutta	7															
41	11900320041	Tushar	7															
42	11900320034	Afroja Akhtar	7															

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY

Sl.	Roll No.	Name of Student	Remedial measures taken by teacher
1	11900319026	RITIK JAISWAL	Arranged extra classes, Talked over phone, Provided study materials
2	11900319027	SUVRANGSHU ROY	Arranged extra classes, Talked over phone, Provided study materials
3	11900319033	GOURAV KUMAR AGARWAL	Arranged extra classes, Talked over phone, Provided study materials
4	1190032003	ARIJIT ROY	Arranged extra classes, Talked over phone, Provided study materials
5	11900320034	Afroja Akhtar	Arranged extra classes, Talked over phone, Provided study materials
6	11900320041	Tushar	Arranged extra classes, Talked over phone, Provided study materials

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that…….has completed the course work allotted to him/ her satisfactorily/ notsatisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

ELECTRONICS & COMMUNICATION ENGINEERING

COURSE FILE

6TH SEM, 3RD YEAR, 2021

SEC – A

PAPER DESCRIPTION : Computer Network

PAPER CODE : EC-602

Course File

Course Title: Computer Network.

Code: EC-602

Semester: 6TH Year: 3rd, 2021

Name of the Faculty: Prof. Anindita Sinha

E-mail: aninditasinha07@gmail.com

Class Schedule				
Lecture			Tutorial	Practical
Tuesday	Wednesday	Thursday	-	Tuesday
11:40 a.m -12:30 a.m	10:00 a.m -10:50 a.m	10:50 a.m- 11:40 a.m		2:10 p.m-4:40 p.m

Hours for meeting students:	
Monday	2:10 p.m- 5:00 p.m
Tuesday	2:10 p.m- 5:00 p.m
Other Days	1.30pm – 2:10pm or by appointment

i) Course Objective

1. To describe how computer networks are organized with the concept of layered approach.
2. To explore the various layers and its related functions of OSI and TCP/IP Model.
3. To describe how the data or packets in the network are delivered.
4. To describe different routing strategies and protocols for packet transmission and its related applications

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Outcomes		Target
EC 602.1	Understand and explore the basics concept of Data Communication and different network protocols, layered architecture and their applications. (B.T LEVEL-1)	60%
EC 602.2	Understand the elementary concepts based on data link layer protocols for error detection and correction. (B.T LEVEL-1)	60%

EC 602.3	Apply various network layer techniques for designing subnets and supernets and also analyse packet flow on basis of routing protocols. (B.T LEVEL-3)	60%
EC 602.4	To administrate a network and flow of information further students can able to understand the concepts of mobile or adhoc networks. (B.T LEVEL-4)	60%
EC 692.1	Have a working knowledge of datagram and internet socket programming.	70%

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform / demonstrate the following:

Sl.	Question	
1.	Explain different type of networks.	CO1
2.	Define redundancy?	CO1
3.	Define topology and explain and explain the topologies of networks?	CO1
4.	Explain the transmission modes in details?	CO2
5.	Define network?	CO3
6.	How performance is improved in CSMA/CD protocol compared to CSMA protocol? Explain	CO2
7.	How CSMA/CA differ from CSMA/CD .explain in brief?	CO2
8.	Explain in details of ICMP, IGMP?	CO3
9.	Explain uni-cast routing protocols in details?	CO3
10.	Explain in detail about process to process delivery?	CO4

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours	Laboratory hours
I. Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study. Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus;	10	

Telephone Network;		
II. Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet(in brief);	10	
III. Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, subnetting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6;. Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm,	12	
IV. Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. Modern topics: ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief Wireless LAN: IEEE 802.11, Introduction to blue-tooth.	10	

iv)Textbooks

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas
7. Miller, Digital & Data Communication, Jaico
8. Shay, Understanding Data Communication & Network, Vikas

Reference Books:

1. Kurose and Rose – "Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3 (4th Ed.)" – Pearson Education/PHI

v) Pre-requisites:

Students have pre-requisites knowledge of digital communication and digital electronics.

(vi) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15

Quiz / assignment	10
Attendance	5
University Exam/External Exam	70
Total	100

* Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

2) Laboratory

Expt. No.	Experiment Name	Schedule
1	Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.	3HRS.
2	Study of Network Devices in Detail.	3 HRS.
3	Study of network IP.	3 HRS.
4	Connect the computers in Local Area Network.	3 HRS.
5	Study of basic network command and Network configuration commands.	3 HRS.
6	Connecting a Switch	3 HRS.
7	Interpreting Ping and Traceroute Output	3 HRS.
8	Implementing an IP Addressing Scheme	3 HRS.
9	Configuring Static and Default Routes	3 HRS.
10	Examining Network Address Translation (NAT)	3 HRS.
11	Planning Network-based Firewalls	3 HRS.
12	Chatting message using Client server programming	3 HRS.

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	40% of the students have attained more than the target level of that CO
Attainment Level 2	50% of the students have attained more than the target level of that CO
Attainment Level 3	60% of the students have attained more than the target level of that CO

Overall Course Attainment Target = 70% of the students will get “A” Grade

Target has been set on the basis of last year’s performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%

B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	-	1	-	-	1	-	-	2	-	-	2	1	1
CO5	2	-	1	-	-	1	-	-	2	-	-	2	1	1

1 = courses in which the student will be exposed to a topic (BT level 1& 2)

2 = courses in which students will gain competency in that area (BT level 3-4)

3= courses in which students will master that skill (BT level 5-6)

- CO1 to CO5 partially satisfies the application of knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems (**PO1**).
- CO4 and CO5 minimally satisfies the Design solutions for design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, & the cultural and societal, environmental consideration(**PO3**).
- CO4 and CO5 minimally satisfies for the students to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**PO6**).
- CO4 & CO5 partially satisfies for the students to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**PO9**).
- CO4 & CO5 partially satisfies for the students to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**PO12**).

(vii) Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
CO1	Structured (Partially Supervised Whole-Class Grouping)	Online Class material, like YouTube's video, NPTEL lectures, PPT presentatition	Discussing different types of protocols, layers, and its related architecture.
CO2	Structured (Partially Supervised Whole-Class Grouping)	Online Class material, like YouTube's video,	**Understanding** the data flow procedure using

		NPTEL lectures, PPT presentatition	collision and without using collision protocols.
CO3	Structured (Partially Supervised Whole-Class Grouping)	Online Class material, like YouTube's video, NPTEL lectures, PPT presentatition	**Studying** the basics of **IP** addressing and its related application in routing.
CO4	Structured (Partially Supervised Whole-Class Grouping)	Online Class material, like YouTube's video, NPTEL lectures, PPT presentatition	Understanding the Domain name concept and explain the architecture of Bluetooth.
CO5	Structured (Partially Supervised Independent work)	MS-DOS Prompt and Internet Connection and JAVA	Demonstrate each and every function of computer network and routing.

(viii) Assessment Methodology

Outcome	Assessment Tool	Specific Question/activity aligned to the Outcome
CO1	QUIZ	1. Protocols are? (a)Agreements on how communication components and DTE's are to communicate (b) Logical communication channels for transferring data. (c)Physical communication channels sued for transferring data (d)None of above 2. Computer Network is A. Collection of hardware components and computers B. Interconnected by communication channels C. Sharing of resources and information D. All of the Above
	Assignment	1.State the functions of MAC?.
		2.How performance is improved in CSMA/CD protocol compared to CSMA protocol?Explain?.
CO2	Internal Test	1. Each IP packet must contain A. Only Source address B. Only Destination address C. Source and Destination address D. Source or Destination address

		2. Bridge works in which layer of the OSI model? A. Application layer B. Transport layer C. Network layer D. Data link layer
		3. Explain in details of ICMP,IGMP? 4. Explain network layer logical addressing?
CO3	QUIZ & Assignment	1. .Router operates in which layer of OSI Reference Model? A. Layer 1 (Physical Layer) B. Layer 3 (Network Layer) C. Layer 4 (Transport Layer) D. Layer 7 (Application Layer) 2. Each IP packet must contain A. Only Source address B. Only Destination address C. Source and Destination address D. Source or Destination address
	Internal Test	3. Explain HTTP and FTP 4. Explain Classless addressing.
CO4	Lab	1. Show different types of media connections using VLAB. 2. Show the working of ping command and traceroute command. 3. Show the Domain name of an unknown IP address. 4. Show the socket programming of Chatting message between Server and Client.

(ix) A. Weekly Lesson Plan

Week	Lectures	Tutorial	Practical	Assignment
1	I. Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN);			
2.	Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model,			

	their comparative study. Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided);			
3.	Circuit switching: time division & space division switch, TDM bus; Telephone Network;			
4.	Types of errors, framing(character and bit stuffing), error detection & correction methods; HDLC; Medium Access sub layer:,			
5.	Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ,			
6.	Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet(in brief);			
7.	Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; RIP, OSPF, BGP;Addressing : IP addressing, subnetting; Other Procols: ARP, IP, ICMP, IPV6			
8	Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols:			
9	Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm,			
10	Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography			
11	Digital Signature Firewalls. Modern topics: ISDN services & ATM, DSL technology, Cable Modem:			
12.	Architecture & Operation in brief Wireless LAN: IEEE 802.11, Introduction to blue-tooth.			

B. Daily Lesson Plan

Lecture	TOPIC/UNIT/ CHAPTER	Plan date with day	Execution date	Details of home work/assignment/mini project/ICT used/other	Details of topics that are beyond syllabus (if any)	Remarks
1	INTRODUCTION TO DATA COMMUNICATION, COMPUTER NETWORK	8.4.21	20.4.21			Google Meet
2	**Data Communications**: Components: Different Networks: LAN,MAN ,WAN	13.4.21	21.4.21			Google Meet
3	Components and Categories and different types of Connections	20.4.21	22.4.21			Google Meet
4	Topologies-STAR, MESH, RING, BUS, HYBRID	21.4.21	27.4.21			Google Meet
5	Protocols and Standards – ISO / OSI MODEL	22.4.21	28.4.21			Google Meet
6	Discussion on Different Layers with practical example	27.4.21	29.4.21			Google Meet
7	Example Networks such as ATM, Frame Relay	28.4.21	4.5.21			Google Meet
8	ISDN Physical layer: Transmission modes	29.4.21	5.5.21			Google Meet
9	Multiplexing-TDM, FDM	4.5.21	6.5.21			Google Meet
10	Transmission Media	5.5.21	7.5.21			Extra Class has taken
11	Switching, Circuit Switched	6.5.21	11.5.21			Google Meet

	Networks					
12	Error – Detection and Correction-Framing	11.5.21	12.5.21			Google Meet
13	Parity – LRC– CRC Hamming code, Flow and Error Control.	12.5.21	13.5.21			Google Meet
14	Noiseless Channels, Noisy Channels	13.5.21	18.5.21			Google Meet
15	HDLC, Point to Point Protocols, Flow Control,	18.5.21	19.5.21			Google Meet
16	111 Medium Access sub layer: ALOHA	19.5.21	20.5.21			Google Meet
17.	Revision Class-I	20.5.21	21.5.21			Google Meet
INTERNAL-1						24-26 th May-Due to 1st Internal examination, there will be no classes.
17	LAN– Ethernet IEEE 802.3	1.6.21	22.5.21			Google Meet
18	IEEE 802.5 – IEEE 802.11	2.6.21	1.6.21			Google Meet
19	CSMA/CA and CSMA/CD	3.6.21	2.6.21			Google Meet
20	IP addressing-different classes	8.6.21	3.6.21			Google Meet
21	Details discussion in IP addressing-IPV4 and IPV6	9.6.21	8.6.21			Google Meet
22	Subnetting and related maths	10.6.21	9.6.21			Google Meet
23	Supernetting and related maths	15.6.21	10.6.21			Google Meet
24	Routing Process-Unicast Routing and Broadcast Routing	16.6.21	15.6.21			Google Meet

25	BGP, RIP, OSPF	17.6.21	16.6.21			Google Meet
26	**Transport Layer:** Process to Process Delivery	22.6.21	17.6.21			Google Meet
27	UDP and TCP protocols	23.6.21	22.6.21			Google Meet
28	Data Traffic,Congestion	24.6.21	23.6.21			Google Meet
29	Congestion Control,	1.7.21	24.6.21			Google Meet
30	QoS, Integrated Services	6.7.21	1.7.21			Google Meet
31	Differentiated Services	7.7.21	7.7.21			Google Meet
32	Domain name space	8.7.21	14.7.21			Google Meet
33	DNS in internet, FTP,www, HTTP	13.7.21	15.7.21			Google Meet
34	SNMP and SMTP	14.7.21	16.7.21			Extra Class
35	Revision Class-II	15.7.21	17.7.21			
INTERNAL-2						20-23 th July-Due to 1st Internal examination, there will be no classes.
36	Practice Class-I	27.7.21	18.7.21			
37	Practice Class-II	28.7.21	29.7.21			

(x) Teaching Strategy / Method

- Assembly language programming
- Interactive question-answer session
- Arrangement of MCQ/quiz

(xa) Strategy to support weak students

- Extra Doubt clearing session beyond class hour
- Assignment
- Weak students grouped with good students

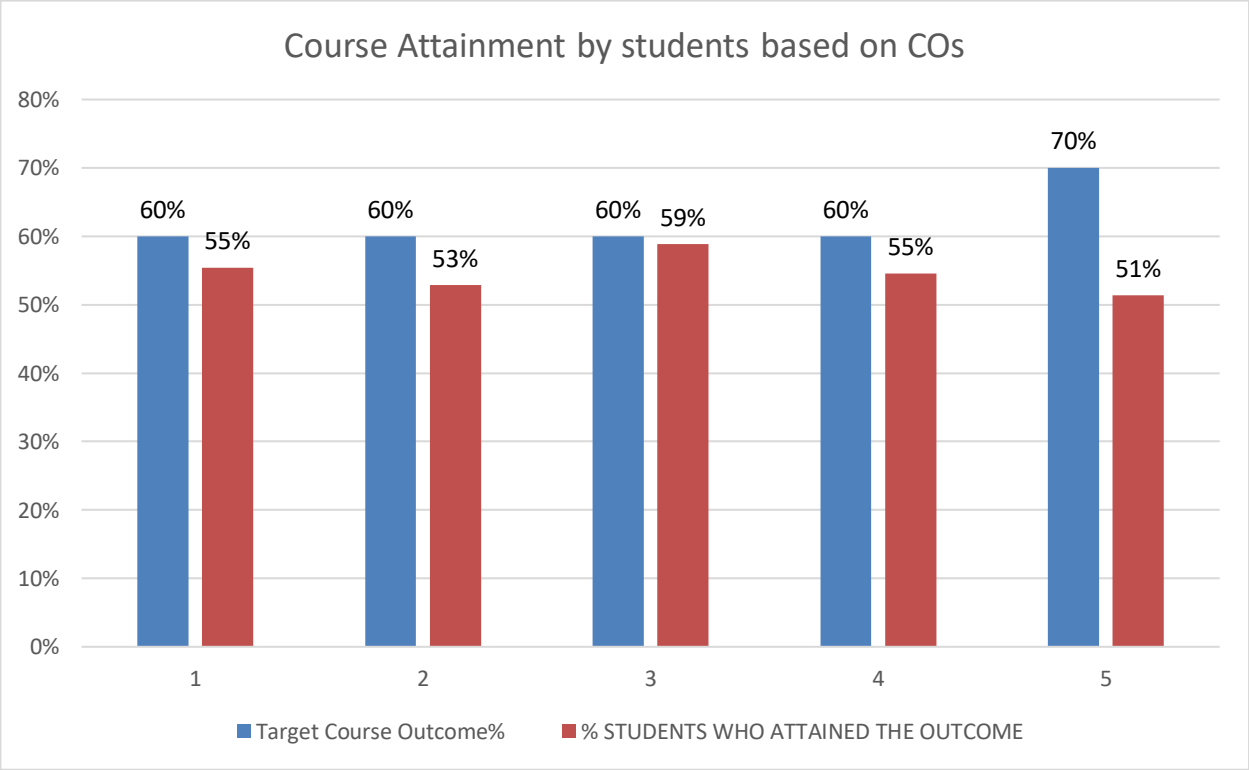
(xb) Strategy to encourage bright students

- High level assignment

(xc) Efforts to keep students engaged

- Asking students to share idea what they learned with fellow students.
- Small project

(xi) Analysis of Students performance in the course



- 55% students have attained the set target of 60% marks for CO1
- 53% students have attained the set target of 60% marks for CO2
- 59% students have attained the set target of 60% marks for CO3
- 55% students have attained the set target of 60% marks for CO4

- 51% students have attained the set target of 70% marks for CO5

(xii) Analysis of Students performance in the course (INTERNAL & university results)

Record of Attainment Level of A Course through University and Internal Assessments					
	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME	Attainment Level
CA	60%	29	16	55%	1
University	70	29	29	100%	3
Overall Attainment of Course Outcome=70% OF University +30% OF CA					2

- 55% students have attained the set target of 60% marks for Internal Exams.

(xiv) Teacher Self-Assessment (at the completion of course)

From the analysis of the results obtained it can be seen that set targets for the course outcome have been achieved successfully by the students. Since this subject will help them for designing systems based on LAN, different topologies. More emphasis must be given for developing theoretical concept and different programming techniques on client programme.

(xiv) Recommendations/Suggestions for improvement by faculty

- More emphasis should be given to clear the concepts related to Transport Layer.
- MCQ/viva may be arranged after the completion of each module in the syllabus.

INTERNAL ASSESMENT RECORD

Subject with code: Computer Network (EC 602)

Section: A Semester: 6th Discipline: Electronic & Communication Engg.

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
1	11900318004	Tenzing Wangchuk Bhutia	35	5	26	27	27	9	23

2	11900318005	Tamoghna Mondal	21	3	15	28	22	7	17
3	11900318006	Sweta Jaiswal	39	5	26	26	26	9	23
4	11900318007	Sushmita Mukherjee	31	4	23	20	26	9	21
5	11900318008	Sumit Kumar	35	4	22	25	26	10	22
6	11900318009	Suman Chandra Dey	21	3	17	17	17	7	15
7	11900318010	Subhajit Sen	27	3	21	26	26	7	19
8	11900318011	Subhajit Dey	40	5	22	30	26	10	23
9	11900318012	Srishti Pal	41	5	24	27	25	10	23
10	11900318013	Soumyadeep Halder	34	4	22	22	26	9	22
11	11900318014	Soumyadeep Das	25	3	25	20	27	8	20
12	11900318015	Souhardya Paul	34	4	24	20	26	8	21
13	11900318016	Shreya Chattopadhyay	39	5	23	23	26	10	23
14	11900318017	Shayantan Kumar Roy	26	4	20	25	25	9	21
15	11900318018	Shakchhi Lama	39	5	26	25	27	10	24
16	11900318019	Satwik Chatterjee	38	5	23	24	23	10	22
17	11900318020	Santosh Shrivastav	34	5	23	25	26	9	23
18	11900318021	Sagnik Ghosh	22	3	12	23	18	8	16
19	11900318023	Sagarnil Chakraborty	22	3	19	21	21	8	18
20	11900318024	Rudra Das Mandal	21	3	22	22	22	7	18
21	11900318025	Roshan Kumar Vats	21	3	20	23	25	7	19
22	11900318027	Rinku Roy	35	5	23	24	25	9	22
23	11900318028	Rahul Shah	23	3	21	22	25	9	20
24	11900318029	Rahul Roy	42	5	27	25	29	10	24
25	11900318030	Priyanka Kundu	41	5	27	25	27	10	23
26	11900318031	Pritam Sen	25	3	23	24	26	8	20
27	11900318032	Pritam Barman	39	4	23	27	27	9	22
28	11900318033	Pratim Kumar Das	40	5	22	23	25	10	22
29	11900318034	Nur Hasan	42	5	21	25	25	10	22

ATTENDANCE SHEET (Practical)

Subject with code: Computer Network Lab (EC-692)

Semester : 6TH Sem, 2021

Discipline: ECE

SL	Name	Roll No.	1 4.5.2021	2 11.5.2021	3 18.5.2021	4 25.5.2021	5 8.6.2021	6 15.6.2021	7 22.6.2021	8 29.6.2021	9 6.7.2021	10 6.7.2021	11 13.7.2021	12 13.7.2021		TOTAL
1.	11900318004	TENZING WANGCHUK	1	1	1	1	1	0	1	1	1	1	1	1		11

2.	11900318005	TAMOGHNA MONDAL	0	1	0	1	1	1	1	0	1	1	0	0		6
3.	11900318006	SWETA JAISWAL	1	1	0	1	1	1	1	1	1	0	1	1		10
4.	11900318007	SUSMITA MUKHERJEE	0	0	1	1	1	1	1	0	1	1	0	0		7
5.	11900318008	SUMIT KUMAR	1	1	0	1	1	1	1	1	1	1	0	1		10
6.	11900318009	SUMAN CHANDRA DEY	0	0	0	1	0	0	1	0	1	1	0	0		4
7.	11900318010	SUBHAJIT SEN	0	0	1	0	1	1	0	1	1	0	0	0		5
8.	11900318011	SUBHAJIT DEY	1	1	1	1	1	1	1	1	1	1	0	0		10
9.	11900318012	SHRISHTI PAL	1	1	1	1	1	1	1	1	1	1	1	1		12
10.	11900318013	SOUMYADEEP HALDER	1	1	0	0	1	1	1	1	1	0	0	1		8
11.	11900318014	SOUMYADEEP DAS	0	0	0	1	1	1	0	1	1	1	1	1		8
12.	11900318015	SOUHARDYA PAUL	1	1	1	1	1	0	0	1	1	1	1	1		10
13.	11900318016	SHREYA CHATTOPADHYAY	1	1	0	1	1	1	1	0	0	0	1	1		8
14.	11900318017	SHAYANTAN KUMAR RAY	0	1	0	1	1	1	1	1	1	1	1	1		10
15.	11900318018	SAKSHI LAMA	1	1	0	1	1	1	1	1	1	1	0	0		9
16.	11900318019	SATWIK CHATTERJEE	1	1	1	1	1	1	1	1	1	1	1	1		12
17.	11900318020	SANTOSH SRIVASTAVA	0	1	1	1	1	1	1	0	1	0	0	0		7
18.	11900318021	SAGNIK GHOSH	0	0	0	1	0	1	1	1	0	0	0	0		4
19.	11900318023	SAGARNIL CHAKRABORTY	0	0	0	0	1	0	1	1	0	0	1	0		4
20.	11900318024	RUDRA DAS MANDAL	0	1	0	0	0	1	1	0	0	0	1	1		5
21.	11900318025	ROSHAN KR VATS	1	0	1	1	1	0	0	1	1	0	0	0		6
22.	11900318027	RINKU ROY	1	1	1	1	1	1	1	1	0	1	1	1		11
23.	11900318028	RAHUL SHAH	0	1	0	1	0	1	0	0	0	0	1	1		5
24.	11900318029	RAHUL ROY	1	1	1	1	1	1	1	1	1	1	1	1		12
25.	11900318030	PRIYANKA KUNDU	1	1	1	1	1	1	1	1	1	1	1	1		12
26.	11900318031	PRITAM SEN	1	0	1	0	0	0	0	1	1	1	0	0		5
27.	11900318032	PRITAM BARMAN	1	1	0	1	1	1	0	1	0	0	1	1		8
28.	11900318033	PRATIM KUMAR DAS	1	1	1	1	1	1	1	1	1	1	1	1		12
29.	11900318034	NUR HASAN	1	1	1	1	1	0	1	1	1	1	1	1		11

Sessional/Practical Performance Record

Subject with code:_____ Section:_____

Semester :_____ Discipline:_____

Sl	Roll No.	Name	Marks in experimentation										Avg.	Viva	Total
			1	2	3	4	5	6	7	8	9	10			

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY			
Sl.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
1.	11900318009	SUMAN CHANDRA DEY	• Preparing them by solving previous year WBUT question papers • Additional doubt clearing sessions • Providing extra assignments • Highlighting important and frequently asked questions
2.	11900318015	SOUHARDYA PAUL	
3.	11900318024	RUDRA DAS MANDAL	
4.	11900318025	ROSHAN KR VATS	

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	**Semester**	**Subject with Code**	**Total Units/ Chapters**	**Remarks**
1.	6th	**Computer Network**	12	

Date :7.08.2021	**Signature of Faculty**

Submitted to HOD
Certificate by HOD
I, the undersigned, certify that……..has completed the course work allotted to him/ her satisfactorily/ not-satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

ELECTRONICS & COMMUNICATION ENGINEERING

COURSE FILE

1ST SEM, 3RD YEAR, 2020

PAPER NAME : Electromagnetic wave

&

Electromagnetic Waves Laboratory

PAPER CODE : EC 501 & EC 591

Course File

Course Title : **Electromagnetic Waves (EC501) & Electromagnetic Wave Laboratory (EC591)**

Semester : **1st Year 3rd , 2020**

Name of the Faculty: **Prof. Dia Ghosh**

E-mail:**dia.slg42@gmail.com**

Class Schedule:

Lecture	Practical
Wednesday 02.10pm – 03.00pm **Thursday** 12.30pm – 01.20pm **Friday** 11.40am – 01.20pm	**Monday** 10.50am – 01.20pm

- An additional Lecture per week has been incorporated for facilitating better understanding and coverage of the syllabus.

Hours for meeting students:

Friday	Saturday	Other Days
1.20pm – 4pm	1.20pm – 4pm	1.30pm – 2pm or by appointment

i) Course Objective

Students will be able to understand the concept of static and time varying EM fields and wave propagation through transmission line.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Outcomes		Target
EC501.1	**Describe** the basic concept of Vector algebra, Maxwell's equations, and apply them in the problems related to static and time varying EM fields. [B.T. LEVEL 1,2,3]	70% marks
EC501.2	**Understand** the wave propagation phenomena in different medium like dielectric, conductor and free space. [B.T. LEVEL 2]	70% marks
EC501.3	**Analyze** wave propagation in transmission line and to understand the concept of basic transmission line parameters & Smith Chart. [B.T. LEVEL 2,4]	70% marks
EC501.4	**Understand** the idea of basic radiating structures, and few primary antennas like, dipole, loop, YagiUda and array antennas.[B.T. LEVEL 2]	70% marks
EC501.5	**Investigate** the basic parameters of different antennas and study the standing wave pattern of transmission line. [B.T. LEVEL 5]	70% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	**Convert** points P(1,3,5), T(0,-4,3) and (-3,-4,-10)from Cartesian to cylindrical and spherical coordinates.	2
2.	Determine the divergence of the vector field $Q = \rho \sin\phi a_\rho + \rho^2 z a_\phi + z\cos\phi a_z$.	2
3.	Planes x=2 and y=-3 respectively carry charges 10 nC/m^2 and 15 nC/m^2.If the line x=0,z=2 carries charge 10π nC/m, **calculate** E at (1,1,-1).	3
4.	In a lossless medium for which $\eta = 60\pi$, $\mu_r = 1$, $\overline{H} = -0.1\cos(\omega t - z)ax + 0.5\sin(\omega t - z)ay$ A/m, **calculate** ε_r, ω, and $\overline{E}$?	3
5.	Explain Skin depth	2
6.	Explain how a $\frac{\lambda}{4}$ short circuited transmission line can be used as a parallel resonant circuit?	4
7.	What is transit time effect?	2
8.	Verify the radiation pattern of a given λ/2 simple dipole at far field. Apply 750 MHz RF signal to the antenna under test. Draw the polar plot	5

	of the radiation pattern and find the following parameters. 1. Directivity, 2. Front to back ratio. 3. Comment on the directivity of your antenna in comparison to short dipole antenna.	
9.	Study the characteristics of wave propagation in rectangular waveguide in TE10 mode when the line is open-circuited. Hence calculate the transmitting free space frequency. Verify the calculated free space frequency with the help of Frequency meter. Comment on the characteristics of standing wave pattern when the wave guide is terminated by a resistive load at the load end	4

iii) Unit Layout

Unit	Lecture Hours	Laboratory hours
I. Basics of Vectors, Vector calculus, Maxwell's Equations, Basic laws of Electromagnetic, Poynting Vector, Boundary conditions at Media Interface.	6 HRS.	-
II. Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wavepolarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Surface current and power loss in a conductor Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.	8 HRS.	3 HRS.
III. Transmission Lines- Equations of Voltage and Current on TX line, Propagationconstant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.	8 HRS.	-
IV. Wave propagation in parallel plane waveguide, Analysis of waveguide general approach,	6 HRS.	-

Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide		
v. Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna.	6 HRS.	-

iv)Textbooks

1. Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education.
3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K
4. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India

Reference books :

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India
2. Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery& T. Van Duzer, JohnWiley
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Electromagnetics, 2ed Edition – J AEdminister, Tata-McGraw-Hill.
5. Engineering Electromagnetics, 7thEdition-W.H.Hayt &J.A.Buck, Tata-McGraw-Hill
6.Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15
Quiz/Assignment/ Presentation	10
Attendance	5
University Exam	70
Total	100

* Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

2) Laboratory

Evaluation Criteria	Marks
Internal Exam*	40
University Exam	60
Total	100

*****Internal Evaluation will be based on daily lab performance as per the following schedule:

Expt. No.	Experiment Name	Schedule	Marks
1	Familiarization with antenna trainer kit & Microwave test bench	3HRS.	40
2	Plotting of Standing Wave Pattern along a transmission line when the line is: A. Open circuited. B. Short Circuited. C. Terminated by a matched load.	3 HRS.	40
3	Study the radiation pattern of dipole antenna.	3 HRS.	40
4	Study the Radiation Pattern of a folded-dipole antenna.	3 HRS.	40
5	Radiation pattern of a 3-element Yagi-Uda Antenna.	3 HRS.	40
6	Study the beam width, gain and radiation pattern of a 3-element, 5-element and 7-element. Yagi-Uda antenna	3 HRS.	40
7	Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.	3 HRS.	40
8	Study of Smith chart	3HRS	40

9	To measure the input impedance of a terminated waveguide using shift in minima technique and smith chart	3HRS	40
10	To study the cross-pole radiation pattern of different antennas, e.g. Dipole, Folded Dipole Yagi-Uda antenna. To measure the polarization purity.	3HRS	40

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2
Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Overall Course Attainment Target (70% of university and 30% of the internal exam) will be =Attainment Level 3

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
EC 401.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
EC 401.2	3	1	1	1	-	-	-	-	2	-	-	-	3	2
EC 401.3	3	2	1	1	-	-	-	-	2	-	-	-	3	2
EC 401.4	3	2	1	1	-	-	-	-	2	-	-	-	2	2
EC 401.5	2	3	-	-	-	-	-	-	2	-	-	-	2	2
EC 401	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**

- CO1, 2,3&4 fully satisfies whereas CO 5partially satisfies the application of knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems (PO1).
- CO1, minimally satisfies, CO 2 &3, 4, moderately satisfies whereas CO 5 fully satisfies the ability of the student to identify, formulate, and analyze engineering problems to arrive at substantiated conclusions (PO2).

- CO 2,3,4 minimally satisfies, the student's ability toDesign solutions for complex Electronics & Communication engineering problems (PO3)
- CO 2,3,4 minimally satisfies the ability of the student to Conduct investigations of complex problems(PO4).
- CO 2,3,4& 5 moderately satisfies the student's ability to function effectively as an individual and as a member in a team (PO9).

(vii) Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
EC 401.1	Structured (Partially Supervised Whole-Class Grouping)	Blackboard & Chalk, Video Lecture, NPTEL materials	Basic concepts related to Vector algebra, Maxwell's equation, static EM field
EC 401.2	Structured (Partially Supervised Whole-Class Grouping)	Blackboard & Chalk, Video Lecture, NPTEL materials	Time varying EM field in lossless, lossy and conducting medium, reflection of EM waves at normal and oblique incidence
EC 401.3	Structured (Partially Supervised Whole-Class Grouping)	Blackboard & Chalk, Video Lecture, NPTEL materials	Distributed circuit (Transmission line) theory
EC 401.4	Structured (Partially Supervised Whole-Class Grouping))	Blackboard & Chalk, Video Lecture, NPTEL materials	Basic radiation mechanism
EC 401.5	Structured (Partially Supervised Independent work)	Hardware Based	Radiation pattern of different antennas, Standing wave pattern of shorted, opened and matched waveguide type transmission line, Basic concept of smith chart

(viii) Assessment Methodology

Outcome	Assessment Tool	Specific Question/activity aligned to the Outcome
EC 501.1	Internal Test	1. What is displacement current density? How Maxwell modified one of his equations valid for static field. What is the importance of the Displacement current? 2. State and explain divergence theorem and stokes theorem.
	Quiz	1.At every point in space $a_\phi . a_\theta = 1$ a. true b. false 2.Point charges $Q_1 = 1nC$ and $Q_2 = 2nC$ which of the following statements are incorrect? a) The force on Q_1 is repulsive b) As the distance between them decreases, the force on Q_1 decreases linearly c) The force on Q_2 is along the line joining them. 3. An electric charge Q is placed in a dielectric medium. Which of the following quantities are independent of the dielectric constant ε of the medium? a) Electric potential V and electric field intensity E b) **b)** Displacement current density **D** and Displacement ψ . **c)** Electric field intensity **E** and displacement density **D.** **d)** Electric potential V and Displacement ψ .
	University Exam	1. Write down the integral form of Maxwell's equation and briefly explain the physical significance of each equation. 2. Explain Gauss's Law.
EC 501.2	Internal Test	1. A lossy dielectric has an intrinsic impedance of $200\angle 30^0 \Omega$ at a particular radian frequency ω. If at that frequency the plane wave propagating through the dielectric has the magnetic field component $H = 10e^{-\alpha x}\cos\left(\omega t - \frac{1}{2}x\right)a_y \, A/m$, find **E** and α . 2.Prove that EM power passing through free space is given by the expression $E \times H \;\; W/m^2$.
	Quiz	1. In a good conductor **E** and **H** are in time phase a. true b. false 2. The electromagnetic waves travel faster in conductors than dielectrics a. true b. false
	University Exam	1. Deduce poynting theorem and clearly explain every term. 2. What do you mean by Uniform plane wave? Derive the expression for Electric field in lossless medium. 3. What is intrinsic impedance of free space?
EC 501.3	Internal Test	1. One end of a transmission line having the characteristic

		impedance of 75Ω and length of 1 cm is short circuited. At 3 GHz , show that the input impedance at the other end of the transmission line is inductive. 2.Explain how a $\frac{\lambda}{4}$ short circuited transmission line can be used as a parallel resonant circuit
	Quiz	1. Consider a transmission line of characteristic impedance of 50 ohm. Let it be terminated at one end by $j50$ ohm. The VSWR produced by it in the transmission line will be a. 1b. 0 c. ∞ d. $+j$ 2. A transmission line whose characteristic impedance is pure resistance a. Must be a loss-less line b. Must be distortion less line. c. May not be a loss-less line b. May not be a distortion-less line
	University Exam	1. Derive the voltage and current equation of two wire transmission line. what is lossless transmission line. 2. What is distortion less line. 3. Derive the expression for the input impedance of a lossless transmission line.
EC 501.4	Internal Test	1. Briefly explain Directivity & Gain. 2. Explain radiation resistance of an antenna. 3. Explain the radiation mechanism of a two element array antenna, where the spacing between the elements is half wavelength and the phase difference between the current in each element is 90^0.
	Quiz	1. FNBW of broadside array varies inversely with *d*; while that for end fire array varies inversely with $\sqrt{d}$. The statement is a. True b. False 2. If the inter-radiator spacing of an array is *d* and inter-radiator phasing is δ ; the condition for maxima at $\phi = 0$ is a. $\delta = -{}^{2\pi d}/_{\lambda}$ b. $\delta = -{}^{d}/_{\lambda}$ c. $\delta = -d$ 3. HPBW for short dipole, half wave dipole and full wave dipoles are respectively a. 90^0, 78^0 and 47^0b. 78^0, 90^0 and 47^0 c. None of these
	University Exam	1. Derive the expression of radiation resistance and total power radiated by a half wave dipole. 2. Explain the radiation mechanism of broad side array antenna. 3. Briefly explain the construction working principle of YagiUda antenna.

EC 501.5	Lab	Study the characteristics of wave propagation in rectangular waveguide in TE10 mode when the line is open-circuited. Hence calculate the transmitting free space frequency. Verify the calculated free space frequency with the help of Frequency meter. Comment on the characteristics of standing wave pattern when the wave guide is terminated by a resistive load at the load end

(ix) A. Weekly Lesson Plan

Week	Lectures	Practical	Quiz
1			-
2	Orthogonal coordinate system rectangular, cylindrical and spherical coordinates, differential elements and Gradient	Familiarization with antenna trainer kit & Microwave test bench	-
3	To understand the physical significance of divergence, curl, Divergence Theorem, Stoke's Theorem, problem related to divergence, curl.	Plotting of Standing Wave Pattern along a transmission line when the line is: D. Open circuited. E. Short Circuited. F. Terminated by a matched load.	-
4	Coulomb's law, electric field intensity, charge distribution. Gauss's Law, Maxwell's equation for static E fields.	Study the radiation pattern of dipole antenna.	
5	Poisson's & Laplace's equations, Biot-Savart law, Ampere's law, Relation between J & H, Vector magnetic	Study the radiation pattern of folded dipole antenna.	-

	Potential. Maxwell's equation for static magnetic fields		
6	Faraday's law & Lenz's law. Displacement Current, Jc - JD Relation, Maxwell's equations. Time-harmonic fields, Wave Equation,	Radiation pattern of a 3-element Yagi-Uda Antenna	-
7	Plane Wave Propagation in Lossy Dielectric, Poynting's theorem	Study the beam width, gain and radiation pattern of a 3-element, 5-element and 7-element. Yagi-Uda antenna	
8	Plane Wave Propagation in Good conductor, Reflection of plane wave at normal incidence.	Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.	-
9	Reflection of plane wave at oblique incidence. Basic Transmission line theory.	Study of Smith chart	
10	Lossless, Distortion less line, Transmission line as a circuit element.	To measure the input impedance of a terminated waveguide using shift in minima technique and smith chart	-
11	Transmission line Matching techniques	To study the cross-pole radiation pattern of different antennas, e.g Dipole, Folded Dipole Yagi-Uda antenna. To measure the polarization purity.	-
12.	Smith Chart-construction and use of Smith chart	Revision Class	
13.	Smith chart, Types of Transmission line	Revision Class	

14.	Types of transmission line , Basic radiation mechanism		
15.	Wave propagation in parallel plane waveguide, Analysis of waveguide general approach,		
16.	Rectangular waveguide, Modal propagation in rectangular waveguide,		
17.	Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.		
18.	Radiation: Solution for potential function,		
19.	Radiation from the Hertz dipole, Power radiated by hertz dipole,		Quiz-1 Static & Time varying EM field, Antenna
20.	Radiation Parameters of antenna,		Quiz-1 Static & Time varying EM field, Antenna,
21.	Receiving antenna, Monopole		
22.	Dipole antenna		

Daily lesson Plan

S. No	Content	Lecturer	Plan date	Execution Date	Remarks
1	Discussion on course objectives and outcome, text & reference books, evaluation scheme and weekly lesson plan. Introduction to Digital communication systems types	**1L**	**19.08.2020**	**19.08.2020**	
2	Basics of Vectors	**1L**	**20.08.2020**	**20.08.2020**	
3	Vector calculus	**2L**	**21.08.2020**	**21.08.2020**	
4	Vector calculus	**1L**	**26.08.2020**	**26.08.2020**	
5	Vector calculus	**1L**	**27.08.2020**	**01.09.2020**	
6	Basic EM Laws and Maxwell's Equation	**2L**	**28.08.2020**	**02.09.2020**	
7	Basic EM Laws and Maxwell's Equation.	**1L**	**02.09.2020**	**03.09.2020**	
8	Boundary conditions at Media Interface	**1L**	**03.09.2020**	**10.09.2020**	
9	Uniform Plane Wave- Uniform plane wave, Propagation of wave,	**2L**	**04.09.2020**	**15.09.2020**	
10	Propagation of wave through free space	**1L**	**09.09.2020**	**16.09.2020**	
11	Propagation of wave through lossy dielectric	**1L**	**10.09.2020**	**17.09.2020**	
12	Propagation of wave through lossy dielectric	**2L**	**11.09.2020**	**23.09.2020**	

13	Problems	**1L**	**16.09.2020**	**24.09.2020**	
14	Poynting Vector	**1L**	**17.09.2020**	**29.09.2020**	
15	Wave propagation in conducting medium	**2L**	**18.09.2020**	**06.10.2020**	
16	Wave polarization, Poincare's Sphere,	**1L**	**23.09.2020**	**07.10.2020**	
17	Plane Waves at a Media Interface-Plane wave in normal direction,	**1L**	**24.09.2020**	**13.10.2020**	
18	Plane Waves at a Media Interface-Plane wave in normal direction,	**2L**	**25.09.2020**	**14.10.2020**	
19	Plane Waves at a Media Interface-Plane wave in normal direction,	**1L**	**30.09.2020**	**15.10.2020**	
20	Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.	**1L**	**30.09.2020**	**12.11.2020**	
21	Transmission Lines-Equations of Voltage and Current on TX line, Smith Chart, Admittance Smith Chart.	**2L**	**07.10.2020**	**17.11.2020**	
22	Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance	**1L**	**08.10.2020**	**18.11.2020**	

23	Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line,	**1L**	**09.10.2020**	**24.11.2020**	
24	Smith Chart, Admittance Smith Chart,	**2L**	**08.10.2020**	**25.11.2020**	
25	Smith Chart, Admittance Smith Chart,	**1L**	**14.10.2020**	**26.11.2020**	
26	Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.	**1L**	**15.10.2020**	**01.12.2020**	
27	Wave propagation in parallel plane waveguide,	**2L**	**16.10.2020**	**03.12.2020**	
28	Wave propagation in parallel plane waveguide,	**1L**	**21.10.2020**	**08.12.2020**	
29	Analysis of waveguide general approach, Rectangular waveguide,	**1L**	**04.11.2020**	**09.12.2020**	
30	Modal propagation in rectangular waveguide, Surface currents on the waveguide walls,	**2L**	**05.11.2020**	**15.12.2020**	
31	Field visualization, Attenuation in waveguide.	**1L**	**06.11.2020**	**16.12.2020**	
32	Radiation: Solution for potential function,	**1L**	**11.11.2020**	**12.01.2020**	
33	Radiation Parameters of antenna	**2L**	**12.11.2020**	**20.01.2020**	
34	Radiation from the Hertz dipole	**1L**	**13.11.2020**	**21.01.2020**	
35	Power radiated by hertz dipole	**1L**	**18.11.2020**	**27.01.2020**	

36	receiving antenna, Monopole and Dipole antenna,	**2L**	**19.11.2020**	**09.02.2021**	**1St Internal Examination(02.02.2021 to 05.02.2021)**
37	Problem Solving	**2L**		**10.02.2021**	
38	Problem Solving	**1L**		**11.02.2021**	
39	Problem Solving	**1L**		**16.02.2021**	
40	Doubt Clearing Class			**17.02.2021**	
41	Doubt Clearing Class			**18.02.2021**	
42	Doubt Clearing Class			**24.02.2021**	
43	Doubt Clearing Class			**25.02.2021**	
					2nd Internal Examination(01.03.2021 to 02.03.2021)

(x) Teaching Strategy/Method

- **Learning by critical thinking and understanding**
  Critical thinking is a collection of mental activities that include the ability to clarify, reflect, connect, infer, and judge. It brings these activities together and enables the student to question what knowledge exists.
- Solving numericals
- Active learning.
- **Employ Team based learning**

  In team-based learning students rely on each other for their own learning and are held accountable for coming to class prepared

(xa) Strategy to support weak students

- Weak students are encouraged to participate in all the interactive discussions.
- They are encouraged to meet me after each class for clearing their doubts.
- They are provided additional assignments

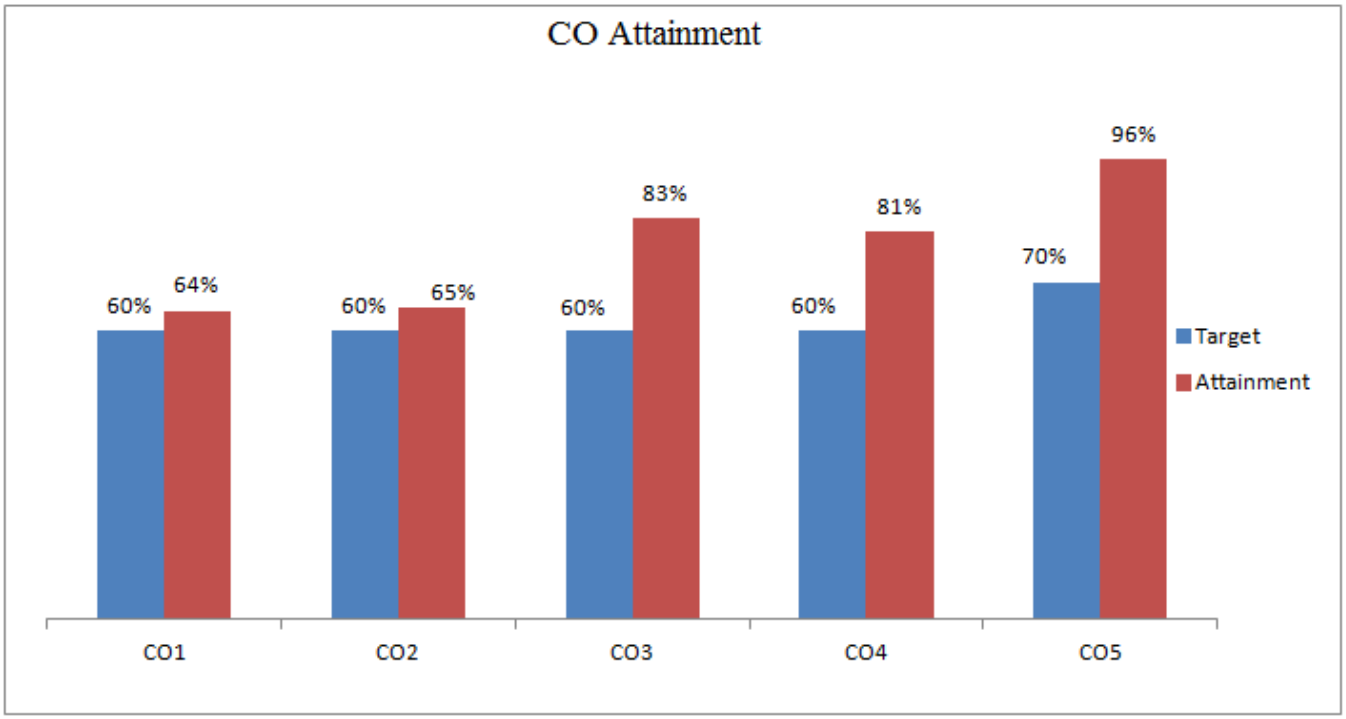
(xb) Strategy to encourage bright students

- Bright students are encouraged to discuss advanced topics related with the latest developments.
- Often, they are encouraged to teach few topics in the class.
- They are also motivated for higher studies.

(xc) Efforts to keep students engaged

- Students are given some topics which are beyond syllabus to understand the recent developments.

(xi) Analysis of Students performance in the course (Internal Results)



- 64% students have attained the set target of 60% marks for CO1
- 65% students have attained the set target of 60% marks for CO2
- 83% students have attained the set target of 60% marks for CO3
- 81% students have attained the set target of 60% marks for CO4
- 96% students have attained the set target of 70% marks for CO5

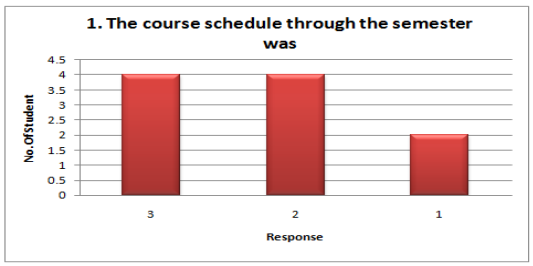
(xii) Analysis of Students performance in the course (University Results)

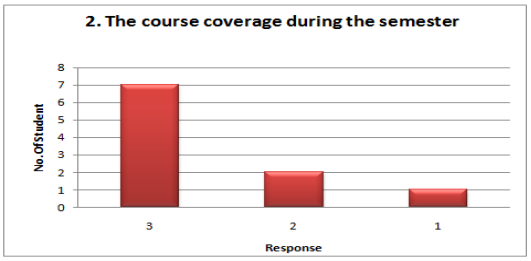
	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME	Attainment Level
University	70	29	29	100%	3

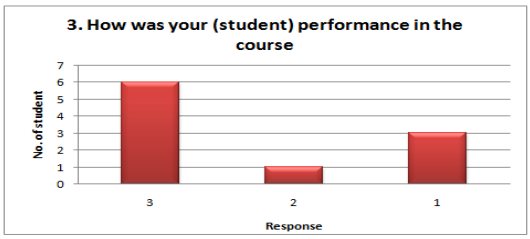
- 96% students have attained the set target of 60% marks for University Exams

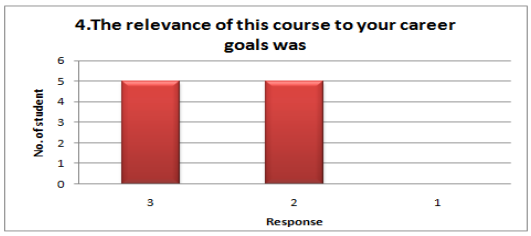
CO Based Feedback Analysis

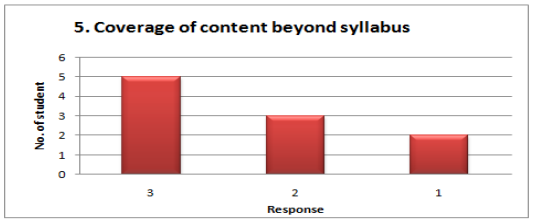
1=Poor 2=Good 3=Excellent

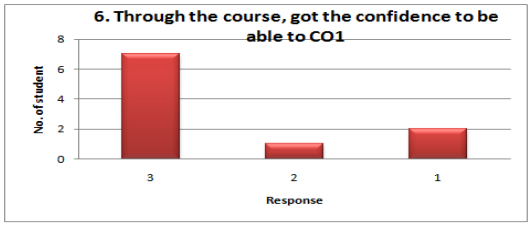


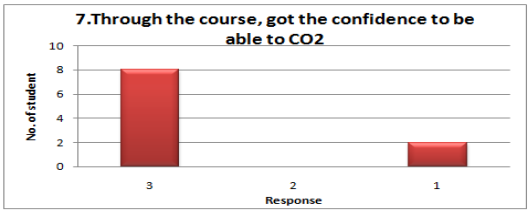


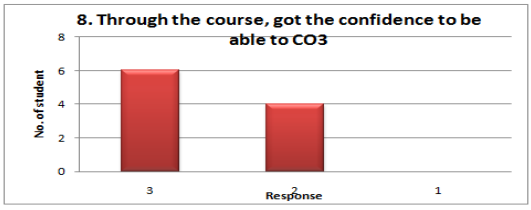


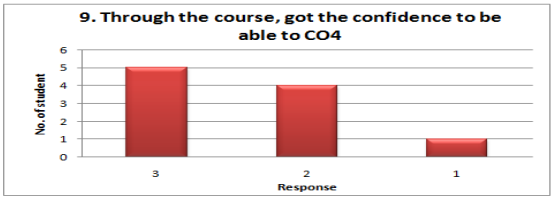


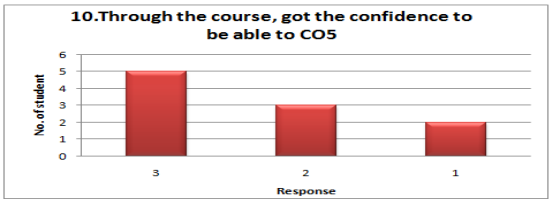


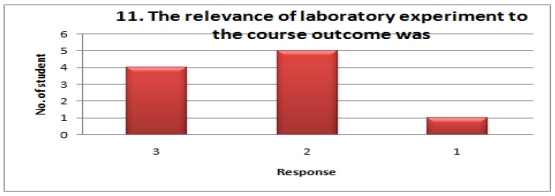


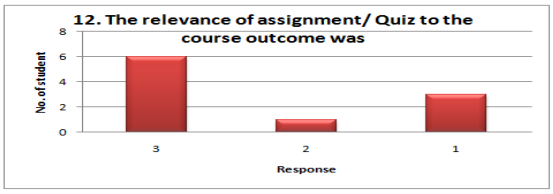


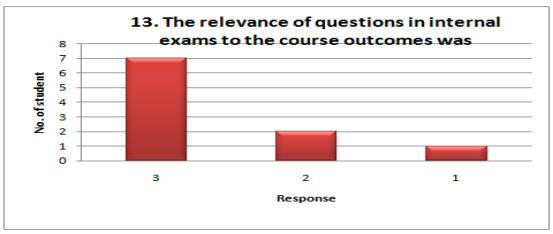


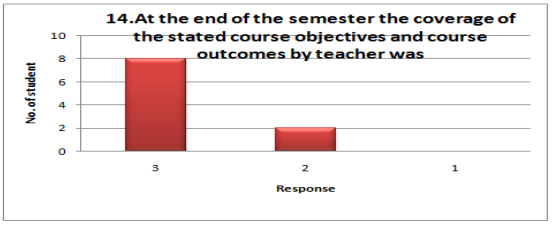


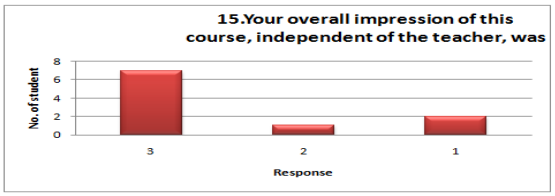


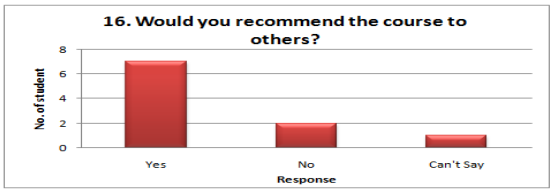












(xiv)Teacher Self-Assessment (at the completion of course)

From the analysis of the results obtained it can be seen that set targets for the CO1&CO2 have been achieved successfully by less amount of students.CO1 deals with the vector algebra, Maxwell's equations, and apply them in the problems related to static and time varying EM fields and CO2 is related to the wave propagation phenomena in different medium like dielectric, conductor and free space. Since these topics are difficult to understand more emphasis must be given to improve the attainment level of CO1 &2.

(xv) Recommendations/Suggestions for improvement by faculty

- More emphasis should be given to clear the concepts related to Plane wave propagation through transmission line, Antenna theory.

Internal Examination Marks

Sl.NO	Roll No.	Name	1st Internal	2nd Internal
1	11900318004	TENZING WANGCHUK BHUTIA	25	24
2	11900318005	TAMOGHNA MONDAL	24	25
3	11900318006	SWETA JAISWAL	27	22
4	11900318007	SUSMITA MUKHERJEE	24	22
5	11900318008	SUMIT KUMAR	26	22
6	11900318009	SUMAN CHANDRA DEY	20	15
1	11900318010	SUBHAJIT SEN	27	25
1	11900318011	SUBHAJIT DEY	27	25
9	11900318012	SHRISHTI PAL	27	25
10	11900318013	SOUMYADEEP HALDER	25	22
11	11900318014	SOUMYADEEP DAS	25	19
12	11900318015	SOUHARDYA PAUL	24	21
13	11900318016	SHREYA CATTOPADHYAY	25	21
14	11900318017	SHAYANTAN KUMAR RAY	26	17
15	11900318018	SAKSHI LAMA	26	20
16	11900318019	SATWIK CHATTERJEE	25	21
17	11900318020	SANTOSH SRIVASTAVA	25	25
18	11900318021	SAGNIK GHOSH	26	10
19	11900318023	SAGARNIL CHAKRABORTY	24	16
20	11900318024	RUDRA DAS MANDAL	AB	22
21	11900318025	ROSHAN KR VATS	25	26
22	11900318027	RINKU ROY	26	24
23	11900318028	RAHUL SHAH	25	24
24	11900318029	RAHUL ROY	26	24
25	11900318030	PRIYANKA KUNDU	28	20
26	11900318031	PRITAM SEN	25	19
27	11900318032	PRITAM BARMAN	26	22
28	11900318033	PRATIM KUMAR DAS	26	25
29	11900318034	NUR HASAN	26	24

LIST OF PRACTICALS

Subject with code: Electromagnetic Waves Lab (EC- 591)

Semester : 5th sem, 2020

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

Sl.	Details of Experiment(s)	Hours allotted
1	Familiarization with antenna trainer kit & Microwave test bench	3
2	Plotting of Standing Wave Pattern along a transmission line when the line is: A. Open circuited. B. Short Circuited. C. Terminated by a matched load.	3
3	Study the radiation pattern of dipole antenna.	3
4	Study the Radiation Pattern of a folded-dipole antenna.	3
5	Radiation pattern of a 3-element Yagi-Uda Antenna.	3
6	Study the beam width, gain and radiation pattern of a 3-element, 5-element and 7-element. Yagi-Uda antenna	3
7	Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.	3
8	Study of Smith chart	3

Sessional/Practical Performance Record

Subject with code: Electromagnetic Lab (EC- 591)

Semester : 5th sem, 2020,

Discipline: ELECTRONICS & COMMUNICATION ENGINEERING

Sl	Name	Roll No.	Marks in experimentation								Total (40)
			1	2	3	4	5	6	7	8	
1.	TENZING WANGCHUK BHUTIA	11900318004	31	30	30	31	31				31
2.	TAMOGHNA MONDAL	11900318005	37	38	38	38	37				38
3.	SWETA JAISWAL	11900318006	22	21	22	21	22				22
4.	SUSMITA MUKHERJEE	11900318007	28	28	28	27	26				28
5.	SUMIT KUMAR	11900318008	22	21	22	21	22				22
6.	SUMAN CHANDRA DEY	11900318009	29	29	29	29	30				29
7.	SUBHAJIT SEN	11900318010	29	31	30	32	28				20
8.	SUBHAJIT DEY	11900318011	30	29	30	30	30				30
9.	SHRISHTI PAL	11900318012	24	23	24	23	24				24
10.	SOUMYADEEP HALDER	11900318013	37	37	37	38	37				37
11.	SOUMYADEEP DAS	11900318014	39	39	39	38	39				39
12.	SOUHARDYA PAUL	11900318015	33	33	33	32	32				33
13.	SHREYA CATTOPADHYAY	11900318016	39	39	39	38	39				39
14.	SHAYANTAN KUMAR RAY	11900318017	39	39	39	38	39				39
15.	SAKSHI LAMA	11900318018	34	34	34	38	34				34
16.	SATWIK CHATTERJEE	11900318019	29	31	30	32	28				20

NAME WITH ROLL Nos. OF STUDENT WHOSE ACADEMIC PERFORMANCE IS NOT SATISFACTORY			
Sl.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
1	11900318005	TAMOGHNA MONDAL	• Additional doubt clearing sessions • Providing extra assignments to students with poor attendance. • Guiding them through previous question papers • Highlighting important and frequently asked questions
2	11900318009	SUMAN CHANDRA DEY	
3	11900318014	SOUMYADEEP DAS	
4	11900318015	SOUHARDYA PAUL	

CERTIFICATE

We, the undersigned, have completed the course allotted to us as shown below

Sl. No.	Semester	Subject with Code	Total Units	Remarks
1.	5th	EM Waves (EC501) & EM Waves Laboratory (EC591)	05	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that **Prof. Dia Ghosh** have completed the course work allotted to them satisfactorily/ not satisfactorily.

Date :	**Signature of HOD**

Submitted to Director

Date :	**Signature of Director**

SILIGURI INSTITUTE OF TECHNOLOGY

CIVIL ENGINEERING

COURSE FILE

5TH SEM, 3RD YEAR, 2020

PAPER DESCRIPTION : Transportation Engineering

PAPER CODE : CE(PC)506

Course File

Course Title : Transportation Engineering

Code : CE(PC)506

Semester: 5th Year : 2020

Name of the Faculty: Mr. Rupam Dutta

Internet Homepage:

E-mail : rupam92.dutta@gmail.com

Class Schedule		
Lecture	**Tutorial**	**Practical**
Monday, 12.30PM – 1.20 PM Tuesday , 10.00 AM – 10.50 AM Thursday, 10.50 AM – 11.40 AM	Wednesday, 02.10 PM – 3.00PM	

Hours for meeting students:
In break time and after 4.40 PM for all week days.

i) Course Objective

To describe students about the different traffic characteristics and geometric features of pavement and to design it with knowing proper testing and design methodology.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
CE(PC)506.1	Understand the knowledge of planning, design and the fundamental properties of highway materials in highway engineering.**(BT 1)**	60% marks
CE(PC)506.2	Apply the knowledge of geometric design and draw appropriate conclusion	60% marks
CE(PC)506.3	Interpret the concept of different methods in design, construction of the pavement.**(BT-3)**	60% marks

CE(PC)506.4	Interpret traffic parameters by applying the knowledge in traffic planning and intersection design **(BT-4)**	60% marks

ii. Once the student has successfully completed this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	How to find the maximum utility value of a National highway?	1
2.	Determine the stopping and overtaking sight distance for a NH?	2
3.	What is super-elevation? Find out the length of a transition curve and extra widening of a road.	2
4.	Find out the length of a summit and valley curve.	2
5.	Differentiate between flexible and rigid pavement. Calculate the ESWL at a certain depth.	3
6.	Find out the cumulative standard axle load with modified CBR method. Calculate the thickness of a road with CBR method.	3
7.	What are the stresses that effect a rigid pavement? Calcualte the wheel load stresses using westergaard's formula.	3
8.	Find out the practical capacity of a rotary. Determine the cycle length using Webster method.	4
9.	Write short notes on the following: Traffic volume study, Traffic speed study, O&D study.	4
10.	Determine the apparent and bulk specific gravity of a mix using Marshall method of mix design	4

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours
Introduction to highway engineering: Scope of highway engineering, Jayakar committee report, saturation system, highway financing and highway economics	2+1
Highway alignment: Factors controlling Highway alignment, Engineering Surveys for Highway alignment	1+1
Highway Geometric Design: Cross-sectional elements, design speed, passing and non passing sight distances, PIEV theory, Requirement and design principle of horizontal alignment including radius of curvature, superelevation, extra widening, transition curve, curve resistance, set-back distance, grade compensation and vertical alignment	8+4

Pavement Design: Evaluation of soil sub-grade, sub-base and base course, Design factors for pavement thickness, ESWL, Group index and CBR method, Westergard analysis of wheel load stresses in rigid pavement, frictional and warping stresses, Design of rigid pavement, Expansion and contraction joints, Benkelman beam test	8+5
Pavement construction techniques: Types of pavement, construction of earth roads, gravel roads, WBM, bitumen and cement concrete roads, joints in CC pavements	2+1
Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic sign and signal design, highway capacity	7+3
Road materials and testing: Soil, stone aggregate, bitumen, Marshall stability test	1+1

iv)Textbooks

Reference books :

1 Highway Engineering Khanna & Justo Nemchand & Brothers, Roorkee
2 Principles of Transportation Engineering P. Chakraborty & A. Das PH1
3 Transportation Engineering C.J Khisty & B.K Lall
4 IS Specifications on concrete, Aggregate & Bitumen Bureau ofIndian Standards
5 Relevant latest IRC Codes (IRC 37, IRC 58, IRC 73. IRC 83,IRC 106, IRC 64,IRC 15)

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Internal Exam*	15
Quiz / assignment	10
Attendance	5
University Exam/External Exam	70
Total	100

* Two internal examinations are conducted; based on those two tests, average of them are considered in a scale of 15.

2) Laboratory

Expt. No.	Experiment Name	Schedule	Marks
1.	Shape test of aggregate	3 hours	40
2.	Crushing test of aggregate	3 hours	
3.	Impact test of aggregate	3 hours	
4.	Los Angeles abrasion test	3 hours	
5.	Specific gravity and water absorption test	3 hours	
6.	Specific gravity test	3 hours	
7.	Penetration test	3 hours	
8.	Static or kinematic viscosity	3 hours	
9.	Softning point test	3 hours	
10.	Flash and fire test	3 hours	
11.	Ductility test	3 hours	
12.	CBR value of sub-grade(soaked and unsoaked)	3 hours	
13.	Marshall stability test		60
University Exam			

Course target attainment levels:

Attainment Level	Inference
Attainment Level 1	40% of the students have attained more than the target level of that CO
Attainment Level 2	50% of the students have attained more than the target level of that CO
Attainment Level 3	60% of the students have attained more than the target level of that CO

Overall Course Attainment Target = 70% of the students will get “A” Grade

Target has been set on the basis of last year’s performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
CO1	2		1	1			1						1	
CO2	2	1	1				1						1	
CO3	2	1	1		1								1	1
CO4	2		1		1	1				1	1	1	1	1

1 = courses in which the student will be exposed to a topic (BT level 1& 2)
2 = courses in which students will gain competency in that area (BT level 3-4)
3= courses in which students will master that skill (BT level 5-6)

CO1 to CO4 partially satisfies application of knowledge of mathematics and science in solving engineering problems. (PO1, PO2).

(vii) Assessment Methodology

Outcome	Assessment Tool
CO1	Internal exam, quiz, assignment, mini project, class test
CO2	Internal exam, quiz, assignment, mini project, class test
CO3	Internal exam, quiz, assignment, mini project, class test
CO4	Internal exam, quiz, assignment, mini project, class test

(VIII) A. Weekly Lesson Plan

Week	Lectures	Tutorial	Practical	Assignment
1	**Introduction to highway engineering**: Scope of highway engineering, Jayakar committee report, saturation system, highway financing and highway economics	Tutorial 1	Brief introduction about all the experiments and distribution of the lab	Assignment 1

			manuals to the students.	
2	**Highway Geometric Design**: Cross-sectional elements, design speed, passing and non passing sight distances, PIEV theory, Requirement and design principle of horizontal alignment including radius of curvature	Tutorial 2	Familiarization with all the equipment's in the lab.	
3	superelevation, extra widening, transition curve, curve resistance, set-back distance, grade compensation and vertical alignment	Tutorial 3	Visual Identification of the road aggregate.	
4	**Pavement Design**: Evaluation of soil sub-grade, sub-base and base course, Design factors for pavement thickness, ESWL, Group index and CBR method.	Tutorial 4	Determination of strength properties of road aggregates.	Assignment 2
5	Westergard analysis of wheel load stresses in rigid pavement, frictional and warping stresses, Design of rigid pavement, Expansion and contraction joints, Benkelmen beam test	Tutorial 5	Familiarization with the manual traffic volume survey techniques	
6	**Pavement construction techniques:** Types of pavement, construction of earth roads, gravel roads, WBM, bitumen and cement concrete roads, joints in CC pavements	Tutorial 6	Determination of grade of bitumen	Assignment 3
7	**Traffic Engineering**: Traffic characteristics, theory of traffic flow, intersection design, traffic sign and signal design, highway capacity	Tutorial 7	Traffic surveys	
8	**Road materials and testing**: Soil, stone aggregate, bitumen, Marshall stability test	Tutorial 8	CBR test	Assignment 1

(VIII) COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY : Mr. Rupam Dutta	**DEPARTMENT :CE**	**SUBJECT:**Transportation Engineering **CODE :** CE(PC)506	**SEMESTER :5th**

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/ mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
1	**Introduction to Highway Engineering**		**06**					
	1.1	Scope of highway engineering, jayakar committee	01	17.08.2020	17.08.2020			
	1.2	Motor vehicle act, CRRI, CRF, IRC, Nagpur plan	02	18.08.2020 24.08.2020	18.08.2020 26.08.2020			
	1.3	20 years road plans	01	25.08.2020	25.08.2020			
	1.4	Road patterns and scope of road development	01	01.09.2020	01.09.2020			
	1.5	Tutorial	01	02.09.2020	03.09.2020			
2	**Highway alignment**		**05**					
	2.1	Factors controlling highway alignment	02	07.09.2020	07.09.2020			
	2.2	Engineering surveys for alignment	02	10.09.2020	11.09.2020			
	2.3	Tutorial	01	14.09.2020	14.09.2020			

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/ mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
3	**Geometric Design**		**12**					
	3.1	Cross sectional elements of highway, Design parameters, vehicle dimensions	02	15.09.2020 21.09.2020	16.09.2020 21.09.2020			
	3.2	Carriageway width, design speed, frictional co-efficient,	02	22.09.2020 24.09.2020	22.09.2020 24.09.2020			
	3.3	Design principal of horizontal alignment, camber, sight distances	02	26.09.2020	26.09.2020			
	3.4	Horizontal curves, superelevation, extra widening	02	29.09.2020 05.10.2020	29.09.2020 05.10.2020			
	3.5	Design principals of vertical alignments, grade compensation,	02	06.10.2020	06.10.2020			
	3.6	Vertical curves	01	09.10.2020	09.10.2020			
	3.7	Tutorial	01	12.10.2020	12.10.2020			
4		**Traffic engineering**	**11**					
	4.1	Traffic studies, fundamental parameters of traffic flow	02	13.10.2020 18.10.2020	13.10.2020 19.10.2020			
	4.2	Traffic studies, speed flow, density, capacity	02	01.11.2020 05.11.2020	03.11.2020 05.11.2020			
	4.3	Spot speed studies, speed and delay studies	01	10.11.2020	10.11.2020			
	4.4	O&D study, intersections	02	12.11.2020 21.11.2020	12.11.2020 24.11.2020			
	4.5	Conflict points, Rotary	01	26.11.2020	26.11.2020			

Unit / Module	Comp. Index	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	Details of home work/assignment/ mini project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)	Details of topics that are beyond syllabus (if any)	Remarks
	4.6	Traffic signs,signal design	01	01.12.2020	01.12.2020			
	4.7	IRC design methods, Webster method	01	03.12.2020	03.12.2020			
	4.8	Tutorial	01	07.12.2020	07.12.2020			
5		**Pavement design**	**13**					
	5.1	Pavement materials, bitumen, aggregate, subgrade soil	01	08.12.2020	08.12.2020			
	5.2	Types of pavement, flexible and rigid pavement	01	10.12.2020	10.12.2020			
	5.3	Design parameters, wheel load, ESWL	02	11.01.2021 12.01.2021	11.01.2021 13.01.2021			
	5.4	Tyre pressure, CBR	01	18.01.2021	18.01.2021			
	5.5	Resilient modulus, poisson's ratio	01	21.01.2021	21.01.2021			
	5.6	Design of flexible pavement using IRC 37	02	03.02.2021	03.02.2021			
	5.7	Design of rigid pavement, Wheel stresses, frictional and warping stresses	02	05.02.2021	05.02.2021			
	5.8	Construction and construction joints, dowel bar and tie bar design	02	09.02.2021	09.02.2021			
	5.9	Tutorial	01	12.02.2021	18.02.2021			

DETAILS OF TUTORIALS

Tutorial	Tutorial No.	Plan date with day	Execution date	Remarks
Tutorial 1	1	02.09.2020	03.09.2020	
Tutorial 2	2	14.09.2020	14.09.2020	
Tutorial 3	3	12.10.2020	12.10.2020	
Tutorial 4	4	07.12.2020	07.12.2020	
Tutorial 5	5	12.02.2021	18.02.2021	

(IX) Teaching Strategy / Method

1. Detailed use of blackboard
2. Good oratory skill with clearly audible volume of lecture
3. Interactive classroom
4. Always encouraging the students to ask questions
5. Use of practical examples or similar models to illustrate the topics.
6. Discussion of the real time application of the topics covered and respective job fields.

(IXA) Strategy to support weak students

1. Paying attention to their problems in understanding the subject
2. Encouraging them to express their point of trouble
3. Allotting extra time beyond schedules class hours to help them understand the topics
4. Suggesting them different ways (as found suitable depending upon the case) to overcome their problem.

(IXB) Strategy to encourage bright students

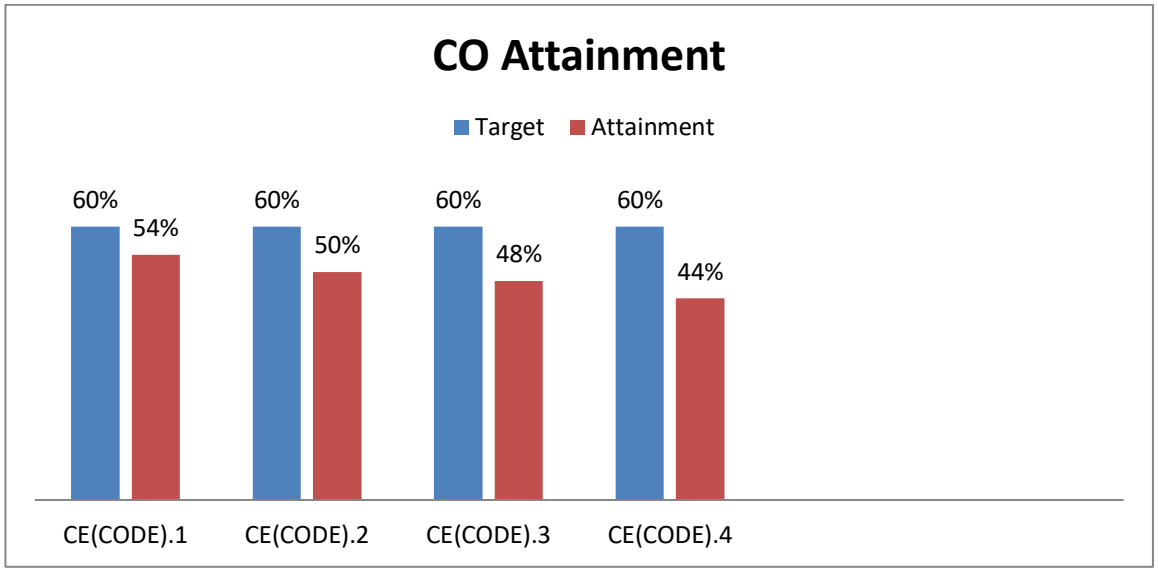
1. Try to encourage them to study beyond the syllabus
2. Ask them to develop the habit of reading anything good and rich in content
3. Advise them to try and solve higher level engineering numerical problems.

(IXC) Efforts to keep students engaged

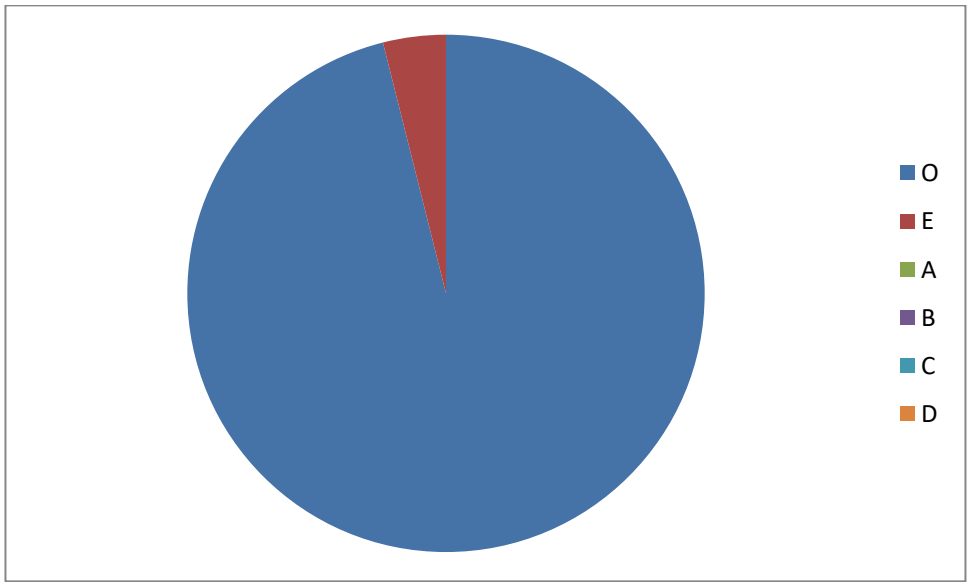
1. During class to avoid monotony some aptitude problems are given to solve.
2. Asking random questions to the students from the topic
3. Sometimes different tricks or techniques are shown to them to make the lecture interesting.
4. Informal technical quiz is also held.
5. Discussion of the future aspects and job opportunities.

(X) Analysis of Students performance in the course

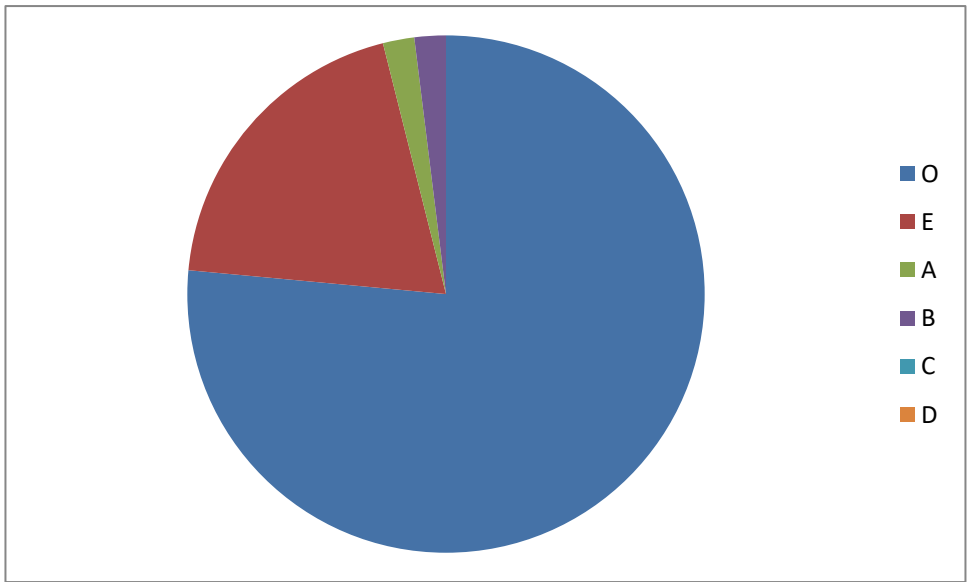
INTERNAL ASSESSMENT



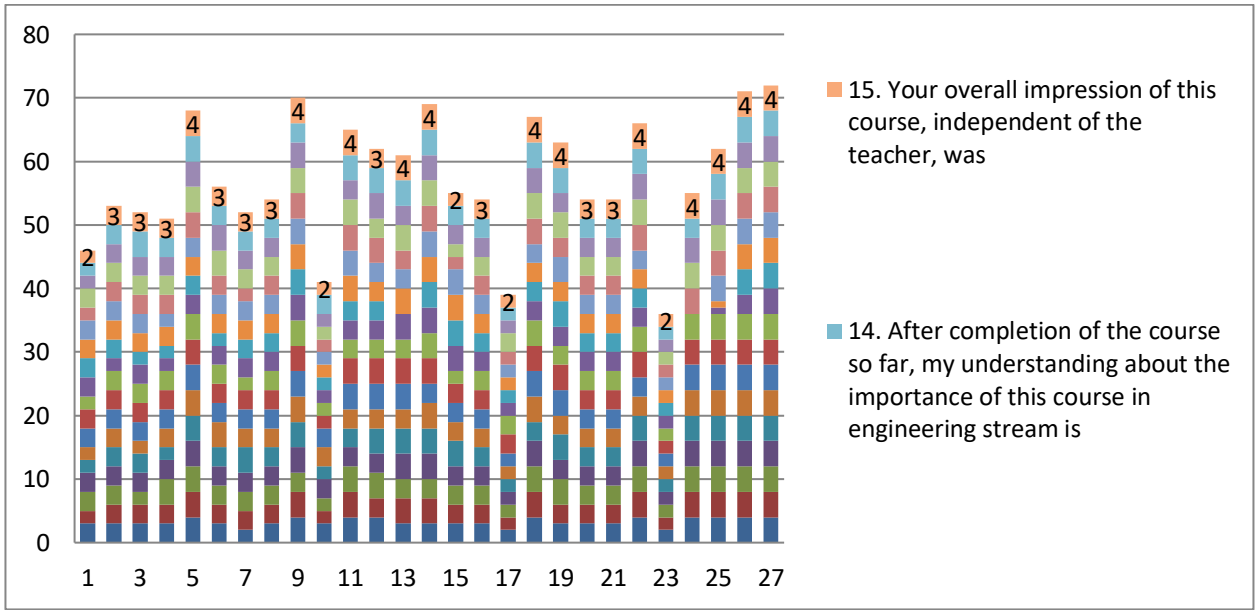
UNIVERSITY EXAMINATION THEORY RESULT ANALYSIS:



UNIVERSITY EXAMINATION PRACTICAL RESULT ANALYSIS:



(XI) Analysis of Student Feed Back



(XII) Teacher Self-Assessment (at the completion of course)

The lecture delivery of the faculty needs to be in multiple languages keeping in mind about the students' feasibility and the teacher need to be more strict in getting the work done from the students end.

(XIV) Recommendations/Suggestions for improvement by faculty

The teacher should aim to deliver the course content with more video lectures, PPT presentations and conduct quiz contest among the student.

INTERNAL ASSESMENT RECORD

Subject with code: Transportation Engineering (CE(PC)506)

Semester :5th **Discipline: Civil Engineering**

Sl.	Roll No.	Name	Attendance		Internal Examination			Assignment / Quiz	Total
			Total	Marks	1st	2nd	Avg.		
	11901318035	SWARAJ BISWAS	5	5	6	8	7	6.75	18.75
	11901318036	SURAJIT BISWAS	5	4	9	7	8	6.75	18.75
	11901318038	SOLANKI SINHA	5	5	8	3	5.5	7.25	17.75
	11901318039	SNEHARTA ROY	5	5	6	9	7.5	6.25	18.75
	11901318040	SUBHAM NAHA	5	5	11	8	9.5	7	21.5
	11901318041	SHIVAM KUMAR	5	4	6	5	5.5	5.5	15
	11901318042	RIBHU BISWAS	5	5	8	10	9	7	21
	11901318043	RAJDEEP GHOSH	5	3	6	4	5	5	13
	11901318044	PROTIK SAHA	5	4	10	14	12	7.25	23.25
	11901318045	PRODYUT ROY	5	4	6	5	5.5	7.75	17.25
	11901318046	PRATIKSHA PRADHAN	5	5	10	11	10.5	8.5	24
	11901318047	MANOB ROY	5	5	5	5	5	6.75	16.75
	11901318048	LOVE OJHA	5	4	9	7	8	7.5	19.5
	11901318049	DIPAN NATH	5	5	6	9	7.5	6.75	19.25

	11901318050	DIGBIJAY SAHA	5	5	13	6	9.5	6.25	20.75
	11901318051	BROJABIHARI DAS	5	5	8	6	7	7.25	19.25
	11901318052	ASHIF IQUBAL	5	5	12	10	11	8	24
	11901318053	ANUBRATA BARMAN	5	5	6	6	6	6	17
	11901318054	ANINDYA MAHAPATRA	5	5	7	5	6	9	20
	11901318055	AJAY KUMAR	5	4	4	6	5	7.25	16.25
	11901319001	SOUMYADIP SINGHA	5	3	3	6	4.5	5.5	13
	11901319002	SUMAN DUTTA	5	4	7	8	7.5	5.5	17
	11901319003	PINKU ROY	5	2	7	9	8	6	16
	11901319004	BISWADIP SARKAR	5	4	13	12	12.5	6	22.5
	11901319005	SHUBHADEEP DEY	5	5	11	8	9.5	5.5	20
	11901319006	RANADITYA ROY	5	3	12	8	10	6.5	19.5
	11901319007	SANGEETA SARKAR	5	4	9	3	6	6.5	16.5
	11901319008	POUSHALI GHOSH	5	5	5	2	3.5	7.5	16
	11901319009	ANKITA DUTTA	5	4	9	12	10.5	8.25	22.75
	11901319010	NINGLAMU TAMANG	5	5	7	8	7.5	8.5	21
	11901319011	ANAMIKA SARKAR	5	4	5	7	6	6.5	16.5
	11901319012	NILADRI GHOSH	5	4	9	4	6.5	7.25	17.75
	11901319013	SUBECHA RAI	5	5	8	2	5	8	18
	11901319014	NIHAL ROUTH	5	4	8	9	8.5	7	19.5
	11901319015	ESHITA GHOSH	5	4	4	3	3.5	7.5	15
	11901319029	RWITWIKA DAS	5	5	8	9	8.5	8	21.5
	11901319030	SOUVIK MANDAL	5	4	12	11	11.5	6	21.5
	11901319031	ARINDAM ROY	5	4	7	3	5	8.5	17.5
	11901319032	NABENDU DEY	5	3	6	10	8	6.5	17.5
	11901319034	PRATIMA BARMAN	5	3	3	3	3	7	13
	11901319036	BISWAJIT DAS	5	3	6	3	4.5	6.5	14

	11901319037	PARIJAT MAJUMDER	5	0	5	8	6.5	6	12.5
	11901319039	SOUMIK DATTA	5	4	3	5	4	3.75	11.75
	11901319040	ABHISHEK CHAKI	5	5	9	8	8.5	6	19.5
	11901319041	MASOOB SARKAR	5	4	10	3	6.5	6.5	17
	11901319043	SHUBHROJEET BASU	5	4	9	6	7.5	7	18.5
	11901319044	PRITHIRAJ DEBNATH	5	4	9	4	6.5	6.25	16.75
	11901319045	TIRTHANKAR SAHA	5	4	6	8	7	6.5	17.5
	11901319046	CHAYAN BISWAS	5	4	6	6	6	7.5	17.5
	11901319047	ABHIK CHOWDHURY	5	5	5	4	4.5	5.5	15
	11901319048	INDRA KUMAR PRASAD	5	4	5	3	4	6.75	14.75

ATTENDANCE SHEET (Lecture)

Subject with code: Transportation Engineering (CE(PC)506)

Semester : 5th **Discipline: Civil engineering**

Sl.	Roll No.	Name	17/8	18/8	24/8	25/8	01/9	03/9	08/9	10/9	14/9	15/9	21/9	22/9	24/9	28/9	29/9	
	11901318035	SWARAJ BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318036	SURAJIT BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318038	SOLANKI SINHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318039	SNEHARTA ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318040	SUBHAM NAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318041	SHIVAM KUMAR	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318042	RIBHU BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318043	RAJDEEP GHOSH	a	a	a	a	p	p	p	p	p	a	a	p	p	p	p	
	11901318044	PROTIK SAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318045	PRODYUT ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318046	PRATIKSHA PRADHAN	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318047	MANOB ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318048	LOVE OJHA	p	p	p	p	p	p	p	a	a	p	p	p	p	a	p	
	11901318049	DIPAN NATH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318050	DIGBIJAY SAHA	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318051	BROJABIHARI DAS	p	p	p	p	p	p	a	p	a	p	a	p	p	p	p	
	11901318052	ASHIF IQUBAL	a	a	a	a	a	a	a	a	a	a	a	p	p	p	p	
	11901318053	ANUBRATA BARMAN	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318054	ANINDYA MAHAPATRA	p	p	p	p	p	p	p	p	p	a	p	p	p	p	p	
	11901318055	AJAY KUMAR	p	a	p	a	p	a	p	p	a	a	p	p	p	p	p	
	11901319001	SOUMYADIP SINGHA	p	a	p	a	a	p	p	p	p	p	p	p	p	p	p	
	11901319002	SUMAN DUTTA	p	p	p	p	p	a	a	a	a	a	p	p	p	p	p	
	11901319003	PINKU ROY	a	a	a	p	p	p	p	a	a	a	p	p	p	p	p	
	11901319004	BISWADIP SARKAR	a	p	p	a	p	a	p	a	p	a	p	p	p	p	p	

	11901319005	SHUBHADEEP DEY	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319006	RANADITYA ROY	p	p	a	p	a	p	p	p	a	p	p	p	p	p	p	
	11901319007	SANGEETA SARKAR	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319008	POUSHALI GHOSH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319009	ANKITA DUTTA	p	p	p	p	p	p	a	p	a	p	p	p	p	p	p	
	11901319010	NINGLAMU TAMANG	p	a	p	p	p	a	p	p	p	p	p	p	p	p	p	
	11901319011	ANAMIKA SARKAR	p	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319012	NILADRI GHOSH	a	p	p	p	p	p	p	a	p	a	p	p	p	p	p	
	11901319013	SUBECHA RAI	a	p	p	p	p	p	p	a	p	a	p	p	p	p	p	
	11901319014	NIHAL ROUTH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319015	ESHITA GHOSH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319029	RWITWIKA DAS	p	p	p	a	a	p	a	p	a	a	p	p	p	p	p	
	11901319030	SOUVIK MANDAL	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319031	ARINDAM ROY	p	p	p	a	a	a	p	a	a	p	a	p	a	a	a	
	11901319032	NABENDU DEY	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319034	PRATIMA BARMAN	a	a	p	p	p	p	a	p	a	p	p	a	a	a	a	
	11901319036	BISWAJIT DAS	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319037	PARIJAT MAJUMDER	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319039	SOUMIK DATTA	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319040	ABHISHEK CHAKI	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319041	MASOOB SARKAR	a	a	a	a	p	p	p	p	p	a	a	p	p	p	p	
	11901319043	SHUBHROJEET BASU	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319044	PRITHIRAJ DEBNATH	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319045	TIRTHANKAR SAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319046	CHAYAN BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319047	ABHIK CHOWDHURY	a	a	a	a	a	a	a	a	a	a	a	a	a	a	p	
	11901319048	INDRA KUMAR PRASAD	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	

ATTENDANCE SHEET (Lecture)

Subject with code: Transportation Engineering (CE(PC)506)
Semester : 5th **Discipline: Civil engineering**

Sl.	Roll No.	Name	05/10	06/10	09/10	12/10	13/10	19/10	03/11	05/11	10/11	12/11	24/11	26/11	01/12	03/12	07/12	
	11901318035	SWARAJ BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318036	SURAJIT BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318038	SOLANKI SINHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318039	SNEHARTA ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318040	SUBHAM NAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318041	SHIVAM KUMAR	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318042	RIBHU BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318043	RAJDEEP GHOSH	a	a	a	a	p	p	p	p	p	a	a	p	p	p	p	
	11901318044	PROTIK SAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318045	PRODYUT ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318046	PRATIKSHA PRADHAN	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318047	MANOB ROY	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901318048	LOVE OJHA	p	p	p	p	p	p	p	a	a	p	p	p	p	a	p	
	11901318049	DIPAN NATH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318050	DIGBIJAY SAHA	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318051	BROJABIHARI DAS	p	p	p	p	p	p	a	p	a	p	a	p	p	p	p	
	11901318052	ASHIF IQUBAL	a	a	a	a	a	a	a	a	a	a	a	p	p	p	p	
	11901318053	ANUBRATA BARMAN	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901318054	ANINDYA MAHAPATRA	p	p	p	p	p	p	p	p	p	a	p	p	p	p	p	
	11901318055	AJAY KUMAR	p	a	p	a	p	a	p	p	a	a	p	p	p	p	p	
	11901319001	SOUMYADIP SINGHA	p	a	p	a	a	p	p	p	p	p	p	p	p	p	p	
	11901319002	SUMAN DUTTA	p	p	p	p	p	a	a	a	a	a	p	p	p	p	p	
	11901319003	PINKU ROY	a	a	a	p	p	p	p	a	a	a	p	p	p	p	p	
	11901319004	BISWADIP SARKAR	a	p	p	a	p	a	p	a	p	a	p	p	p	p	p	
	11901319005	SHUBHADEEP DEY	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319006	RANADITYA ROY	p	p	a	p	a	p	p	p	a	p	p	p	p	p	p	
	11901319007	SANGEETA SARKAR	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319008	POUSHALI GHOSH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319009	ANKITA DUTTA	p	p	p	p	p	p	a	p	a	p	p	p	p	p	p	
	119013190	NINGLAMU	p	a	p	p	p	a	p	p	p	p	p	p	p	p	p	

	10	TAMANG																
	11901319011	ANAMIKA SARKAR	p	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319012	NILADRI GHOSH	a	p	p	p	p	p	p	a	p	a	p	p	p	p	p	
	11901319013	SUBECHA RAI	a	p	p	p	p	p	p	a	p	a	p	p	p	p	p	
	11901319014	NIHAL ROUTH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319015	ESHITA GHOSH	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319029	RWITWIKA DAS	p	p	p	a	a	p	a	p	a	a	p	p	p	p	p	
	11901319030	SOUVIK MANDAL	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	
	11901319031	ARINDAM ROY	p	p	p	a	a	a	p	a	a	p	a	p	a	a	a	
	11901319032	NABENDU DEY	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319034	PRATIMA BARMAN	a	a	p	p	p	p	a	p	a	p	p	a	a	a	a	
	11901319036	BISWAJIT DAS	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319037	PARIJAT MAJUMDER	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319039	SOUMIK DATTA	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	
	11901319040	ABHISHEK CHAKI	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319041	MASOOB SARKAR	a	a	a	a	p	p	p	p	p	a	a	p	p	p	p	
	11901319043	SHUBHROJEET BASU	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319044	PRITHIRAJ DEBNATH	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319045	TIRTHANKAR SAHA	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319046	CHAYAN BISWAS	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
	11901319047	ABHIK CHOWDHURY	a	a	a	a	a	a	a	a	a	a	a	a	a	a	p	
	11901319048	INDRA KUMAR PRASAD	a	a	a	a	a	a	a	a	a	a	p	p	p	p	p	

Sl.	Roll No.	Name	08/12	10/12	11/01	13/01	18/01	21/01	18/02	
	11901318035	SWARAJ BISWAS	p	p	p	p	p	p	p	
	11901318036	SURAJIT BISWAS	p	p	p	p	p	p	p	
	11901318038	SOLANKI SINHA	p	p	p	p	p	p	p	
	11901318039	SNEHARTA ROY	p	p	p	p	p	p	p	
	11901318040	SUBHAM NAHA	p	p	p	p	p	p	p	
	11901318041	SHIVAM KUMAR	p	p	p	p	p	p	p	
	11901318042	RIBHU BISWAS	p	p	p	p	p	p	p	
	11901318043	RAJDEEP GHOSH	a	a	a	a	p	p	p	
	11901318044	PROTIK SAHA	p	p	p	p	p	p	p	
	11901318045	PRODYUT ROY	p	p	p	p	p	p	p	
	11901318046	PRATIKSHA PRADHAN	p	p	p	p	p	p	p	
	11901318047	MANOB ROY	p	p	p	p	p	p	p	
	11901318048	LOVE OJHA	p	p	p	p	p	p	p	
	11901318049	DIPAN NATH	a	a	a	a	a	a	a	
	11901318050	DIGBIJAY SAHA	a	a	a	a	a	a	a	
	11901318051	BROJABIHARI DAS	p	p	p	p	p	p	a	
	11901318052	ASHIF IQUBAL	a	a	a	a	a	a	a	
	11901318053	ANUBRATA BARMAN	a	a	a	a	a	a	a	
	11901318054	ANINDYA MAHAPATRA	p	p	p	p	p	p	p	
	11901318055	AJAY KUMAR	p	a	p	a	p	a	p	
	11901319001	SOUMYADIP SINGHA	p	a	p	a	a	p	p	
	11901319002	SUMAN DUTTA	p	p	p	p	p	a	a	
	11901319003	PINKU ROY	a	a	a	p	p	p	p	
	11901319004	BISWADIP SARKAR	a	p	p	a	p	a	p	
	11901319005	SHUBHADEEP DEY	a	a	a	a	a	a	a	
	11901319006	RANADITYA ROY	p	p	a	p	a	p	p	
	11901319007	SANGEETA SARKAR	a	a	a	a	a	a	a	
	11901319008	POUSHALI GHOSH	a	a	a	a	a	a	a	

	11901319009	ANKITA DUTTA	p	p	p	p	p	p	a	
	11901319010	NINGLAMU TAMANG	p	a	p	p	p	a	p	
	11901319011	ANAMIKA SARKAR	p	a	a	a	a	a	a	
	11901319012	NILADRI GHOSH	a	p	p	p	p	p	p	
	11901319013	SUBECHA RAI	a	p	p	p	p	p	p	
	11901319014	NIHAL ROUTH	a	a	a	a	a	a	a	
	11901319015	ESHITA GHOSH	a	a	a	a	a	a	a	
	11901319029	RWITWIKA DAS	p	p	p	a	a	p	a	
	11901319030	SOUVIK MANDAL	a	a	a	a	a	a	a	
	11901319031	ARINDAM ROY	p	p	p	a	a	a	p	
	11901319032	NABENDU DEY	a	a	a	a	a	a	a	
	11901319034	PRATIMA BARMAN	a	a	p	p	p	p	a	
	11901319036	BISWAJIT DAS	a	a	a	a	a	a	a	
	11901319037	PARIJAT MAJUMDER	a	a	a	a	a	a	a	
	11901319039	SOUMIK DATTA	a	a	a	a	a	a	a	
	11901319040	ABHISHEK CHAKI	p	p	p	p	p	p	p	
	11901319041	MASOOB SARKAR	a	a	a	a	p	p	p	
	11901319043	SHUBHROJEET BASU	p	p	p	p	p	p	p	
	11901319044	PRITHIRAJ DEBNATH	p	p	p	p	p	p	p	
	11901319045	TIRTHANKAR SAHA	p	p	p	p	p	p	p	
	11901319046	CHAYAN BISWAS	p	p	p	p	p	p	p	
	11901319047	ABHIK CHOWDHURY	a	a	a	a	a	a	a	
	11901319048	INDRA KUMAR PRASAD	a	a	a	a	a	a	a	

ATTENDANCE SHEET (Tutorial)

Subject with code: Transportation Engineering (CE(PC)506)

Semester :5th **Discipline: Civil Engineering**

Sl.	Roll No.	Name	20/08	03/09	17/09	24/09	08/10	05/11	17/12	07/01	21/01							
	11901318035	SWARAJ BISWAS	p	p	p	p	p	p	p	p	p							
	11901318036	SURAJIT BISWAS	p	p	p	p	p	p	p	p	p							
	11901318038	SOLANKI SINHA	p	p	p	p	p	p	p	p	p							
	11901318039	SNEHARTA ROY	p	p	p	p	p	p	p	p	p							
	11901318040	SUBHAM NAHA	p	p	p	p	p	p	p	p	p							
	11901318041	SHIVAM KUMAR	p	p	p	p	p	p	p	p	p							
	11901318042	RIBHU BISWAS	p	p	p	p	p	p	p	p	p							
	11901318043	RAJDEEP GHOSH	a	a	a	a	p	p	p	p	a							
	11901318044	PROTIK SAHA	p	p	p	p	p	p	p	p	p							
	11901318045	PRODYUT ROY	p	p	p	p	p	p	p	p	p							
	11901318046	PRATIKSHA PRADHAN	p	p	p	p	p	p	p	p	p							
	11901318047	MANOB ROY	p	p	p	p	p	p	p	p	p							
	11901318048	LOVE OJHA	p	p	p	p	p	p	p	a	p							
	11901318049	DIPAN NATH	a	p	a	a	p	a	a	a	a							
	11901318050	DIGBIJAY SAHA	a	p	p	a	p	p	p	a	p							
	11901318051	BROJABIHARI DAS	p	p	p	p	p	p	a	p	p							
	11901318052	ASHIF IQUBAL	a	p	p	p	p	a	p	p	p							
	11901318053	ANUBRATA BARMAN	a	a	a	a	a	a	a	a	a							
	11901318054	ANINDYA MAHAPATRA	p	p	p	p	p	p	p	p	p							
	11901318055	AJAY KUMAR	p	a	p	a	p	a	p	p	p							
	11901319001	SOUMYADIP SINGHA	p	a	p	a	a	p	p	p	p							
	11901319002	SUMAN DUTTA	p	p	p	p	p	a	a	a	p							
	11901319003	PINKU ROY	a	a	a	p	p	p	p	a	a							

	11901319004	BISWADIP SARKAR	a	p	p	a	p	a	p	a	p							
	11901319005	SHUBHADEEP DEY	a	a	a	a	a	a	a	a	a							
	11901319006	RANADITYA ROY	p	p	a	p	a	p	p	p	a							
	11901319007	SANGEETA SARKAR	p	p	p	p	a	a	p	a	p							
	11901319008	POUSHALI GHOSH	p	p	p	p	p	a	p	p	p							
	11901319009	ANKITA DUTTA	p	p	p	p	p	p	a	p	p							
	11901319010	NINGLAMU TAMANG	p	a	p	p	p	a	p	p	p							
	11901319011	ANAMIKA SARKAR	p	p	p	a	a	a	a	a	p							
	11901319012	NILADRI GHOSH	a	p	p	p	p	p	p	a	p							
	11901319013	SUBECHA RAI	a	p	p	p	p	p	p	a	p							
	11901319014	NIHAL ROUTH	p	p	p	p	p	p	p	p	p							
	11901319015	ESHITA GHOSH	a	a	a	a	a	a	a	a	a							
	11901319029	RWITWIKA DAS	p	p	p	a	a	p	a	p	p							
	11901319030	SOUVIK MANDAL	a	a	a	a	a	a	a	a	a							
	11901319031	ARINDAM ROY	p	p	p	a	a	a	p	a	p							
	11901319032	NABENDU DEY	a	a	a	a	a	a	a	a	a							
	11901319034	PRATIMA BARMAN	a	a	p	p	p	p	a	p	p							
	11901319036	BISWAJIT DAS	p	a	p	p	p	p	a	a	p							
	11901319037	PARIJAT MAJUMDER	a	a	a	a	a	a	a	a	a							
	11901319039	SOUMIK DATTA	a	p	p	p	p	p	p	p	p							
	11901319040	ABHISHEK CHAKI	p	p	p	p	p	p	p	p	p							
	11901319041	MASOOB SARKAR	a	a	a	a	p	p	p	p	a							
	11901319043	SHUBHROJEET BASU	p	p	p	p	p	p	p	p	p							
	11901319044	PRITHIRAJ DEBNATH	p	p	p	p	p	p	p	p	p							
	11901319045	TIRTHANKAR SAHA	p	p	p	p	p	p	p	p	p							
	11901319046	CHAYAN BISWAS	p	p	p	p	p	p	p	p	p							
	11901319047	ABHIK CHOWDHURY	a	p	p	p	p	a	p	a	p							
	11901319048	INDRA KUMAR PRASAD	p	a	a	a	p	p	p	p	a							

ATTENDANCE SHEET (Practical)

Subject with code: Transportation Engineering Laboratory(CE(PC)596)

Semester :5th Discipline: Civil Engineering

Sl.	Roll No.	Name	4/12/2020	10/12/2020	23/12/2020	6/1/2021	15/01/2021	10/2/2021	17/2/2021	4/3/2021							
	11901318035	SWARAJ BISWAS	P	P	P	P	P	P	P	P							
	11901318036	SURAJIT BISWAS	P	P	P	P	P	P	P	P							
	11901318038	SOLANKI SINHA	P	P	P	P	P	P	P	P							
	11901318039	SNEHARTA ROY	P	P	P	P	P	P	P	P							
	11901318040	SUBHAM NAHA	P	P	P	P	P	P	P	P							
	11901318041	SHIVAM KUMAR	P	P	P	P	P	P	P	P							
	11901318042	RIBHU BISWAS	P	P	P	P	P	P	P	P							
	11901318043	RAJDEEP GHOSH	A	A	A	A	P	P	P	P							
	11901318044	PROTIK SAHA	P	P	P	P	P	P	P	P							
	11901318045	PRODYUT ROY	P	P	P	P	P	P	P	P							
	11901318046	PRATIKSHA PRADHAN	P	P	P	P	P	P	P	P							
	11901318047	MANOB ROY	P	P	P	P	P	P	P	P							
	11901318048	LOVE OJHA	P	P	P	P	P	P	P	P							
	11901318049	DIPAN NATH	A	P	A	A	P	A	A	A							
	11901318050	DIGBIJAY SAHA	A	P	P	A	P	P	P	P							
	11901318051	BROJABIHARI DAS	P	P	P	P	P	P	A	A							
	11901318052	ASHIF IQUBAL	A	P	P	P	P	A	P	P							
	11901318053	ANUBRATA BARMAN	A	A	A	A	A	A	A	A							
	11901318054	ANINDYA MAHAPATRA	P	P	P	P	P	P	P	P							
	11901318055	AJAY KUMAR	P	A	P	A	P	A	P	P							
	11901319001	SOUMYADIP SINGHA	P	A	P	A	A	P	P	P							
	11901319002	SUMAN DUTTA	P	P	P	P	P	A	A	A							
	11901319003	PINKU ROY	A	A	A	P	P	P	P	P							

	11901319004	BISWADIP SARKAR	A	P	P	A	P	A	P	P								
	11901319005	SHUBHADEEP DEY	A	A	A	A	A	A	A	A								
	11901319006	RANADITYA ROY	P	P	A	P	A	P	P	P								
	11901319007	SANGEETA SARKAR	P	P	P	P	A	A	P	P								
	11901319008	POUSHALI GHOSH	P	P	P	P	P	A	P	P								
	11901319009	ANKITA DUTTA	P	P	P	P	P	P	A	A								
	11901319010	NINGLAMU TAMANG	P	A	P	P	P	A	P	P								
	11901319011	ANAMIKA SARKAR	P	P	P	A	A	A	A	A								
	11901319012	NILADRI GHOSH	A	P	P	P	P	P	P	P								
	11901319013	SUBECHA RAI	A	P	P	P	P	P	P	P								
	11901319014	NIHAL ROUTH	P	P	P	P	P	P	P	P								
	11901319015	ESHITA GHOSH	A	A	A	A	A	A	A	A								
	11901319029	RWITWIKA DAS	P	P	P	A	A	P	A	A								
	11901319030	SOUVIK MANDAL	A	A	A	A	A	A	A	A								
	11901319031	ARINDAM ROY	P	P	P	A	A	A	P	P								
	11901319032	NABENDU DEY	A	A	A	A	A	A	A	A								
	11901319034	PRATIMA BARMAN	A	A	P	P	P	P	A	A								
	11901319036	BISWAJIT DAS	P	A	P	P	P	P	A	A								
	11901319037	PARIJAT MAJUMDER	A	A	A	A	A	A	A	A								
	11901319039	SOUMIK DATTA	A	P	P	P	P	P	P	P								
	11901319040	ABHISHEK CHAKI	P	P	P	P	P	P	P	P								
	11901319041	MASOOB SARKAR	A	A	A	A	P	P	P	P								
	11901319043	SHUBHROJEET BASU	P	P	P	P	P	P	P	P								
	11901319044	PRITHIRAJ DEBNATH	P	P	P	P	P	P	P	P								
	11901319045	TIRTHANKAR SAHA	P	P	P	P	P	P	P	P								
	11901319046	CHAYAN BISWAS	P	P	P	P	P	P	P	P								
	11901319047	ABHIK CHOWDHURY	A	P	P	P	P	A	P	P								
	11901319048	INDRA KUMAR PRASAD	P	A	A	A	P	P	P	P								

LIST OF PRACTICALS

Subject with code: Highway Engineering Lab (CE(PC)596)

Semester 5th **Discipline: Civil Engg.**

Sl.	Details of Experiment(s)	Hours allotted
1.	Shape test of aggregate	2
2.	Crushing test of aggregate	2
3.	Impact test of aggregate	2
4.	Los Angeles abrasion test	2
5.	Specific gravity and water absorption test	2
6.	Specific gravity test	2
7.	Penetration test	2
8.	Static or kinematic viscosity	2
9.	Softning point test	2
10.	Flash and fire test	2
11.	Ductility test	2
12.	CBR value of sub-grade(soaked and unsoaked)	
13.	Marshall stability test	2

Practical Performance Record

Subject with code: Highway Engineering Lab. Code CE(PC)596

Semester : 5th **Discipline: Civil Engineering**

Sl	Roll No.	Name	Marks in experimentation										Avg.	Exam	Viva	Total
			1	2	3	4	5	6	7	8						
1	11901318035	SWARAJ BISWAS	38	40	**39**	36	38	36	38	39			**38**	40	18	96
2	11901318036	SURAJIT BISWAS	37	38	**36**	37	38	36	36	38			**37**	36	16	89
3	11901318038	SOLANKI SINHA	38	40	**39**	36	38	36	38	39			**38**	40	18	96
4	11901318039	SNEHARTA ROY	38	40	**39**	36	38	36	38	39			**38**	40	17	95
5	11901318040	SHUVAM NAHA	38	40	**39**	36	38	36	38	39			**38**	40	18	96
6	11901318041	SHIVAM KUMAR	38	40	**38**	36	37	36	38	37			**37.5**	40	17	94.5
7	11901318042	RIBHU BISWAS	37	37	**37**	36	37	36	37	35			**36.5**	28	12	76.5
8	11901318043	RAJDEEP GHOSH	34	30	**33**	37	0	35	33	30			**29**	40	14	83
9	11901318044	PROTIK SAHA	35	37	**35**	36	33	36	37	35			**35.5**	40	18	93.5
10	11901318045	PRODYUT ROY	34	33	**35**	35	33	33	35	34			**34**	36	17	87
11	11901318046	PRATIKSHA PRADHAN	38	40	**39**	36	38	36	38	39			**38**	40	17	95
12	11901318047	MANAB ROY	33	30	**32**	36	0	34	33	30			**28.5**	32	12	72.5
13	11901318048	LOVE OJHA	38	40	**39**	36	38	36	38	39			**38**	40	18	96
14	11901318049	DIPAN NATH	33	32	**32**	36	0	34	0	33			**25**	40	17	82
15	11901318050	DIG BIJAY SHAHA	35	33	**35**	36	33	36	37	35			**35**	40	18	93
16	11901318051	BROJABIHARI DAS	37	38	**36**	37	38	36	36	38			**37**	36	17	90
17	11901318052	ASHIF IQUBAL	38	40	**38**	36	37	36	38	37			**37.5**	40	17	94.5
18	11901318053	ANUBRATA BARMAN	35	37	**35**	36	33	36	37	35			**35.5**	40	18	93.5
19	11901318054	ANINDYA MAHAPATRA	38	40	**39**	36	38	36	38	39			**38**	40	17	95
20	11901318055	AJAY KUMAR	37	38	**36**	37	38	36	36	38			**37**	40	17	94
21	11901319001	SOUMYADEEP SINGHA	31	30	**31**	33	0	35	30	30			**27.5**	40	14	81.5

22	11901319002	SUMAN DUTTA	38	40	**39**	36	38	36	38	39			**38**	40	17	95
23	11901319003	PINKU ROY	34	30	**36**	37	0	35	34	30			**29.5**	40	18	87.5
24	11901319004	BISWADIP SARKAR	34	33	**35**	35	33	33	35	34			**34**	36	17	87
25	11901319005	SHUBHADEEP DEY	37	35	**36**	36	36	36	38	34			**36**	40	17	93
26	11901319006	RANADITYA ROY	37	37	**37**	36	37	36	37	35			**36.5**	40	18	94.5
27	11901319007	SANGEETA SARKAR	38	40	**39**	36	38	36	38	39			**38**	40	17	95
28	11901319008	POUSHALI GHOSH	38	40	**38**	36	37	36	38	37			**37.5**	36	18	91.5
29	11901319009	ANKITA DUTTA	38	40	**39**	36	38	36	38	39			**38**	40	17	95
30	11901319010	NINGLAMU TAMANG	38	40	**39**	36	38	36	38	39			**38**	40	18	96
31	11901319011	ANAMIKA SARKAR	35	37	**35**	36	33	36	37	35			**35.5**	40	17	92.5
32	11901319012	NILADRI GHOSH	37	38	**36**	37	38	36	36	38			**37**	40	17	94
33	11901319013	SUBECHA RAI	38	40	**39**	36	38	36	38	39			**38**	40	18	96
34	11901319014	NIHAL ROUTH	38	40	**38**	36	37	36	38	37			**37.5**	40	18	95.5
35	11901319015	ESHITA GHOSH	37	38	**36**	37	38	36	36	38			**37**	40	18	95
36	11901319029	RWITWIKA DAS	38	40	**38**	36	37	36	38	37			**37.5**	40	17	94.5
37	11901319030	SOUVIK MANDAL	37	37	**38**	0	33	36	37	38			**32**	40	14	86
38	11901319031	ARINDAM ROY	35	37	**35**	36	33	36	37	35			**35.5**	36	17	88.5
39	11901319032	NABENDU DEY	30	32	**30**	32	0	38	0	30			**24**	40	16	80
40	11901319034	PRATIMA BARMAN	33	30	**32**	37	0	33	33	30			**28.5**	40	16	84.5
41	11901319036	BISWAJIT DAS	37	37	**38**	0	37	36	37	38			**32.5**	32	16	80.5
42	11901319037	PARIJAT MAJUMDER	30	28	**0**	37	0	29	0	28			**19**	36	14	69
43	11901319039	SOUMIK DATTA	38	40	**38**	36	37	36	38	37			**37.5**	40	18	95.5
44	11901319040	ABHISHEK CHAKI	38	40	**39**	36	38	36	38	39			**38**	40	18	96
45	11901319041	MASOOB SARKAR	37	37	**37**	36	37	36	37	35			**36.5**	40	16	92.5
46	11901319043	SHUBHROJEET BASU	34	35	**34**	37	31	35	33	37			**34.5**	40	17	91.5
47	11901319044	PRITHIRAJ	37	37	**37**	36	33	36	37	35			**36**	36	18	90

		DEBNATH														
48	11901319045	TIRTHANKAR SAHA	37	38	**36**	37	38	36	36	38			**37**	40	18	95
49	11901319046	CHAYAN BISWAS	35	37	**35**	36	33	36	37	35			**35.5**	40	17	92.5
50	11901319047	ABHIK CHOWDHURY	37	38	**36**	37	38	36	36	38			**37**	40	18	95
51	11901319048	INDRA KUMAR PRASAD	37	38	**36**	37	38	36	36	38			**37**	40	17	94

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY			
Sl.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
1	11901318049	Dipan Nath	**Notes provided, assignments were given to solve in Google classroom**
2	11901318043	RAJDEEP GHOSH	**Notes provided, assignments were given to solve in Google classroom**
3	11901318047	MANOB ROY	**Notes provided, assignments were given to solve in Google classroom**
4	11901319003	PINKU ROY	**Notes provided, assignments were given to solve in Google classroom**
5	11901319032	NABENDU DEY	**Notes provided, assignments were given to solve in Google classroom**

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks
1	5th	Transportation Engineering (CE(PC)506)	6	

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that Mr. Rupam Dutta has completed the course work allotted to him satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY
MASTER OF BUSINESS ADMINISTRATION

COURSE FILE
1ST SEMESTER, 1ST YEAR

PAPER NAME: QUANTITATIVE TECHNIQUES
PAPER CODE: MB 106
(NEW SYLLABUS FROM ODD SEMESTER 2018)

Session: 2020 – 21 (Odd Semester 2020)

Online Google Class Code: c745x4p **for COVID 19 Pandemic**

Course File

Course Title: Quantitative Techniques

Code: MB 106

Semester: 1st, Year 1st

Name of the Faculty: Shomnath Dutta

E-mail: shomnath76@gmail.com

Class Schedule: MB 106; MAKAUT Odd Semester 2020

Lecture (Online Google Class & Google Meet)			Tutorial/Case Study	Practical
Monday			**04.40 pm - 05.00 pm**	**N.A**
Tuesday	**10.50 - 11.40 am**			**N.A**
Wednesday	**12.30 - 01.20 pm**			**N.A**
Thursday	**11.40 - 12.30 am**			**N.A**
Friday	**11.40 - 12.30 am**	**02.10 - 03.00 pm**		**N.A**
Saturday	**Special & Doubt Clearance Class, Tutorial**			**N.A**

Hours for meeting students:

Day	Time
Monday	**04.40 pm – 05.10 pm (Online Mode due to Covid 19 pandemic)**
Tuesday	**01.30 pm – 02.00 pm (Online Mode due to Covid 19 pandemic)**
Wednesday	**01.30 pm – 02.00 pm (Online Mode due to Covid 19 pandemic)**
Thursday	**04.40 pm – 05.10 pm (Online Mode due to Covid 19 pandemic)**
1st & 3rd Saturday	**02.00 pm – 03.00 pm (Online Mode due to Covid 19 pandemic)**

i) Course Objective

The primary objective of this course is to make better decisions in complex scenarios by the application of a set of advanced analytical methods. It couples theories, results and theorems of mathematics, statistics and probability with its own theories and algorithms for problem solving.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Description of COs		Target
MB106.1	Understand the basic probability axioms with rules and operations research techniques which will deal with the uncertainty in the business and optimal use of the recourses respectively *(Knowledge, Remembering*) [BT 1]	60%
MB106.2	Understand how to calculate the simple statistical measure and determine the optimu the Business objectives engaged in the decision making processes by using the variou research tools and techniques. *(Knowledge*) [BT 1]	60%
MB106.3	Apply and utilize certain mathematical techniques, produce the extreme outputs in the Business policies involving limited resources (*Applying)* [BT 2]	60%
MB106.4	Apply the most widely used quantitative and statistical techniques in decision making process for the best result (*Applying)* [BT 2]	60%
MB106.5	Testing the statistical observation can identify project goals, constraints, d performance criteria, control needs, and resource requirements in order to achi success (*Analyzing, Evaluating*)	60%

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level

<table>
<tr><td>1.</td><td>How do the Mean, Median & Mode measures of Central tendency are related with each other?</td><td>BT 1</td></tr>
<tr><td>2.</td><td>Explain properties & assumptions of LPP in Simplex and in Hungarian method of solving assignment problems.</td><td>BT 2</td></tr>
<tr><td>3.</td><td>A firm can produce 3 types of cloth say A, B and C. Three kinds of wool are required for it say red, green and blue. One unit length of type A cloth needs 2 metres of red wool and 3 metres of blue wool. One unit length of B type cloth needs 3 metres of red wool, 2 metres of green wool and 2 metres of blue wool; and 1 unit length of type C cloth needs 5 metres of green wool and 4 metres of blue wool. The firm has a stock of 8 metres of red wool, 10 metres of green wool and 15 metres of blue wool, it is assumed that the income obtained from one unit length of type A cloth is `3, of B `5 and of C `4. Determine how the firm should use the available material so as to maximize the income from the finished cloth. Formulate the above problem as LPP.</td><td>BT 3</td></tr>
<tr><td>4.</td><td>Consider the following Pay-off of a 2 person zero-sum game:-
Player B
Player A $\begin{pmatrix} -4 & 0 & 4 \\ 1 & 4 & 2 \\ -1 & 5 & -3 \end{pmatrix}$
Find the Optimal strategies for both the players & also Value of the game.
Is the game (a) ‘Strictly determinable’? (b) Fair?</td><td>BT 4</td></tr>
<tr><td>5.</td><td>Graphically solve the LPP: Maximize ‘Z’ = $3x_1 + 5x_2$
Subject to constraints $x_1 + 2x_2 \le 2{,}000$
$x_1 + x_2 \le 1{,}500$
$x_2 \le 600$
Where all $x_1, x_2 \ge 0$</td><td>BT 2</td></tr>
<tr><td>6.</td><td>If P(A) = 0.3 P(B) = 0.2 and P(C) =0.1 and A, B, C are independent events then find the probability of occurrence of at least one of the three events A,B, C?</td><td>BT 4</td></tr>
<tr><td>7.</td><td>Find the optimal Solution of the following transportation problem
<table>
<tr><td></td><td>W1</td><td>W2</td><td>W3</td><td>W4</td><td>W4</td><td>Supply</td></tr>
<tr><td>F1</td><td>55</td><td>30</td><td>40</td><td>50</td><td>50</td><td>40</td></tr>
<tr><td>F2</td><td>35</td><td>30</td><td>100</td><td>45</td><td>60</td><td>20</td></tr>
<tr><td>F3</td><td>40</td><td>60</td><td>95</td><td>35</td><td>30</td><td>40</td></tr>
<tr><td>Demand</td><td>25</td><td>10</td><td>20</td><td>30</td><td>15</td><td></td></tr>
</table></td><td>BT 5</td></tr>
<tr><td>8.</td><td>A card is drawn at random from a well shuffled pack of cards. Find the probability that it is heart or a queen?</td><td>BT 1</td></tr>
<tr><td>9.</td><td>Find the optimal assignment schedule of following machine – location installation problem
<table>
<tr><td></td><td>J1</td><td>J2</td><td>J3</td><td>J4</td><td>J5</td></tr>
<tr><td>M1</td><td>9</td><td>11</td><td>15</td><td>10</td><td>11</td></tr>
<tr><td>M2</td><td>12</td><td>9</td><td>--</td><td>10</td><td>9</td></tr>
<tr><td>M3</td><td>--</td><td>11</td><td>14</td><td>11</td><td>7</td></tr>
<tr><td>M4</td><td>14</td><td>8</td><td>12</td><td>7</td><td>8</td></tr>
</table></td><td>BT 5</td></tr>
<tr><td>10.</td><td>Obtain the dual of the following Linear programming problem
$z = 2x_1 + 3x_2 + x_3$
$subject\ to, 4x_1 + 3x_2 + x_3 = 6;\ x_1 + 2x_2 + +5x_3 = 4;$
$where\quad x_1, x_2, x_3 \ge 0$</td><td>BT 3</td></tr>
<tr><td>11.</td><td>Find the variance of the random variable x whose probability distribution is given below
x: 8 12 16 20 24
p(x): 1/8 1/6 3/8 1/4 1/12</td><td>BT 3</td></tr>
</table>

12.	The following table gives the ages and blood pressure of 10 women Age(X): 56, 42, 36, 47, 49, 42, 60, 72, 63, 55 Blood Pressure(Y): 147, 125, 118, 128, 145, 140, 155, 160, 149, 150 Determine the (a) regression line of Y on X (b) regression line of X on Y (c) correlation coefficient between X and Y (d) Estimate the blood pressure of a women whose age is 45 years	BT 4

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours	Tutorials
1. Linear Programming: Concepts & Terminologies, Formulating maximization/minimization L.P problems; Graphical solution,	2	On LPP formulation, Graphical solution;
LPP solution by Simplex method, Artificial Variables – Big M – Method, Special cases of LPPs	3	On LPP by Simplex & Big-M
Duality of LP and its interpretation, Applications of LP.	1	On Duality
2. Transportation Problems: (a) Introduction-Mathematical formulation of transportation problem - the Transportation method for finding initial solutions-North West Corner Method - Least Cost Method	3	On NWCM and VAM
(b) Vogel's Approximation method - test for optimality - steps of MODI method-loops in transportation table - Degeneracy	2	On MODI Optimality test
3. Assignment Problems: (a) Introduction - Mathematical statement of the problem-Hungarian method of solution	3	On Hungarian method
(b) Maximization case in assignment problem—unbalanced assignment problem - restrictions on assignment - Travelling salesman problem.	2	On unbalanced, restricted problems
4. Theory of Games: (a) Introduction, Two person zero sum games, Pure strategies, games with saddle points	2	Saddle point determination
(b) Mixed strategies - Game without saddle points - the rules of dominance - Methods of solution for games without saddle points—algebraic methods, graphical methods	2	On mixed strategy games, dominance, graphical solution
5. Basic Statistics: Basic Concept (Variables, Population v/s Sample, Central tendency, Dispersion, data Visualization, Simple Correlation and Regression.	4	Correlation and Regression
6. Probability & Distribution: Probability – Introduction, Rules of Probability, Conditional Probability (Baye's Theorem), Random Variables, Discrete and Continuous Distributions (Binomial, Poisson and Normal), Sampling – Types and Distribution**.**	6	Basic Probability, Bayes theorem, Probability Distribution (p.m.f & p.d.f)
7. Theory of Estimation: Estimation – estimation problems, standard error, margin of error, confidence error, confidence interval, characteristics of estimators, consistency unbiasedness, sufficiency and efficiency, most sufficient estimators. Point Estimation and Interval Estimation.	4	Standard Error, Point Estimation and Interval Estimation.
8. Statistical Inference: Hypothesis Testing, Parametric Test – Z, F, t test, ANOVA, Non Parametric Test – Chi square test (goodness of fit, independence of attributes) Spearman's Rank Correlation Coefficient.	6	Z, F, t test, ANOVA; Rank Correlation

IV) Textbooks

1. Problems in Operations Research – Gupta & Heera; S Chand
2. Operations Research – K. Sridhara Bhatt; Himalaya Publishing House
3. Operations Research – Anand Sharma; Himalaya Publishing House
4. Operations Research -P. K. Gupta, Man Mohan, Kanti Swarup: Sultan Chand.
5. Business Statistics, Problems & Solutions by JK Sharma

Reference Books

1. Operations Research by - A Ravindran, Don T Philips and James J Solberg
2. Operations Research by - V K Kapoor; Sultan Chand
3. Operations Research by - S K Kalavathy
4. Quantitative Management, N. D. Vohra: Tata McGraw Hill
5. Business Statistics by GC Berry

(v) Evaluation Scheme

Theory

Evaluation Criteria (MAKAUT Odd Sem' 18 Onwards)	Marks	
Internal Exam (CA2 & CA 4)	25	Marks of CA1 to CA4 are Averaged out by MAKAUT & Converted to 30
Assignment (CA 1)	10	
Quiz/Presentation (CA 3)	10	
Attendance	5	
University End Semester Exam	70	
Total	100	

* Two Internal Examinations are conducted in CA2 & CA4 as prescribed by MAKAUT

Course Target Attainment Levels for Internal Assessment:

Target (No. of Students)	Target Level of CO (Marks)	Attainment Level
≤49.9 %	60%	1
50 – 59.9 %	60%	2
60 % and above	60%	3

Overall Course Attainment Target = 70% of the students will get 60% marks. Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Letter Grade	Point
O	**10**
E	**9**
A	**8**
B	**7**
C	**6**
D	**5**
F	**Less Than 5**

Course target attainment levels for university assessment:

Target (No. of Students)	Target Level of CO (Marks) in point	Attainment Level
≤ 49.9 %	7	1
50 – 59.9 %	7	2
60 % and above	7	3

Overall Course Attainment Target = 60% of the students will get 7 points.

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes						PSOs	
	1	2	3	4	5	6	1	2
C MB106.1	-	-	-	-	-	-	-	-
C MB106.2	-	2	1	-	1	-	-	
C MB106.3	-	1	-	-	-	-	-	-
C MB106.4	1	2	-	-	-	-	-	-
C MB106.5	-	1	1	-	-	-	-	1
Avg CO MB 106	1	1.5	1	-	1	-	-	1

1 = courses in which the student will be exposed to a topic (BT level 1& 2)

2 = courses in which students will gain competency in that area (BT level 3-4)

3= courses in which students will master that skill (BT level 5-6)

CO1 to CO5 partially satisfies application of knowledge of Operations Research & Statistical concepts in solving real life Business Management problems along with partially satisfying the concepts of individual and team work. Therefore in short, CO1 to CO5 partially satisfies the concept of applied Mathematical & Statistical Science through operations research tools and demonstrate proficiency in use of software to be required to practice Statistical & O.R based Business Management profession.

Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
CMB106.1	Structured, partially supervised	Power point presentation, Numerical example	Assignment, Quiz, Internal
CMB106.2	Structured, partially supervised	Numerical Class Lectures, Power point presentation	Assignment, Quiz, Internal
CMB106.3	Structured, partially supervised	Numerical Class Lectures, Power point presentation	Case Study, Assignment, Quiz, Internal
CMB106.4	Structured, partially supervised	Numerical Class Lectures, Power point presentation	Case Study, Assignment, Quiz, Internal
CMB106.5	Structured, partially supervised	Numerical Class Lectures, real life example	Case Study, Assignment, Quiz, Internal

(viii) Assessment Methodology

Outcome	Assessment Tool	Specific Question/activity aligned to the Outcome
CMB106.1, CMB106.2, CMB106.3	Internal Test	1. Maximize $Z = 4x_1 + x_2 + 7x_3$ s.t $x_1 + 7x_2 - 3x_3 \leq 4$ $5x_1 - x_2 + x_3 \geq 12$ $x_1 + x_2 + x_3 = 10$ where All the $x_1, x_2, x_3 \geq 0$ 2.
CMB106.3, CMB106.4, CMB106.5	Assignment	Solve the game Player B Player A $\begin{pmatrix} 7 & 0 \\ 0 & 8 \end{pmatrix}$
CMB106.1, CMB106.2, CMB106.3, CMB106.4, CMB106.5	End Semester (Even) Examination	Solve the LPP graphically Maximize $Z = 7x + 3y$ Subject to $4x + 5y \leq 40$ $x + y \geq 3$ where $x, y \geq 0$

Weekly Lesson Plan

Week	Lectures	Tutorial	Assignment
Week 1	**Linear Programming:** Concepts & Terminologies, Formulating maximization/minimization L.P problems; Graphical solution	L.P.P by Graphical solution & Simplex method	Assignment 1: On LPP by Graphical solution; Simplex & Big-M; Duality
Week 2	LPP solution by Simplex method, Artificial Variables – Big M – Method, Special cases of LPPs; Duality of LP and its interpretation, Applications of LP		
Week 3	**Transportation Problems:** Introduction-Mathematical formulation of transportation problem - the Transportation method for finding initial solutions-North West Corner Method - Least Cost Method	NWCM Method - Least Cost Method; MODI method of Optimality test	Assignment 2: On NWCM, VAM and optimality using MODI
Week 4	Vogel's Approximation method (VAM) - test for optimality - steps of MODI method; Degeneracy		
Week 5	**Assignment Problems**: Introduction - Mathematical statement of the problem-Hungarian method of solution	Hungarian method; Maximization case; restrictions on assignment	Assignment 3: On Hungarian method of Assignment problem
Week 6	Maximization case in assignment problem—unbalanced assignment problem - restrictions on assignment - Travelling salesman problem		

Week 7	**Theory of Games**: Introduction, Two person zero sum games, Pure strategies, games with saddle points	Two person zero sum games, Saddle Point;	Assignment 4 On Game without & without saddle points and graphical methods
Week 8	**Mixed strategies** - Game without saddle points - the rules of dominance - Methods of solution for games without saddle points— algebraic methods, graphical methods		
Week 9	**Basic Statistics**: Basic Concept (Variables, Population v/s Sample, Central tendency, Dispersion, data Visualization, Simple Correlation and Regression.	Correlation and Regression.	Mean & Mode, Regression
Week 10	**Probability** – Introduction, Rules of Probability, Conditional Probability (Baye's Theorem), Random Variables,	Conditional Probability	Baye's Theorem
Week 11	**Probability Distribution**: Discrete and Continuous Distributions (Binomial, Poisson and Normal),	Continuous Distributions	Binomial, Poisson and Normal Distribution
Week 12	**Sampling** – Types and Distribution. Theory of Estimation: Estimation – estimation problems, Standard Error, margin of error, confidence error, confidence interval, characteristics of estimators	Standard Error	Standard Error, Sampling Distribution (SRSWR/SRSWOR).
Week 13	Consistency unbiasedness, Sufficiency and efficiency, most sufficient estimators. Point Estimation and Interval Estimation. Concept of Hypothesis Testing	Point Estimation and Interval Estimation	Point Estimation and Interval Estimation
Week 14	Parametric Test – Z, F, t test, ANOVA, Non Parametric Test – Chi square test (goodness of fit, independence of attributes) Spearman's Rank Correlation Coefficient.	ANOVA	Z, F, t test Rank Correlation

COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY Mr. SHOMNATH DUTTA	**DEPARTMENT** **M.B.A**	**SUBJECT:** QUANTITATIVE TECHNIQUES **SUBJECT CODE:** MB106 (MBA New Syllabus w. e. f 2018 Session)	**SEMESTER: 1st** **(Odd Sem'20)**

Sl. No.	Unit No	Lecture No	Topic Description (to be quoted from syllabus)	Planned Date	Execution Date	Teaching Pedagogy
Unit 1: L.P.P (LINEAR PROGRAMMING)						
1	1.1	01 - 07	Formulating LPP problems in terms of maximization/minimization types	01.12.20	01.12.20	Online Google Class & Google Meet + Digital White Board CANVAS **FOR COVID 19 PANDEMIC**
	1.2		Graphical Solution of LPP both maximization & minimization types	02.12.20	02.12.20	
	1.3		SIMPLEX Method of solving LPP both Maximization & Minimization types	03.12.20 04.12.20	03.12.200 4.12.20	
	1.4		Artificial Variables – Big M Method & 2-Phase Methods	08.12.20 09.12.20	08.12.200 9.12.20	
	1.5		Special cases of LP, Duality of LP and its interpretation, Post Optimality/Sensitivity Analysis, Applications of LPP	12.12.20	12.12.20	
Unit 2: TRANSPORTATION PROBLEM						
2	2.1	08 - 13	Introduction, Terminologies and Mathematical formulation of transportation problem	15.12.20	15.12.20	Online Google Class & Google Meet + Digital White Board CANVAS
	2.2		Transportation method for finding initial solutions - North West Corner Method (NWCM) Numerical Examples	16.12.20	16.12.20	
	2.3		Least Cost Method - Vogel's Approximation method (VAM) Numerical Examples	17.12.20	17.12.20	
	2.4		Test for Optimality in Transportation Models – MODI with Numerical	18.12.20 19.12.20	18.12.20 19.12.20	
	2.5		Degeneracy in Transportation Problems	22.12.20 23.12.20	22.12.20 23.12.20	
Unit 3: ASSIGNMENT PROBLEM						
3	3.1	14 - 18	Assignment Problems: Introduction - Mathematical statement of the problem -Hungarian method of solution	03.01.21	03.01.21	Online Google Class & Google Meet + Digital White
	3.2		Maximization case in assignment problem for Hungarian method of solution	05.01.21 06.01.21	05.01.21 06.01.21	

	3.3		Unbalanced Assignment problem & Restrictions on Assignment	07.01.21	07.01.21	Board CANVAS
	3.4		Travelling salesman problem using Hungarian method	08.01.21	08.01.21	
Unit 4: GAME THEORY						
4	4.1	19 - 24	Theory of Games: Introduction - Two person zero sum games	13.01.21	13.01.21	Online Google Class & Google Meet + Digital White Board CANVAS
	4.2		Pure strategies - Games with saddle points - Rules to determine saddle points	14.01.21 15.01.21	14.01.21 15.01.21	
	4.3		Mixed strategies - Game without saddle points - the rules of principle of dominance	19.01.21	19.01.21	
	4.4		Methods of solution for games without saddle points—algebraic methods, graphical methods	20.01.21 21.01.21	20.01.21 21.01.21	
5	Extra Class For Weak students		Doubt Clearance Class I on LPP solution by SIMPLEX & Big M methods	16.01.21	16.01.21	Google Meet + Digital White Board CANVAS
6	Extra Class For Weak students		Doubt Clearance Class II on Assignment & Transportation problems	30.01.21	30.01.21	
7	Extra Class		Typical Numerical Problem Solving from Previous MAKAUT Semester Exam. Question Papers	06.02.21	06.02.21	
			Basic Statistics			
8	5.1	25	Basic Statistics: Basic Concept (Variables, Population v/s Sample)	27.01.21	27.01.21	Online Google Class & Google Meet + Digital White Board CANVAS
9	5.2	26	Central tendency, Dispersion, data Visualization	28.01.21	28.01.21	
10	5.3	27	Simple Correlation & Numerical	29.01.21	29.01.21	
11	5.4	28	Regression & Numerical	02.02.21	02.02.21	
			Probability & Distribution			
12	6.1	29	Probability: Introduction, Rules of Probability & Numerical	03.02.21	03.02.21	Online Google Class & Google Meet + Digital White Board CANVAS
13	6.2	30	Conditional Probability & Numerical	04.02.21	04.02.21	
14	6.3	31	Baye's Theorem, Basic concept of Random Variables	05.02.21	05.02.21	
15	6.4	32	Probability Distribution generation: Concepts of PDF & PMF Functions	09.02.21	09.02.21	
16	6.5	33	Discrete distribution: Binomial, Poisson distribution	10.02.21	10.02.21	
17	6.6	34	Continuous Distribution: Normal distribution	11.02.21	11.02.21	
			Sampling & Estimation			
18	7.1	35	Sampling – Types and Distribution. Theory of Estimation: Estimation – estimation problems,	18.02.21	18.02.21	Online Google Class & Google Meet + Digital White Board CANVAS
19	7.2	36	Standard Error, margin of error, confidence error, confidence interval, characteristics of estimators	19.02.21	19.02.21	
20	7.3	37	Consistency unbiasedness, Sufficiency and efficiency, most sufficient estimators.	23.02.21	23.02.21	
			Hypothesis Testing			
21	8.1	38	Concept of Hypothesis Testing; Point Estimation and Interval Estimation.	24.02.21	24.02.21	Online Google Class & Google Meet + Digital White Board CANVAS
22	8.2	39	Parametric Test – Z, F, t test, ANOVA	25.02.21	25.02.21	
23	8.3	40	Non Parametric Test – Chi square test (goodness of fit, independence of attributes) Spearman's Rank Correlation Coefficient.	26.02.21	26.02.21	
24	Extra Class For Weak students		Doubt Clearance Class I on Regression & Probability	12.02.21	12.02.21	Google Meet + Digital White Board CANVAS
25	Extra Class For Weak students		Doubt Clearance Class II on Probability distribution	20.02.21	20.02.21	
26	Extra Class For Weak students		Doubt Clearance Class III on Hypothesis Testing & Statistical tests	27.02.21	27.02.21	
27	Extra Class		Typical Numerical Problem Solving from Previous MAKAUT Semester Exam. Question Papers	01.03.21 to 04.03.21	01.03.21 to 04.03.21	

B. Daily Lesson Plan (Repeat format for each topic/unit/chapter)

TOPIC/UNIT/Module

Title: **Linear Programming Problem (LPP) Basics & LPP Formulation**

Week 1

CONTENTS

Discussion of Course outcome and program outcome.

Introduction to O.R & LPP fundamentals, Terminologies & Formulation

Topic/Unit/Chapter Objectives

Broad Objectives of the chapter/topic are:

1. To aware concept, utilities & scopes of Operations Research in Business parlance
2. To know about LPP concept, structure, terminologies
3. To understand how to formulate LPP problem.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. What do you mean by Operations Research? Explain its utility and scope of business applications.
2. What is the basic structure of a LPP problem? Define its components.
3. Formulate the LPP problem from the following–

Raw Materials	X	Y	Z	Availability (Tons)
A	1	2	1	36
B	2	1	4	60
C	2	5	1	45
Profit per Unit (Rs)	40	25	50	

A company makes 3 products X, Y, Z from three raw materials A, B, C. Number of units of raw materials needed to produce one unit of product is given below. Find the output of each type of products.

4. Four different metals namely iron, copper, zinc and manganese are required to produce three commodities A, B and C. To produce one unit of A, 40kg iron, 30kg copper, 7kg zinc and 4kg manganese are needed. Similarly to produce one unit of B, 70kg iron, 14kg copper and 9kg manganese are needed and to produce one unit of C 50kg iron, 18kg copper, and 8kg zinc are required. The total available quantities of metals are 1 metric ton iron, 5 quintals of coppers, 2 quintals zinc and manganese. The profits are Rs. 300, Rs. 200 and Rs. 100 in selling per unit of A, B and C respectively. Formulate the problem mathematically with proper logic

TOPIC/UNIT/Module

Title: LPP formulation & Graphical Solution

CONTENTS

Discussion on Graphical solution of a LPP problem with Special cases

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To aware of Graphical methodology to solve a LPP problem.
2. To discuss various special issues (Unbounded, Infeasible, multiple solutions)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. **S**olve the following problem graphically (L2) Minimize $Z = 20x_1 + 40x_2$

Subject to: $36x_1 + 6x_2 \geq 108$

$3x_1 + 12x_2 \geq 36$

$20x_1 + 10x_2 \geq 100$ where $x_1, x_2 \geq 0$

2. A rubber company is engaged in producing 3 different kinds of tyres A, B and C. These three different tyres are produced at the company's 2 different plants with different production capacities. In a normal 8 hrs working day plant 1 produces 50, 100 and 100 tyres of A, B and C respectively. Plant 2 produce 60, 60 and 200 tyres of type A, B and C respectively. The monthly demand for tyre A, B and C is 2,500, 3,000 and 7,000 units respectively. The daily cost of operation of plant 1 and 2 is `2,500 and `3,500 respectively. Find the minimum number of days of operation per month at 2 different plants to minimize the total costs while meeting the demand by formulating problem & then solving graphically. **(L3)**

TOPIC/UNIT/ Module

Title: SIMPLEX method of solving LPP

CONTENTS

Discussion & numerical exercise on SIMPLEX method of solving LPP

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To aware about methodology of SIMPLEX method in Maximisation, Minimization & Mixed cases
2. Understanding Special cases (Alternate solution, Unboundedness, Infeasibility, Degeneracy) from SIMPLEX table.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Solve by Simplex method (L4) $z = x_1 - x_2 + 3x_3$

$$\text{subject to}$$

$$x_1 + x_2 + x_3 \leq 10,$$

$$2x_1 - x_3 \leq 2,$$

$$2x_1 - 2x_2 + 3x_3 \leq 0$$
$$x_1, x_2, x_3 \geq 0$$

2. Solve by Simplex method(L4) Maximize $Z = 4x_1 + x_2 + 7x_3$
Subject to $x_1 + 7x_2 - 3x_3 \leq 4$
$5x_1 - x_2 + x_3 \geq 12$
$x_1 + x_2 + x_3 = 10$
All the $x_1, x_2, x_3 \geq 0$

3. A retail store stocks two types of shirts A and B. These are packed in attractive card board boxes. During a week the store can sell a maximum of 400 shirts of type A & maximum of 300 shirts of type B. The storage capacity, however, is limited to a maximum of 600 of both types combined. Type A shirt fetches a profit of Rs. 2/- per unit and type B a profit of Rs. 5/- per unit. How many of each type the store should stock per week to maximize the total profit? Formulate a mathematical model of the problem. (L5)

4. Solve the following LPP using Big M Method.(L4)
Minimize $Z = 8x_1 + 10x_2$
Subject to constraints
$3x_1 + 9x_2 \geq 100$
$8x_1 + 4x_2 \geq 150$
Where $x_1, x_2 \geq 0$

5. Solve the Minimization L.P.P. given below(L4)
Min. Z= 1x – 3y + 2z
Subject to 3x– 1y– + 3z ≤ 7
– 2x+ 4y+ 0z ≤ 12
– 4x+ 3y+ 8z ≤ 10 and
x, y, and z ≥ 0

6. Solve using Simplex:- (L4) $z = 2x_1 + 3x_2 + x_3$
$$subject\ to, 4x_1 + 3x_2 + x_3 = 6;$$
$$x_1 + 2x_2 + +5x_3 = 4;$$
$$x_1, x_2, x_3 \geq 0$$

7. Use Simplex to solve: (L4) Minimise Z= 4a+ 2b
Subject to 3a + 1b ≥ 27
–1a – 1b ≤–21
1a + 2b ≥ 30 And a, b ≥ 0

TOPIC/UNIT/Module
Title: **Duality in LPP**
Week 3

CONTENTS
Discussion on Duality concept in LPP

Topic/Unit/Chapter Objectives
Broad Objectives of the chapter/topic are:
1. To aware of Duality in LPP & its conversion from Primal LPP
2. Economic Interpretation of Duality

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. Write the dual of the primal problem given and solve and interpret the results. (L4)
Maximize Z = 5a + 20b
s. t 5a + 2b ≤ 20
1a + 2b ≤ 8
1a + 6b ≤ 12
Both a & b ≥ 0
2. Write the dual of the given primal problem: (L4)
Minimize: 1a+ 2b+ 3c
s.t. 2a + 3b – c ≥ 20
a + 2b + 3c ≤ 15
b + 2c = 10
a, b, c ≥0
3. Convert the following LPP into its dual LPP (L4)
$$z = 2x_1 - 3x_2$$
$$subject\ to\ 2x_1 + 7x_2 \leq 22,$$
$$x_1 + x_2 \geq 6,$$
$$5x_1 + x_2 = 10$$
$$x_1, x_2 \geq 0$$

TOPIC/UNIT/Module
Title: Transportation Problem
Week 4 & 5

CONTENTS

Solution of Transportation Problem by NWCM, VAM & MODI test for Optimality

Topic/Unit/Chapter Objectives

Broad Objectives of the chapter/topic are:

1. NWCM, Least Cost & VAM methodology for initial basic solution of Transportation Problem
2. Optimality test tools – MODI & Stepping stone methods & Degeneracy in Transportation

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Solve the following transportation problem(L4)

	D1	D2	D3	D4	Supply
A	19	20	50	10	7
B	70	30	40	60	9
C	40	8	70	20	18
Demand	5	8	7	14	

2. Obtain the initial solution to above TP using northwest corner method(L4)

	A	B	C	D	Supply
I	1	5	3	3	34
II	3	3	1	2	15
III	0	2	2	3	12
IV	2	7	2	4	19
Demand	21	25	17	17	

3. Find the Optimal Solution of the following transportation problem using MODI(L4)

	W1	W2	W3	W4	W4	Supply
F1	55	30	40	50	50	40
F2	35	30	100	45	60	20
F3	40	60	95	35	30	40
Demand	25	10	20	30	15	

4. Find the initial basic feasible solution for the following Transportation problem using North-West Corner rule and VAM techniques & comment on results. (L4)

	D1	D2	D3	D4	Supply
O1	21	16	15	3	11
O2	17	18	14	23	13
O3	32	27	18	41	19
Demand	6	10	12	15	

TOPIC/UNIT/Module

Title: Assignment Problem

Week 6 & 7

CONTENTS

Solution of Assignment problems using Hungarian algorithm

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Hungarian method of Solving Assignment Problems
2. Maximization type Assignment Problem, Restricted cases & Travelling salesman problems

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Find the optimal assignment schedule of following machine – location installation problem (L4)

	J1	J2	J3	J4	J5
M1	9	11	15	10	11
M2	12	9	--	10	9
M3	--	11	14	11	7
M4	14	8	12	7	8

2. Find out the maximum profit for the assignment problem (L4)

	A	B	C	D	E
1	62	78	50	101	82
2	71	84	61	73	59
3	87	92	111	71	81
4	48	64	87	77	80

3. A company has 4 machines of which to do 3 jobs. Each job can be assigned to one and only machine. The cost of each job on each machine is given in the following table: (L4)

	W	X	Y	Z
Job A	18	24	28	32
Job B	8	13	17	18
Job C	10	15	19	22

4. Solve the following Assignment Problem & check optimality(L4)

	I	II	III	IV
1	11	10	18	5
2	14	13	12	19
3	5	3	4	2
4	15	18	17	9

TOPIC/UNIT/ Module

Title: Game Theory

Week 8

CONTENTS

Discussion on Game Theory Concepts & Applications

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Pure Strategy Games with saddle point & their solution of 2 Person Zero Sum Game
2. Mixed Strategy Games without saddle point & their solution of 2 Person Zero Sum Game
3. Principle of Dominance in solving 2 Person Zero Sum Game.

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. A company management and the labour union are negotiating a new three year settlement. Each of these has 4 strategies:

I: Hard and aggressive bargaining II:-Reasoning and logical approach

III:- Legalistic strategy IV:-Conciliatory approach

The cost to the company is given for every pair of strategy choice.

Union Strategies	Company Strategies			
	I	II	III	IV
I	20	15	12	35
II	25	14	8	10
III	40	2	10	5
IV	-5	4	11	0

Determine optimal strategies(L5)

2. Consider the following Pay-off of a 2 person zero-sum game:-

Player B

Player A $\begin{pmatrix} -4 & 0 & 4 \\ 1 & 4 & 2 \\ -1 & 5 & -3 \end{pmatrix}$

Find the Optimal strategies for both the players & also Value of the game.

Is the game (a) 'Strictly determinable'? (b) Fair?

3. For what value of λ, the game with following pay-off matrix is strictly determinable? (L4)

Player A	Player B		
	B_1	B_2	B_3
A_1	Λ	6	2
A_2	-1	λ	-7
A_3	-2	4	λ

4. Solve the following games by using maximin & minimax principle, whose payoff matrix are given below: Include in your answer: (i) strategy selection for each player,(ii) the value of the game to each player. Does the game have a saddle point? (L4)

a)

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	1	7	3	4
A_2	5	6	4	5
A_3	7	2	0	3

b)

Player A	Player B				
	B_1	B_2	B_3	B_4	B_5
A_1	-2	0	0	5	3
A_2	3	2	1	2	2
A_3	-4	-3	0	-2	6
A_4	5	3	-4	2	6

TOPIC/UNIT/Module

Title: **Tutorial on SIMPLEX method of LPP**

CONTENTS

Revision of Simplex solution of LPP & Duality

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

In depth understanding & clarification of doubts on Simplex solution of a LPP

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Maximize 'Z' = $300x_1 + 400x_2$

Subject to $5x_1 + 4x_2 \leq 200$

$3x_1 + 5x_2 \leq 150$

$5x_1 + 4x_2 \geq 100$

$8x_1 + 4x_2 \geq 80$ where $x_1, x_2 \geq 0$

2. Solve using Simplex

Maximise $'Z' = 3x + 2y$

Sub. to $x - y \leq 15$

$2x - y \leq 40$

$x, y \geq 0$

3. Solve using Simplex

Minimize: $Z = 3x_1 + 4x_2$

Subject to $2x_1 + x_2 \leq 6$

$2x_1 + 3x_2 \geq 9$

With, x_1, x_2 non-negative.

4. Determine the dual of the given primal problem

Minimise $Z = 12x_1 + 26x_2 + 80x_3$

$2x_1 + 6x_2 + 5x_3 \geq 4$

$4x_1 + 2x_2 + x_3 \geq 10$

$x_1 + x_2 + 2x_3 \geq 6$

With all variables non-negative.

5. Solve the following LPP using the Big M method

Maximise $'Z' = 40x_1 + 60x_2$ [Subject to constraints]

$2x_1 + x_2 \leq 70$

$x_1 + x_2 \geq 40$

$x_1 + x_2 \geq 40$

$x_1 + 3x_2 \leq 90$

Where, $x_1, x_2 \geq 0$

6. Find the Dual of the following LPP

Maximize $Z = 4x_1 + x_2 + 7x_3$

subject to $x_1 + x_2 + x_3 = 10$

$x_1 + 7x_2 - 3x_3 \leq 4$

$5x_1 - x_2 + x_3 \geq 12$

and $x_1, x_2, x_3 \geq 0$

TOPIC/UNIT/ Module

Title: **Tutorial on Transportation; Assignment Problems & Game Theory**

CONTENTS

Revision Class on Transportation; Assignment & Game Theory

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

In depth understanding & clarification of doubts on typical cases on Transportation; Assignment & Game Theory problems

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Determine an IBFS by Vogel's Approximation method

Source	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18

2. Three fertilizers factories X, Y and Z located at different places of the country produce 6, 4 and 5 lakh tones of urea respectively. Under the directive of the central government, they are to be distributed to 3 States A, B and C as 5, 3 and 7 lakh respectively. The transportation cost per tones in rupees is given below

	A	B	C
X	11	17	16
Y	15	12	14
Z	20	12	15

Find out suitable transportation pattern at minimum cost by North West Corner method and Least Cost method.

3. A departmental has five employees with five jobs to be performed. The time (in hours) each men will take to perform each job is given in the effectiveness matrix.

jobs	1	2	3	4	5
a	10	5	13	15	16
b	3	9	18	13	6
c	10	7	2	2	2
d	7	11	9	7	12
e	7	9	10	4	12

4. Find the optimal strategies & value of the following Game

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	-5	3	1	10
A_2	5	5	4	6
A_3	4	-2	0	-5

5. Solve the following Game using Graphical Method

Player A	Player B		
	B_1	B_2	B_3
A_1	-1	2	-2
A_2	6	4	-6

6. Find the range of values of p and q that will render the entry of a saddle point for the game

Player A	Player B		
	B_1	B_2	B_3
A_1	2	4	5
A_2	10	7	q
A_3	4	P	6

TOPIC/UNIT/ Module

Title: Previous MAKAUT Question Discussion on O.R

CONTENTS

Solutions of Previous MAKAUT End Semester Questions on Operations Research

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To get acquainted with type of Questions that usually come in University End Semester

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Do Graphical Solution of following LPP

Max $Z = 22x_1 + 18x_2$

subject to : $3x_1 + 2x_2 \leq 48$

$x_1 + x_2 \leq 20$

whereas $x_1, x_2 \geq 0$

Solve it with the Graphical Method.

2. Calculate total assignment cost for assigning four jobs A, B, C, D to four machines 1, 2, 3, 4

	1	2	3	4
A	15	13	14	17
B	11	12	15	13
C	13	12	10	11
D	15	17	14	16

Find the assignment of salesmen to various districts which will yield maximum profit.

3. Using Simplex solve the following

Minimize $Z = 150\,x_1 + 150\,x_2 + 100\,x_3$

subject to, $2\,x_1 + 3\,x_2 + x_3 \geq 4$

$3\,x_1 + 2\,x_2 + x_3 \geq 3$

and $x_1, x_2, x_3 \geq 0$

4. Apply big M to solve the given LPP

Max $z = 2x_1 + 9x_2 + x_3$

subject to

$x_1 + 4x_2 + 2x_3 \geq 5$

$3x_1 + x_2 + 2x_3 \geq 4$

$x_1, x_2, x_3 \geq 0.$

5. Formulate the from the following a LPP and solve by Simplex

A firm can produce three types of cloth, say *A*, *B* and *C*. Three kinds of wool are required for it, red, green and blue wool. One unit length of type *A* cloth needs 2 yards of red wool and 3 yards of blue wool. One unit length of type *B* cloth needs 3 yards of red wool, 2 yards of green wool and 2 yards of blue wool and one unit length of type *C* cloth needs 5 yards of green wool and 4 yards of blue wool. The firm has a stock of only 8 yards of red wool, 10 yards of green wool and 15 wards of blue wool. It is assumed that the income obtained from one unit length of type *A* cloth is Rs. 3, of type *B* cloth is Rs 5 and that of C is Rs 4

6. Find solution of following assignment problem that will minimize distribution cost.

	MACHINES			
	W	*X*	*Y*	*Z*
A	18	24	28	32
JOBS B	8	13	17	19
C	10	15	19	22

x) Teaching Strategy/Method (Instructional methods, usage of ICT, efficient and engaging instructions and displays the best practices on institutional website)

- Learning by analogous examples
- Learning by question and answering
- Learning by different Current industry business models and Pilot Business Plan
- Learning by team work (think, pair, share)
- Learning by solving numerical problems
- Learning by good video lectures and animation

(x.a) Strategy to support weak students

- Encouraging them to express their point of trouble
- Paying extra attention regarding subject matter beyond the class and regular follow up
- Involve them in such real life based live business project work/designing of business plan

- Engage some bright students to put attention on their friends i.e. weak students

(x.b) Strategy to encourage bright students

- Try to encourage them to study beyond the syllabus
- Suggest them to follow comparatively advanced and well equipped text books
- Motivate them to browse the internet and go through the latest invention/developments in the particular field
- Encourage them to implement some real life based hand on business oriented project work on the subject matter

(x.c) Efforts to keep students engaged

- Asking random questions to the students found unmindful from the topic
- Engage them by providing interesting problem solving
- Introducing some informal business quiz among different groups
- Assigning regular home works and follow up
- Delivering some interesting lectures apart from conventional teaching

DETAILS OF TUTORIALS of MB 106 [QT Module I (O.R)] Odd Semester 2020

Tutorial No	Tutorial Online (Google Meet) Topic	Plan date with day	Execution date	Remarks
01	LPP Solution by Graphical Method	12.12.20	12.12.20	Online Google Class & Google Meet + Digital White Board CANVAS **FOR COVID 19 PANDEMIC**
02	LPP Solution by Simplex Rule	19.12.20	19.12.20	
03	LPP Solution by Big M & 2 Phase using Simplex	09.01.21	09.01.21	
04	Primal to Dual Conversion	16.01.21	16.01.21	
05	NWC Rule & VAM method of Solving Transportation Problem	30.01.21	30.01.21	
06	MODI method of Optimality Test for Transportation Problem	13.02.21	13.02.21	
07	Hungarian Method of Assignment Problem, Maximisation Case	20.02.21	20.02.21	
08	Solution of 2 Person Zero Sum Game with & without Saddle Point	27.02.21	27.02.21	
09	Special Cases of LPP in Graphical & Simplex, Degeneracy in Transportation	06.03.21	06.03.21	

ATTENDANCE SHEET (Online Tutorial)

Subject: Quantitative Techniques **Subject Code: MB 106**

Semester:1st **Discipline: MBA (New)**

	Roll No.	Name								
1	11900920001	AJAY KUMAR PRASAD	P		P	P			P	P	
2	11900920002	KUSHAL DAM	A	P	P		P	P	P	P	P
3	11900920003	SUROJIT PAUL	P	P	P	P		P	P		
4	11900920004	RUPJIT DUTTA		P	P	P		P			
5	11900920005	SIMRAN CHOUDHURY	P	P			P			P	P
6	11900920006	BIPLOB BARMAN		P	P	P	P			P	
7	11900920007	PRAYANKAR DAHAL	P	P	P	P	P		P	P	
8	11900920008	ROHIT THAPA	P	P		P	P			P	P
9	11900920009	PRATIK CHHETRI	P	P	P		P		P		P
10	11900920010	SANKHA GHOSH	P	P		P		P	P	P	
11	11900920011	SOURAV DAS		P	P		P	P	P	P	
12	11900920012	RISHAV DUTTA (GJC)			P	P	P			P	
13	11900920013	SATIRTHA DUTTA	P	P	P	P	P		P	P	
14	11900920014	RINJI SHERPA		P	P		P	P	P		
15	11900920015	RIYA SARKAR	P		P	P	P				
16	11900920016	RIYA PRADHAN		P		P	P	P		P	
17	11900920017	BISWAJIT BAKSHI		P		P					
18	11900920018	PRIYADARSHINI MUKHERJEE	P	P	P	P	P	P	P		
19	11900920019	RIYA DEB	P	P	P	P		P	P	P	P

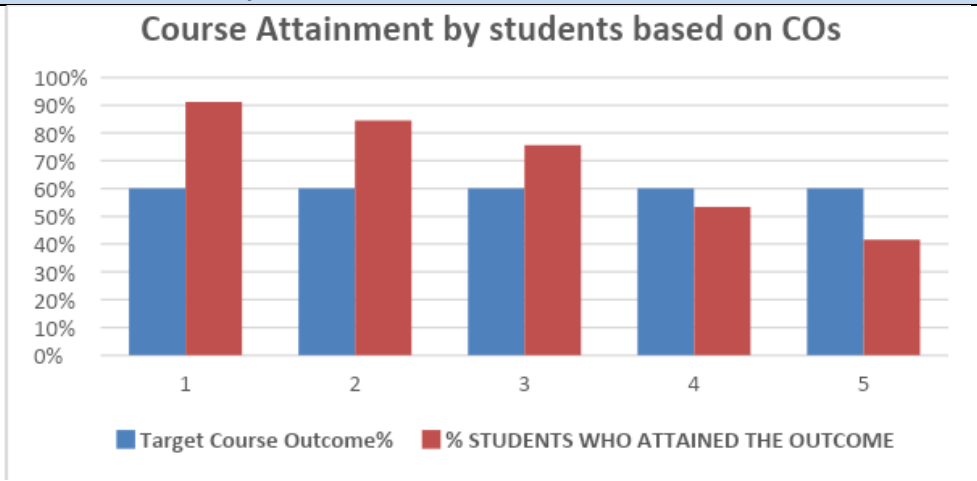
20	11900920020	SUSHMA THAPA	P	P		P	P	P	P	P	
21	11900920021	DEBANJAN DAS	P	P	P	P		P	P	P	P
22	11900920022	RUPANKAR BARMAN			P	P	P			P	
23	11900920023	ANKUSH AICH	P	P	P	P	P		P	P	
24	11900920024	SUPRIYO GHOSH		P			P	P	P		
25	11900920025	PRIANKA MUNDA				P	P			P	
26	11900920026	NILADRI BISWAS	P	P		P	P		P	P	
27	11900920027	MANISH CHETTRI		P	P		P	P	P		
28	11900920028	PRENA GUPTA				P	P			P	
29	11900920029	ROHIT ALAM			P	P	P			P	
30	11900920030	ASHMITA SHARMA	P	P		P	P		P	P	P
31	11900920031	RUBI SARKAR		P			P	P	P		
32	11900920032	SUBARNA CHOWDHURY				P	P			P	
33	11900920033	ASHISH SHARMA			P	P	P			P	
34	11900920034	KIRTY DAS	P	P	P	P	P		P	P	P
35	11900920035	PRABIR AICH		P			P	P	P		
36	11900920036	SOUMYAJIT DAS	P			P			P	P	
37	11900920037	PUNAM KUMARI GUPTA	A	P	P		P	P	P	P	P
38	11900920038	SHUVODEEP GHOSH	P	P	P	P		P	P		
39	11900920039	DEBANGI DAS	P		P	P			P	P	
40	11900920040	TANMOY DEY	P	P	P	P		P	P	P	P
41	11900920041	PRIYANKA NANDI	P	P		P	P	P	P	P	
42	11900920042	TINNY SARKAR	P	P	P	P		P	P	P	P
43	11900920043	MAINI SARKAR	P	P	P		P	P			
44	11900920044	DEBAPRIYA RAHA			P	P	P	P			
45	11900920045	SOUMYAJIT GUHA		P	P		P		P	P	
46	11900920046	SUBHANKAR DAS	P		P	P			P	P	
47	11900920047	KAJAL GUPTA	P	P	P	P		P	P	P	P
48	11900920048	ARABINDU BOSE	P	P	P	P		P	P		
49	11900920049	RISHAV DUTTA (SIT)	P		P	P			P	P	
50	11900920050	ANGELA YOLMO	P	P	P	P		P	P	P	P
51	11900920051	REKHA POKHREL	P	P		P	P	P	P	P	
52	11900920052	GHANANTIKA BARUA	P	P	P	P		P	P	P	P
53	11900920053	ASHMITA SHERPA	P	P	P		P	P			
54	11900920054	SAMAJIT DEY			P	P	P	P			
55	11900920055	RIYA GURUNG		P	P		P		P	P	
56	11900920056	SITANGSHU BANDHU CHATTERJEE	P	P	P	P		P	P		
57	11900920057	ARUNABH MODAK	P		P	P			P	P	
58	11900920058	SHREYA PALIT	P	P	P	P		P	P	P	P
59	11900920059	ANINDA BHATTACHARYA	P	P		P	P	P	P	P	
60	11900920060	DEEPAK KUMAR	P		P	P			P	P	

CONSOLIDATED INTERNAL TEST RECORDS of MB 106; MAKAUT Odd Semester 2020

	Roll No.	Name	Continuous Assessment			
			CA 1	CA 2	CA 3	CA 4
1	11900920001	AJAY KUMAR PRASAD	No Notification from MAKAUT		21	23
2	11900920002	KUSHAL DAM			19	23
3	11900920003	SUROJIT PAUL			20	23
4	11900920004	RUPJIT DUTTA			18	21
5	11900920005	SIMRAN CHOUDHURY			20	21
6	11900920006	BIPLOB BARMAN			19	22
7	11900920007	PRAYANKAR DAHAL			20	22
8	11900920008	ROHIT THAPA			19	18
9	11900920009	PRATIK CHHETRI			20	22
10	11900920010	SANKHA GHOSH			21	22
11	11900920011	SOURAV DAS			19	23
12	11900920012	RISHAV DUTTA (GJC)			20	23
13	11900920013	SATIRTHA DUTTA			09	15
14	11900920014	RINJI SHERPA			20	23

15	11900920015	RIYA SARKAR		22	24
16	11900920016	RIYA PRADHAN		21	24
17	11900920017	BISWAJIT BAKSHI		18	21
18	11900920018	PRIYADARSHINI MUKHERJEE		23	25
19	11900920019	RIYA DEB		22	25
20	11900920020	SUSHMA THAPA		18	19
21	11900920021	DEBANJAN DAS		08	10
22	11900920022	RUPANKAR BARMAN		20	23
23	11900920023	ANKUSH AICH		15	18
24	11900920024	SUPRIYO GHOSH		20	23
25	11900920025	PRIANKA MUNDA		19	22
26	11900920026	NILADRI BISWAS		21	22
27	11900920027	MANISH CHETTRI		21	25
28	11900920028	PRENA GUPTA		22	24
29	11900920029	ROHIT ALAM		18	20
30	11900920030	ASHMITA SHARMA		20	23
31	11900920031	RUBI SARKAR		22	24
32	11900920032	SUBARNA CHOWDHURY		21	24
33	11900920033	ASHISH SHARMA		19	21
34	11900920034	KIRTY DAS		17	20
35	11900920035	PRABIR AICH		18	23
36	11900920036	SOUMYAJIT DAS		20	23
37	11900920037	PUNAM KUMARI GUPTA		18	22
38	11900920038	SHUVODEEP GHOSH		21	24
39	11900920039	DEBANGI DAS		21	20
40	11900920040	TANMOY DEY		22	24
41	11900920041	PRIYANKA NANDI		23	24
42	11900920042	TINNY SARKAR		23	22
43	11900920043	MAINI SARKAR		23	25
44	11900920044	DEBAPRIYA RAHA		21	25
45	11900920045	SOUMYAJIT GUHA		20	23
46	11900920046	SUBHANKAR DAS		19	22
47	11900920047	KAJAL GUPTA		20	22
48	11900920048	ARABINDU BOSE		20	24
49	11900920049	RISHAV DUTTA (SIT)		22	24
50	11900920050	ANGELA YOLMO		21	22
51	11900920051	REKHA POKHREL		23	22
52	11900920052	GHANANTIKA BARUA		21	24
53	11900920053	ASHMITA SHERPA		20	22
54	11900920054	SAMAJIT DEY		22	23
55	11900920055	RIYA GURUNG		22	25
56	11900920056	SITANGSHU BANDHU CHATTERJEE		23	24
57	11900920057	ARUNABH MODAK		20	24
58	11900920058	SHREYA PALIT		22	24
59	11900920059	ANINDA BHATTACHARYA		21	23
60	11900920060	DEEPAK KUMAR		21	20

Analysis of Students performance in the course (CAs) (Case Study, Class-tests, Assignments, Quiz, Internal Exam etc)



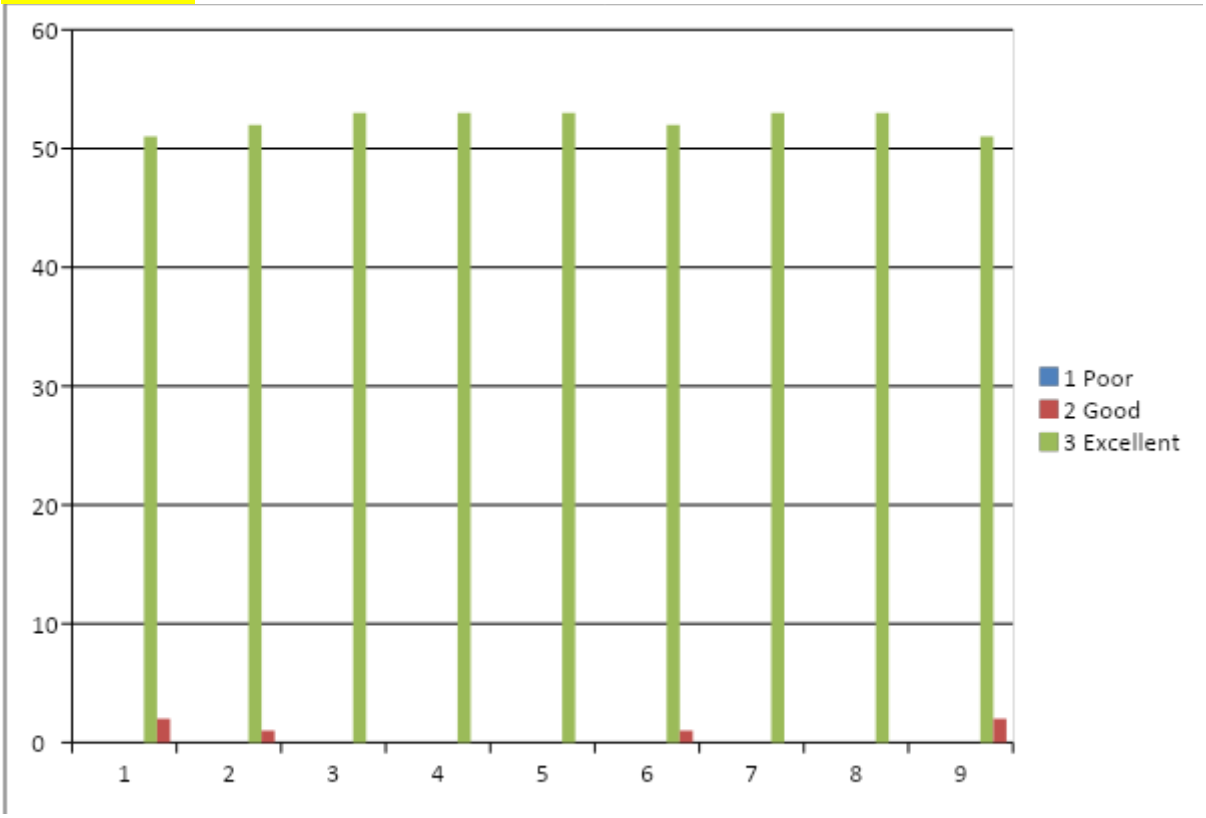
(xii) Analysis of Students performance in the course (University Results)

University Roll No.	NAME OF STUDENTS	Letter Grade (Point) Obtained Theory	ATTAINMENT
	Maximum Point	10	
	Set Target Level (In Point)	6	
11900920001	AJAY KUMAR PRASAD	7	1
11900920002	KUSHAL DAM	7	1
11900920003	SUROJIT PAUL	7	1
11900920004	RUPJIT DUTTA	8	1
11900920005	SIMRAN CHOUDHURY	8	1
11900920006	BIPLOB BARMAN	6	1
11900920007	PRAYANKAR DAHAL	8	1
11900920008	ROHIT THAPA	5	0
11900920009	PRATIK CHHETRI	7	1
11900920010	SANKHA GHOSH	7	1
11900920011	SOURAV DAS	8	1
11900920012	RISHAV DUTTA (GJC)	9	1
11900920014	RINJI SHERPA	9	1
11900920015	RIYA SARKAR	8	1
11900920016	RIYA PRADHAN	9	1
11900920017	BISWAJIT BAKSHI	8	1
11900920018	PRIYADARSHINI MUKHERJEE	8	1
11900920019	RIYA DEB	9	1
11900920020	SUSHMA THAPA	9	1
11900920022	RUPANKAR BARMAN	8	1
11900920023	ANKUSH AICH	7	1
11900920024	SUPRIYO GHOSH	9	1
11900920025	PRIANKA MUNDA	8	1
11900920026	NILADRI BISWAS	7	1
11900920027	MANISH CHETTRI	7	1
11900920028	PRENA GUPTA	9	1
11900920029	ROHIT ALAM	7	1
11900920030	ASHMITA SHARMA	7	1
11900920031	RUBI SARKAR	9	1
11900920032	SUBARNA CHOWDHURY	7	1
11900920033	ASHISH SHARMA	8	1
11900920034	KIRTY DAS	6	1
11900920035	PRABIR AICH	7	1
11900920036	SOUMYAJIT DAS	9	1
11900920037	PUNAM KUMARI GUPTA	7	1
11900920038	SHUVODEEP GHOSH	8	1
11900920039	DEBANGI DAS	7	1
11900920040	TANMOY DEY	8	1
11900920041	PRIYANKA NANDI	8	1
11900920042	TINNY SARKAR	9	1
11900920043	MAINI SARKAR	8	1
11900920044	DEBAPRIYA RAHA	8	1
11900920045	SOUMYAJIT GUHA	7	1
11900920046	SUBHANKAR DAS	8	1
11900920047	KAJAL GUPTA	8	1
11900920048	ARABINDU BOSE	7	1
11900920049	RISHAV DUTTA (SIT)	8	1
11900920050	ANGELA YOLMO	9	1
11900920051	REKHA POKHREL	9	1
11900920052	GHANANTIKA BARUA	8	1
11900920053	ASHMITA SHERPA	5	1
11900920054	SAMAJIT DEY	9	1
11900920055	RIYA GURUNG	8	1
11900920056	SITANGSHU BANDHU CHATTERJEE	9	1

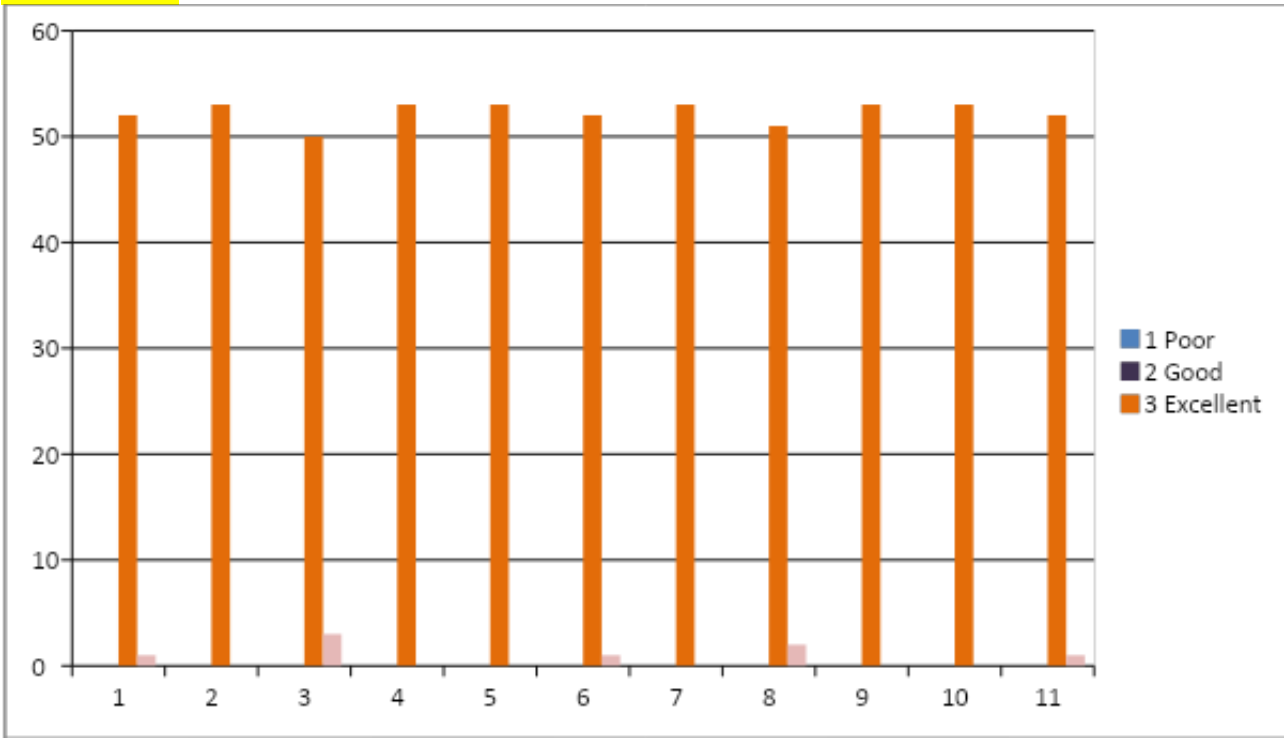
11900920057	ARUNABH MODAK	8	1
11900920058	SHREYA PALIT	7	1
11900920059	ANINDA BHATTACHARYA	8	1
11900920060	DEEPAK KUMAR	8	1
Total No. of Students		58	56
%age of students who attained target		96.55%	
TARGET(%)		60	

(xiii) Analysis of Student Feed Back_MB 106_Total Students 58_Odd Sem 2020

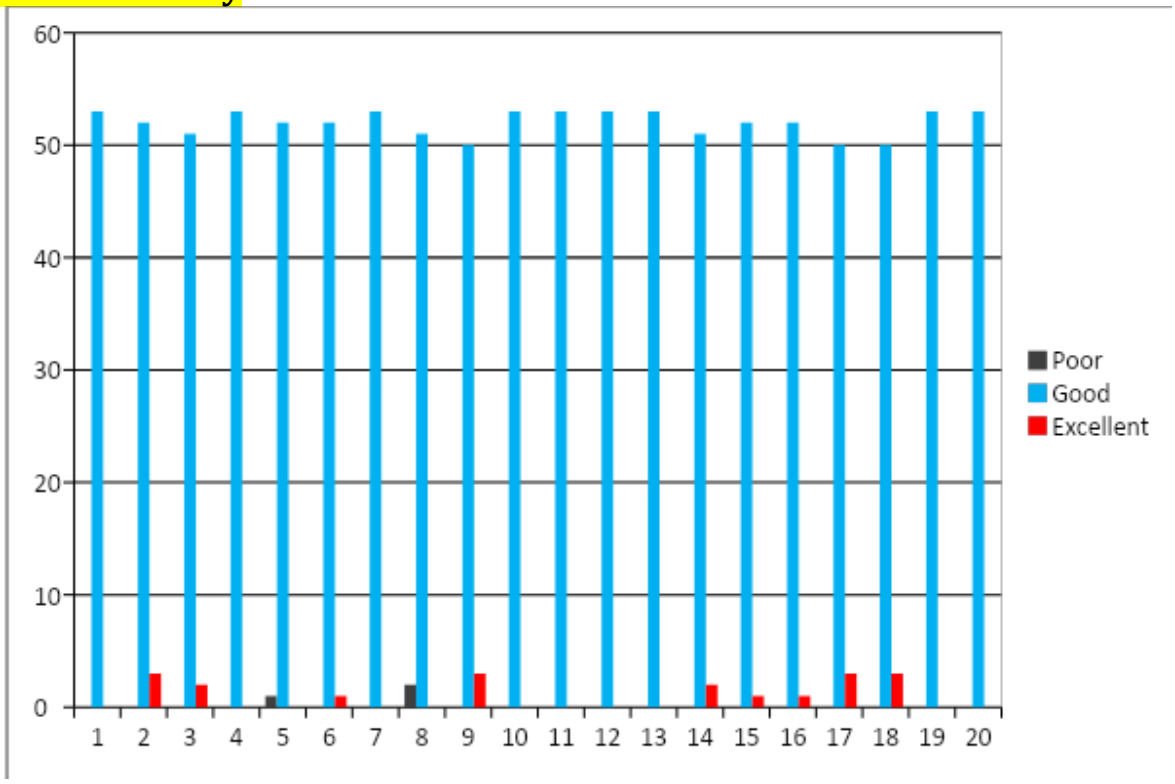
Summative



Formative



Course Survey



List of Students with Roll Nos whose Academic Performance is poor			
Serial No	**Roll No**	**Name of Student**	**Remedial measures taken by Teacher**
01	11900920002	KUSHAL DAM	Extra Classes via Online Mode taken using Live Google Meet & Canvas digital board for Conceptualisation & Numerical
02	11900920022	RUPANKAR BARMAN	Extra Live Google Meet & Canvas digital board for Numerical
03	11900920023	ANKUSH AICH	Extra Live Google Meet & Canvas digital board for Numerical
04	11900920034	KIRTY DAS	Extra Classes via Online Mode taken using Live Google Meet & Canvas digital board for Conceptualisation & Numerical
05	11900920053	ASHMITA SHERPA	Extra Live Google Meet & Canvas digital board for Numerical

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks
01.	1st	Quantitative Techniques (MB - 106) MBA New Syllabus w. e. f 2018-19	08	

Date : **Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that……has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.

Date : **Signature of HOD**

Submitted to Principal/Director

Date : **Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY
MASTER OF BUSINESS ADMINISTRATION

COURSE FILE
2ND SEM, 1ST YEAR

SESSION 2020 - 2021 (EVEN SEMESTER'20)

ONLINE Mode via Google Classroom & Google Meet for COVID 19: 2nd Wave Pandemic

Google Class Room Code: zphr2gc

PAPER NAME : OPERATIONS MANAGEMENT
PAPER CODE: MB 204
MBA [NEW SYLLABUS FROM 2018 SESSION]

Course File

Course Title: Operations Management

Code: MB 204 (MBA New Syllabus from 2018-19 Session)

Semester 2nd, Year 1st

Name of the Faculty: Shomnath Dutta

E-mail: shomnath76@gmail.com

Class Schedule of MB 204 (Even Semester'21)

Lecture (ONLINE Google Class & Meet for Covid 19: 2nd wave)			Tutorial	
Monday	10.00 AM - 10.50 AM			02.15 PM - 04.00 PM
Tuesday	10.00 AM - 10.50 AM			
Wednesday				
Thursday	10.00 AM - 10.50 AM			
Friday	10.50 AM - 11.40 AM			

Hours for meeting students:

Day	Time
Monday	**01.30 PM – 02.00 PM (ONLINE Google Meet for Covid 19 2nd wave)**
Tuesday	**04.40 PM – 05.00 PM (ONLINE Google Meet for Covid 19 2nd wave)**
Wednesday	**04.40 PM – 05.00 PM (ONLINE Google Meet for Covid 19 2nd wave)**
Thursday	**01.30 PM – 02.00 PM (ONLINE Google Meet for Covid 19 2nd wave)**

Course Objective

This course facilitates the students about the role of Operations Management in the overall business strategy of the firm & the interdependence of the operating system with other key functional areas of the firm followed by application of operations management policies and techniques to the service sector as well as manufacturing firms.

Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

Description of Course Outcomes		Target
CO1	Understand the role of Operations in overall Business Strategy of the firm - the application of OM policies and techniques to the service sector as well as manufacturing firms. *(Knowledge, Comprehending, Remembering)*	60%
CO2	Understand and apply the concepts of Material Management, Supply Chain Management and TQM perspectives. *(Knowledge, Comprehending, Applying)*	60%
CO3	Identify and evaluate the key factors and their interdependence of these factors in the design of effective operating systems. (*Comprehending, Applying*)	60%
CO4	Analyze / understand the trends and challenges of Operations Management in the current business environment. (*Analyzing*)	60%
CO5	Apply techniques for effective utilization of operational resources and managing the processes to produce good quality products and services at competitive prices. (*Analyzing, Evaluating*)	60%

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question	BT Level
1.	State the working principle of Production/Operations system & associated sub-systems with the help of block diagram representation.	BT 1
2.	Explain the Plant location selection and Layout design considerations. How does PPC get affected by Layout and material handling decisions?	BT 2
3.	How is the Break Even Analysis applied to find out the best plant location and manufacturing process selection? Can Make/Buy be evaluated by Break Even Analysis tool? If so how	BT 3
4.	Analyze the Inventory control of perishable items as per EOQ Models with quantity discount	BT 4

5.	State the features and relative merits & demerits of different Production systems (Jobshop/Batch/Mass/Project)? How are scheduling & sequencing designed in various production systems?	BT 2
6.	Give an analytical overview of situations call for Make or Buy decisions. Analytically explain the Assembly Line Balancing techniques.	BT 4
7.	Evaluate the comparative evaluation of Product & Process layout design & their applications. Evaluate Capacity Planning cases.	BT 5
8.	State the Meaning & Features of TQM, JIT, Kaizen philosophies of Quality Management, ERP basics	BT 1
9.	Appraise the P-System & Q-System of Inventory Control techniques	BT 5
10.	How do you apply Forward & Backward pass methodologies in PERT networking Project schedule preparation?	BT 3

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours	Tutorials
Difference between Manufacturing & service Operations, Product Process Matrix, Concept of Production Cycle, Capacity planning, Production Planning & Control Concept, Production as a Coordination Function, Responsibilities of Production Manager	4	Numerical on Capacity planning & Production Cycle
Manufacturing Systems Characteristics of Manufacturing Systems; Classification of Manufacturing Systems Batch, Job-shop, Mass etc with Examples; Differences between Intermittent and Continuous Production	2	Numerical on Process selection using Break Even criteria
Plant Location: Need for a Good Plant Location; Factors influencing Plant Location; Tangible and Intangible Factors; Economic Survey of Site Selection	2	Numerical on different models of Plant Location selection
Plant Layout Fundamentals: Need for a Good Plant Layout; Characteristics of a Good Layout; Different types of Layouts-Product, Process, Hybrid etc; Process Layout vs. Product Layout; Optimization in a Process Layout and Product Layout; Designing Product and Process Layout; CORELAP, ALDEP, CRAFT software packages etc;	4	Conceptual issues in plant Layout Design
Assembly Line Balancing – Concept and Problems; Cellular Manufacturing Concept	2	Numerical on Line balancing using Heuristics
Maintenance Management: Objectives, Benefits, Cost Domains etc –. Principles followed; Types of Maintenance Breakdown and Preventive Maintenance & their features; Total Productive Maintenance (TPM) & Numerical	3	Numerical on Replacement problems & OEE calculation
Purchase Management: Purchasing Procedure; Value Analysis; Vendor Selection; Negotiation; Make or Buy decision	2	Numerical on Vendor rating & Make/Buy decision
Inventory Management: Classification of inventory items – ABC, FSN, VED classification; Introduction to EOQ and EBQ; Deterministic demand model–EOQ- Continuous and Periodic review Inventory models	4	Numerical on EOQ models, ABC & P system & Q system
MRP – Concept, inputs and outputs, benefits, examples; Master Production Schedule and MRP; Concepts of MRP II, JIT and ERP	3	Numerical on Product Tree & MRP outputs from BOM

Inspection & Quality Control: Types and criteria of inspection significance & benefits of quality control; Statistical Quality Control: Meaning, Benefits; Control charts for Variables & attributes with numerical application	3	Numerical on Control Charts
Acceptance Sampling – Need, Meaning; OC Curve, Consumer's & Producer's risk, LTPD, AQL	2	
Scheduling & Sequencing – Definition and Assumptions; Sequencing of n jobs on a single machine; Shortest Processing Time , Longest Processing Time, Earliest Due Date and First Come First Serve basis; Sequencing of 2 jobs on 2 machines – ***Gantt Charts,*** Limitations of Gantt Charts; ***Johnson's Rule***: Sequencing of n jobs on 2 and 3 machines	3	Numerical on Johnson's Rule; EDD, FCFS etc
Introduction to **Project Management** – CPM and PERT basics; Identification and Importance of the Critical Path, Forward & Backward pass, Slack/Floats	3	Numerical on PERT & CPM network drawing & Critical path identification
Work Study: Definition and its Importance; Basic Procedure in Performing a Work Study; ***Method Study*** – Objectives and Procedure; ***Work Measurement***–Objectives and Procedure; Concepts of Performance Rating, Basic Time, Allowances and Standard Time	4	Numerical on Standard Time Calculation

IV) Textbooks

Bedi – Production and Operations Management (2k edition); Oxford University Press
Chary, S.N. – Production and Operations Management (3k edition); TMH
Chase, Jacobs, Aquilano and Agarwal – Operations Management for Competitive Advantage (11th edition); TMH
Buffa, E. S. and Sarin, R. K. – Modern Production /Operations Management; John Wiley
Aswathappa & Bhat K Sridhara – Production & Operations Management; HPH

Reference Books

Mahadevan – Operations Management; Pearson Education
Krajewski, Ritzman and Malhotra – Operations Management (8k edition); Pearson Education
Hansen and Ghare – Quality Control and Applications; PHI
Gaither and Frazier – Operations Management (9k edition); Thomson Learning
Hansen and Ghare – Quality Control and Applications; PHI

(v) Evaluation Scheme

Theory

Evaluation Criteria (MAKAUT Odd Sem' 18 Onwards)	**Marks**	
Internal Exam (CA2 & CA 4)*	25	Marks of CA1 to CA4 are Averaged out by MAKAUT & Converted to 30
Assignment (CA 1)	10	
Quiz/Presentation (CA 3)	10	
Attendance	5	
University End Semester Exam	70	
Total	100	

* Two Internal Examinations are conducted in CA2 & CA4 as prescribed by MAKAUT

Course Target Attainment Levels for Internal Assessment:

Target (No. of Students)	Target Level of CO (Marks)	Attainment Level
≤49.9 %	60%	1
50 – 59.9 %	60%	2
60 % and above	60%	3

Overall Course Attainment Target = 70% of the students will get 60% marks.
Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Letter Grade	Point
O	10
E	9
A	8
B	7
C	6
D	5
F	Less Than 5

Course target attainment levels for university assessment:

Target (No. of Students)	Target Level of CO (Marks) in point	Attainment Level
≤ 49.9 %	7	1
50 – 59.9 %	7	2
60 % and above	7	3

Overall Course Attainment Target = 60% of the students will get 7 points.

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes						PSOs	
	I	II	III	IV	V	VI	I	II
C MB204.1	1	1	1	-	-	-	-	-
C MB204.2	-	1	-	-	1	-	-	-
C MB204.3	1	1	-	-	-	1	-	-
C MB204.4	1	2	-	-	1	-	-	1
C MB204.5	2	2	-	-	-	-	-	-
Avg CO MB 204	1.5	1.4	1	1	1	1	-	1

1 = courses in which the student will be exposed to a topic (BT level 1& 2)
2 = courses in which students will gain competency in that area (BT level 3-4)
3 = courses in which students will master that skill (BT level 5-6)

CO1 to CO5 partially satisfies application of knowledge of scientific management in solving real life Shop floor Management problems. (PO1, PO2).
CO1 to CO4 partially satisfies the concept of individual and team work.
CO1 to CO5 partially satisfies the concept of applied management science, mathematics through mathematical & operations research tools and demonstrate proficiency in use of software to be required to practice Production/Operations related managerial profession.

Delivery Methodology

Outcome	Method	Supporting Tools	Demonstration
C MB204.1	Structured, partially supervised	Power point presentation, real life example	Assignment, Quiz, Internal
C MB204.2	Structured, partially supervised	Class Lectures, Power point presentation	Assignment, Quiz, Internal
C MB204.3	Structured, partially supervised	Class Lectures, Power point presentation	Assignment, Quiz, Internal
C MB204.4	Structured, partially supervised	Class Lectures, Power point presentation	Tutorial, Assignment, Quiz, Internal
C MB204.5	Structured, partially supervised	Class Lectures, real life example	Tutorial, Assignment, Quiz, Internal

Assessment Methodology

Outcome	Assessment Tool	Specific Question/activity aligned to the Outcome
C.MB204.1, C.MB204.2, C.MB204.3, C.MB204.4, C.MB204.5	Internal Test	1. Discuss several types of Production methodologies with applicability 2. Explain the factors determining selection of a plant location. 3. Discuss different types of Plant layouts used in manufacturing & service units along with their relative merits/demerits. 4. Explain the functionalities involved & features & benefits of PPC 5. Discuss how Johnson's Rule can be applied in sequencing ***n*** jobs in 2 machines 6. Discuss different types of Plant Maintenance policies – Breakdown, Preventive, Planned etc 7. Explain the concepts of Performance Rating, Allowances, Normal & Standard Times 8 Discuss the objectives and benefits of TPM 9. Write short notes on Process-Product matrix and Production Cycle
C.MB204.2, C.MB204.3, C.MB204.	Assignment	1. Explain the functionalities involved in Loading, Scheduling & Sequencing of Jobs 2. Give a brief account of value Analysis 3. Write short notes on Control Charts & OC curve. 4. Discuss on Capacity Planning
C.MB204.1, C.MB204.2, C.MB204.3, C.MB204.4, C.MB204.5	End of Semester Test	

A. Weekly Lesson Plan

Week	Lectures	Tutorial	Practical	Assignment
Week 1	a. Discussion of Course outcome and program outcome. b. Conceptual understanding of Operations Management as a System in a manufacturing/Service unit. c. **Different types of Manufacturing System** – Mass, Assembly line, Job-shop, Batch, Project type, Cellular, Make-to-Order, Make-to-Stock etc	Decision making on Process Selection		
Week 2	**Plant Location Decision:** Plant Location selection factors & Location decision models	Numerical on Plant location models		<u>Assignment 1</u>: a. Problems on Factor rating, ROI and Break even models of Plant Location selection b. Assembly Line balancing problem
Week 3	**Plant Layout Fundamentals** **a.** Characteristics of a Good Layout; Different types of Layouts-Product, Process, Hybrid etc b. Process Layout vs. Product Layout;	Numerical on Line balancing problem		

	Optimization in a Process Layout and Product Layout; Designing Product and Process Layout; CORELAP, ALDEP, CRAFT software packages c. Assembly Line Balancing technique			c. Application of Johnson's rule of job scheduling & sequencing
Week 4	**Scheduling & Sequencing**: **a.** Sequencing of n jobs on a single machine Shortest Processing Time, Longest Processing Time, Earliest Due Date and First Come First Serve basis **b.** Sequencing of 2 jobs on 2 machines – Gantt Charts, Limitations of Gantt Charts **c**. Sequencing of n jobs on 2 and 3 machines – Johnson's Rule	Numerical on Johnson's Algorithm & on EDD, FCFS rule etc		
Week 5	**Work Study fundamentals -** Method Study & Work Measurement	Standard time Calculation		<u>Assignment 2</u>: a. Numerical on Method study & Work sampling b. Numerical on Make/buy & Vendor rating
Week 6	**a. Vendor Rating exercise –** Methods & Application, **b. Make/Buy Decision -** Methods & Application, **c**. **PPC Concept:** Meaning, Features, Components; Elements of Production Planning & Production Control functions;	Numerical on Make/buy & Vendor rating		
Week 7	**Project Networking & Scheduling** – Networking fundamentals, drawing of Project network, - Forward & Backward pass scheduling in PERT & CPM - Critical path & Float determination in CPM/PERT	Numerical on PERT/CPM		<u>Assignment 3</u>: a. Numerical on PERT/CPM b. Capacity planning
Week 8	**a.** Product Process Matrix, Concept of Production Cycle, Capacity planning, **b.** Production as a Coordination Function, Responsibilities of Production Manager	Numerical on Capacity calculation, Takt time, throughput		
Week 9	**a. Purchase Management**: Purchasing Principles & Procedure; Value Analysis; **b. MRP Concepts –** Independent demand, BOM explosion, Inputs & Outputs of MRP-I model	MRP table Calculations		
Week 10	**Inventory fundamentals**- Meaning, Benefits, Types of Inventories, Types of Inventory Costs, **EOQ Models** – Basic; without shortage, with shortage, with price breaks; Effect of quantity discount;	Numerical on EOQ Models		<u>Assignment 4</u>: a. EOQ Models b. ABC analysis c. Control Charts
Week 11	**Inventory Control Tools** – ABC, FSN and VED classification; Perpetual, Two-bin and Periodic Inventory System	Numerical on ABC Analysis		
Week 12	**Plant Maintenance –** **a.** Objectives, Benefits, Cost Domains etc Types of Maintenance Breakdown and	Numerical on machine replacement		

	Preventive Maintenance & their features; b. Total Productive Maintenance (TPM) & Numerical			
Week 13	**Statistical Quality Control (SQC) & Inspection -** Types and criteria of inspection significance of quality control, Statistical Quality Control, Control charts, Acceptance Sampling Plans; Numerical on Control Charts	Numerical on Control charts		

B. Topic/Chapter wise Weekly Lesson Plan

TOPIC/UNIT/ Module
Title: **Basics of Production/Operations System**
Week No 1

CONTENTS
Discussion of Course outcome and program outcome.
Introduction to Production/Operations System & its components for Manufacturing/Service unit

Topic/Unit/Chapter Objectives
Broad Objectives of the chapter/topic are:
1. To be familiar with the basic characteristics and working principle of Production/Operations System
2. To aware & conceptualise several types of Production methodologies with applicability

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. Explain the basic characteristics of Production/operations system. [L1]
2. Discuss the features & relative merits and demerits of several Production Methodologies [L2]
3. Differentiate between various Production systems techniques. [L1]

TOPIC/UNIT/ Module
Title: **Plant Location Decision**
Week No 2

CONTENTS
Discussion on Plant Location decision factors & site evaluation models

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. Detailed discussion on Plant Location decision factors & evaluation techniques

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. Explain the factors determining selection of a plant location. [L1]
2. How plant location selection is carried out by Break Even , Factor rating, ROI methods [L2]

TOPIC/UNIT/ Module
Title: **Tutorial on Plant Location Decision**
Week 2

CONTENT
Numerical on Plant Location Selection

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. To solve numerical problem on Plant Location decision

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. A TV manufacturer of Gujarat has to select one of the two locations from Sanand and Ramgarh. Based on the following Locational and factor ratings following 10 point and 5 point scales respectively. Which option is suitable for the company to set up its plant?

		Location Rating	
Particulars	**Factor Rating**	**Sanand**	**Ramgarh**
Proximity to market	4	6	5
Skilled Labour availability	5	7	6
Energy Provisions & Cost	2	6	4
Transport & Communication	4	9	8
Civic & Municipal amenities	2	8	9

Environment friendliness	1	5	4	
Technical & Managerial Talents	3	2	4	
R&D and Financial facilities	3	1	2	[L4]

2. Akash Dairy Limited. Made location survey to set up its new plant for processing & distributing milk and milk-based items and found two potential locations A and B. The estimated cost & revenue structure of the two locations are:-

Location	**Annual fixed Cost (Rs)**	**Variable Cost (Rs)/Unit**	**Revenue (Rs)/Unit**
A	5 Lakhs	63	68
B	8 Lakhs	52	68

Calculate the following:-

(a) The best plant location with respect to break even production volume.
(b) Production level at which either of the two locations can be selected.
(c) At 20000 liters of milk production, which location will be economical? [L4]

3. A cement manufacturing company intends to select one of the three shortlisted locations – Pune, Bilaspur and Rourkela for its new factory. Based on the following information what location do you suggest as the best site to the company for their new factory?

Particulars	**Pune**	**Bilaspur**	**Rourkela**
Total Investment (Rs)	250000	315000	250000
Raw material expenses (Rs)	80000	90000	105000
Expenses on service utilities (Rs)	50000	40000	25000
Expenses on Distribution (Rs)	50000	50000	80000
Wage & Salary (Rs)	25000	30000	25000
Taxes (Rs)	5000	10000	15000
Projected Revenue (Rs)	340000	390000	350000

TOPIC/UNIT/ Module
Title: **Plant Layout & Its Design decisions**
Week No 3

CONTENTS
Discussion on Plant Layout design decision

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:

1. Detailed discussion on Plant Layout decision factors & principles
2. Study of different Plant Layout designs and their applicability situations, merits demerits
3. Layout Design Issues & Software Packages

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the objectives & factors determining selection of a plant layout [L1]
2. Discuss different types of Plant layouts used in manufacturing & service units along with their relative merits/demerits. [L1]
3. Make a comparative assessment of Product, Process layout & their design issues [L2]
4. Briefly discuss the available layout design software packages ALDEP, CORELAP, CRAFT [L1 & L2]

HOME WORK:

TOPIC/UNIT/ Module
Title: **Production/Operations Planning & Control**
Week No 6 (later half)

CONTENTS
Production Planning & Control – concepts & components
Discussion on activities involved in Production Planning & Production Control

Topic/Unit/Chapter Objectives
Broad Objectives of the chapter/topic are:
1. Detailed discussion on various functions of Production Planning & Control

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Brief overview of Production Planning & Control Mechanisms (L1)
2. Explain the functionalities involved & features & benefits of PPC (L2)

TOPIC/UNIT/ Module

Title: **Job scheduling & Sequencing & Johnson's Algorithm**

Week No 4

CONTENTS

Basic Concepts of Loading, Job scheduling Job Sequencing,
Priority sequencing Rules & Johnson's Algorithm

Topic/Unit/Chapter Objectives

Broad Objectives of the chapter/topic are:

1. Forward & Backward scheduling,
2. Priority sequencing Rules – FCFS, EDD, SPT, CR rule
3. Johnson's Rule of scheduling n jobs on 2 and 3 machines

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the functionalities involved in Loading, Scheduling & Sequencing of Jobs (L1)
2. Discuss how Johnson's Rule can be applied in sequencing ***n*** jobs in 2 machines (L3)

TOPIC/UNIT/ Module

Title: **Tutorial on** Priority Sequencing Rules & **Johnson's Algorithm**

CONTENTS

Solving Numerical Problems on Johnson's Algorithm in sequencing ***n*** jobs by 2 machines

Topic/Unit/Chapter Objectives

Broad Objectives of the chapter/topic are:

1. To solve numerical problems on Johnson's Algorithm

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. M/s. Raj Engineering Works, Durgapur has been given a contract by Indian Railways to make seven components. Each of these components requires processing on two machines M_1 and M_2 in the order M_1 , M_2 . The time required by each of these jobs for processing on two machines is given below. Find the optimal sequence for processing the seven jobs and calculate the waiting time for jobs

Job	**A**	**B**	**C**	**D**	**E**	**F**	**G**
M1	9	5	8	3	4	1	7
M2	2	4	10	5	6	11	6

2. A book binder has one printing press, one binding machine and manuscripts of seven different books. The time required for performing printing and binding operations for different books are shown below:

Book:	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Printing Time (Days):	20	90	80	20	120	15	65
Binding time (Days):	25	60	75	30	90	35	50

Decide the optimum sequence of processing of books in order to minimize the total time required to turn out all the books.

3. Jobs *A* through *E* in the aircraft repair facility must each pass through the Sheet Metal centre and then through Paint centre. The processing time for each job in each centre is shown below. Find the sequence that minimizes completion time of the job. Calculate the cumulative flow time and idle time.

PROCESSING TIME IN DAYS

Job	Work Center 1 (Sheet metal center)	Work Center 2 (Paint Center)
A	4	5
B	17	7
C	14	12
D	9	2
E	11	6

TOPIC/UNIT/ Module

Title: **Plant Maintenance**

Week No 12

CONTENTS

Plant Maintenance fundamentals

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Plant Maintenance- meaning, Need, Objectives, Benefits.
2. Different types of Maintenance,
3. Concept of TPM & Overall Equipment effectiveness (OEE)

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the Objectives & benefits of Plant maintenance.
2. Discuss different types of Plant Maintenance policies – Breakdown, Preventive, Planned etc
3. Brief account on Total Productive Maintenance and OEE parameters

HOME WORK:

TOPIC/UNIT/ Module: I

Title: **Work Study**

Week No 5

CONTENTS

Concept of Work Study – Method Study and its applications.

Concept of Time study & Work Measurement techniques

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Details of Work Study procedure - Method study & Motion study
2. How to determine Performance Rating, Allowances, Calculation of Standard time
3. How to Conduct Time Study & Work Measurement

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the objectives & procedure of conducting Method study, Time study, Work Sampling [L1]
2. Explain the concepts of Performance Rating, Allowances, Normal & Standard Times[L1]
3. Explain the steps involved in Time Study & Work measurement by various methods[L2]
4. Different Work Measurement tools – PMTS, MTM, Work Sampling [L1]
5. What is Standard time? Discuss the process of computation of standard time from a time study exercise. Why is the performance rating factor used in such a computation? [L1 & L2]

TOPIC/UNIT/ Module

Title: **Tutorial on Work study Numerical**

CONTENTS

Numerical Calculation of Normal & Standard Time

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To solve numerical problems on Elemental & a Job's Normal and Standard time

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Work measurement study in a plant was conducted in a shift of 8 hours. The study reveals the following data:- No. of workers observed = 15; Shift production = 400 units; Idle time recorded = 15%
Total allowance entitled = 20%; Average performance of workers = 75%
Find out the standard time per unit produced and per shift production quantity. [L4]

2. An industrial Engineer conducted a time study of a job consisting of 3 elements. Stop watch readings of all elements in 3 cycles are given below:-

	Cycle Time (minute)		
Element	**I**	**II**	**III**
P	0.5	4.2	8.6
Q	1.5	5.7	9.9
R	3.8	8.1	12.6

Performance ratings assessed for three elements are 105%, 115% and 95% respectively. If allowances for relaxation and contingency allowed are 12% and 3% respectively, find the standard time of the job. Calculate the daily production if the shop-floor works on a 2 shift (8 hours each) basis considering half an hour lunch break in each shift. [L4]

3. Work sampling study in a workshop of 40 machines was conducted and first two days analysis recorded machine idle time 40%. If the study was planned for +2 % to -2% accuracy with 95% confidence limit. Determine the following –

a. No. of observations and no. of rounds undertaken.
b. Now of rounds per day and the average time between the successive rounds, considering 26 working days with single shift (8 hours) in each day for the entire study. [L4]

4. An 8 hour work measurement study in a plant reveals the following:-

Units produced = 320 nos. Idle time 15%; Performance rating = 120 % of normal time.

Determine the standard time per unit produced. [L4]

5. A group of 10 workmen working 8 hours per day (one shift) on a group of engine lathes produced 320 pieces of a component. During the study, it was observed that workmen were idle for 20% of the total available time and 80% of the available time they worked at an average performance of 75%. Calculate standard time for the job assuming the operation to be completely manual and the workmen are entitled to 20% allowance for this type of work. [L4]

6. In a work measurement exercise, a worker was observed for 30 minutes continuously. In this period, the worker completed 42 parts. The performance rating for the worker is 130 If the company allows 15% as a fatigue and personal time allowance, what should be the Normal time for the job, Standard time for the job?

TOPIC/UNIT/ Module

Title: **Purchase Issues**

Week No 9 (First half)

CONTENTS

Fundamentals of Purchasing

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Purchasing Management -Concept, Objectives, Scope, Benefits
2. Purchasing policy, procedure, 5R principles, different types of purchase

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the conceptual basics behind management of materials with benefits, significance[L1]
2. Discuss Purchasing Cycle & governing Principles and relevant documents [Purchase Indent]
3. Explain detailed process involved in various types of Purchasing schemes used in Industry[L1]

TOPIC/UNIT/ Module

Title: **Project Networking**

Week No 7

CONTENTS

Project Networking fundamentals & time scheduling of a Project Network Scheduling by CPM & PERT

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. Concept of a Project & its features
2. Basic understanding of Project Networking & Scheduling
3. To be familiar with the working principle of PERT & CPM tools of Project Scheduling
4. To study the identification of Critical path & Floats from a Project Network using CPM/PERT

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Explain the meaning of a Project & Project Network [L1]
2. How to draw a Project Network maintaining rules of Drawing Project Network [L3]
3. Explain the concepts of Forward & Backward Pass Time-Calculations of a Project network [L2]
4. Discuss the method of identification of Critical Activities & Critical Path in a Project applying PERT/CPM along with Floats for each activity, if any. [L3]
5. What do you mean by PERT in Project analysis? What are the three time estimates related to PERT? Write down the difference between PERT and CPM? [L1 & L2]

TOPIC/UNIT/ Module

Title: **Tutorial on PERT& CPM**

CONTENTS

Numerical Problems on Project Scheduling by PERT & CPM

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:
To solve numerical problems on PERT & CPM

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. A small project is composed of time activities whose time estimates are given below :

ACTIVITY	Optimistic Duration (week)	Most Duration (week)	Pessimistic Duration (week)
A	2	2	8
B	2	5	8
C	4	4	10
D	2	2	2
E	2	5	14
F	3	6	15
G	2	5	8
H	5	8	11
I	3	6	15

Activities A, B and C can start simultaneously. Activity D follows activity A while E follows B. Activity D and E are followed by activity G while F is dependent on C H depends on D and E, while I depends on F and G. Construct the network. Find the expected duration and variance of each activity. What is the critical path and expected project duration of the project?

2. ABC organization is preparing a project proposal to the major projects of Department of Information & Technology for development of product for a disabled person. The following table shows the activities, times and sequence require

ACTIVITY	Immediate Predecessor	Optimistic Duration (week)	Most Duration (week)	Pessimistic Duration (week)
A	NONE	2	3	4
B	NONE	1	5	9
C	A	1	3	5
D	B	2	3	4
E	C,D	2	3	4
F	E	2	4	6
G	F	2	4	10
H	E	5	7	9
I	E	3	5	7
J	G,H,J	5	7	9
K	J	2	3	4

Draw the network diagram. Show the ES, EF, LS, LF expected time of each activity. Find the critical path and expected project completion time.

TOPIC/UNIT/ Module
Title: **Vendor Rating & Make/Buy Decision**
Week No 6 (First half)

CONTENTS
Vendor Rating Methodologies

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. To be familiar with the detailed discussion of Vendor rating & selection mechanism
2. To gain knowledge on three main methods of Vendor evaluation
3. To understand the situations calling for Make or Buy decision
4. To be familiar with the criteria which leads to making in-house or procuring from outside

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. State the objectives of vendor rating. [L1]
2. Mention the usual criteria or factors based on which vendors are assessed. Give one quantitative technique by which vendor rating can be performed.
3. Explain the cost ratio method of Vendor evaluation & rating

4. When does Make or Buy decision arise? [L1]
5. Give arguments in favour of (In-house) Making option and also favouring Outsourcing [L1]
6. Explain the concept of Make/Buy Trade-off using Break-even Analysis. [L2 & L3]

TOPIC/UNIT/ Module

Title: **Tutorial class on Vendor Rating & Make/Buy**

CONTENTS

Numerical problems on Vendor Rating & Make/Buy

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To solve numerical on Vendor Rating & Make/Buy

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. A gear making firm consumes on an average 7580 units of a component per annum. If the component is outsourced, it costs Rs 2.80 per unit purchased to the company but when made in-house, it will incur a fixed cost of nearly Rs 10000 and variable expense of Rs 1.50 per unit manufactured. Find the amount of that component at which the firm should switch from outsourcing to in-house making? Considering the given annual requirement, which option will be favourable for the company – whether making in-house or purchasing from outside?

2. From the information furnished below, select the best vendor after conducting rating analysis. The company has assigned weightages for Quality: 50%, for Delivery: 25%, for Price: 15% and for suggestion response: 10%. The following table provides various performance data of the three vendors namely – A, B and C as given below:-

Particulars of Vendor	A	B	C
Quantity received	1200	1500	1350
Quantity accepted	1100	1400	1050
Basic unit price (Rs)	6.00	5.80	6.20
Committed delivery period	4 weeks	3 weeks	4 weeks
Actual delivery	4.2 weeks	2.9 weeks	4.5 weeks
Suggestions made	2	4	3

TOPIC/UNIT/ Module

Title: **MRP (Material Requirement Planning)**

Week No 9 (Second half)

CONTENTS

In-depth study of Objectives, Functions & detailed MRP processing logic

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To familiar with MRP concepts, terminologies
2. MRP processing logic & solving MRP problems

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. What do you understand by 'Material Requirement Planning'? How is it used in planning for materials?
2. Discuss the working mechanism of MRP. Briefly discuss the various reports generated by MRP system
3. Explain the terms BOM, MPS, Scheduled Receipt, and Planned Order Release & Planned Order Receipt.
4. Differentiate between MRP I & MRP II

TOPIC/UNIT/ Module: II

Title: **Tutorial on MRP I**

Week No

CONTENTS

Numerical problems on MRP processing logic

Topic/Unit/Chapter Objectives:

Broad Objectives of the chapter/topic are:

1. To solve numerical on MRP

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Each unit of A is composed of one unit of B, two units of C, and one unit of D. C is composed of two units of D and three units of E. Items A, C, D, and E have on-hand inventories of 20, 10, 20, and 10 units, respectively. Item B has a scheduled receipt of 10 units in period 1, and C has a scheduled receipt of 50 units in Period 1. Lot-for-lot (L4L) is used for Items A and B. Item C requires a minimum lot size of 50

units. D and E are required to be purchased in multiples of 100 and 50, respectively. Lead times are one period for Items A, B, and C, and two periods for Items D and E. The gross requirements for A are 30 in Period 2, 30 in Period 5, and 40 in Period 8. Find the planned order releases for all items. [L4]

TOPIC/UNIT/Module
Title: **Inventory control & Management**
Week No 10

CONTENTS
a. Basics of Inventory Management – Need, Objectives, Terminologies & Basic EOQ Model
b. EOQ Model Variants; P-System, Q-System, ABC, VED & Probabilistic Models

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. To be familiar with the concept of Inventory & its Management, Inventory Costs
2. Introduction to Basic EOQ Models with different situations/conditions
3. To be familiar with the concept of ROL, Safety stock, Lead time

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. Explain different types of Inventory Costs. Discuss how these costs behave in Quantity Discount model with changes in order size.
2. Discuss why ordering costs decrease with increase in management?
3. Derive the basic EOQ model along with assumptions
4. Explain concepts of ROL and need for safety stock &. Discuss how these ROL & Safety Stock changes in P-System & Q-Systems
5. Discuss working principle of ABC Analysis
6. How do fluctuations in lead time and safety stock affect inventory decisions?
7. Differentiate between P-system and Q-system of inventory control. Explain Recorder level (ROL) and safety stock.

TOPIC/UNIT/Module
Title: **Tutorial class on Inventory Management**
Week No

CONTENTS
Numerical problems on EOQ Model & Inventory Control techniques

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. To solve numerical on EOQ Model & Inventory Control techniques

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. A factory uses annually 24,000 units of raw material, costing Rs. 1.25 per unit. Placing an order costs Rs. 25 per order carrying cost is 6% per year of the average inventory. If the factory works for 320 days a year and procurement time is 10 days, find the maximum inventory level and ROL. Assume safety stock 450 units.

2. A company manufacturing electrical control panels uses 4000 toggle switches a year. It costs approximately Rs. 3,000.00 to prepare an order and receive it. Carrying costs are 40 per cent of purchase price per unit on annual basis. Determine the optimal order quantity and total annual cost considering switches are priced as follows:

Range of Order	**Unit price (Rs.)**
1 to 499	90.00
500 to 999	85.00
1000 and above	80.00

3. Develop an ABC classification for a store with the following data:

Item No	Average Monthly Demand (Units)	Price per unit (Rs)
1	1500	20
2	8000	1
3	700	6
4	200	4
5	2000	12
6	2500	1
7	100	10
8	3000	2
9	1000	2

10	500	10

4. A publishing house purchase 2,000 units of particular item per year at a unit cost of Rs. 20, the ordering cost per order is Rs. 50 and the inventory ordering cost is 25%. Find the optimal order quantity and the minimum total cost including purchase cost. If a 3% discount is offered by the supplier for purchase in lots of 1, 000 or more, should the publishing house accept the order?

5. A spare part "I-10" is produced by a water pump manufacturer from a local firm and the average usage rate in pump manufacturing activity is 500 numbers per month. Ordering cost of "I-10" is Rs. 36 per order and the cost of holding this inventory is Rs. 1·20 per piece per year determine the quantity that should be procured at a time to optimize the total cost. If the usage of I-10 increases to 40 numbers per day and inventory carrying cost becomes Re. 0·02 per unit per day, what will be the revised EOQ? (Assume: 300 days in a year.) From the sum, show that ordering cost is equal to inventory holding cost in case of EOQ. If the company maintains a safety stock of 1000 units, calculate total cost (ordering cost and inventory carrying cost) with respect to above.

TOPIC/UNIT/Module
Title: **Statistical Quality Control (SQC)**
Week No 13

CONTENTS
Introduction to Statistical Quality Control (SQC) & associated concepts
Fundamentals of Control Charts & Acceptance Sampling

Topic/Unit/Chapter Objectives:
Broad Objectives of the chapter/topic are:
1. Detailed discussion of SQC as quality control tool
2. Understanding SQC terminologies – Variable/Attribute, Variations, Inspections for Quality Control
3. Discussion on Control Charts for Variables & Attributes
4. Detailed Study on Acceptance Sampling

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):
1. State and explain the objectives and benefits of SQC. (L1)
2. Differentiate assignable and chance variations.
3. Explain the significance of Inspection in Quality Control. Differentiate between Inspection & SQC
4. Explain the different control limits used in Control charts with mathematical expressions[L1]
5. Discuss the significance of Acceptance sampling. [L2].
6. Explain the terms – AQL, LTPD, Consumer's Risk & Producer's Risk [L1]
7. What is operating characteristics curve (OC)? What are the parameters of OC curve? [L1]

TOPIC/UNIT/ Module
Title: **Tutorial class on Control Charts**
Week No

CONTENTS
Numerical problems on Control Charts

Topic/Unit/Chapter Objectives:
To solve numerical on Control Charts for both Variables and Attributes

Once the student has completed this topic/ chapter he/she will be able to answer following questions/perform the following activities with Levels of Bloom's Taxonomy):

1. Draw the Mean and Range chart from the following data and comment on the results of process control:-

Sample No	Value of sampled items inspected (Diameter in mm)			
1	15.58	18.82	15.45	15.71
2	15.94	15.07	15.02	15.81
3	15.63	15.67	15.60	15.54
4	15.17	15.08	14.81	15.02
5	15.18	15.40	15.34	15.36

Given that $A_2 = 0.73$, $D_3 = 0$, $D_4 = 2.282$ for sample size, n = 4.

2. 10 samples of 100 bolts each are taken at random and the number of defectives in each sample are noted below:-

Sample Number	1	2	3	4	5	6	7	8	9	10
No of defectives	18	12	6	15	2	20	14	10	8	6

Draw p-chart and comment on the result

3. 10 woollen carpets were studied critically for total number of defects in each sample in their texture. The details of the numbers of defects found in each carpet are given below:

Sample Number	1	2	3	4	5	6	7	8	9	10
No of defects	2	4	3	5	1	3	2	3	4	3

Draw the relevant control chart and comment on the process control. [WBUT B.Tech Exam'10]

4. 10 samples each of size 50 of a pipe were inspected in pressure testing. The results of the inspection are given below:

Sample Number	1	2	3	4	5	6	7	8	9	10
No of defectives	2	3	2	0	2	3	2	1	2	3

Draw the np-chart and comment on the status of process control.

COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY	DEPARTMENT	SUBJECT: OPERATIONS MANAGEMENT	SEMESTER: 2ND
Mr. SHOMNATH DUTTA	M.B.A	CODE : MB 204	

Sl. No.	Lecture No	Unit No	Topic Description (to be quoted from syllabus)	Planned Date	Execution Date	Teaching Pedagogy
MODULE I (Total No of Lectures: 18)						
1	1	1	Difference between Manufacturing & service Operations	12.04.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	2		Product Process Matrix, Concept of Production Cycle	13.04.21		
	3		Capacity planning, Production Planning & Control Concept,	13.04.21		
	4		Production as a Coordination Function, Responsibilities of Production Manager	12.04.21		
2	5	2	Characteristics of Manufacturing Systems; Classification of Manufacturing Systems Batch, Job-shop, Mass etc with Examples	16.04.21		
	6		Differences between Intermittent and Continuous Production	16.04.21		
3	8	3	Plant Location: Need for a Good Plant Location; Factors influencing Plant Location	19.04.21		
	9		Tangible and Intangible Factors; Economic Survey of Site Selection	19.04.21		
4	10	4	Plant Layout: Need for a Good Plant Layout; Characteristics of a Good Layout	20.04.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	11		Plant Layout: Need for a Good Plant Layout; Characteristics of a Good Layout; Different types of Layouts-Product, Process, Hybrid etc	20.04.21		
	12		Process Layout vs. Product Layout; Optimization in a Process Layout and Product Layout	22.04.21		
	13		Designing Product and Process Layout; CORELAP, ALDEP, CRAFT software packages etc	23.04.21		
	14		Assembly Line Balancing Technique – Concept and Problems	26.04.21		
	15		Cellular Manufacturing Concept	27.04.21		
5	16	5	Maintenance Management: Objectives, Benefits, Cost Domains etc –. Principles followed	07.05.21		
	17		Types of Maintenance Breakdown and Preventive	10.05.21		

			Maintenance & their features			
	18		Total Productive Maintenance (TPM) & Numerical	11.05.21		
MODULE II (Total No of Lectures: 22)						
6	19	6	Purchase Management: Purchasing Procedure, 5R Principles; Value Analysis	25.05.21		
	20		Vendor Selection; Negotiation; Make or Buy decision	27.05.21		
7	21	7	Inventory Management: Classification of inventory items – ABC, FSN, VED classification;	28.05.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	22		Introduction to EOQ and EBQ	31.05.21		
	23		Deterministic demand model–EOQ- Continuous and Periodic review Inventory models	01.06.21		
	24		MRP – Concept, inputs and outputs, benefits, examples	03.06.21		
	25		Master Production Schedule and MRP	04.06.21		
	26		Concepts of MRP II, JIT and ERP	07.06.21		
8	27	8	Inspection & Quality Control: Types and criteria of inspection significance & benefits of quality control	13.05.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	28		Statistical Quality Control: Meaning, Benefits	13.05.21		
	29		Control charts for Variables & attributes with numerical application	17.05.21		
	30		Acceptance Sampling – Need, Meaning	18.05.21		
	31		OC Curve, Consumer's & Producer's risk, LTPD, AQL	18.05.21		
9	32	9	Scheduling & Sequencing – Definition and Assumptions; Sequencing of n jobs on a single machine Shortest Processing Time, Longest Processing Time, Earliest Due Date and First Come First Serve basis	29.04.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	33		Sequencing of 2 jobs on 2 machines – Gantt Charts, Limitations of Gantt Charts	30.04.21		
	34		Sequencing of n jobs on 2 and 3 machines – Johnson's Rule;	03.05.21		
	35		Introduction to Project Management – CPM and PERT basics	04.05.21		
	36		Identification and Importance of the Critical Path, Forward & Backward pass, Slack/Floats	06.05.21		
10	37	10	Work Study: Definition and its Importance	20.05.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
	38		Basic Procedure in Performing a Work Study; Method Study –Objectives and Procedure;	20.05.21		
	39		Work Measurement–Objectives and Procedure;	21.05.21		
	40		Concepts of Performance Rating, Basic Time, Allowances and Standard Time	24.05.21		
11	Extra Class		Doubt Clearance Class I	08.06.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
12	Extra Class		Doubt Clearance Class II	10.06.21		
13	Extra Class		Typical numerical problem Solving from previous MAKAUT papers	11.06.21		

DETAILS OF TUTORIALS

Tutorial No	Tutorial Topic	Plan date with day	Execution date	Remarks
01	Manufacturing Process selection – Factors & Numerical evaluation	19.04.21		Google Class (Code:zphr2gc) & Google Meet & Digital White Board: Canvas For COVID 19 2nd WAVE Pandemic
02	Plant Location Selection – Factor Rating method, Break Even Analysis, ROI method, Combined method	03.05.21		
03	Priority Sequencing Rule (FCFS, EDD, SPT, CR) & Johnson's Rule (n x 2 and n x 3)	10.05.21		
04	Work Study Numerical on Standard Time Calculation in Time study & Work sampling	30.05.21		
05	PERT & CPM methods of Project Network Scheduling	24.05.21		

	& Critical Path Identification			
06	Numerical Evaluations of Vendor Rating Exercise & Make/Buy decision taking	31.05.21		
07	Control Chart (Mean & Range Charts, p-Chart, np-Chart, c-Chart etc)	07.06.21		
08	Inventory Control – EOQ Models, P system & Q system, ABC analysis, ROP	14.06.21		

ATTENDANCE OF TUTORIAL CLASS on MB 204 (Even 21)

	Roll No.	Student Name	19.04.21 Mondy	03.05.21 Mondy	10.05.21 Mondy	24.05.21 Mondy	30.05.21 Mon	31.05.21 Mon	07.06.21 Mon	14.06.21 Mon
1	11900920001	AJAY KUMAR PRASAD	P		P	P		P	P	
2	11900920002	KUSHAL DAM	A	P	P		P	A	A	P
3	11900920003	SUROJIT PAUL	P	P	P	P	P	P	P	P
4	11900920004	RUPJIT DUTTA		P		P	P			P
5	11900920005	SIMRAN CHOUDHURY	P	P			P	P	P	P
6	11900920006	BIPLOB BARMAN		P	P	P	P			P
7	11900920007	PRAYANKAR DAHAL	P	P	P	P	P	P	P	P
8	11900920008	ROHIT THAPA	P	P			P	P	P	P
9	11900920009	PRATIK CHHETRI	P	P	P	P	P	P	P	P
10	11900920010	SANKHA GHOSH	P	P		P		P	P	P
11	11900920011	SOURAV DAS		P	P	P	P			P
12	11900920012	RISHAV DUTTA (GJC)			P	P	P			
13	11900920014	RINJI SHERPA	P	P	P	P	P	P	P	P
14	11900920015	RIYA SARKAR		P	P		P			P
15	11900920016	RIYA PRADHAN	P		P	P	P	P	P	
16	11900920017	BISWAJIT BAKSHI		P		P	P			P
17	11900920018	PRIYADARSHINI MUKHERJEE		P		P				P
18	11900920019	RIYA DEB	P	P	P	P		P	P	P
19	11900920020	SUSHMA THAPA	P	P	P	P		P	P	P
20	11900920022	RUPANKAR BARMAN	P	P		P	P	P	P	P
21	11900920023	ANKUSH AICH	P	P	P	P		P	P	P
22	11900920024	SUPRIYO GHOSH			P	P	P			
23	11900920025	PRIANKA MUNDA		P		P			P	P
24	11900920026	NILADRI BISWAS	P		P	P		P		P
25	11900920027	MANISH CHETTRI	A	P	P		P	A	P	P
26	11900920028	PRENA GUPTA	P	P	P	P	P	P	P	P
27	11900920029	ROHIT ALAM		P		P	P		P	
28	11900920030	ASHMITA SHARMA	P	P			P	P	P	
29	11900920031	RUBI SARKAR		P	P	P	P		P	P
30	11900920032	SUBARNA CHOWDHURY	P	P	P	P	P	P	P	P
31	11900920033	ASHISH SHARMA	P	P			P	P	P	
32	11900920034	KIRTY DAS	P	P	P	P	P	P	P	P
33	11900920035	PRABIR AICH	P	P		P		P	P	
34	11900920036	SOUMYAJIT DAS		P	P	P	P		P	P
35	11900920037	PUNAM KUMARI GUPTA			P	P	P			P
36	11900920038	SHUVODEEP GHOSH	P	P	P	P	P	P	P	P
37	11900920039	DEBANGI DAS		P	P		P		P	P
38	11900920040	TANMOY DEY	P		P	P	P	P		P
39	11900920041	PRIYANKA NANDI		P		P	P		P	
40	11900920042	TINNY SARKAR		P		P			P	
41	11900920043	MAINI SARKAR	P	P	P	P		P	P	P
42	11900920044	DEBAPRIYA RAHA	P	P	P	P		P	P	P
43	11900920045	SOUMYAJIT GUHA	P	P		P	P	P	P	
44	11900920046	SUBHANKAR DAS	P	P	P	P		P	P	P
45	11900920047	KAJAL GUPTA			P	P	P			P
46	11900920048	ARABINDU BOSE	P	P	P	P	P	P	P	P

47	11900920049	RISHAV DUTTA (SIT)		P			P		P	
48	11900920050	ANGELA YOLMO				P	P			
49	11900920051	REKHA POKHREL	P	P		P	P	P	P	
50	11900920052	GHANANTIKA BARUA		P	P	P	P		P	P
51	11900920053	ASHMITA SHERPA				P	P			
52	11900920054	SAMAJIT DEY			P	P	P			P
53	11900920055	RIYA GURUNG	P	P		P	P	P	P	
54	11900920056	SITANGSHU BANDHU CHATTERJEE		P			P		P	
55	11900920057	ARUNABH MODAK				P	P			
56	11900920058	SHREYA PALIT			P	P	P			P
57	11900920059	ANINDA BHATTACHARYA	P	P	P	P	P	P	P	P
58	11900920060	DEEPAK KUMAR		P		P	P		P	

Teaching Strategy/Method (describes instructional methods, usage of ICT, efficient and engaging instructions and displays the best practices on institutional website)

- Learning by analogous examples
- Learning by question and answering
- Learning by different Current industry business models and Pilot Business Plan
- Learning by team work (think, pair, share)
- Learning by solving numerical problems
- Learning by good video lectures and animation

Strategy to support weak students

- Encouraging them to express their point of trouble
- Paying extra attention regarding subject matter beyond the class and regular follow up
- Involve them in such real life based live business project work/designing of business plan
- Engage some bright students to put attention on their friends i.e. weak students

Strategy to encourage bright students

- Try to encourage them to study beyond the syllabus
- Suggest them to follow comparatively advanced and well equipped text books
- Motivate them to browse the internet and go through the latest invention/developments in the particular field
- Encourage them to implement some real life based hand on business oriented project work on the subject matter

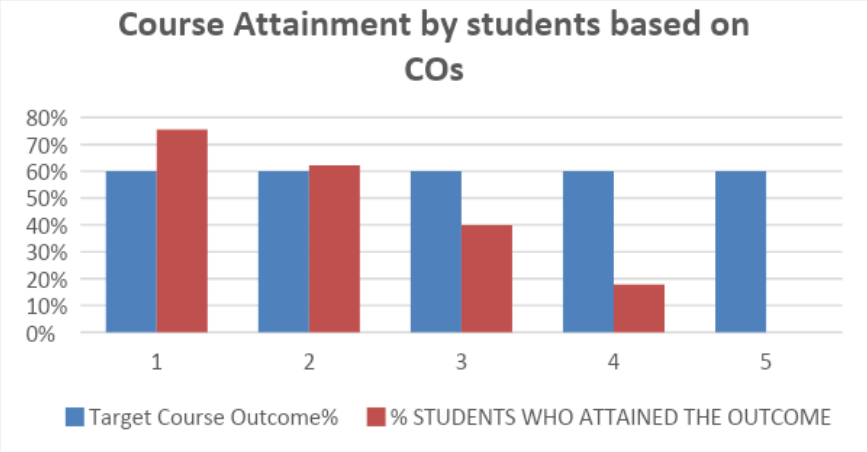
Efforts to keep students engaged

- Asking random questions to the students found unmindful from the topic
- Engage them by providing interesting problem solving
- Introducing some informal business quiz among different groups
- Assigning regular home works and follow up
- Delivering some interesting lectures apart from conventional teaching

CONTINUOUS ASSESSMENT RECORDS_ MB 204; MAKAUT Even Semester 2021

	Roll No.	Name	Continuous Assessment			
			CA 1 Assignment /Quiz (25)	**CA 2** 1st Internal Test (25)	**CA 3** Quiz/ (25) Assignment	**CA 4** 2nd Internal Test (25)
1	11900920001	AJAY KUMAR PRASAD	23	24	24	24
2	11900920002	KUSHAL DAM	21	22	20	23
3	11900920003	SUROJIT PAUL	23	24	24	23
4	11900920004	RUPJIT DUTTA	23	24	25	24
5	11900920005	SIMRAN CHOUDHURY	23	24	24	24
6	11900920006	BIPLOB BARMAN	24	25	24	24
7	11900920007	PRAYANKAR DAHAL	24	24	24	24
8	11900920008	ROHIT THAPA	22	23	23	23
9	11900920009	PRATIK CHHETRI	23	24	24	24
10	11900920010	SANKHA GHOSH	24	24	25	25
11	11900920011	SOURAV DAS	23	24	23	24
12	11900920012	RISHAV DUTTA (GJC)	23	23	23	23
13	11900920014	RINJI SHERPA	22	24	23	24
14	11900920015	RIYA SARKAR	24	25	25	25
15	11900920016	RIYA PRADHAN	24	25	24	25
16	11900920017	BISWAJIT BAKSHI	22	23	23	24
17	11900920018	PRIYADARSHINI MUKHERJEE	24	25	25	25
18	11900920019	RIYA DEB	24	25	25	25
19	11900920020	SUSHMA THAPA	24	23	24	25
20	11900920022	RUPANKAR BARMAN	22	23	23	25

21	11900920023	ANKUSH AICH	22	23	23	25
22	11900920024	SUPRIYO GHOSH	22	24	24	25
23	11900920025	PRIANKA MUNDA	23	24	24	25
24	11900920026	NILADRI BISWAS	23	24	24	24
25	11900920027	MANISH CHETTRI	23	24	24	24
26	11900920028	PRENA GUPTA	23	24	24	25
27	11900920029	ROHIT ALAM	23	24	24	24
28	11900920030	ASHMITA SHARMA	23	23	23	25
29	11900920031	RUBI SARKAR	24	24	25	24
30	11900920032	SUBARNA CHOWDHURY	24	24	24	24
31	11900920033	ASHISH SHARMA	23	24	24	24
32	11900920034	KIRTY DAS	22	23	23	25
33	11900920035	PRABIR AICH	23	24	24	25
34	11900920036	SOUMYAJIT DAS	23	24	24	24
35	11900920037	PUNAM KUMARI GUPTA	23	24	24	24
36	11900920038	SHUVODEEP GHOSH	24	25	24	25
37	11900920039	DEBANGI DAS	24	23	25	25
38	11900920040	TANMOY DEY	23	24	25	24
39	11900920041	PRIYANKA NANDI	24	24	25	25
40	11900920042	TINNY SARKAR	24	25	25	25
41	11900920043	MAINI SARKAR	24	25	25	25
42	11900920044	DEBAPRIYA RAHA	23	24	25	25
43	11900920045	SOUMYAJIT GUHA	23	22	23	24
44	11900920046	SUBHANKAR DAS	23	24	24	25
45	11900920047	KAJAL GUPTA	23	24	24	25
46	11900920048	ARABINDU BOSE	23	23	23	24
47	11900920049	RISHAV DUTTA (SIT)	23	24	25	25
48	11900920050	ANGELA YOLMO	23	24	25	25
49	11900920051	REKHA POKHREL	23	24	24	25
50	11900920052	GHANANTIKA BARUA	23	24	24	25
51	11900920053	ASHMITA SHERPA	23	22	23	24
52	11900920054	SAMAJIT DEY	23	22	24	25
53	11900920055	RIYA GURUNG	23	24	25	25
54	11900920056	SITANGSHU BANDHU CHATTERJEE	23	24	25	25
55	11900920057	ARUNABH MODAK	23	23	23	24
56	11900920058	SHREYA PALIT	23	24	24	25
57	11900920059	ANINDA BHATTACHARYA	23	24	24	25
58	11900920060	DEEPAK KUMAR	23	24	24	24



Analysis of Students performance in the course (University Results)

University Roll No.	NAME OF STUDENTS	Letter Grade (Point) Obtained Theory	ATTAINMENT

	Maximum Point	10	
	Set Target Level (In Point)	6	
11900920001	AJAY KUMAR PRASAD	5	0
11900920002	KUSHAL DAM	7	1
11900920003	SUROJIT PAUL	7	1
11900920004	RUPJIT DUTTA	8	1
11900920005	SIMRAN CHOUDHURY	8	1
11900920006	BIPLOB BARMAN	6	1
11900920007	PRAYANKAR DAHAL	8	1
11900920008	ROHIT THAPA	7	1
11900920009	PRATIK CHHETRI	7	1
11900920010	SANKHA GHOSH	7	1
11900920011	SOURAV DAS	8	1
11900920012	RISHAV DUTTA (GJC)	9	1
11900920014	RINJI SHERPA	9	1
11900920015	RIYA SARKAR	8	1
11900920016	RIYA PRADHAN	7	1
11900920017	BISWAJIT BAKSHI	8	1
11900920018	PRIYADARSHINI MUKHERJEE	8	1
11900920019	RIYA DEB	9	1
11900920020	SUSHMA THAPA	7	1
11900920022	RUPANKAR BARMAN	8	1
11900920023	ANKUSH AICH	7	1
11900920024	SUPRIYO GHOSH	9	1
11900920025	PRIANKA MUNDA	4	0
11900920026	NILADRI BISWAS	4	0
11900920027	MANISH CHETTRI	7	1
11900920028	PRENA GUPTA	9	1
11900920029	ROHIT ALAM	7	1
11900920030	ASHMITA SHARMA	7	1
11900920031	RUBI SARKAR	9	1
11900920032	SUBARNA CHOWDHURY	7	1
11900920033	ASHISH SHARMA	8	1
11900920034	KIRTY DAS	6	1
11900920035	PRABIR AICH	7	1
11900920036	SOUMYAJIT DAS	9	1
11900920037	PUNAM KUMARI GUPTA	7	1
11900920038	SHUVODEEP GHOSH	8	1
11900920039	DEBANGI DAS	7	1
11900920040	TANMOY DEY	8	1
11900920041	PRIYANKA NANDI	8	1
11900920042	TINNY SARKAR	9	1
11900920043	MAINI SARKAR	8	1
11900920044	DEBAPRIYA RAHA	8	1
11900920045	SOUMYAJIT GUHA	7	1
11900920046	SUBHANKAR DAS	8	1
11900920047	KAJAL GUPTA	8	1
11900920048	ARABINDU BOSE	7	1
11900920049	RISHAV DUTTA (SIT)	8	1
11900920050	ANGELA YOLMO	6	1
11900920051	REKHA POKHREL	7	1
11900920052	GHANANTIKA BARUA	8	1
11900920053	ASHMITA SHERPA	8	1
11900920054	SAMAJIT DEY	7	1
11900920055	RIYA GURUNG	6	1
11900920056	SITANGSHU BANDHU CHATTERJEE	6	1
11900920057	ARUNABH MODAK	8	1
11900920058	SHREYA PALIT	7	1
11900920059	ANINDA BHATTACHARYA	8	1
11900920060	DEEPAK KUMAR	6	1

Total No. of Students	58	55
%age of students who attained target	94.82%	3
TARGET(%)	60	

Analysis of Student Feed Back: MB 204 Even Semester 2021

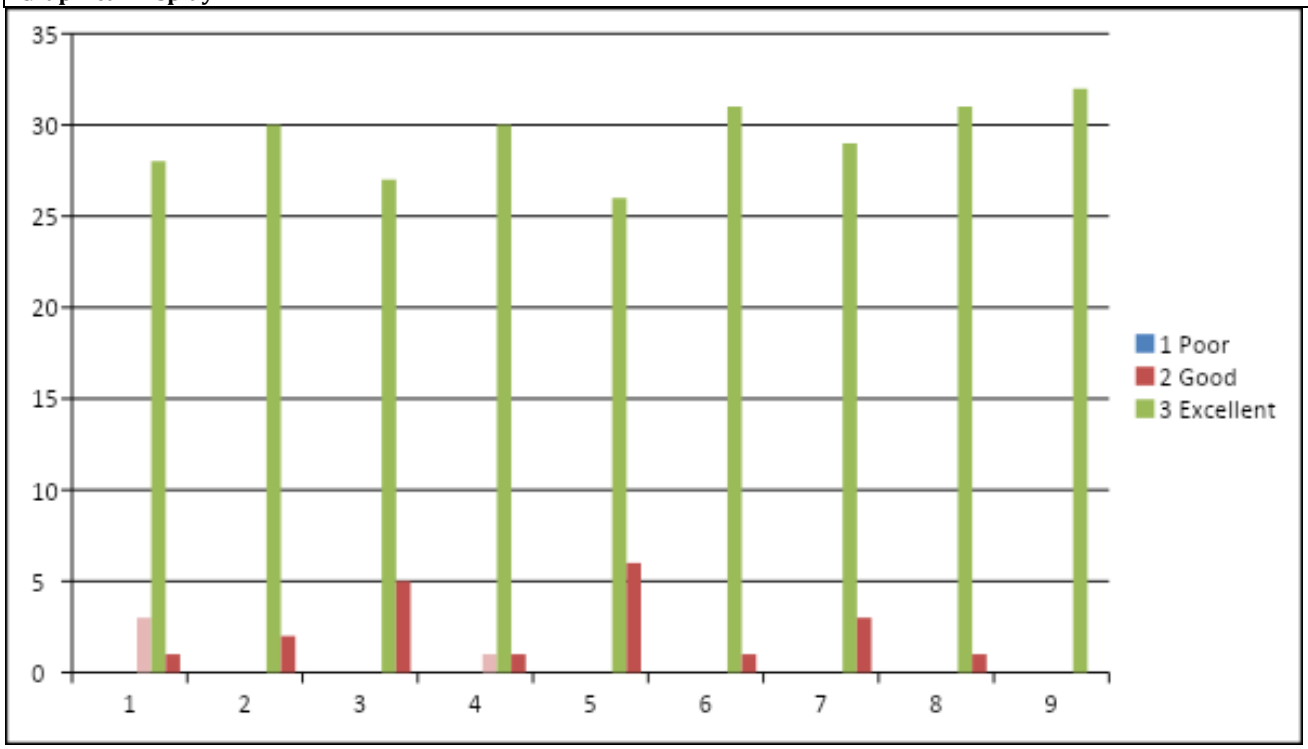
Teacher Self-Assessment (at the completion of course)

(A) Summative Feedback [MB 201/Even Semester 2021]

Faculty: Shomnath Dutta — Semester 2nd; Year 1st

Course Title: Operations Management — Course code MB 204

Total no. of survey form				32
Sl.	**Parameter**	**1 Poor**	**2 Good**	**3 Excellent**
1	The course description shared with me in the first week of the semester was adequate for me to understand what I should expect to achieve in the course	3	28	1
2	Course progressing as per the lesson plan	0	30	2
3	Presentation and completion of units are	0	27	5
4	Co-relation of the conceptual/theoretical knowledge with real world application and its explanation	1	30	1
5	My ability to apply theoretical concepts to problem solving	0	26	6
6	My Performance in Internal Exam is	0	31	1
7	Continuous evaluation of student performance is	0	29	3
8	Encouragement for self-learning	0	31	1
9	After completion of the course so far, my understanding about the importance of this course in management stream is	0	32	0
Major comments : List out the important ones				
Graphical Display				



(B) Course Survey [MB 201/Even Semester 2021]

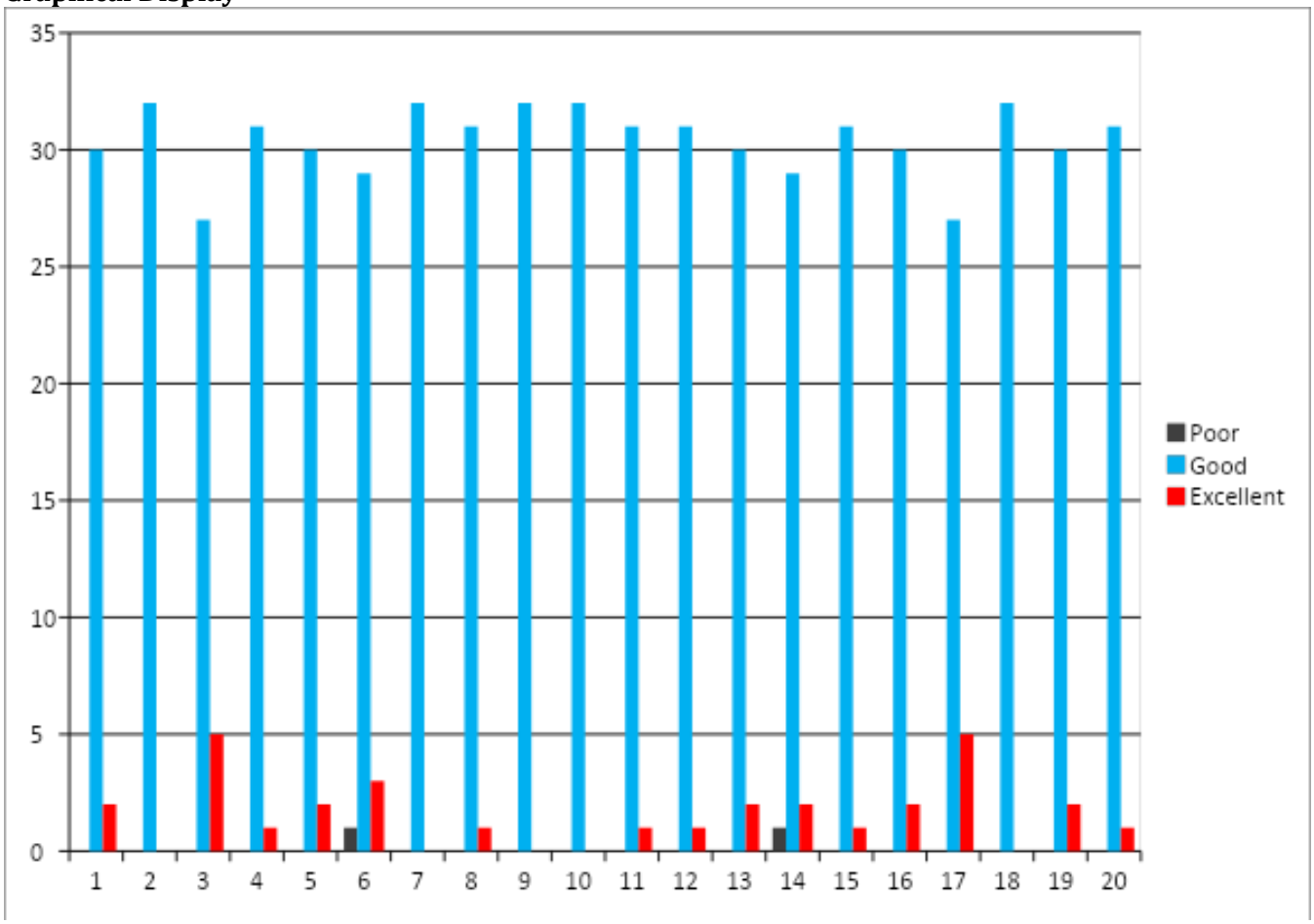
Faculty: Shomnath Dutta — Semester 2nd; Year 1st

Course Title: Operations Management — Course code MB 204

Total no. of survey form		32			
Sl.	**Parameter**		**1 Poor**	**2 Good**	**3 Excellent**
1	The course description shared with me in the first week of the semester was adequate for me to understand what I should expect to achieve in the course	1	0	30	2
2	The course schedule through the semester was	2	0	32	0
3	The entire course contents were covered during the semester	3	0	27	5

4	How was your performance in the course	4	0	31	1
5	The relevance of this course to your career goals was	5	0	30	2
6	The work load for the course was	6	1	29	3
7	At the end of the semester the coverage of the stated course objectives and course outcomes by teacher was	7	0	32	0
8	The text books for the course were	8	0	31	1
9	Coverage of course beyond syllabus	9	0	32	0
10	The relevance of laboratory experiment Sessional/Case Study to the course outcomes was:	10	0	32	0
11 CO1	Through the course, got the opportunity and confidence to: CO1	11	0	31	1
CO2	CO2		0	31	1
CO3	CO3		0	30	2
CO4	CO4		1	29	2
CO5	CO5		0	31	1
12	The relevance of assignment to the course outcomes was:	12	0	30	2
13	The relevance of quiz to the course outcomes was:	13	0	27	5
14	The relevance of questions in internal exams to the course outcomes was:	14	0	32	0
15	The course was conducted in an interactive teaching-learning environment :	15	0	30	2
16	Your overall impression of this course, independent of the teacher, was	16	0	31	1

Graphical Display



(C) Formative Feedback Assessment [MB 201/Even Semester 2021]

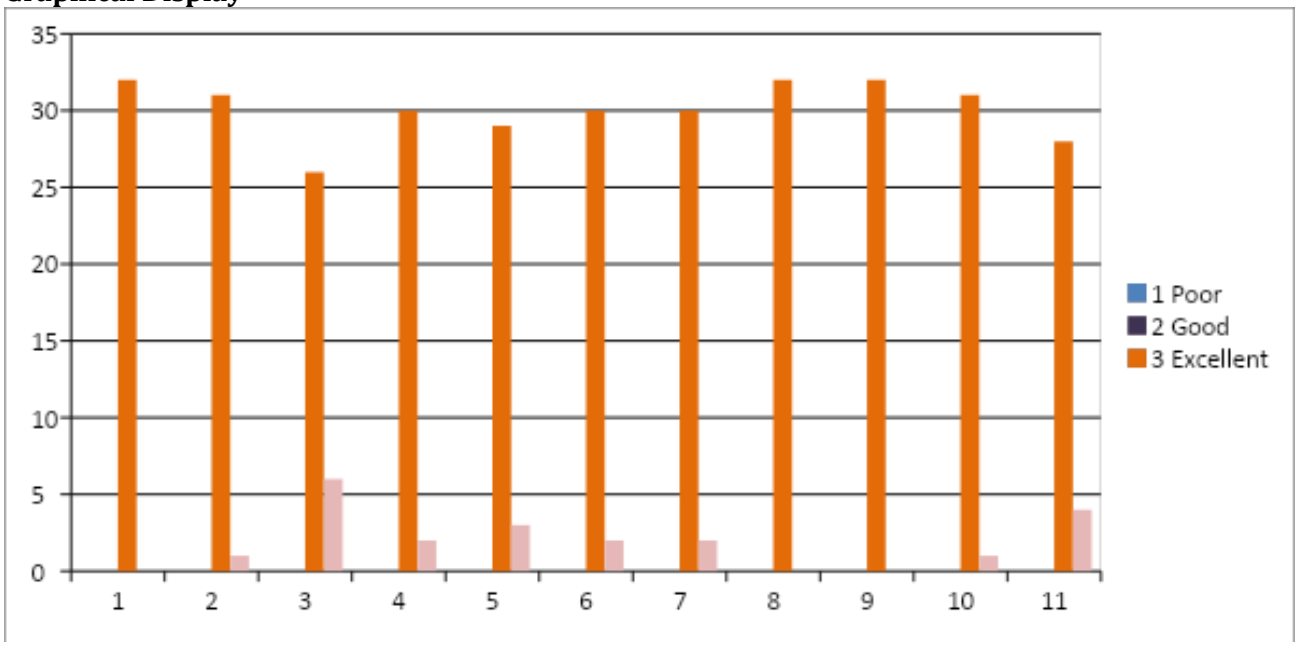
Faculty: Shomnath Dutta — Semester: 2nd; Year 1st

Course Title: Operations Management — Course code: MB 204

Total No. of Survey Form	50

Sl.		1 Poor	2 Good	3 Excellent
1	The course description shared with me in the first week of the semester was adequate for me to understand what I should expect to achieve in the course	0	32	0
2	The course schedule is	0	31	1
3	Presentation and delivery of lecture is	0	26	6
4	Class environment for learning is	0	30	2
5	The class interactions are supportive in understanding the course	0	29	3
6	Initiative to generate queries and discuss them	0	30	2
7	Course progressing as per the lesson plan	0	30	2
8	Tutorials are conducted as per the schedule	0	32	0
9	Lab/Sessional/Case Study are conducted as per the schedule	0	32	0
10	Lab/Sessional/Case Study environment for learning is	0	31	1
11	After completion of the course so far, my understanding about the importance of this course in management stream is	0	28	4
Major comments : List out the important ones				

Graphical Display



(xiv) Recommendations/Suggestions for improvement by faculty

List of Students with Roll Nos whose Academic Performance is poor			
Serial No	**Roll No**	**Name of Student**	**Remedial measures taken by Teacher**
01	11900920002	KUSHAL DAM	Extra Classes via Online Mode taken using Live Google Meet & Canvas digital board for Conceptualisation & Numerical
02	11900920022	RUPANKAR BARMAN	Extra Live Google Meet & Canvas digital board for Numerical
03	11900920023	ANKUSH AICH	Extra Live Google Meet & Canvas digital board for Numerical
04	11900920034	KIRTY DAS	Extra Classes via Online Mode taken using Live Google Meet & Canvas digital board for Conceptualisation & Numerical
05	11900920053	ASHMITA SHERPA	Extra Live Google Meet & Canvas digital board for

			Numerical

CERTIFICATE				
I, the undersigned, have completed the course allotted to me as shown below				
Sl. No.	**Semester**	**Subject with Code**	**Total Units/ Chapters**	**Remarks**
01.	MBA (N) 2nd 2021	Operations Management (MB-204)	20	
Date :				**Signature of Faculty**
Submitted to HOD				
Certificate by HOD				
I, the undersigned, certify that……..has completed the course work allotted to him/ her satisfactorily/ not satisfactorily.				
Date :				**Signature of HOD**
Submitted to Principal/Director				
Date :				**Signature of Principal/Director**

SILIGURI INSTITUTE OF TECHNOLOGY

ELECTRICAL ENGINEERING

COURSE FILE

4TH YEAR 2ND SEMESTER, 2021

PAPER DESCRIPTION : ENERGY MANAGEMENT & AUDIT

PAPER CODE : EE-801C

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION OF THE INSTITUTE :

To be a recognised institution offering high quality education, opportunities to students to become globally employable Engineers/Professionals in best ranked industries and research organisation.

MISSION OF THE INSTITUTE :

To impart quality technical education for holistic development of students who will fulfil the needs of the industry/society and be actively engaged in making a successful career in industry/research/higher education in India & abroad.

VISION OF THE DEPARTMENT:

To emerge as a leading Department of Electrical Engineering that caters to the latest needs of power sector, electrical & allied industry in the region.

MISSION OF THE DEPARTMENT:

To evolve as an innovative & globally competent Electrical Engineering department that contributes to the socio - economic growth of region by utilizing the advancement in Electrical Engineering by providing conducive learning and interactive environment to students and faculty.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Apply science, engineering, mathematics through differential and integral calculus, complex variables to solve electrical engineering problems.

PSO2: Demonstrate proficiency in use of software & hardware to be required to practice Electrical engineering profession.

PROGRAM EDUCATION OBJECTIVE (PEO):

The graduates of Electrical Engineering will:

1. Possess strong educational foundation in science, mathematics and Electrical Engineering which is essential in making successful careers in Industry/ research / higher education and will understand the professional responsibility in modern electrical power and energy related Industry through global and rigorous education.

2. Possess technical competence in the fields of Electrical engineering & allied disciplines and will be successful for the execution of engineering solutions which are technically sound and environment friendly.

3. Utilize their broad based knowledge, skills and resources to design, invent and develop novel technology and find creative and innovative solutions to engineering problems in a multidisciplinary work environment.

4. Be professional with leadership qualities, effective communication skills, ethical attitude and competence to excel individually and work efficiently in teams.

5. Possess attitude to learn and adopt new technologies as it evolves and be lifelong learners.

SILIGURI INSTITUTE OF TECHNOLOGY

Academic/activity Calendar for the year 2020 - 2021

EVEN SEMESTER

Sl. No.	Event	Time / Duration	
		Continuing batch	**New batch**
1.	Commencement of Academic Program (AICTE courses)	12.04.2021	
2.	Enrolment of students for Even Semester	20.04.2021	24.04.2021
3.	**Submission of CA I**	**28.04.2021 – 03.05.2021**	
4.	**1st Internal Test**	01.04.2021 – 07.04.2021	
5.	**Submission of CA II**	**27.05.2021 – 31.05.2021**	
6.	**Submission of PCA1**	**27.05.2021 – 31.05.2021**	
7.	**Submission of CA III**	**25.06.2021 – 30.06.2021**	
8.	**2nd Internal Test**	25.05.2021 – 31.05.2021	
9.	**Submission of CA IV**	**21.07.2021 – 24.07.2021**	
10.	**Submission of PCA2**	**21.07.2021 – 24.07.2021**	
11.	Pre-examination activities / form fill-up	29.06.2021	
12.	Student's course survey	21.07.2021 – 24.07.2021	
13.	**Practical Examinations, Sessionals, Viva-voce**	05.08.2021 – 08.08.2021	
14.	**Theory Examinations**	13.07.2021 – 20.07.2021 (Final Year) **09.08.2021 – 21.08.2021 (Others)**	

Note : The academic Calendar is subject to modification as per the advice from the University and on the advisories of the other statutory bodies in the Covid-19 pandemic situation.

Course File

Course Title : ENERGY MANAGEMENT & AUDIT

Code : EE-801C

Semester 2ND Year 4th

Name of the Faculty: Prof. Jayanta Bhusan Basu

Internet Homepage: https://sites.google.com/site/apjbbasu/

E-mail : jbb.sit@gmail.com

Class Schedule

Lecture		
Monday **10.00 – 10.50 am**	**Wednesday** **10.00 – 10.50 am**	**Friday** **12.30 – 13.20 pm**

Hours for meeting students:

Monday	14.10 -15.00 pm
Tuesday	14.10 -15.00 pm
Friday	14.10 -15.00 pm
Or by appointment	

i) Course Objective

Students will acquire basic knowledge about current energy scenario, energy management, auditing and conservation.

ii) Course Outcomes

i. After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will be able to:

		Target
C801C.1	Demonstrate knowledge about Energy management and energy auditing approaches **(BT 2)**	Students will attain 70% marks
C801C.2	Explain Energy Scenario. **(BT 2)**	Students will attain 70% marks
C801C.3	Understand the importance of energy conservation and related policies **(BT 2)**	Students will attain 70% marks
C801C.4	Explain reasons for climate change and related protocols & adaptations for sustainable development. **(BT 2)**	Students will attain 70% marks
C801C.5	Discuss about different energy efficient technologies in electrical systems. **(BT 3)**	Students will attain 70% marks

ii. Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

Sl.	Question
1.	List down the objective of energy management.
2.	State the importance of energy policy for industries.
3.	Write the benefits of benchmarking energy consumption
4.	Explain briefly the difference between preliminary and detailed energy audits
5.	Define the following terms with three examples for each - a) Primary and Secondary Energy. b) Commercial and Non-commercial Energy
6.	Describe how is economic growth linked to energy consumption?
7.	Explain CDM and its objectives.
8.	Discuss the main role of UNFCCC?
9.	Discuss the benefits of standard & Labeling (S & L)
10.	Compute the generation cost per Kwh from the following data. Installed capacity – 200 MW Capital cost – Rs. 3000.00 per Kw Interest & depreciation – 12%

Sl.	Question
	Fuel consumption – 0.9 Kg/Kw Fuel cost – Rs. 70.00 per Tonnes Misc. cost – 20% of Fuel cost Load Factor – 80% Peak load – 170 MW
11.	Explain the terms cell, module and array as applicable to photovoltaic.
12.	Discuss the criteria for selection of wind mill installation?
13.	What are the advantages of energy efficient motors?
14.	Explain the working of a soft starter and its advantage over other conventional starters.

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours
Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments and intervals of EA regulation.	6
Energy Scenario: Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Concept of smart grid, Tariff.	6
Energy Conservation Act-2001 and related policies: Energy Conservation Act-2001 and its features, Notification Under the act, Designated agencies, Schemes of Bureau of Energy Efficiency(BEE)-ECBC, S & L, DSM, BLY, SME's, Designated Consumers, Electricity Act 2003, Integrated Energy Policy,	6
Energy Efficiency and Climate changes: Energy and environment, Air pollution, Climate change, United Nations Framework Convention on climate change (UNFCCC), Kyoto Protocol, Clean Development Mechanism (CDM), CDM methodology and Procedures, Sustainable development	6
Non-Conventional Energy Sources: Concept of renewable Energy and importance, Different types of renewable Energy, Solar energy, Wind energy, Biomass energy, Hydro-energy, Fuel cells, Energy from wastes, Wave, Tidal and geothermal. Concept of energy storing device.	6
Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology	6

iv) Text books

1. Energy Management Supply and Conservation, Dr. Clive Beggs, Butterworth Heinemann, 2002 .
2. Handbook of Energy Engineering, Albert Thumann & Paul Mehta, The Fairmont Press, INC.
3. Plant Engineers & Manager Guide to Energy Conservation, Albert.
4. Energy Management Handbook, Wayne C, John Willey and Sons

Reference books :

1. NPC energy audit manual and reports

2. Guide to Energy Management, Cape Hart, Turner and Kennedy

3. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council

4. www.bee.org

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

* The Internal Marks will be determined through the continuous evaluation (CA) which is needed to be submitted 4 times in a semester based on performance of the students assessed as per the schedule published in the academic calendar published by the University. The 4 nos of CAs are based on test/ viva/ quiz/ presentation/seminar/ GD etc out of which 2 nos preferably would be tests. **(MAKAUT notification Ref No. COE/MAKAUT/FACULTY/1/2019-20 Date: 13/09/2019).**

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2
Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Course Target for the university examination = 75% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(vi) Mapping of Course Outcomes and Program Outcomes:

Course Outcomes	Program Outcomes												PSOs	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	1.	2.
EE801C.1	-	2	-	-	-	-	2	-	-	-	1	1	2	-
EE801C.2	2	-	-	-	-	-	2	-	-	-	1	1	2	-
EE801C.3	2	2	-	-	-	3	3	-	-	-	1	1	2	-
EE801C.4	2	2	-	-	-	3	3	-	-	-	-	1	1	-
EE801C.5	2	2	-	-	-	2	3	-	-	-	-	1	3	-
EE801C	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**2**	**-**

1 = courses in which the student will be exposed to a topic
2 = courses in which students will gain competency in that area
3 = courses in which students will master that skill

- CO1 requires finding engineering solution by the understanding of societal impact in present scenario and basic knowhow of financial conditions to provide long term solutions for energy problems. Hence it is partially linked with PO2, PO7 & PSO1 and minimally linked with PO11 & PO12.
- CO2 requires application of engineering knowledge & understanding of environmental contexts and also requires knowledge of engineering to provide long lasting solutions of energy problem. Hence it is partially linked with PO1, PO7 & PSO1 and minimally linked with PO11 & PO12.
- CO3 requires knowledge about application of engineering knowledge & understanding of environmental contexts and providing economical engineering solutions for intelligent consumption of energy which is sustainable in long term. Hence it is highly linked with PO6 & PO7, partially linked with PO1, PO2 & PSO1 and minimally linked with PO11 & PO12.
- CO4 requires knowledge about understanding of engineering knowledge & understanding of environmental conditions to assess societal application and providing sustainable engineering solutions in long term. Hence it is highly linked with PO6 & PO7, partially linked with PO1, PO2 and minimally linked with PO12 & PSO1.
- CO5 deals with different energy efficient technologies in electrical systems which requires good engineering knowledge so that environment friendly sustainable solutions can be found for energy related problems. Hence it is highly linked with PO7 & PSO1, partially linked with PO1, PO2 & PO6 and minimally linked with PO12.

(vii) Assessment Methodology

Outcome	Assessment Tool
EE801C.1	Internal Test, Quiz, Assignment, University Exam
EE801C.2	Internal Test, Quiz, Assignment, University Exam
EE801C.3	Internal Test, Quiz, Assignment, University Exam
EE801C.4	Internal Test, Quiz, Assignment, University Exam
EE801C.5	Internal Test, Quiz, Assignment, University Exam

(viii) A. Weekly Lesson Plan

Week	Lectures
1	**Discussion of Course outcome and program outcome.** **Energy Management & Audit:** • Definition • Energy audit- need • Types of energy audit • Energy management (audit) approach-understanding energy costs • Bench marking • Energy performance
2	**Energy Management & Audit:** • Matching energy use to requirement • Maximizing system efficiencies • Optimizing the input energy requirements • Fuel and energy substitution • Energy audit instruments and intervals of EA regulation.
3	**Energy Scenario:** • Commercial and Non-Commercial Energy • Primary Energy Resources • Commercial Energy Production • Final Energy Consumption • Energy Needs of Growing Economy • Long Term Energy Scenario
4	**Energy Scenario:** • Energy Pricing • Energy Sector Reforms • Concept of smart grid • Tariff

Week	Lectures

5	**Energy Conservation Act-2001 and related policies:**
	
	• Energy Conservation Act-2001 and its features
	• Notification Under the act
	• Designated agencies
	• Schemes of Bureau of Energy Efficiency(BEE)
	  ○ ECBC
	  ○ S & L

6	**Energy Conservation Act-2001 and related policies:**
	
	• Schemes of Bureau of Energy Efficiency(BEE)
	  ○ ECBC
	  ○ DSM
	  ○ BLY
	  ○ SME's
	  ○ Designated Consumers
	• Electricity Act 2003
	• Integrated Energy Policy

7	**Energy Efficiency and Climate changes:** • Energy and environment • Air pollution • Climate change • United Nations Framework Convention on climate change (UNFCCC)
8	**Energy Efficiency and Climate changes:** • Kyoto Protocol • Clean Development Mechanism (CDM) • CDM methodology and Procedures • Sustainable development
9	**Non-Conventional Energy Sources:** • Concept of renewable Energy and importance • Different types of renewable Energy • Solar energy • Wind energy • Biomass energy
10	**Non-Conventional Energy Sources:** • Hydro-energy • Fuel cells • Energy from wastes • Wave energy • Tidal energy • Geothermal energy • Concept of energy storing device
11	**Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers

Week	Lectures
	Automatic power factor controllers Energy efficient motors Soft starters with energy saver
12	**Energy Efficient Technologies in Electrical Systems:** Variable speed drives Energy efficient transformers Electronic ballast Occupancy sensors Energy efficient lighting controls Energy saving potential of each technology

(VIII) B. COMBINED DAILY LESSON PLAN & EXECUTION REPORT

NAME OF FACULTY : Mr. J. B. Basu	**DEPARTMENT :EE**	**SUBJECT:** ENERGY MANAGEMENT & AUDIT **CODE :** EE-801C	**SEMESTER : 8th**

Unit / Module	Topic Description (to be quoted from syllabus)	No. of Lecture(s)	Plan Date(s)	Execution Date(s)	**Online class materials**	**Details of home work/assignment/min i project/ ICT used/ partial delivery of courses by industry experts, Eminent speakers etc.)**	Details of topics that are beyond syllabus (if any)
Introduction	Discussion of Course outcome and program outcome. Overview of the course.	I	12.04.2021	12.04.2021	https://www.youtube.com/watch?v=U8RlQSJry7s	https://forms.gle/ZEgDaVdy8viqPe5AA	
Energy Management & Audit:	Definition, Energy audit-need, Types of energy audit	I	16.04.2021	16.04.2021	https://drive.google.com/open?id=1u0PhgisWf5-x79JOKWT917A9ntIlo-QB&authuser=1	https://forms.gle/FQEocBMGeZZsJXjj8	
	Energy management (audit) approach-understanding energy costs, Bench marking	II	21.04.2021	21.04.2021	https://drive.google.com/open?id=1bHzT_K0Hy6PlgZickKqZIqymDxqwYOkz&authuser=1	https://forms.gle/oCBn51DA7f1hm61v5	
	Energy performance, Matching energy use to requirement	III	23.04.2021	23.04.2021	https://drive.google.com/open?id=1bHzT_K0Hy6PlgZickKqZIqymDxqwYOkz&authuser=1	https://forms.gle/oCBn51DA7f1hm61v5	
	Maximizing system efficiencies, Optimizing the input energy requirements	IV	23.04.2021	23.04.2021			
	Fuel and energy substitution	V	26.04.2021	26.04.2021	https://drive.google.com/open?id=1B8902mUIGqznoWYJhEPjzLAfX-Fz-sRR&authuser=1	https://forms.gle/ZKxMfbfWEBYGSJFw9	
	Energy audit instruments and intervals of EA regulation	VI	26.04.2021	26.04.2021			
Energy Scenario	Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production,	I	28.04.2021	28.04.2021	https://drive.google.com/open?id=1gXB4qCRBBFbc01ULlV1GHC9RwjwrCTXK&authuser=1	https://forms.gle/gfEMLMS8Jm65yVa17	
	Final Energy Consumption, Energy Needs of	II	28.04.2021	28.04.2021			

	Growing Economy						
	Long Term Energy Scenario	III	30.04.2021	30.04.2021	https://drive.google.com/open?id=1C3kl9Cmr7m1iINFnDPY194KGQkYXHXB1&authuser=1	https://forms.gle/porKXBJjre6WxHap9	
	Energy Pricing, Energy Sector Reforms	IV	30.04.2021	30.04.2021			
	Concept of smart grid	V	30.04.2021	30.04.2021			
	Tariff	VI	03.05.2021	03.05.2021	https://drive.google.com/open?id=1c17m1JA_zYwNI1lmsS7bGssELp1X1RwN&authuser=1	https://forms.gle/arS3irUa3kWyCWqg7	
Energy Conservation Act-2001 and related policies:	Energy Conservation Act-2001 and its features,	I	05.05.2021	05.05.2021	https://drive.google.com/open?id=1fXD8em9ak-x6CbHO24tlHJPY3S16tlHZ&authuser=1	https://forms.gle/KLeXNfkPcTXCidzHA	
	Notification Under the act, Designated agencies	II	05.05.2021	05.05.2021			
	Schemes of Bureau of Energy Efficiency(BEE)-ECBC, S & L, DSM, BLY, SME's,	III	07.05.2021	07.05.2021	https://drive.google.com/open?id=1XXT_MPpIQPoLaK7iOnw4Moz-iXvig5oI&authuser=1	https://forms.gle/mDSR7AfabjocrVFk9	
	Designated Consumers	IV	07.05.2021	07.05.2021			
	Electricity Act 2003	V	10.05.2021	10.05.2021	https://drive.google.com/open?id=1y6t1weN2K-Hf5SOJqSSnU1dYW0o3kPKh&authuser=1	https://forms.gle/MuGMFMtts4EFuHP99	
	Integrated Energy Policy	VI	10.05.2021	10.05.2021			
Energy Efficiency and Climate changes	Energy and environment,	I	12.05.2021	12.05.2021	https://drive.google.com/open?id=1iZLD0zih9P7xFx8pY49qHgXFm-QS22xF&authuser=1	https://forms.gle/X6ezTQ3J3HYzWobv5	
	Air pollution	II	12.05.2021	12.05.2021			
	Climate change, United Nations Framework Convention on climate change (UNFCCC)	III	12.05.2021	12.05.2021			
	Kyoto Protocol	IV	14.05.2021	14.05.2021	https://drive.google.com/open?id=1b9YUXNSOrzp91y8Tf8fzNTGPT5Yj8HhQ&authuser=1	https://forms.gle/34rsnmmgtaHmmgio8	
	Clean Development Mechanism (CDM)	V	14.05.2021	14.05.2021			
	CDM methodology and Procedures, Sustainable development	VI	14.05.2021	14.05.2021			
Non-Conventional Energy Sources:	Concept of renewable Energy and importance, Different types of renewable Energy, Solar energy, Wind energy	I	17.05.2021	17.05.2021	https://drive.google.com/file/d/1urhGLYIUM73atLewf7vcqK3V3hg-2q1p/view?usp=drive_web&authuser=1	https://forms.gle/AnDM8Ef3BxLHfgEh7	
	Biomass energy, Hydro-energy	II	19.05.2021	19.05.2021	https://drive.google.com/file/d/1eOCh_OFK4pz6irFkYUtGwoIC9QUIFEBY/view?usp=drive_web&authuser=1	https://forms.gle/BFdEK5DSzts5AJPLA	
	Wave, Tidal and geothermal	V	21.05.2021	21.05.2021	https://drive.google.com/file/d/1Mi-bEtgnFdFdf4eLART5i9cX-0SJqNXm/view?usp=drive_web&authuser=2	https://forms.gle/cRhsdWVQWFg9Te3v6	
	Fuel cells	III	28.05.2021	28.05.2021	https://drive.google.com/file/d/1kBH4woku8dl1LXksZDlf0jcuRNtWyGB8/view?usp=drive_web&authuser=2	https://forms.gle/M1YJjS4cDJRGb2Tu6	
	Energy from wastes	IV	31.05.2021	31.05.2021	https://drive.google.com/file/d/1d0Qft61xMDT15xgFseUAJyFc7zEv4CWq/view?usp=drive_web&authuser=4	https://forms.gle/vpxStCiZ9r9STu2n7	

	Concept of energy storing device	VI	02.06.2021	02.06.2021	https://drive.google.com/file/d/1TQXSWvIUiTttgeSOU75znUXIgHRHH5wD/view?usp=drive_web&authuser=4	https://forms.gle/kExfAr7kEpS5WY956	
Energy Efficient Technologies in Electrical Systems:	Maximum demand controllers, Automatic power factor controllers,	I	09.06.2021	09.06.2021	https://drive.google.com/file/d/1FGiFep5iPW4znvzLKwL0uUOqJa5TrhO5/view?usp=drive_web&authuser=4	https://forms.gle/TMhtVr6c1ZPzR2PH7	
	Energy efficient motors,	II					
	Soft starters with energy saver	III	11.06.2021	11.06.2021	https://drive.google.com/file/d/1Mg3Oxdbll_y6zab6-sQKgiPpM4W8Dmd2/view?usp=drive_web&authuser=4	https://forms.gle/LrhaGrNKDT9qg1w48	
	Variable speed drives, Energy efficient transformers,	IV					
	Electronic ballast, Occupancy sensors	V	14.06.2021	14.06.2021	https://drive.google.com/file/d/1rt04OqDWuxGyNKEwuyitgyM_ji8xX7zk/view?usp=drive_web&authuser=4	https://forms.gle/KWJrbUqYSWVEkoWq6	
	Energy efficient lighting controls, Energy saving potential of each technology	VI					
	Recapitulation of the course & discussions on the previous year's University question papers	**1**	15.06.2021	15.06.2021			

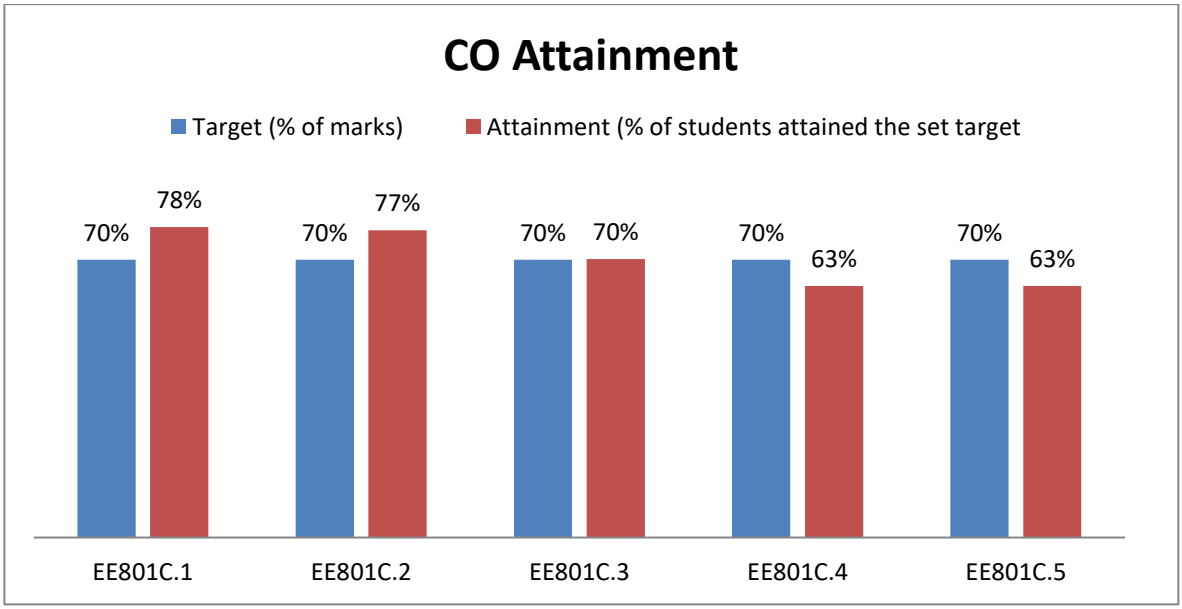
Record of Assessment

QUIZ 1	27.04.2021	https://forms.gle/MohfAxk9qDKnkyGT7
QUIZ 2	16.06.2021	https://forms.gle/n1QsdwnzzbqEj1SV9
1st INTERNAL ASSESSMENT	25.05.2021	https://forms.gle/R2MVmmhE7Nqnqmbq5
2ND INTERNAL ASSESSMENT	23.06.2021	https://forms.gle/AbDPYtKBoqg3Nttj7

(ix) Teaching Strategy/Method

The classes were conducted in online mode. During online mode various online resources were shared with the students also doubt clearing classes were conducted using online platform Google Meet.
The materials were shared using Google Classroom

(xi) Analysis of Students performance in the course



- 78% students have attained the set target of 70% marks for EE801C.1
- 77% students have attained the set target of 70% marks for EE801C.2
- 70% students have attained the set target of 70% marks for EE801C.3
- 63% students have attained the set target of 70% marks for EE801C.4
- 63% students have attained the set target of 70% marks for EE801C.5

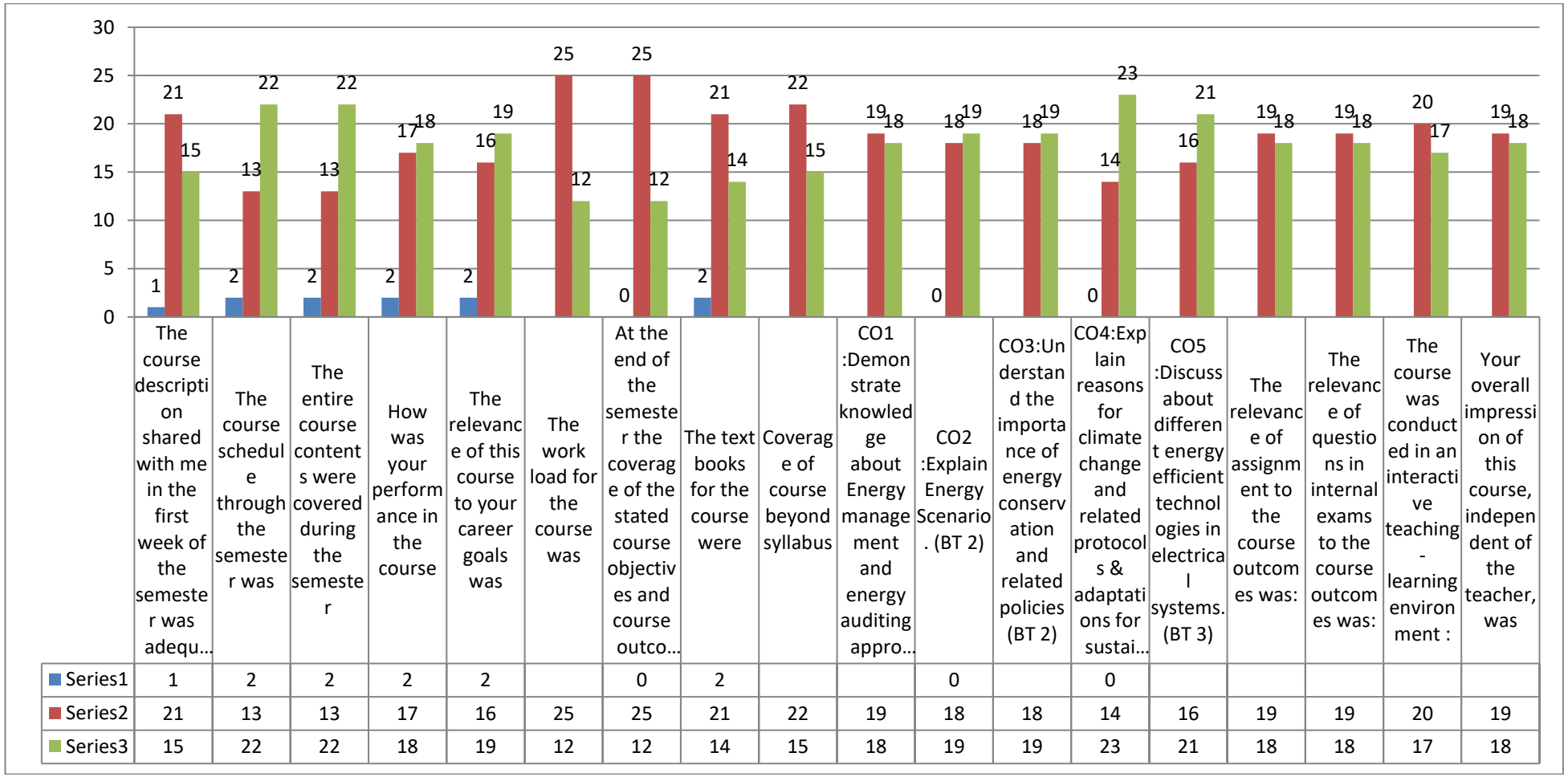
(xii) Analysis of Students performance in the course (university results)

	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME
University	8	72	66	89%

- 89% students have attained the set target of 8 in point for University Exams

(xiii) Analysis of Student Feed Back

Total number of feedback forms received from students = 37



	The course description shared with me in the first week of the semester was adequ...	The course schedule through the semester was	The entire course contents were covered during the semester	How was your performance in the course	The relevance of this course to your career goals was	The work load for the course was	At the end of the semester the coverage of the stated course objectives and course outco...	The text books for the course were	Coverage of course beyond syllabus	CO1 :Demonstrate knowledge about Energy management and energy auditing appro...	CO2 :Explain Energy Scenario. (BT 2)	CO3:Understand the importance of energy conservation and related policies (BT 2)	CO4:Explain reasons for climate change and related protocols & adaptations for sustai...	CO5 :Discuss about different energy efficient technologies in electrical systems. (BT 3)	The relevance of assignment to the course outcomes was:	The relevance of questions in internal exams to the course outcomes was:	The course was conducted in an interactive teaching - learning environment :	Your overall impression of this course, independent of the teacher, was
Series1	1	2	2	2	2		0	2			0		0					
Series2	21	13	13	17	16	25	25	21	22	19	18	18	14	16	19	19	20	19
Series3	15	22	22	18	19	12	12	14	15	18	19	19	23	21	18	18	17	18

(xiv) Teacher Self-Assessment (at the completion of course)

The course started in a face-to-face mode but later on was completed by online mode due to the pandemic. As teaching through online mode was not a regular affair hence initially we faced some difficulties but as time progressed the conduction of classes became easier. However due to poor network connectivity many students faced difficulties to attend the online classes. To complete the course properly many revision classes were conducted for all the modules.

(xiv) Recommendations/Suggestions for improvement by faculty

As the situation suggest that in the new normal we may have to adopt hybrid classes hence proper planning and usage of ICT is required for conducting online classes. Uses of open source MOODLE platform may be very helpful to organise the lectures, sharing contents & assessment using online platform.

INTERNAL ASSESMENT RECORD

Course Name: Energy Management & Audit
Course Code: EE-801C
Semester : 8th
Discipline: Electrical Engineering

Sl.	Roll No.	Name	Attendance (%)	Internal Examination		Quiz/Assignment/Term Paper		
				1st	2nd	Quiz1	Quiz2	Term Paper
1	11901617017	Tanushree	72	9	18	9	0	6
2	11901617018	Tanmoy Ghosh	84	20	19	7	7	9
3	11901617019	Swaraj Paul	44	27	19		7	9
4	11901617020	Susanta Saha	80	27	21		7	8
5	11901617021	Suraj Kumar Maharaj	64	27	21	6	7	9
6	11901617022	Surabhi Ghosh	76	23	23	9	7	5
7	11901617023	Sunanda Sinha	84	28	19	8	7	5
8	11901617024	Subir Ghosh	100	27	21	9	7	9
9	11901617025	Subham Pal	92	23	11	10	5	9
10	11901617026	Subhajit Acharjee	84	28	21	8	9	8
11	11901617027	Soyeb Parvez	44	27	19	8	7	9
12	11901617028	Sourav Singha	68	28	23	8	7	5
13	11901617029	Soumyadeep Pandit	68	22	11	8	5	8
14	11901617030	Soumya Dey	36	0	0			9
15	11901617031	Sohel Anjum	72	27	21	9	7	0
16	11901617032	Snehal Shubham	48	23	19		7	0
17	11901617033	Sneha Paul	72	27	19	9	7	5
18	11901617034	Simantika Saha	60	23	21	10	9	10
19	11901617035	Shreeya Sen	72	23	23	9	7	9
20	11901617036	Shibam Das	76	22	23	8	7	8
21	11901617037	Sayoni Saha	84	29	23	9	7	9
22	11901617038	Sandip Mana	84	22	22	8	6	5
23	11901617039	Rounak Chatterjee	84	23	23	9		0
24	11901617040	Ravi Ranjan	72	27	19		7	6
25	11901617041	Rakesh Debnath	68	27	22	9	8	7
26	11901617042	Raihan Azom Roushan	72	24	17	9	5	9
27	11901617043	Rahul Raj Mandal	60	10	20	1	6	9
28	11901617044	Rahul Kumar	68	27	20	7	7	8
29	11901617045	Rahul Dutta	60	27	21	8	7	9
30	11901617046	Prasanjit Sarkar	64	21	11	9	5	5
31	11901617047	Piya Mohanta	68	25	23	6	9	8

32	11901617048	Paulami Ghosh	92	23	19	10	7	9
33	11901617049	Moni Pushpak Majumdar	92	22	15		5	5
34	11901617050	Mayukh Nandi	80	26	0			6
35	11901617051	Madhu Agarwal	80	23	25	9	9	9
36	11901617052	Kushal Dey	52	23	19	8	7	5
37	11901617054	Jyotirmay Das	52	27	19	8	7	10
38	11901617055	Jabed Akhtar	96	28	22	9	8	8
39	11901617056	Indibar Saha	52	27	21	5	7	8
40	11901617057	Dipsona Banik	72	22	19	7	7	8
41	11901617058	Dipanjan Bishnu	48	28	22	9	6	5
42	11901617059	Dibyojyoti Sarkar	88	26	24	10	8	5
43	11901617060	Debopriya Sarkar	68	26	22	7	8	9
44	11901617061	Debojit Biswas	72	23	25	10	9	9
45	11901617062	Biswajit Kumar Laskar	84	27	20	10	8	9
46	11901617063	Bishal Kumar Mandal	84	27	23	10	7	8
47	11901617064	Avroroop Pal	76	22	19	10	7	8
48	11901617065	Ashish Ranjan	84	24	21	7	7	6
49	11901617066	Ashish Mandal	68	24	22	9	8	9
50	11901617067	Arunima Ray	52	26	19		7	5
51	11901617068	Arnab Seal	68	27	21	10	7	8
52	11901617069	Arghya Deep Saha	68	21	23	9	7	5
53	11901617070	Anurag Mishra	52	0	0			5
54	11901617071	Anubhab Chattopadhyay	72	23	21	10	7	10
55	11901617072	Anjali Kumari Barai	84	26	22	8	8	8
56	11901617074	Akash Roy	88	27	19	9	7	7
57	11901617075	Akash Mishra	96	25	22	10	8	9
58	11901617076	Abijeet Rai	92	27	19	9	7	9
59	11901617077	Abhishek Kundu	68	28	21	10	7	9
60	11901617078	Abhirup Roy	72	27	20	9	8	10
61	11901617079	Abhirup Haldar	72	27	0	8		5
62	11901617080	Abhiranjan Sharma	52	22	16	8	8	5
63	11901618001	Tamaghna Chatterjee	80	28	22	8	6	7
64	11901618002	Noushad Hossain	72	29	23	10	7	9
65	11901618003	Nilabha Majumdar	88	15	20	7	6	8
66	11901618004	Kanstav Kumar Prasad	80	0	0			9
67	11901618005	Doma Yankey Dukpa	88	28	19	9	7	8
68	11901618006	Dibyajyoti Sarkar	92	25	17		5	7
69	11901618007	Avik Majumder	84	27	23	10	7	6
70	11901618008	Arijit Chandro Paul	64	28	21	9	7	6
71	11901618009	Ankit Sarkar	64	25	19	7	7	8
72	11901618010	Amit Bhowmik	44	27	19	8	7	5

NAME WITH ROLL NO.s OF STUDENT WHOSE ACADEMIC PERFOMANCE IS NOT SATISFACTORY			
Gr.	**Roll No.**	**Name of Student**	**Remedial measures taken by teacher**
All	11901618004 11901617070	Kanstav Kumar Prasad Anurag Mishra	• Additional doubt clearing sessions beyond the class hours • Providing extra assignments to students. • Asking them to solve previous question papers. • Highlighting important and frequently asked questions

CERTIFICATE

I, the undersigned, have completed the course allotted to me as shown below

Sl. No.	Semester	Subject with Code	Total Units/ Chapters	Remarks

Date :	**Signature of Faculty**

Submitted to HOD

Certificate by HOD

I, the undersigned, certify that……..has completed the course work allotted to him / her satisfactorily / not satisfactorily.

Date :	**Signature of HOD**

Submitted to Principal/Director

Date :	**Signature of Principal/Director**

Student Feedback on Course Objectives & Outcomes

Faculty Prof. Jayanta Bhusan Basu **Semester** 2nd **Year** 4th
Course code EE-801C **Course Title** Energy Management & Audit

Dear Students

This feedback that I intend to take from you is very precisely about fulfillment of course objectives and course outcomes. My course objectives and course outcomes are as follows that I had shared with you in the beginning of the semester, the same is repeated here.

Course Objectives
Students will acquire basic knowledge about current energy scenario, energy management, auditing and conservation.
Course Outcomes
The students will be able to:

EE801C.1 - Demonstrate knowledge about Energy management and energy auditing approaches (BT 2)
EE801C.2 - Explain Energy Scenario. (BT 2)
EE801C.3 - Understand the importance of energy conservation and related policies (BT 2)
EE801C.4 - Explain reasons for climate change and related protocols & adaptations for sustainable development. (BT 2)
EE801C.5 - Discuss about different energy efficient technologies in electrical systems. (BT 3)

The survey questions below has been designed to obtain your feedback so as to determine the extent of attainment of the intended course objectives and course outcomes.

1 = Poor 2= Good 3= Excellent

1.	Parameter	1	2	3
2.	The course description shared with me in the first week of the semester was adequate for me to understand what I should expect to achieve in the course			
3.	The course schedule through the semester was			
4.	The entire course contents were covered during the semester			
5.	How was your performance in the course			
6.	The relevance of this course to your career goals was			
7.	The work load for the course was			
8.	At the end of the semester the coverage of the stated course objectives and course outcomes by teacher was			
9.	The text books for the course were			
10.	Coverage of course beyond syllabus			
11.	The relevance of laboratory experiment to the course outcomes was:			
12.	Through the course, got the opportunity and confidence to:			
	• **Demonstrate knowledge about Energy management and energy auditing approaches (BT 2)**			
	• **Explain Energy Scenario. (BT 2)**			
	• **Understand the importance of energy conservation and related policies (BT 2)**			
	• **Explain reasons for climate change and related protocols & adaptations for sustainable development. (BT 2)**			
	• **Discuss about different energy efficient technologies in electrical systems. (BT 3)**			
13.	The relevance of assignment to the course outcomes was:			
14.	The relevance of quiz to the course outcomes was:			
15.	The relevance of questions in internal exams to the course outcomes was:			
16.	The course was conducted in an interactive teaching-learning environment :			
17.	Your overall impression of this course, independent of the teacher, was			

Thank You

THANK YOU FOR YOUR FEEDBACK

QUIZ - 1 (EE 801C - ENERGY MANAGEMENT AND AUDIT)

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"The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions" is the definition of (EE801C.1)
Energy conservation
Energy policy
Energy Audit
Energy Management

The objective of energy management includes (EE801C.1)
Minimizing energy costs
Minimizing waste
Minimizing environmental degradation
All the above

Energy audit is a tool to implement Energy management program (EE801C.1)
True
False

When an energy audit is conducted to bring about energy savings in lighting system the type of energy audit is called (EE801C.1)
Preliminary Energy Audit
Targeted Energy Audit
Detailed Energy Audit

An energy policy does not include (EE801C.1)
Target energy consumption reduction
Time period for reduction
Declaration of top management commitment
Future production projection

Walk through Audit is conducted in (EE801C.1)
The Pre-audit Phase
The Audit Phase
The Post-Audit Phase

The tool used for performance assessment and logical evaluation of avenues for improvement in Energy management and audit is (EE801C.1)
Fuel substitution
Monitoring and verification
Energy pricing
Bench marking

Replacement of steam based hot water generation by solar system is an example of (EE801C.1)
matching energy usage to the requirement
maximising system efficiency
Energy substitution
Performance improvement

One unit of electricity is equivalent to ___ kcal heat units. (EE801C.1)
800
860
400
680

Infrared thermometer is used to measure (EE801C.1)
Flame temperature
Flue gas temperature
Surface temperature
Hot water temperature

QUIZ - 2 (EE 801C - ENERGY MANAGEMENT AND AUDIT)

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The energy sources, that are either found or stored in nature are: (EE801C.2) 1 point
Secondary Energy Sources
Primary Energy Sources
Both Primary & Secondary sources

Indian per capita energy consumption is ____ of the world average. (EE801C.2) 1 point
1
4
10
20

AMI means (EE801C.2) 1 point
Automated Metering Instrument
Alternate Metering Instrument
Advanced Metering Instrument
Advanced Metering Infrastructure

Bureau of Energy Efficiency (BEE) has been established in the Year (EE801C.3) 1 point
2001
2002
2003
2004

“A public expression of organisation's commitment to energy conservation and environmental protection” is called as (EE801C.3) 1 point
Company policy
Management philosophy
Energy policy
Corporate plan

Which one of the following is a positive force towards achieving goal of reduced energy consumption? (EE801C.3) 1 point
tax on energy consumption
competing corporate priorities
Insufficient financial resources to fund
Absence of corporate energy policy

Kyoto protocol addresses the issues of (EE801C.4) 1 point
Biodiversity Conservation
Ground water pollution
Climate change
Soil Pollution

For sustainable development in developing countries, Kyoto protocol defines the Clean Development Mechanism, CDM (EE801C.4) 1 point
true
false

The core used in Energy Efficient Transformer is made of (EE801C.5) 1 point
silicon alloyed iron
metallic glass alloy
Ferrite core
Air core

Typical loss in conventional magnetic chokes for a 40 W FTL is of the order of (EE801C.5) 1 point
8 Watts
14 Watts
20 Watts
6 Watts

Siliguri Institute of Technology
Department of Electrical Engineering
B. Tech. 4th Year 8th Semester 1st Internal Examination, 2021
Paper Name & Code: Energy Management & Audit (EE-801C)
Time Allotted: 1 Hour Full Marks: 30

Section – 1
EACH QUESTION CARRIES 1 MARK

"The judicious and effective use of energy to maximise profits and enhance competitive positions". This can be the definition of: (CO1)
Energy conservation
Energy management
Energy policy
Energy Audit

To determine ways to reduce energy consumption per unit of product output or to lower operating cost is a primary objective of (CO1)
Energy Audit
Energy Management

The objective of energy management includes (CO1)
Minimizing energy costs
Minimizing waste
Minimizing environmental degradation
All the above

The support for energy management is expressed in a formal written declaration of commitment. This is called (CO1)
Company policy
Management policy
Energy policy
Energy efficiency policy

When an energy audit is conducted to bring about energy savings in lighting system the type of energy audit is called (CO1)
Preliminary Energy Audit
Targeted Energy Audit
Detailed Energy Audit

The tool used for performance assessment and logical evaluation of avenues for improvement in Energy management and audit is (CO1)
Fuel substitution
Monitoring and verification
Energy pricing
Bench marking

The benchmarking parameter for an air conditioning equipment is (CO1)
kW/Ton of refrigeration
kW/kg of refrigerant handled
kCal/m3 of chilled water
Differential temperature across chiller

One unit of electricity is equivalent to ___ kcal heat units. (CO1)
860
800
680
400

Non contact speed measurements can be carried out by (CO1)
Tachometer

Stroboscope
Oscilloscope
Speedometer

Replacement of steam based hot water generation by solar system is an example of (CO1)
matching energy usage to the requirement
maximising system efficiency
Energy substitution
Performance improvement

Lux meter is used to measure…… (CO1)
Illumination level
Sound intensity and illumination level
Harmonics
Speed

The ratio of maximum demand to the connected load is termed as (CO2)
Load factor
Demand factor
Contract demand
none of the above

Which of the following factor is not taken into account to decide the electricity tariff (CO2)
Types of Load
Maximum demand
The type of generating plant
The time at which load is required
The energy sources, that are either found or stored in nature are (CO2)
Secondary Energy Sources
Primary Energy Sources
both (a) and (b)
none of the above

BEE Stands for ---------- (CO3)
BUREAU OF ENERGY EFFICIENCY
BUREAU OF ELECTRICAL EFFICIENCY
BRITISH ELECTRICAL ENERGY
none

Energy consumption per unit of GDP is called as: (CO3)
Energy Ratio
Energy intensity
Per capita consumption
None

AMI means (CO3)
Automated Metering Instrument
Alternate Metering Instrument
Advanced Metering Infrastructure
Advanced Metering Instrument

BEE star rating is mandatory for (CO3)
Ceiling Fans
Color TV
Washing Machine
Computer (Notebook/Laptops)

Star rating is a part of _____ programme of BEE (CO3)
Energy Conservation Building Code (ECBC)
Standards & Labeling (S & L)
Demand Side Management (DSM)
Designated Consumers (DC)

Which of the following is not a designated consumer (CO3)

Fertilizer plant
chemical plant
Textile plant
Sugar Plant

Section – 2

EACH QUESTION CARRIES 2 MARK

If the power factor of a system is 0.7, the angle between voltage & current is (CO2)
0 deg
30 deg
45 deg
60 deg

A single phase induction motor is drawing 10 amps at 230 volts. If the operating power factor of the motor is 0.9, then the power drawn by the motor is (CO2)
2.3 kW
3.58 kW
2.07 kW
2.70 kW

The energy consumed by a 50 kW motor loaded at 40 kW over a period of 4 hours is (CO2)
50 kWh
160 kWh
40 kWh
2000 kWh

Which of the following is not a benefit of Smart Grid (CO2)
Financial benefits
Increasing reliability
Fast demand response
Disempowered customer

_____ has brought the qualitative transformation of the electricity sector: (CO3)
Regulatory Commission Act 1998
Indian Electricity Act 1910
Supply Act 1948
Electricity Act 2003

2ND INTERNAL ASSESSMENT
EE801C - ENERGY MANAGEMENT & AUDIT
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EACH QUESTION CARRIES 1 MARK

1. Stratosphere extends from CO4
80 to 700 km
50 to 80 km
12 to 50 km
0 to 12 km

2. Biological materials are not responsible for the air pollution CO4
True
False

3. The United Nations Framework Convention on Climate Change (UNFCCC) entered into force on _____ CO4
9 May 1992
3 June 1992
14 June 1992
21 March 1994

4. CDM-projects are done between countries that both have commitments CO4
True
False

5. Which wind turbine has higher Power generation efficiency CO4
Vertical-axis wind turbines (VAWT)
Horizontal-axis turbines (HAWT)

6. Friction & windage losses are load dependent loss in a motor CO5
True
False

7. Which will be better to start a lamp during the condition of the low voltage CO5
Electronic ballast
Conventional ballast

8. Which is used in a hotel energy management system to detect when a hotel room is occupied CO5
Ultrasonic sensors
PIR
Keycard light slots
Door operated switch

9. In Energy Efficient Motor larger conductor is used to reduce CO5
Iron losses
copper losses
Friction & windage losses
Stray losses

10. Using Star Delta Starter the starting current is reduced by 1/3 times CO5
True
False

EACH QUESTION CARRIES 2 MARKS

1. Match the Following CO4

Name		Volume in % present in air	
A	Carbon dioxide	1	20.946
B	Nitrogen	2	0.04
C	Oxygen	3	78.084

A(1), B(2), C(3)
A(2), B(3), C(1)
A(3), B(1), C(2)
A(2), B(1), C(3)

2. Match the Following CO4

Type of Plant	Capacity
A. Small Hydro	i. 5 kW – 100 kW
B. Mini Hydro	ii. 1 – 15 MW
C. Micro Hydro	iii. 100 kW – 1 MW

A(i), B(ii), C(iii)
A(ii), B(iii), C(i)
A(ii), B(i), C(iii)
A(i), B(iii), C(ii)

3. High-temperature fuel cells operate at greater than _____ and Low-temperature fuel cells typically operate below _____. CO4
700 °C , 350 ºC
600 °C , 250 ºC
250 ºC , 600 °C
350 ºC , 700 °C

4. Why waste land filling is to be discouraged CO4
landfill is a waste of energY
Landfill needs a lot of land areas
To stimulate recycling
All of these

5. What is the most common way of generating energy from municipal solid waste? CO4
Incineration
Gasification
Plasma gasification
Pyrolysis
Hydrolysis and fermentation

6. Choose the correct option CO5

Solar Thermal Device	Temperature
A. *Low-Grade Heating Devices*	1. *above 300°C*
B. *Medium-Grade Heating Devices*	2. *Up to 100°C*
C. *High-Grade Heating Devices*	3. *100°-300°C*

A(1), B(2), C(3)
A(3), B(1), C(2)
A(2), B(3), C(1)
A(2), B(1), C(3)

7. If the power factor of a system is 0.7, the angle between voltage & current is CO5
0 deg
30 deg
45 deg
60 deg

8. If the rated speed of a motor is 1500 RPM, using VFD what will be the minimum speed that can be achieved while controlling the speed. CO5

150 RPM
165 RPM
180 RPM
195 RPM

9. In variable torque applications, the torque required varies with the _____ of the speed, and the horsepower required varies with the _____ of the speed CO5
cube, square
square, cube
square, square
cube, cube

10. Which of the following is not an energy savings options in lighting System
Switch off when not required
Make minimum use of natural light
Select light colors for interiors
Provide lighting controls- timer switches

Siliguri Institue of Technology
Course Outcome Attainment
Course Code: EE-801C
Course Name: ENERGY MANAGEMENT & AUDIT

Record of Assessement Carried from different Sheets									
Total No of Students in the Class:			**72**						
S.No.	Exam	EE801C.1	EE801C.2	EE801C.3	EE801C.4	EE801C.5		Target	Overall Achievement
1	1st Internal Exam	65	65	65				70%	65
2	2nd Internal Exam			36	36	36		70%	36
3	Lab								
4	Term Paper	47	47	47	47	47		70%	47
5	Quize-1	57						70%	57
6	Quize-2		54	54	54	54		70%	54
	Average Internals	56	55	51	46	46		70%	51

Record of Assessement Through Internals					
Course Outcome	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME	Attainment Level of Each Course Outcome
EE801C.1	70%	72	56	78%	3
EE801C.2	70%	72	55	77%	3
EE801C.3	70%	72	51	70%	3
EE801C.4	70%	72	46	63%	2
EE801C.5	70%	72	46	63%	2
0					
EE801C	70%	72	51	70.42%	3

Record of Attainment Level of A Course through University and Internal Assessments					
	Target Course Outcome%	TOTAL STUDENTS	TOTAL STUDENT WHO ATTAINED OUTCOME	% STUDENTS WHO ATTAINED THE OUTCOME	Attainment Level
Internal Assessment	70%	72	51	70%	3
Assessment through University Exam	8	72	64	89%	3
Overall Attainment of Course Outcome					3

EE801C.1	Demonstrate knowledge about Energy management and energy auditing approaches (BT 2)
EE801C.2	Explain Energy Scenario. (BT 2)
EE801C.3	Understand the importance of energy conservation and related policies (BT 2)
EE801C.4	Explain reasons for climate change and related protocols & adaptations for sustainable development. (BT 2)
EE801C.5	Discuss about different energy efficient technologies in electrical systems. (BT 3)