Curriculum of Diploma Programme

in

Computer Engineering

Department of Science, Technology and Technical Education (DSTTE), Govt. of Bihar

State Board of Technical Education (SBTE), Bihar

Semester – III
Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2418301	**BCC**	**Data Structures and Algorithm** (CSE, AIML)	03	-	04	02	09	06
2418302	**PCC**	**Operating System**	02	01	-	02	05	04
2418303	**PCC**	**Discrete Structures**	02	01	-	02	05	04
2418304	**PCC**	**Digital Electronics & Microprocessor**	03	-	04	02	09	06
2418305	**BCC**	**Python Programming** (CE, CSE, AIML, EE, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	03	-	04	02	09	06
2418306	**PSI**	**Summer Internship – I** (After 2nd Sem) (Common for All Programmes)	-	-	02	02	04	02
2400008	**NRC**	**Sports, Yoga and Meditation** (Common for All Programmes)	-	-	01	01	02	01
2400111	**NRC**	**Principles of Management** (CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)	01	-	-	-	01	01
Total			**14**	**2**	**15**	**13**	**44**	**30**

Note: Prefix will be added to course code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - III
Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418301	**BCC**	**Data Structures and Algorithm** (CSE, AIML)	30	70	20	30	20	30	200
2418302	**PCC**	**Operating System**	30	70	20	30	-	-	150
2418303	**PCC**	**Discrete Structures**	30	70	20	30	-	-	150
2418304	**PCC**	**Digital Electronics & Microprocessor**	30	70	20	30	20	30	200
2418305	**BCC**	**Python Programming** (CE, CSE, AIML, EE, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	30	70	20	30	20	30	200
2418306	**PSI**	**Summer Internship – I** (After 2nd Sem) (Common for All Programmes)	**-**	**-**	10	15	10	15	50
2400008	**NRC**	**Sports, Yoga and Meditation** (Common for All Programmes)	-	-	10	-	6	9	25
2400111	**NRC**	**Principles of Management** (CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)	25	-	-	-	-	-	25
Total			**175**	**350**	**120**	**165**	**76**	**114**	**1000**

Note: Prefix will be added to course code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

A) Course Code : **2418301(T2418301/P2418301/S2418301)**

B) Course Title : Data Structures and Algorithm (AIML, CSE)

C) Pre- requisite Course(s) : Programming with C

D) Rationale :

Data structures are ways of organizing and storing data to be accessed and manipulated efficiently. An algorithm is a set of instructions or procedures designed to solve a particular problem or accomplish a specific task. Selecting the appropriate data structures optimizes the performance of algorithms that operate on that data.

This course fosters students to select appropriate data structures and algorithms for a given problem so as to optimize the performance of the program and improve its overall efficiency.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

CO-1 Analyze the efficiency of algorithm

CO-2 Implement operations on linear data structures

CO-3 Implement operations on non-linear data structures

CO-4 Apply different searching, sorting and hashing techniques to solve real world problems.

CO-5 Design efficient algorithms to solve the real-world problems.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	1	-	-	-	-	-	1		
CO-2	2	2	1	1	-	-	-		
CO-3	2	2	1	1	-	-	-		
CO-4	2	3	1	1	-	-	-		
CO-5	2	3	1	1	-	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418301	Data Structures and Algorithm	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

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H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418301	Data Structures and Algorithm	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

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I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2418301

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe different data types in data structure. *TSO 1b.* Classify the types of data structure based on its characteristics *TSO 1c.* Calculate the complexity of a given algorithm in terms of time and space. *TSO 1d.* Determine the running time of an algorithm using the given notation *TSO 1e.* Determine the time complexity of recursive algorithm	**Unit-1.0 Fundamentals of Algorithms and its Analysis** 1.1. Data Types System defines data types, User defined data types 1.2. Basic concept of data structure Linear data structure, Non-linear data structure , Abstract data types 1.3. Algorithm and its analysis - Introduction of algorithm, Time Complexity of algorithm, Space Complexity of algorithm, Worst case analysis, Best case analysis, Average case analysis 1.4. Asymptotic Notation Big-O Notation, Omega- Ω Notation, Theta Notation 1.5 Time complexity of recursive algorithm Basic concept of recursion, Time complexity analysis using Master theorem	**CO-1**
TSO 2a. Create resizable arrays TSO 2b. Implement basic operations on arrays and string TSO 2c. Create linked lists that can dynamically allocate and deallocate memory TSO 2d. Identify the different types of Linked List TSO 2e. Implement basic operations on linked lists, such as insertion, deletion, and traversal. TSO 2f. Evaluate postfix and infix expression TSO 2g. Implement basic operation on stack such as insertion, deletion, and traversal TSO 2h. Implement basic operations on queue, such as insertion, deletion, and traversal. TSO 2i. Explain the use of Queue data structure for real-world problems. TSO 2j. Implement enqueue and dequeue operations	**Unit 2.0 Linear Data Structures** 2.1 Array and String Concept of arrays, Single and Multi-dimensional arrays, Dynamic arrays, Array operations, Time and space complexity of array operations, Introduction to string, String manipulation 2.2 Linked List Introduction to linked list, Singly Linked List, circular Linked List, Basic operation on Linked List: Traversing List, Insertion, deletion, and modification in Linked List 2.3 Stacks and Queue Introduction to Stack, Stack operations, Implementation of Stack using simple array, dynamic array, and Linked List, Application of stack for evaluating Infix or Postfix Expression, balancing the symbols, function calls, Introduction to Queue, Queue operations, Implementation of Queue using simple array, dynamic array, and Linked List, Application of Queue	**CO-2**
TSO 3a. Create Binary search tree (BST) for given data set	**Unit 3.0 Non-linear Data Structure** 3.1 Tree	**CO-3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3b. Find minimum/maximum or k^{th}- smallest element in tree TSO 3c. Performs different traversal order of tree TSO 3d. Create a heap(min/max) for given array data TSO 3e. Perform different operation on heap such as insertion and deletion of an element, TSO 3f. Represent the given graph using: Adjacency Matrix, Adjacency List, and Adjacency Set TSO 3g. Perform graphs traversal using different methods TSO 3h. Find shortest path in various types of graphs TSO 3i. Evaluate minimum spanning tree of a graph using given algorithm	- Basic terminologies: tree, Degree of a node, Degree of tree, level of node, Depth/height of tree, In-degree, Out-degree, Path, Ancestor & Descendent node - Types of trees: Binary Tree, Binary Search tree (BST), Balance tree, B-tree - Traversal of Binary tree: In order, pred order, post order traversal 3.2 Priority Queue and Heaps - Introduction to priority queue, Different operations in priority queue, Implementation of priority queue using BST - Basics of Min heap, Max heap, and Binary heap, Basic operation on Binary heap, Heapifying the elements of binary heap 3.3 Graphs - Basics terminologies: Vertex and edge of graph, weighted and unweighted Graph, directed and undirected graph, Degree, in-degree and out-degree of a node (vertex), Articulation point - Graph representation: Adjacency Matrix, Adjacency List, Adjacency Set - Graph Traversal: BFS, DFS - Shortest Path in unweighted, weighted, and negative edge graph, Shortest Path algorithm in weighted graph [Dijkstra's], Shortest Path algorithm in negative edge graph [Bellman-Ford Algorithm] - Shortest Path algorithm in weighted directed graph [Floyd-Warshall algorithm] - Spanning tree in graph, Minimum Spanning tree algorithm: Prim's algorithm, Kruskal's algorithm	
TSO 4a. Develop algorithm for sorting a given dataset using the specified sorting method. TSO 4b. Explain the working of given searching method with an example TSO 4c. Develop an algorithm for searching an element a using binary search technique. TSO 4d. Perform basic operations of Hash Table TSO 4e. Apply Hash Tables to various data structures such as arrays, linked lists	**Unit 4.0 Sorting and Searching Techniques** 4.1 Sorting techniques: - bubble sort, selection sort, insertion sort, quicksort, merge sort 4.2 Searching techniques: Linear search, Binary search 4.3 Hash Table Introduction to Hash Table, Hash Function, Hash Collision resolution Techniques: Direct chaining, Open addressing	**CO-4**
TSO 5a. Apply Huffman coding algorithm for solving real world problems TSO 5b. Apply divide and conquer techniques to solve a problem TSO 5c. Explain the features of dynamic programming approaches TSO 5d. Find shortest path of a given graph	**Unit 5.0 Algorithm Design Techniques** 5.1 Element of Greedy algorithm - Greedy choice property, Optimal substructure - Huffman coding algorithm 5.2 Divide and Conquer Techniques - Divide and Conquer Visualization	**CO-5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
using dynamic algorithm TSO 5e. Find longest common subsequence from given strings	5.3 Dynamic Programming Approaches - Top-down and button-up Dynamic programming - Basics of Overlapping subproblem and Memorization techniques 5.4 Dynamic Programming Problem Longest common subsequence, Knapsack problem, Matrix chain multiplication	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418301

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Find size of different data types	1.	a. Write Program to find size of different data types.	CO-1
LSO 2.1. Implement insertion and deletion operation on array. *LSO 2.2.* Implement different operations on given strings. *LSO 2.3.* Apply insertion, deletion, traversing over a singly linked list. *LSO 2.4.* Implement insertion, deletion, traversing over a circular linked list. *LSO 2.5.* Create stack using array and linked list *LSO 2.6.* Implement stack for the evaluation of given expression *LSO 2.7.* Implement enqueue and dequeue operations on Queue using array and linked list	2.	a. Write a program to insert an element in a given array. b. Write a program to delete an element from a given array c. Write a program to modify a character in a string d. Write a program to insert a node at beginning, mid, and end of a given singly linked list e. Write a program to insert a node at beginning, mid, and end of a given circular linked list f. Write a program using stack for a given expression evaluation. g. Write a program to perform enqueue and dequeue operations on Queue	CO-2
LSO 3.1. Develop program to create a tree *LSO 3.2.* Develop program to perform traversal operations on a given tree. *LSO 3.3.* Create a priority queue using heap *LSO 3.4.* Create a priority queue using BST *LSO 3.5.* Perform the following operations on the heap: a. Insert an element into the heap. b. Delete the root element (highest priority) from the heap. c. Retrieve the root element without removing it. d. Check if the heap is empty *LSO 3.6.* Develop program to perform following operation on a given Priority Queue:	3.	a. Write programs to perform in order pre order, and post order traversal on a tree. b. Write functions to perform the following operations on the heap: i. Insert an element into the heap. ii. Delete the root element (highest priority) from the heap. iii. Retrieve the root element without removing it. iv. Check if the heap is empty c. Write a program to perform following operation on a given Priority Queue: i. Enqueue of an element ii. Dequeue of an element	CO-3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
a. Enqueue of an element b. Dequeue of an element c. Find the element with highest priority d. Determine the size of Priority Queue e. Empty check of Priority Queue *LSO 3.7.* Develop program to detect a cycle in a given graph using DFS *LSO 3.8.* Develop program to find an articulation point in a given undirected graph.		iii. Find the element with highest priority iv. Determine the size of Priority Queue v. Empty check of Priority Queue d. Write programs to perform following operation on graph i. To detect a cycle in a given graph using DFS ii. To find an articulation point in a graph using DFS iii. To find the shortest path between two given nodes using BFS e. Apply Bellman-Ford algorithm to find shortest path for a given negative edge graph. f. Apply Floyd-Warshall algorithm to find shortest path for a given weighted directed graph.	
LSO 4.1. Apply an insertion sort, selection sort, and bubble sort on a given unsorted array. *LSO 4.2.* Implement a quick sort on a given unsorted array. *LSO 4.3.* Implement a merge sort on a given unsorted array. *LSO 4.4.* Apply a counting sort on a given list of elements *LSO 4.5.* Write the steps to separate even and odd numbers for given array. *LSO 4.6.* Apply a binary search to search an element *LSO 4.7.* Write program to search an element which appears maximum number of times in given array. *LSO 4.8.* Create hash table data structure using array data structure. *LSO 4.9.* Perform the following operations on the hash table: a. Insert a key-value pair into the hash table. b. Retrieve the value associated with a given key from the hash table. c. Delete a key-value pair from the hash table. d. Check if a key exists in the hash table.	4	a. Develop a Program to: i. Apply insertion sort, quicksort, and merge sort on given dataset. ii. Apply binary search to find an element in given array. b. Write a program to create a hash table using array data structure. c. Write a program to perform the following operations on the hash table: i. Insert a key-value pair into the hash table. ii. Retrieve the value associated with a given key from the hash table. iii. Delete a key-value pair from the hash table. iv. Check if a key exists in the hash table.	CO-4
LSO 5.1. Find Longest common sequence in given string *LSO 5.2.* Find shortest path using Bellman-Ford algorithm for a given graph	5.	Develop Program to: i. Find Longest common sequence in given strings.	CO-5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 5.3. Apply divide and conquer method Find minimum and maximum value from a list of elements using.		ii. Find shortest path using Bellman-Ford algorithm for a given graph. iii. Find minimum and maximum value from n elements using divide and conquer method.	

L) Suggested Term Work and Self Learning: S2418301 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Build a phonebook application that stores contacts using doubly linked list.
2. Implement an algorithm to solve a Sudoku puzzle.
3. Build a spell checker that suggests corrections for misspelled words
4. Implement the Huffman coding algorithm to compress and decompress text files
5. Create a calculator that uses a stack data structure to evaluate expressions.

c. Seminar topics:

1. Scope of Data Structure and Algorithm in real world.
2. Height balance tree
3. Comparative analysis of given sorting methods

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory and Term work for ensuring CO attainment. The response/performance of the student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	20%	20%	5%	5%
CO-2	20%	20%	20%	20%	20%	20%	20%
CO-3	25%	25%	25%	20%	20%	25%	25%
CO-4	20%	20%	20%	20%	20%	25%	25%
CO-5	20%	20%	20%	20%	20%	25%	25%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Fundamentals of algorithms and its analysis	8	CO-1	10	3	3	4
Unit 2.0 Linear Data Structures	10	CO-2	14	4	4	6
Unit 3.0 Non-linear data structure	10	CO-3 and CO-4	18	5	3	10
Unit 4.0 Sorting and Searching Techniques	12	CO-5	14	4	3	7
Unit 5.0 Algorithm Design Techniques	8	CO-6	14	4	4	6
Total	**48**	**-**	**70**	**20**	**17**	**33**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA /ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Write Program to find size of different data types.	CO-1	30	60	10
2.	a. Write a program to insert an element in a given array. b. Write a program to delete an element from a given array c. Write a program to modify a character in a string d. Write a program to insert a node at beginning, mid, and end of a given singly linked list e. Write a program to insert a node at beginning, mid, and end of a given circular linked list f. Write a program using stack for a given expression evaluation. g. Write a program to perform enqueue and dequeue operations on Queue	CO-2	30	60	10
3.	a. Write programs to perform in order pre order, and post order traversal on a tree. b. Write functions to perform the following operations on the heap: i. Insert an element into the heap. ii. Delete the root element (highest priority) from the heap. iii. Retrieve the root element without removing it. iv. Check if the heap is empty c. Write a program to perform following operation on a given Priority Queue: i. Enqueue of an element ii. Dequeue of an element	CO-3	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA /ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	iii. Find the element with highest priority iv. Determine the size of Priority Queue v. Empty check of Priority Queue d. Write programs to perform following operation on graph i. To detect a cycle in a given graph using DFS ii. To find an articulation point in a graph using DFS iii. To find the shortest path between two given nodes using BFS e. Apply Bellman-Ford algorithm to find shortest path for a given negative edge graph. f. Apply Floyd-Warshall algorithm to find shortest path for a given weighted directed graph.				
4.	a. Develop a Program to: i. Apply insertion sort, quicksort, and merge sort on given dataset. ii. Apply binary search to find an element in given array. b. Write a program to create a hash table using array data structure. c. Write a program to perform the following operations on the hash table: i. Insert a key-value pair into the hash table. ii. Retrieve the value associated with a given key from the hash table. iii. Delete a key-value pair from the hash table. iv. Check if a key exists in the hash table.	CO-4	30	60	10
5.	Develop Program to: i. Find Longest common sequence in given strings. ii. Find shortest path using Bellman-Ford algorithm for a given graph. iii. Find minimum and maximum value from n elements using divide and conquer method.	CO-5	30	60	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad **Specifications** (No Generic) Give basic configuration or Latest	Relevant Experiment/Practical Number
1	Computer System	Any General-purpose Computer	1 to 5
2	Complier	Turbo C/ Dev C/any other C programming language complier	1 to 5

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1	Data Structures Using C	Reema thareja	Oxford university press INDIA ISBN-10 : 0198099304 ISBN-13 : 978-0198099307
2	Introduction to Algorithms	Thomas H. Cormen.	The MIT Press ISBN-10 : 9780262033848 ISBN-13 : 978-0262033848
2	Algorithms in C	Robert Sedgewick	Pearson Education ISBN-10 : 0201314525 ISBN-13 : 978-0201314526
3	Data Structures and Algorithms in C	Mark Allen Weiss	Pearson Education, second edition ISBN-10 : 8177583581 ISBN-13 : 978-8131714744

(b) Online Educational Resources:

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.programiz.com/dsa
3. https://www.freecodecamp.org/news/tag/data-structures/
4. https://www.w3schools.in/data-structures/intro

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Lab Manuals

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A) Course Code : **2418302(T2418302/S2418302)**

B) Course Title : Operating System

C) Pre- requisite Course(s) :

D) Rationale :

To work with an application on a computer system, an operating system is required which provides a platform to run applications and manage systems activities. An Operating System is basically a system program that controls the execution of application programs and acts as an interface between applications and the computer hardware. It manages the computer system resources to be used in an efficient manner. This course enables to learn internal functioning of operating system and will help in identifying appropriate Operating System for given applications/task.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in classroom/ laboratory/ workshop/ field/ industry. The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

After completion of the course, the students will be able to-

- **CO-1** Enumerate the types and functions of operating systems.
- **CO-2** Explain the process and inter process communication.
- **CO-3** Analyze issues related to CPU scheduling and deadlocks.
- **CO-4** Illustrate the concept of Memory management and virtual memory.
- **CO-5** Illustrate the concept of File management.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme SpecificOutcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	2	-	-	-	-	-	1		
CO-2	1	2	-	-	-	-	2		
CO-3	1	2	3	-	1	-	2		
CO-4	2	2	1	-	-	-	1		
CO-5	2	2	1	-	1	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418302	Operating System	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418302	Operating System	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2418302

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.1a Explain concepts and role as system software of an operating system. TSO.1b Explain major functions of an operating system TSO.1.c Explain the different views of an operating. TSO.1d Identify various types of operating systems and their characteristics. TSO.1e. Explain the concept of system Calls.	**Unit-1.0: Operating System Concepts-** 1.1 Operating System – Concept, Components of OS, System Software 1.2 Functions of O.S : Program Management, Resource management, File Management, Device Management, Security and protection. 1.3Views of OS: User view, System View 1.4 Types of Operating Systems and their characteristics: Batch operating system, Multi Programming, Time Shared OS, Multiprocessing OS, Distributed OS, Real-time systems, Mobile OS. 1.5 Services of Operating System. 1.6 System Calls- Concept, types of system calls	**CO-1**
TSO.2a Explain functions carried out in the given process state. TSO.2b Justify the need of PCB with relevant example. TSO.2.c Explain the process of inter process communication with example. TSO.2d Explain characteristics of the given multithreading model.	**Unit-2.0: Process Management** 2.1 Process-: process states, Process Control Block (PCB). 2.2 Process Scheduling- Scheduling Queues, Schedulers, Context switch. 2.3 Inter-process communication (IPC) : Introduction, shared memory system & message passing system. 2.4 Threads - Benefits, users and kernel threads, Multithreading Models - Many to One, One to One, Many to Many.	**CO-2**
TSO.3a Justify the need and objective of job scheduling with relevant example. TSO.3b Explain the procedure of allocation of CPU to a process with example. TSO.3.c Calculate turnaround time and average waiting time of the given scheduling algorithm. TSO.3d Explain the given necessary condition leading to deadlock.	**Unit-3.0: CPU Scheduling and Algorithm** 3.1 Scheduling types – scheduling Objectives, CPU and I/O burst cycles, Pre-emptive, Non- Pre-emptive Scheduling, Scheduling criteria. 3.2 Types of Scheduling algorithms - First come first served (FCFS), Shortest Job First (SJF), Shortest Remaining Time First (SRTF), Round Robin (RR) Priority scheduling, multilevel queue scheduling. 3.3 Deadlock - System Models, Necessary Conditions leading to Deadlocks, Deadlock Handling - Preventions, avoidance.	**CO-3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.4a Justify the need of memory management. TSO.4b Explain characteristic of the given memory management techniques. TSO.4.c Write algorithm for the given page replacement technique. TSO.4d Calculate Page fault for the given page reference string.	**Unit- 4.0: Memory Management** 4.1 Basic Memory Management - Partitioning, Fixed and Variable, Free Space management Techniques - Bitmap, Linked List. 4.2 Virtual Memory – Introduction to Paging, Segmentation, Fragmentation, and Page fault. 4.3 Page Replacement Algorithms: FIFO, LRU, Optimal.	**CO-4**
TSO.5a Explain the structure of the given file system with example. TSO.5b Describe mechanism of the given file access method. TSO.5.c Explain procedure to create and access directories and assign the given files access permissions.	**Unit-5.0: File Management** 1.1 File – Concepts, Attributes, Operations, types and File System Structure. 1.2 Access Methods – Sequential, Direct, Swapping, File Allocation Methods- Contiguous, Linked, Indexed. 1.3 Directory structure-– Single level, two levels, tree-structured directory, Disk Organization and disk Structure- Physical structure, Logical structure.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) **Suggested Term Work and Self Learning: S2418302** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

i. Create a report depicting features of different types of Operating systems- Batch operating system, Multi Programmed, Time Shared, Multiprocessor Systems, , Real time systems. Mobile OS with example.
ii. Make a comparative statement to calculate page fault for given page reference string by using different page replacement algorithms.
iii. Make a comparative chart to calculate total waiting and turnaround time of n processes with different CPU scheduling algorithm.
iv. Compare different process scheduling algorithms such as First Come First Serve (FCFS), Shortest Job First (SJF), Round Robin (RR), and Priority Scheduling.
v. Analyze their advantages, disadvantages, and performance of different process scheduling algorithms.
vi. Prepare a report summarizing your findings and recommendations for selecting a suitable process scheduling algorithm in different contexts.
vii. Identify the Disk organization and disk structure (Logical and Physical) and Access Method for Windows and Linux Operating System.

c. Other Activities:

Other than the classroom learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

1. **Seminar Topics:**
   (a) Operating Systems: Evolution and Challenges
   (b) Operating Systems for mobile Computing
   (c) Operating Systems for Real-Time Data Processing and Analytics

2. **Visits: -**

3. **Self-Learning Topics:**

   Emerging Trends and Technologies: Stay updated with the latest trends and technologies in operating systems. Research topics like edge computing, serverless computing, container orchestration, or operating system support for machine learning and artificial intelligence.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	20%	20%	-	-
CO-2	25%	25%	15%	20%	20%	-	-
CO-3	20%	20%	20%	20%	20%	-	-
CO-4	20%	20%	20%	20%	20%	-	-
CO-5	15%	15%	25%	20%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	-	-
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit 1.0 Operating System Concepts-	7	CO-1	14	5	7	3
Unit 2.0 Process Management	11	CO-2	16	4	8	3
Unit 3.0 CPU Scheduling and Algorithm	9	CO-3	14	3	8	3
Unit 4.0 Memory Management	9	CO-4	14	4	7	4
Unit 5.0 File Management	6	CO-5	12	4	5	2
Total	**48**	-	**70**	**20**	**35**	**15**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	--
2.	Operating systems	Like Windows, Linux and others	--

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Operating System Concepts	Silberschatz, Galvin	John Wiley and Sons Ninth Edition ISBN: 978-51-265-5427-0
2.	Operating Systems: Internals and Design Principles	Stallings William	Pearsons, 8 edition ISBN: 978-0133805918
3.	Operating Systems	Harvey M. Deitel	Third Edition, Pearson Education, 2004, ISBN:9780131828278

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
4.	Operating Systems-A Concept Based Approach	Dhamdhare	Tata McGrawHill, ISBN-9780070611948
5	Operating Systems: Concepts	G. Sreehitha Reddy and K. Reddy Pradeep	Publisher : Notion Press; 1st edition (7 November 2019) ISBN-10 : 1646789814 ISBN-13 : 978-1646789818

(b) Online Educational Resources:

1. www.en.wikipedia.org/wiki/Operating system
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://openstax.org/subjects/computer-science

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

******

A) Course Code : **2418303(T2418303/S2418303)**

B) Course Title : Discrete Structure

C) Pre- requisite Course(s) : Applied Mathematics- B

D) Rationale :

Discrete structures are important in computer science because they provide a framework for modelling and solving real-world problems. By using discrete structures, complex problems can be broken down into simpler components which are easier to analyze and comprehend. This makes it possible to develop efficient algorithms for solving problems, as well as to design computer programs. In addition, discrete structure is essential for understanding computer science, as it provides the theoretical foundations for many areas such as cryptography, game theory, artificial intelligence, data structures, algorithms, and software engineering. Logic and proof techniques are essential tools for reasoning about the correctness of algorithms and programs. Sets and relations are used in databases and programming languages. Combinatorics is used to analyze the efficiency of algorithms, estimate the complexity of problems, and develop optimization strategies. Graph theory is used in a wide range of applications including computer networking, optimization, and scheduling. Fuzzy logic is a mathematical framework for dealing with uncertainty, vagueness, and imprecision in data. It is also increasingly important in many areas of computer science, including artificial intelligence and machine learning.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Demonstrate proficiency in recognizing and applying various logic and proof techniques for engineering applications.
- **CO-2** Apply the concepts of set theory, relations and their application in modeling computer science engineering-based problems.
- **CO-3** Apply combinatorial principles to solve branch specific problems.
- **CO-4** Use graph theoretic principles to solve computer science engineering related problems.
- **CO-5** Solve computer science engineering-based problems using the basics of fuzzy set theory.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	2	2	1	1	-	1		
CO-2	3	1	-	-	-	-	-		
CO-3	2	2	-	-	1	-	1		
CO-4	3	2	2	-	1	1	1		
CO-5	2	1	1	-	-	-	-		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418303	Discrete Structure	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

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Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

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C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hour

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418303	Discrete Structure	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA Term work & self-learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, and seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2418303

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Identify difference between propositional and predicate logic. *TSO 1b.* Use logical equivalences concept to simply compound statements. *TSO 1c.* Express the given statement using "predicate logic". *TSO 1d.* Apply basic proof techniques to prove mathematical statements. *TSO 1e.* Use nested quantifiers to express complex statements. *TSO 1f.* Use the concept of Mathematical induction to prove the given statement.	**Unit-1.0 Logic and Proof Techniques** 1.1 Propositional logic: Connectives and Truth Tables, Tautologies and Contradictions, Logical Equivalences. 1.2 Predicate logic: Quantifiers, Nested Quantifiers, Inference rules for predicate logic. 1.3 Mathematical proofs: Basic proof techniques: Direct proofs, Proof by contrapositive, proof by contradiction and Proof by mathematical induction	**CO1**
TSO 2a. Use set theoretic operations to solve given problems. *TSO 2b.* Use De Morgan's Law to simplify expressions for applied problems. *TSO 2c.* Identify different types of relations. *TSO 2d.* Determine the Domain and range of a Relation *TSO 2e.* Use equivalence relations to solve given problems.	**Unit-2.0 Set Theory and Relation** 2.1 Set and subsets. 2.2 Operations on sets. 2.3 Venn diagrams and De Morgan's law. 2.4 Relations and their properties. 2.5 Equivalence relation.	**CO2**
TSO 3a. Apply fundamental counting principle to solve counting problems. *TSO 3b.* Differentiate between Permutations and Combinations on the basis of given applied problems and then solve. *TSO 3c.* Apply permutations and combinations to solve problems based on arranging letters in a word for practical applications. *TSO 3d.* Apply the pigeonhole principle to solve combinatorial problems. *TSO 3e.* Use binomial theorem to solve problems involving binomial coefficients and powers. *TSO 3f.* Solve counting problems using generating functions.	**Unit-3.0 Combinatorics** 3.1 Basics counting principles. 3.2 Permutations and Combinations. 3.3 Pigeonhole principle (without proof and its application. 3.4 Binomial theorem. 3.5 Generating functions.	**CO3**
TSO 4a. Explain different types of graphs and calculate the degree of a vertex. *TSO 4b.* Identify the isomorphic graphs. *TSO 4c.* Define walks, paths, and cycles in graphs. *TSO 4d.* Apply Eulerian graphs and their applications to solve given problems. *TSO 4e.* Calculate the connectivity of a graph and identify its components.	**Unit- 4.0 Graph Theory** 4.1 Basic concepts and definition. 4.2 Types of Graph and degree of vertex. 4.3 Sub graph and Isomorphic Graphs. 4.4 Walks, Paths, Cycle. 4.5 Eulerian Graph (without proof) and its application. 4.6 Connectivity and Components	**CO4**
TSO 5a. Differentiate between classical set theory and fuzzy set theory. *TSO 5b.* Use the concept of membership functions and degrees of membership to applied problems. *TSO 5c.* Define the concept of fuzzy propositions and truth values.	**Unit-5.0 Introduction to Fuzzy Set Theory** 5.1 Basics of Fuzzy set theory. 5.2 Membership functions and degrees of membership. 5.3 Fuzzy set theoretic operations. 5.4 Fuzzy propositions and truth values.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Tutorials and Outcomes:

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
1.1 Verify the statement "An object is either in motion or it is not in motion." is a Tautology, prove it? 1.2 Use the concept of "proof by contradiction", to establish the uniqueness of the solution. 1.3 Verify the correctness of the circuit design of the given Boolean equation using predicate logic. 1.4 Verify the correctness of the given algorithm using "contrapositive". 1.5 Apply principle of mathematical induction to prove given mathematical statements.	1.	• Analysis of moving object using "Tautology". • Uniqueness of solutions by contradiction. • Verification of circuit design correctness using predicate logic • Verification using "contra-positiveness". • Application of Mathematical induction.	CO1
1.1 Represent different operations on given sets by Venn Diagram. 1.2 Prove De Morgan's law geometrically and interpret the result. 1.3 Apply Equivalence relations for equivalence partioning to check validity.	2.	• Operations on set. • Geometrical interpretation of De Morgan's Law. • Applications of Equivalence relation.	CO2
3.1 Apply counting techniques to count the number of possible outcomes in given algorithms or programs. 3.2 Count the number of possible routes for a delivery driver. 3.3 Count the number of possible configurations of a network. 3.4 Find duplicate entries in a database using Pigeonhole Principle. 3.5 Use Pigeonhole Principle to find the minimum number of items required to guarantee that at least two of them share a certain property. 3.6 Write programs in a programming language to implement the binomial theorem for computing binomial coefficients by expanding binomial expressions. 3.7 Compute generating functions using Mathematica or Python.	3.	• Applications of counting techniques. • Applications of Pigeonhole Principle. • Binomial theorem and its applications. • Applications of generating functions.	CO3
4.1 Use graph theory to Schedule the tasks such that the overall time to complete all the tasks is minimized. 4.2 Use Graph theory to allocate the resources such that all constraints are satisfied and the overall cost is minimized. 4.3 Find the shortest path between two routers, considering the cost of each link.	4.	• Applications of graph theory for minimization problems. • Applications of graph theory for shortest path problems. • Graph theory and algorithm.	CO4

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
4.4 Use graph theory algorithm in Internet Routing.			
1.1 Use fuzzy set theory to Predict final grade of the student using input variables such as attendance, homework scores and exam score. 1.2 Create membership functions and define fuzzy sets using built-in functions or libraries.	5.	• Applications of fuzzy set theory. • Applications of membership functions	CO5

L) Suggested Term Work and Self Learning: S2418303 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1. Identify logical errors in a given code snippet by applying debugging techniques and logical reasoning.
2. Apply formal verification or model checking method to ensure the correctness of critical software components.
3. Apply contradiction or contraposition proof techniques to prove the correctness of a loop invariant in an iterative algorithm.
4. Prove the correctness of a sorting algorithm by using mathematical induction.
5. Identify valid and invalid arguments in engineering applications and demonstrate their correctness using inference rules.
6. Determine the subsets of data points that belong to specific categories or classes in a dataset used for training a machine learning model.
7. Define sets based on different attributes based on the set of all male individuals or the set of individuals above a certain age threshold for a given data set containing information about individuals such as age, gender, and occupation.
8. Consider a scenario where you have multiple datasets. Perform set operations to identify common elements or unique elements among the datasets.
9. Create Venn diagrams to illustrate the relationships between sets in real-life scenarios, such as the intersection of sets representing different groups of customers for market segmentation.
10. Consider a dataset of students and available courses. Calculate the number of possible combinations to assign students to courses while meeting the prerequisites and capacity constraints.
11. Apply generating functions to analyze the performance of iterative optimization algorithms used in machine learning, such as gradient descent or genetic algorithms.
12. In a machine learning model that uses binary classification, apply the binomial theorem to calculate the probabilities of different outcomes and evaluate the model's performance.
13. In a computer network, analyze the distribution of IP addresses among devices using the pigeonhole principle to identify any IP address collisions or conflicts.
14. Apply generating functions in the analysis of probabilistic algorithms used in machine learning, such as generating functions for calculating expected values or probabilities.
15. Consider a transportation network where nodes represent cities and edges represent roads or routes. Define the graph and determine the number of vertices and edges based on real-life data.
16. Find the shortest path between two vertices using suitable algorithm.

17. Perform fuzzy set union and intersection operations on two given fuzzy sets.
18. Determine the complement of a fuzzy set and interpret its meaning in a real-world context.
19. Apply the extension principle to combine fuzzy sets with different membership functions.
20. Define a triangular membership function for a fuzzy set representing "temperature" with three linguistic terms: "cold," "warm," and "hot".

b. Micro Projects:

1. Prepare charts for displaying the truth table for a set of logical operators that your program will be able to handle. For example, you might choose to include "and", "or", "not", and "implies".
2. Prepare a chart containing simple programming language of Computer science using predicate logic.
3. Prepare a chart consisting of 8-10 mathematical algorithms containing quantifier.
4. Prepare Charts displaying different operations on sets using Venn Diagram with animation.
5. Write a blog over applications of equivalence relations in computer science engineering.
6. Make a short video of duration 5-7 minutes over the use of set theory and related operations in our day to day life.
7. Create a program that counts the number of vowels and consonants in a given sentence.
8. Develop a program to solve Permutation and Combination problems for engineering applications.
9. Create a simple program to solve the Traveling Salesman problem using the Pigeonhole Principle.
10. Design a program to check the validity of a Sudoku puzzle based on the Pigeonhole Principle.
11. Develop a program to find the number of mappings from one set of elements to another using the Pigeonhole Principle.
12. Investigate the use of generating functions in solving differential equations for engineering applications.
13. Explore the use of generating functions to solve problems related to machine learning, such as analyzing the performance of different classifiers.
14. Build a program to solve the traveling salesman problem using graph algorithms.
15. Build a program to find the shortest path between two nodes in a graph.
16. Prepare Fuzzy set theory -based Student Performance Prediction System
17. Prepare Fuzzy set theory-based Temperature Control System for a Room.

c. Other Activities:

1. Seminar Topics:

    - Importance of Tautologies in Mathematics and Computer Science.
    - Significance of Truth Tables in Computer Science engineering.
    - Role of predicate logic in modeling and design of software and hardware system.
    - Use of “Proof by contrapositive” in circuit Analysis and design.
    - Application of set theory in Computer Science.
    - Equivalence relations and its applications in Computer science engineering.
    - Applications of Permutation and Combination in Computer Science.
    - Pigeonhole principle for programming languages in Computer Science.
    - Applications of the Binomial theorem in Algorithms.
    - Analyzing Algorithms using Generating Functions.
    - Applications of Generating functions for solving counting problems.
    - Applications of graph theory in Computer science.
    - Use of graph theory in machine learning.
    - Use of graph theory in computer vision.
    - Fuzzy Sets and its engineering applications.

2. Visits: Visiting following places would provide students an opportunity to see the application of various branches of mathematics in different fields. This will also help students to comprehend the career opportunities available in the field of mathematics.

    - Visit to a mathematics museum.
    - Visit to a mathematics research institute.
    - Visit to a Data Science Center.
    - Visit to a mathematics department of a college or university.
    - Visit to a software company.
    - Visit to a Science Museum.
    - Visit to planetarium.
    - Visit to a Game Studio.

3. Self-Learning Topics:

    - Numberphile and 3Blue1Brown YouTube channels for Logic and proof techniques videos.
    - Set Theory through Mathsisfun
    - Combinatorics through Mathigon.
    - Graph Theory Tutorial by Tutorials point.
    - "Fuzzy Logic Tutorials" by Tutorials Point (Online resource)**.**

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		**Term Work Assessment (TWA)**			**Lab Assessment (LA)#**	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	**End Theory Assessment (ETA)**	**Term Work & Self Learning Assessment**			**Progressive Lab Assessment (PLA)**	**End Laboratory Assessment (ELA)**
			Assignments	**Micro Projects**	**Other Activities***		
CO-1	20%	20%	25%	20%	25%	-	-
CO-2	18%	18%	15%	20%	15%	-	-
CO-3	22%	25%	25%	20%	25%	-	-
CO-4	25%	22%	25%	20%	25%	-	-
CO-5	15%	15%	10%	20%	10%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	**-**	**-**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each Cos.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Logic and Proof Techniques.	10	CO1	14	4	4	6
Unit-2.0 Set Theory and Relation	8	CO2	13	5	4	4
Unit-3.0 Combinatorics	12	CO3	18	4	6	8
Unit-4.0 Graph Theory	12	CO4	16	4	6	6
Unit-5.0 Introduction to Fuzzy Set Theory	6	CO5	09	3	4	2
Total	**48**	**-**	**70**	**20**	**24**	**26**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested AssessmentTable for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High end computers	Processor Intel Core i7 with Compilers and Programming Languages, RAM 32 GB, DDR3/DDR4, HDD 500 GB, OS Windows 10	All
2.	Software	Scientific Calculators, Graphing Calculator, SCILAB, GraphEq^2.13, Micro soft Mathematics, GeoGebra, Math3D	1,2,3,4,5
3.	Printer	High Speed Duplex Printer	
4.	Scanner	Handheld 3D scanner, Accuracy up to 0.1 mm, Resolution up to 0.2 mm, Wireless technology with an inbuilt touch screen and battery, Extended field of view for capturing both large and small objects	

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Graph Theory	Frank Harary	Addison- Wesley publishing Company, 1969 ISBN: 8185015554, 9788185015552
2.	Handbook of Logic and Proof Techniques for Computer Science	Steven G. Krantz	1st edition 2002, Springer Science+ Business Media New York ISBN 978-1-4612-6619-8
3.	Discrete Mathematics with combinatorics and graph theory	S. Santha	CENGAGE Learning, 1st edition, ISBN 978-8131510988
4.	A Textbook of Discrete Mathematics	Swapan Kumar Sarkar	S. CHAND & COMPANY LTD. ISBN: 9788121922326
5.	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5
6.	Engineering Mathematics (Third edition)	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
7.	Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems	Guanrong Chen and Trung Tat Pham	CRC Press, Boca Raton London New York Washington, D.C. ISBN: 0-8493-1658-8

(b) Online Educational Resources:

1. https://ocw.mit.edu/
2. https://tutorial.math.lamar.edu/
3. https://www.khanacademy.org/
4. https://www.feynmanlectures.caltech.edu/
5. https://www.wolframalpha.com/
6. https://www.dplot.com/
7. https://www.geogebra.org/
8. https://www.easycalculation.com/
9. https://www.scilab.org/
10. https://www.desmos.com/
11. https://nptel.ac.in/
12. https://swayam.gov.in/
13. https://ndl.iitkgp.ac.in/
14. https://parakh.aicte-india.org/
15. https://ekumbh.aicte-india.org/
16. https://learnengg.com/LE/Index

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Online Mathematics Courses.
2. Mathematics Communities and Forums.
3. Mathematics Journals.
4. Mathematics Podcast.
5. Mathematics Tutorials.
6. Mathematics Quizzes.
7. Mathematics Animation.
8. Mathematics Simulations.
9. Mathematics Games.
10. Mathematics Puzzles.
11. Mathematics Brain Teasers.
12. Mathematics Apps.
13. Mathematics Blog.

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A) Course Code : **2418304(T2418304/P2418304/S2418304)**

B) Course Title : Digital Electronics and Microprocessor

C) Pre- requisite Course(s) : Fundamentals of Electrical and Electronic Engineering

D) Rationale :

Currently, most of the state-of-art electronic equipment like mobiles, computers, ATM, TV, music system, air conditioners, automobiles are embedded with digital circuits; and in fact, microprocessor is called as the heart of a computer. The ICs used in any electronic equipment needs continuous monitoring for their proper upkeep. For this work, knowledge and skills related with logic gates, combinational circuits, sequential circuits, data converters and memory are a must for diploma engineers. This course is meant to provide the basic skills to use and solve the application problems based on digital integrated circuits and microprocessor. In addition, this course will enable the students to inculcate assembly language programming concepts and also help to develop hardware related projects.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Minimize the Boolean expressions and implement it using logic gates.
- **CO-2** Test simple combinational and sequential circuits.
- **CO-3** Use data converters and memory in digital electronic systems.
- **CO-4** Develop simple assembly language programs for various operations using instruction set of 8085 microprocessors.
- **CO-5** Interface the memory and I/O devices to 8085 microprocessors.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	1	-	-	-	1	1		
CO-2	3	-	2	1	-	1	1		
CO-3	3	-	2	-	-	1	1		
CO-4	3	2	3	1	-	1	-		
CO-5	3	-	2	-	-	1	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418304	Digital Electronics and Microprocessor	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418304	Digital Electronics and Microprocessor	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2418304

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the given number system. *TSO 1b.* Convert a given number in any number system into another specified number system. *TSO 1c.* Perform the specific arithmetic operation with respect to given number(s) in a given number system. *TSO 1d.* Determine 1's and 2's complement of given binary number. *TSO 1e.* Represent negative number in 1's and 2's complement. *TSO 1f.* Use 1's and 2's complement for subtraction. *TSO 1g.* Minimize the given Boolean expression using Boolean algebra and K-map. *TSO 1h.* Realize the logical expression using logic gates.	**Unit-1.0 Number Systems, Boolean Algebra and Logic Gates** 1.1 Different number systems: • Binary, Octal, Decimal, Hexadecimal • Conversion from one number system to another number systems. 1.2 Arithmetic operation of Binary, Octal, Hexadecimal number systems. 1.3 Complements: 1's and 2's complement. 1.4 Data Representation: • Representation of negative number in 1's and 2's complement • Subtraction using 1's and 2's complement 1.5 Boolean Algebra: • Rules and laws of Boolean Algebra • De-Morgan's Theorem 1.6 Standard Boolean Representation: • Sum of Product (SOP) • Product of Sum (POS) 1.7 Minimization: • Karnaugh's Map (K-map) up to three variables • Simplification of Boolean expressions using Boolean laws and K-map. 1.8 Logic Gates and applications: • AND, OR, NOT, Buffer, NAND, NOR, XOR, XNOR (Symbol, Truth table, Logic expression and its applications) 1.9 Implementation of Boolean expressions using basic gates	**CO1**
TSO 2a. Develop simple arithmetic circuits using logic gates. *TSO 2b.* Implement multiplexer and de-multiplexer using logic gates. *TSO 2c.* Use encoder and decoder in digital circuits. *TSO 2d.* Differentiate combinational and sequential circuits. *TSO 2e.* Explain the ripple counter for up/down sequence with block diagram.	**Unit-2.0 Combinational and Sequential Logic Circuits** 2.1 Arithmetic Circuits: • Half Adder and Full Adder • Half Subtractor and Full Subtractor 2.2 Multiplexer: • 2 to 1 MUX • 4 to 1 MUX • Applications	**CO1, CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 2f. Differentiate synchronous and asynchronous counter. *TSO 2g.* Explain the ring counter with block diagram	2.3 De-multiplexer: • 1 to 2 DEMUX • 1 to 4 DEMUX • Applications 2.4 Encoder and Decoder 2.5 Flip-Flops : SR, JK, T, D, and JK, Master Slave JK flip-flop 2.6 Shift Registers: • Serial In Serial Out • Serial In Parallel Out • Parallel In Serial Out • Parallel In Parallel Out 2.7 Counters: • Modulus of counter • Asynchronous Counter: Ripple up/down counter • Synchronous Counter: Ring Counter	
TSO 3a. Calculate the output voltage of given Op-amp circuit. *TSO 3b.* Explain the DAC and ADC. *TSO 3c.* Compare various type of memory in terms of its functionality. *TSO 3d.* List the memory chip.	**Unit-3.0 Data Converters and Memory Devices** 3.1 Data Converters: • Op-Amp: Introduction (Inverting and Non inverting) • Digital to analog and Analog to digital converter: Uses 3.2 Random Access Memory: Introduction and its types 3.3 Read Only Memory: Introduction and its types	**CO3**
TSO 4a. Interpret the general-purpose microprocessor. *TSO 4b.* Explain the architecture of 8085 microprocessor with block diagram. *TSO 4c.* Explain various types of interrupts. *TSO 4d.* Classify the different types of instruction used in 8085. *TSO 4e.* Differentiate addressing modes of 8085 microprocessor. *TSO 4f.* Differentiate addressing modes of 8085 microprocessor. *TSO 4g.* Use various types of instruction to write simple Assembly Language Program.	**Unit-4.0 Basics, Instruction Set and Programming of 8085 Microprocessor** 4.1 Basics of Microprocessor: • Evolution of Microprocessors • Architecture and Pin diagram of 8085 • Timing Diagram and Memory Organization • Interrupts 4.2 Instruction Set: • Data Transfer Instructions • Control instructions • Arithmetic instructions • Logical instructions • Branching instructions 4.3 Different types of Addressing Modes: • Immediate Addressing Mode • Register Addressing Mode • Direct Addressing Mode • Indirect Addressing Mode • Indexed Addressing Mode 4.4 Assembly Language Programming	**CO4**
TSO 5a. Interface Intel PPI 8255 with 8085.	**Unit-5.0 Interfacing with 8085 Microprocessor:**	**CO4, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5b. Interface various memory chips with 8085 microprocessors. *TSO 5c.* Explain the operation of interfacing chips. *TSO 5d.* Differentiate between the serial and parallel communication modes of 8085 microprocessor.	5.1 Programmable Peripheral Interface (PPI)- Intel 8255 (Generation of I/O Ports) 5.2 Programmable Interval timers (Intel 8253/8254) 5.3 Overview of Memory chips and their interfaces 5.4 Overview of other interfacing chips (Name and Application(s) only)	

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418304

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 List the IC number of different types of logic gates. *LSO 1.2* Verify the truth table of identified logic gate IC.	1.	Test the functionality of logic gates using ICs.	CO1
LSO 2.1 Build the circuit on breadboard for making AND gate using NOR gate. *LSO 2.2* Verify the truth table of the developed AND gate. *LSO 2.3* Build the circuit on breadboard similarly for other gates using NOR gate. *LSO 2.4* Verify the truth table of the developed gate.	2.	Implement logic gates using universal NAND gate IC only.	CO1
LSO 3.1 Build the circuit on breadboard for making AND gate using NOR gate. *LSO 3.2* Verify the truth table of the developed AND gate. *LSO 3.3* Build the circuit on breadboard similarly for other gates using NOR gate. *LSO 3.4* Verify the truth table of the developed gate.	3.	Implement logic gates using universal NOR gate IC only.	CO1
LSO 4.1 Build the circuit of Half Adder using basic gates on breadboard. *LSO 4.2* Test the functionality of Half Adder. *LSO 4.3* Build the circuit of Half Subtractor on breadboard. *LSO 4.4* Test the functionality of Half Subtractor.	4.	Implement Half Adder and Half Subtractor using basic gates.	CO2
LSO 5.1 Build the circuit of Full Adder using basic gates on breadboard. *LSO 5.2* Check the result of binary addition on the developed circuit.	5.	Implement Full Adder using basic gates.	CO2
LSO 6.1 Build the circuit of Full Subtractor using NOR gate on breadboard. *LSO 6.2* Check the result of binary subtraction on the developed circuit.	6.	Implement Full Subtractor using basic gates.	CO2
LSO 7.1 Build the circuit connection of multiplexer on trainer kit. *LSO 7.2* Test whether the particular input line is available at output for given data select line.	7.	Test the functionality of multiplexer on trainer kit.	CO2
LSO 8.1 Build the circuit connection of De-multiplexer. *LSO 8.2* Test whether the given data available at input is distributed correctly to output for given data select line.	8.	Test the functionality of de-multiplexer on trainer kit.	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 9.1 Build the circuit of SR flip-flop using NAND gate on breadboard. *LSO 9.2* Verify the characteristic table of SR flip-flop.	9.	Verify the function of SR flip-flop using NAND gate.	CO2
LSO 10.1 Build the circuit of SR flip-flop using NOR gate on breadboard. *LSO 10.2* Verify the characteristic table of SR flip-flop.	10.	Verify the function of SR flip-flop using NOR gate.	CO2
LSO 11.1 Construct the circuit diagram of D flip-flop on breadboard. *LSO 11.2* Test the functionality of D flip-flop.	11.	Test the functionality of D flip-flop using IC 7476.	CO2
LSO 12.1 Construct the circuit diagram of T flip-flop on breadboard. *LSO 12.2* Test the functionality of T flip-flop.	12.	Test the functionality of T flip-flop using IC 7476.	CO2
LSO 13.1 List the IC number of DAC. *LSO 13.2* Test its functionality.	13.	Test the functionality of DAC using IC.	CO3
LSO 14.1 List the IC number of ADC. *LSO 14.2* Test its functionality.	14.	Test the functionality of ADC using IC.	CO3
LSO 15.1 Examine the 8085 Trainer kit. *LSO 15.2* Identify the various components in 8085 Trainer Kit.	15.	Test and verify the features of 8085 Trainer Kit.	CO4, CO5
LSO 16.1 Write an assembly language program based on Data transfer Instructions & Arithmetic Instructions. *LSO 16.2* Test the results by executing the assembly language program.	16.	Write and execute an ALP for 8085 to add two 8-bit Nos. which is stored at two different memory locations and store the result (with carry & without carry cases) at another memory locations.	CO4
LSO 17.1 Write an assembly language program based on Data transfer Instructions & Arithmetic Instructions. *LSO 17.2* Test the results by executing the assembly language program.	17.	Write and execute an ALP for 8085 to Subtract two 8-bit Nos. which is stored at two different memory locations and store the result (with carry & without carry cases) at another memory locations.	CO4
LSO 18.1. Develop an assembly language program to interface 7 segment display with 8051 Microcontroller *LSO 18.2.* Test the results by executing the assembly language program.	18.	Develop a program to interface 7 segment display with 8051.	CO5

L) Suggested Term Work and Self Learning: S2418304 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Build a Binary to Gray code converter trainer kit.
2. Build a circuit to implement 4 bit adder.
3. Build a circuit for LED flasher.
4. Build a trainer kit of 4 to 1 multiplexer.
5. Build a circuit to test seven segment display.
6. Build a circuit to display the pin code of your college using seven segment display.
7. Develop and Execute an 8085 Assembly language programme to alternatively blink LEDs connected on 8255 port at an interval of 0.1 second. Build the circuit.

c. Other Activities:

1. Seminar Topics:
   - Biometric voting machine
   - Night vision technology
   - Digital locker
   - Barcodes Reader

2. Visits: Visit nearby radio station/industry/ electronic shops. Prepare report of visit with special comments of digital electronics component/batch production/mass production and cost of component.

3. Self- learning topics:
   - PCB design technique
   - Key board encoder
   - 2-bit comparator
   - Carry look ahead adder
   - Self-complimentary code like 2421, 3321

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	10%	15%	-	20%	15%	20%
CO-2	25%	25%	25%	25%	20%	30%	20%
CO-3	15%	20%	15%	25%	20%	20%	20%
CO-4	30%	30%	30%	25%	20%	25%	20%
CO-5	15%	15%	15%	25%	20%	10%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Number Systems, Boolean Algebra and Logic Gates	8	CO1	13	4	4	5
Unit-2.0 Combinational and Sequential Logic Circuits	10	CO1, CO2	16	4	7	5
Unit-3.0 Data Converters and Memory Devices	8	CO3	12	4	4	4
Unit-4.0 Basics, Instruction Set and Programming of 8085 Microprocessor	14	CO4	18	4	8	6
Unit-5.0 Interfacing with 8085 Microprocessor	8	CO4, CO5	11	3	4	4
Total	**48**	**-**	**70**	**20**	**26**	**24**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Test the functionality of given logic gates using ICs.	CO1	30	60	10
2.	Implement logic gates using universal NAND gate IC.	CO1	40	50	10
3.	Implement logic gates using universal NOR gate IC.	CO1	40	50	10
4.	Implement Half Adder and Half Subtractor using basic gates.	CO2	30	60	10
5.	Implement Full Adder using basic gates.	CO2	40	50	10
6.	Implement Full Subtractor using basic gate.	CO2	40	50	10
7.	Test the functionality of multiplexer on trainer kit.	CO2	20	70	10
8.	Test the functionality of de-multiplexer on trainer kit.	CO2	40	50	10
9.	Verify the function of SR flip-flop using NAND gate.	CO2	20	70	10
10.	Verify the function of SR flip-flop using NOR gate.	CO2	40	50	10
11.	Test the functionality of D flip-flop using IC 7476.	CO2	40	50	10
12.	Test the functionality of T flip-flop using IC 7476.	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Test the functionality of DAC using IC.	CO3	30	60	10
14.	Test the functionality of ADC using IC.	CO3	30	60	10
15.	Test and verify the features of 8085 Trainer Kit.	CO4, CO5	30	60	10
16.	Write and execute an ALP for 8085 to add two 8-bit Nos. which is stored at two different memory locations and store the result (with carry & without carry cases) at another memory locations.	CO4	40	50	10
17.	Write and execute an ALP for 8085 to Subtract two 8-bit Nos. which is stored at two different memory locations and store the result (with carry & without carry cases) at another memory locations.	CO4	40	50	10
18.	Develop a program to interface 7 segment display with 8051.	CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools, and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Oscilloscope	Dual Channel 20MHz	All
2.	Function generator	100MHz Function & Arbitrary Generator, 500MSa/s-DG4102	All
3.	Digital IC Trainer Kits	Power Supply: +5V, +/- 12V Display Type: 2 Digit BCD to Decimal Display	All
4.	Logic Gates ICs	Two input and 3-Input	1 to 6
5.	Bread Board	MB 102 Breadboard with Power Supply Module, Jumper Wires, Battery Clip,830 & 400 tie-Points	All
6.	Digital Multimeter	DM-86 Digital Multimeter AC Frequency Response: 40-400Hz Low Battery Display: Approx. < 7.5V	All

S. No.	Name of Equipment, Tools, and Software	Broad Specifications	Relevant Experiment/Practical Number
7.	IC Tester	• Package: Digital ICs of 14, 16, 18,20,24,28 & 40 pins dual in line. • Range: Tristate, Open Collector & Bidirectional TTL/CMOS ICs. • Method: Truth table comparison. • Sockets: 20 and 40 pin ZIF. • Keyboard: 24 feather touch keys. • Display: 16 digit 0.5" Seven segment LED display. • Voltage: 230 volts + 10% 50Hz, AC.	All
8.	Microprocessor Trainer Kit	Single board systems with 8K RAM, ROM memory with battery backup, 16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler, RS- 232, USB, interfacing facility with built in power supply.	15,16, 17,18
9.	Keyboard Trainer Board	Keyboard 4*4 trainer board	Term work
10.	7-segment LED Display	7-segment LED Display: -0.56 in 1-digit, common anode/common cathode	18
11.	Display Trainer Board	LCD trainer board	Term work
12.	Trainer Boards for DAC & ADC	DAC (0808) trainer board, ADC (0808) trainer board	13, 14

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition, ISBN: 978- 9339203405
2.	Digital Electronics, Principles and Applications	Roger L. Tokheim	McGraw-Hill Education (ISE Editions); International 2nd revised edition, ISBN: 978-0071167963
3.	Digital Electronics – An Introduction to Theory and Practice	William H. Gothmann	Prentice Hall India Learning Private Limited; 2nd edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth & Larry L. Kinney	Jaco Publishing House; First edition, ISBN: 978-8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi, (Edition 2018), ISBN: 978-93-82609445
6.	8085 Microprocessor	Ramesh S. Gaonkar	5th Edition, Prentice Hall ISBN: 0130195707
7.	Fundamentals of Microprocessor & Microcontroller	B. Ram	Dhanpat Rai & Sons Pub., 3rd edition, 2008, ISBN: 978-8189928605

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/108105132
2. https://onlinecourses.nptel.ac.in/noc22_ee55/preview
3. https://archive.nptel.ac.in/courses/108/105/108105132/
4. https://in.coursera.org/learn/digital-systems
5. Virtual Labs: https://www.vlab.co.in/
6. https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Operating / Manufacturers' Manuals
2. Lab Manuals
3. Data books / Data sheets of digital components (TTL, CMOS, etc.)
4. Software's like NI Circuit Design Suite/ Xcircuit / easyEDA/ circuitlab & like.

******

A) Course Code : **2418305(T2418305/P2418305/S2418305)**

B) Course Title : Python Programming

(CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)

C) Pre- requisite Course(s) :

D) Rationale :

Python programming has emerged as a popular programming language across wide range of application segments from Scientific to Machine Learning to mobile app development, and so on. Python is a high-level general-purpose programming language.

Because code is automatically compiled to byte code and executed, Python is suitable use as a scripting language, Web application implementation language, etc.
In Python there are multiple levels of organizational structure: functions, classes, modules, and packages. These assist in organizing code. An excellent and large example is the Python standard library.

The Object-oriented Python provides a consistent way to use objects: in Python it is easy to implement new object types (called classes in object-oriented programming).
This introductory course to learn basic Python programming features which can be used as building blocks to develop different kind of applications using Python 3.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Use various data types and operators in formation of expressions.
- **CO-2** Write and execute programs using control statements.
- **CO-3** Perform relevant operations on Sequence data types
- **CO-4** Create functions in modules
- **CO-5** Use object-oriented approach and features in writing python programs
- **CO-6** Handle data files and exceptions.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	1	-	1	-	-	-	-		
CO-2	1	2	2	1	-	1	-		
CO-3	1	2	2	1	-	1	-		
CO-4	1	2	2	1	-	1	2		
CO-5	1	2	2	1	-	1	-		
CO-6	1	2	2	1	-	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418305	Python Programming	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418305	Python Programming	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2418305

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between Procedure Oriented and Object Oriented Programming approach with example. *TSO 1b.* Use the concept of L -value and R -value *TSO 1c.* Write python program using various data types and operators	**Unit-1.0 Basics of Python Programming syntax** 1.1 Python character set, Python tokens, variables, concept of L-value and R-value, use of comments. 1.2 Data types: number (integer, floating point, complex), Boolean, sequence (string, list, tuple), none, mapping (dictionary), mutable and immutable data types 1.3 Operators: arithmetic operators, relational operators, logical operators, assignment operator, augmented assignment operators. Expressions, statement, type conversion & input/output: precedence of operators, expression, evaluation of expression.	**CO-1**
TSO 2a. Write Python program using decision making statements *TSO 2b.* Write Python program using loop structure to solve iterative problems	**Unit-2.0 Conditional and Iterative statements** 2.1 Conditional statements: simple if statement, if- else statement, if-elif-else statement 2.2 Iterative statements: while loop, for loop, range function, break and continue statements, nested loops	**CO-2**
TSO 3a. Perform various operations on string using string operators and methods *TSO 3b.* Perform various operations on List using list operators and methods *TSO 3c.* Perform various operations on tuples using tuples operators and methods *TSO 3d.* Perform various operations on set using set methods *TSO 3e.* Perform various operations on dictionary using dictionary methods	**Unit-3.0 String, List, Tuples, set and Dictionary** 3.1 String: indexing, string operations (concatenation, repetition, membership & slicing), traversing a string using loops, built-in functions. 3.2 Lists: introduction, indexing, list operations: concatenation, repetition, membership & slicing, traversing a list, built- in list functions, linear search on list of numbers and counting the frequency of elements in a list 3.3 Tuples: Creating, initializing, accessing elements, tuple assignment, performing operations on tuples, tuple methods and built-in functions, nested tuples 3.4 Set: Creating set, traversing, adding, removing data in set, performing set operations like join, Union intersection, difference	**CO-3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.5 Dictionary: accessing items in a dictionary using keys, mutability of dictionary: adding a new item, modifying an existing item, built-in dictionary functions.	
TSO 4a. Create and use user defined functions to implement modular programming approach *TSO 4b.* Differentiate variable scope with example. *TSO 4c.* Import and use Python modules, libraries	**Unit-4.0 Python Functions, Modules and packages** 4.1 Functions: types of function (built- in functions, functions defined in module, user defined functions), creating user defined function, arguments and parameters, default parameters, positional parameters, Lambda functions, returning value, scope of a variable: global scope, local scope 4.2 Modules and Packages: Importing module using 'import' Regular Expressions, Exception Handling, PyPI Python Package Index, Pip Python package manager, Importing Libraries and Functions	**CO-4**
TSO 5a. Write simple Python programs with object oriented approach *TSO 5b.* Use constructors and destructors appropriately in python program *TSO 5c.* Explain different type of inheritance based on its characteristic *TSO 5d.* Implement given type of inheritance in Python. *TSO 5e.* Implement the concept of Polymorphism in Python	**Unit-5.0 Object Oriented Programming (OOP)** 5.1 OOPs Object oriented programming concepts and approach, Abstraction, encapsulation, class, object, class method vs static method in Python, class and static variable, constructor and destructors in python 5.2 Inheritance: types of inheritance: single, multiple, multilevel, hierarchical 5.3 Polymorphism: Polymorphism with class method, polymorphism with inheritance, method overriding, overloading	**CO-5**
TSO 6a. Explain different types of Exceptions in python *TSO 6b.* Write Python programs for exception handling in Python *TSO 6c.* Differentiate different modes of file opening. *TSO 6d.* Perform read, Write, Append operations in files	**Unit 6.0 Exception and File Handling in Python** 6.1 Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes. 6.2 File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files, file access modes	**CO-6**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Write, execute and debug simple Python program using Integrated Development and Learning Environment (IDLE)	1.	a) Download and Install IDLE. Write and execute Python program to- b) Calculate the Area of a Triangle where its three sides a, b, c are given. s=(a+b+c)/2,	CO-1

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.2. Write and execute simple 'C' program using variables, arithmetic expressions.		Area=square root of s(s-a)(s-b)(s-c) (write program without using function) c) Swap Two Variables d) Solve quadratic equation for real numbers.	
LSO 2.1. Write and execute python programs using conditional statements. *LSO 2.2.* Write and execute python programs using various types of Loop statements	2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	CO-2
LSO 3.1. Write and execute Python program to perform various operations on string using string operators and methods	3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	CO-2, CO-3
LSO 4.1. Write and execute Python program to perform various operations on List using List operators and methods	4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	CO-2, CO-3
LSO 5.1. Write and execute Python program to perform various operations on Tuple using Tuple operators and methods.	5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	CO-2, CO-3
LSO 6.1. Write and execute Python program to perform various operations on sets using set methods.	6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	CO-2, CO-3
LSO 7.1. Write and execute Python program to perform various operations on Dictionary using Dictionary methods	7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common	CO-2, CO-3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	
LSO 8.1. Write and execute Python program to create user defined functions and call them.	8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.	CO-2, CO-4
LSO 9.1. Write and execute Object Oriented Python program to define a class and its instances. *LSO 9.2.* Develop and execute Python program Using various types of inheritances. *LSO 9.3.* Develop and execute Python program Using various types of Polymorphism.	9.	Write program using OOP approach to – a) create an instance of a specified class and display the namespace of the said instance b) create a Python class named Student with two attributes: student_id, student_name. Add a new attribute: student_class. Create a function to display all attributes and their values in the Student class. c) Create a Python class named Student with two instances student1, student2 and assign values to the instances' attributes. Print all the attributes of the student1, student2 instances d) Write programs to demonstrate use of following types of inheritance: i. Single inheritance ii. Multiple inheritance iii. Multilevel inheritance e) Demonstrate use of polymorphism with following situations: i. Polymorphism in operator ii. Polymorphism in user defined method iii. Polymorphism in built-in function iv. Polymorphism with class method v. Polymorphism with method overriding	CO-2, CO-5
LSO 10.1. Develop and execute Python program to handle various type of exceptions. *LSO 10.2.* Develop and execute Python program to perform file operations.	10.	a) Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. Type Error ii. Name Error iii. Index Error iv. Key Error v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	CO-6, CO-1, CO-2,

Note: in addition to above listed practical, students are suggested to practice all the examples covered by the teacher during theory sessions.

L) Suggested Term Work and Self Learning: S2418305 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments:** Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Crete a shop billing system
2. Create income tax calculation system.
3. Develop number guessing game (random integer will be selected by the system and the user has to guess that integer in the minimum number of guesses. Maximum 5 guess allowed.)
4. Assign numbers to alphabet a-z as (1-26). User will input a word. System will convert in to a number by adding all the individual alphabet of that word.
5. Design a basic calculator program that performs arithmetic operations like addition, subtraction, multiplication, and division based on user input.
6. Any other micro-projects suggested by subject faculty on similar line.

(Students may use file and sequence data types to develop above listed applications)

c. Other Activities:

1. Seminar Topics:

- Tkinter widgets in python
- Python date/time module and its applications
- wxPython and its applications

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	10%	10%	15%	16%	16%	10%	16%
CO-2	15%	15%	15%	16%	16%	15%	16%
CO-3	25%	25%	20%	18%	18%	25%	18%
CO-4	15%	15%	15%	16%	16%	15%	16%
CO-5	25%	25%	25%	18%	18%	25%	18%
CO-6	10%	10%	10%	16%	16%	10%	16%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Basics of Python Programming syntax	4	CO-1	7	3	2	2
Unit-2.0 Conditional and Iterative statements	6	CO-2	10	3	3	4
Unit-3.0 3.0 String, List, Tuples, set and Dictionary	12	CO-3	18	5	3	10
Unit-4.0 Python Functions, Modules and packages	7	CO-4	10	3	3	4
Unit-5.0 Object Oriented Programming (OOP)	12	CO-5	18	4	5	9
Unit-6.0 Exception and File Handling in Python	7	CO-6	7	2	2	3
Total	**48**	**-**	**70**	**20**	**18**	**32**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	CO-1	40	50	10
2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	CO-2	40	50	10
3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels.	CO-2, CO3	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string				
4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	CO-2, CO-3	40	50	10
5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	CO-2, CO-3	40	50	10
6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	CO-2, CO-3	40	50	10
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	CO-2, CO-3	40	50	10
8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.	CO-2, CO-4	40	50	10
9.	Write program using OOP approach to – a) create an instance of a specified class and display the namespace of the said instance b) create a Python class named Student with two attributes: student_id, student_name. Add a new attribute: student_class. Create a function to display all attributes and their values in the Student class. c) Create a Python class named Student with two instances student1, student2 and assign values to the instances' attributes. Print all the attributes of the student1, student2 instances	CO-2, CO-5	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	d) Demonstrate use of polymorphism with following situations: i. Polymorphism in operator ii. Polymorphism in user defined method iii. Polymorphism in built-in function iv. Polymorphism with class method v. Polymorphism with method overriding				
10.	Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. TypeError ii. NameError iii. IndexError iv. KeyError v. ValueError vi. IOError vii. ZeroDivisionError	CO-2, CO-6	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	All
2.	Integrated Development and Learning Environment (IDLE)	S/w to be downloaded for python 3.11.3 or higher	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Computing and Problem-Solving using Python	E. Balagurusamy	McGraw Hill Education (India)Pvt. Ltd.1st Edition /2016
2.	Learning Python Programming	Jeffrey Elkner, Allan B.Downey, Chris Meyers	Samurai Media Limited. 2016
3.	Python Programming	Ashok Namdev Kamthane and Amit Ashok Kamthane	McGraw Hill Education (India) Pvt.Ltd.2020, 2nd Edition
4.	Programming in Python	Dr. Pooja Sharma	BPB Publications 2017

(b) Online Educational Resources:

1. https://docs.python.org/3/tutorial/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

******

A) Course Code : 2418306(P2418306/S2418306)

B) Course Title : Summer Internship -I (Common For all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/ s/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- **CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- **CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- **CO-4** Identify the probable job function and job position in their relevant programme of study.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	1	-	-	1		
CO-2	3	-	-	1	-	-	1		
CO-3	3	-	-	-	1	-	2		
CO-4	3	-	-	-	1	-	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2418306	Summer Internship -I	-	-	02	02	04	02

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2418306	Summer Internship -I	-	-	10	15	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **Suggested Instructional/Implementation Strategies:** Mentors/ Coordinators/ Teachers need to plan and implement the summer internship in their respective programme as per the outcome expected from the programme. However in general, summer internship would help in exploring and exposing the student to the below mentioned dimensions of the world of work. These dimensions can further be explored in depth as per the need and advancement in respective programmes in later stages. Mentors/ Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the whole to part approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the specific diploma programme and then teaching the related concepts ('Part') of the same in subsequent semesters.

- Industrial Layout
- Organizational Structure
- Corporate Communications
- Strategic, Rolling and Developmental plans
- Maintenance Procedures
- Inventory Control and Management System
- Purchase and Store Procedures
- Major Machinery, Tools, Equipment, Devices, Software, Control System etc.
- Product Development, Manufacturing, Packaging and Delivery
- Project Management
- Operation and Maintenance
- Warehouse Management
- Assembly Line
- Quality Assurance and Testing Cell
- Process/ Software Development/ Fabrication/ Construction Work Management
- Testing and Quality Assurance Practices
- Total quality management
- Calliberation and Certification practices
- Safety Practices
- Industrial Acts
- Industrial Grievances
- Behavioural Aspects
- Conduction of Meetings and Discussions
- Sales and Marketing Strategies
- Forecasting and Target Setting
- Production Planning and Control
- Storage Retrieved and Material handling Practices
- Automation and Control Facilities
- Enterprise Resource Planning (ERP)
- Supply Chain
- Customer Satisfaction Strategies
- Finance and Accounts
- Research and Development
- Promotion and Capacity Building Schemes
- Reduce, Reuse and Recycling Efforts and Policies
- Recognitions and Rewards
- After Sale Services
- Promotional Avenues

- Social Corporate responsibilities

J) Assessment of Summer Internship -I

S. No.	Criteria of Assessment	% of Weightage
1.	Maintaining the log book after having exposure to different types of industry/ world of work	15
2.	Preparing the list of job functions and job positions of relevant programme	20
3.	Identify the probable enterprise/ startup for futuristic planning	15
4.	Report writing of summer internship as per the prescribed format	30
5.	Presentation of Report	20
Total		**100**

Note: S. no. 1 to 3 shall be considered for progressive assessment. While S. No. 4 & 5 shall be considered for end term assessment

*****

A) Course Code : **2400008(P2400008/S2400008)**

B) Course Title : Sports, Yoga and Meditation (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale

Sports or Physical Education, Yoga and Meditation is an integral part of a person's overall well-being and is imperative for a healthy mind and body balance. So, it is necessary that every educational institutes should lay ample emphasis on including sports, yoga and meditation as a necessary part of education, however, it depends on how it is introduced in the curriculum makes all the difference. Sports, Yoga and Meditation plays a very important role in overall Well-being for a good personality, develops value system, sense of friendliness, feeling of togetherness thereby developing team spirit and mutual cooperation. Its also plays a major role in reducing level of stress/anxiety and add to the mental toughness. Looking to the ample benefits there is need to inculcate sports, Yoga and meditation as a day to day habit and imparting education related to physical education is more critical than ever before.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

CO-1 Select appropriate physical activities to maintain healthy lifestyle.

CO-2 Apply basic principles and practices of Yoga and meditation for overall growth & development.

CO-3 Use fitness and wellness techniques for optimal health and wellbeing

CO-4 Apply ancient Indian ayurvedic methods and techniques, exercises, yoga and meditation for fitness and wellness.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	3	3	-	1	-	2		
CO-2	3	3	3	-	1	-	2		
CO-3	3	3	3	-	1	-	2		
CO-4	3	2	1	-	1	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400008	Sports, Yoga and Meditation	-	-	01	01	02	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400008	Sports, Yoga and Meditation	-	-	10	-	6	9	25

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units:

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.1a Explain ancient history and development of yoga in India *TSO.1b* Compare the ancient Indian games with the modern games. *TSO.1c* Differentiate between given terms used in sports *TSO.1d* Describe the different aspects of Mental Toughness *TSO.1e* Use Imagery Training for sports *TSO.1f* Apply motivation techniques to motivate students in sports. *TSO.1g* Use concentration techniques for playing and exercising. *TSO.1h* Manage Stress, Anxiety and Arousal during sports. *TSO.1i* Select sports and exercise for healing and developing health and mental wellness *TSO.1j* Describe the impact of parents' involvement in their children's sports activities *TSO.1k* Select sports and exercises for physically challenged as per their need.	**Unit-1.0 Sports and Exercises** 1.1 Historical development of physical activities and sports in India, Indian ancient games- Kho-Kho and Kabaddi, Chariot races, riding elephants and horse, swordsmanship, wrestling, boxing, atyapatya, archery, dancing, dands baithak, malkhamb, lezim, lathi etc 1.2 Origin of traditional sports, 3rd century BCE- martial arts and archery, indoor games like Chess and Snakes & Ladders have origins in ancient India, in the form of games of Chaturanga and Gyan Chauper, 1.3 Dholavira, the world's oldest terraced arena 3000 BC 1.4 Definition of play, game, sports, exercise, psychology, sports psychology and exercise psychology, psychology and common sense. 1.5 Mental toughness- mind, Imagery, use of imagery and imagery in sports, types of imagery (visual, kinesthetic, auditory and olfactory) 1.6 Motivation in sport and goalsetting in sports 1.7 Arousal regulation – self-awareness of regulation, anxiety reduction techniques- somatic anxiety reduction techniques, cognitive Anxiety reduction, multimodal anxiety reduction, coping with stress. Arousal -inducing techniques. Arousal and anxiety measurement factors, Arousal and anxiety signs recognition 1.8 Nutrition and rehabilitation, Importance of concentration and attentional focus in sports and training, Impact of health on healing from physical athletic injuries. Impact of exercise to increase mental wellness, Role of coach in sports, parents' involvement in their children's sports activities. 1.9 Adaptation of sports and exercises for physically challenged students in all levels.	**CO1, CO4**
TSO.2a Explain ancient history and development of yoga in India *TSO.2b* Identify the physiology of yoga and meditation. *TSO.2c* Evaluate meditation and yoga as a healing modality. *TSO.2d* Select asanas and pranayama as per need.	**Unit-2.0 Yoga and Meditation** 2.1 Origin of yoga, History and development of yoga, Adi yogi, evidences of yoga in pre-Vedic period (2700 B.C.), Vedic Period, Pre-Classical Period, Classical Period- Patanjali's period, Modern Period.	**CO2, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.2e Describe the effect of yoga and meditation on ageing, stress and hypertension. *TSO.2f* Select mediation techniques as per the need. *TSO.2g* Explain Bandha, Mudra and Chakra *TSO.2h* Enumerate the steps of Suryanamaskar. *TSO.2i* Select Yoga and Meditation for physically challenged as per their need.	2.2 Yoga practices and the related literature- Vedas (4), Upanishads (108), Smritis, teachings of Buddhism, Jainism, Panini, Epics (2), Puranas (18) 2.3 Importance of Yoga & Mediation, meaning of the term Yoga and Meditation, Fundamentals Principles of Yoga & Fitness training, Eight Limbs of Yoga 2.4 Difference between yoga asana and physical exercises, Difference between yoga and meditation 2.5 Role of Yoga and Meditation in Purificatory Process, in character building, developing concentration, will power and discipline 2.6 Types of Yoga Practices - Asanas, Pranayama, Meditation 2.7 Mindfulness – knowing the mind, training the mind, feeling the mind 2.8 Different Methods of meditation, Physiology of meditation, Mental, physical and emotional benefits of Asanas, Pranayama, Concentration and Meditation 2.9 Bandha, Mudra and Chakra 2.10 Effects of Asanas and pranayama on physiology of human body 2.11 Importance of "Suryanamaskar 2.12 Adaptation of Yoga and meditations for physically challenged students in all levels. 2.13 Yoga Asanas Do's and Don'ts for Beginners	
TSO.3a Explain the ancient Indian ayurvedic methods for fitness and wellness *TSO.3b* Identify the different factors affecting the fitness and wellness in the given situation *TSO.3c* Use different methods to maintain Health and Wellness *TSO.3d* Explain the components of Balance Diet *TSO.3e* Identify the causes of stress and anxiety in the given situation *TSO.3f* Use stress reduction techniques to manage Stress and Anxiety *TSO.3g* Manage Stress, Anxiety and Depression in the given situation *TSO.3h* Select recovery process for energy replenishment after exercise.	**Unit 3.0 Fitness and Wellness** 3.1 Evolution of wellness, 3,000-1,500 BC: Ayurveda –holistic system, Tailored Ayurvedic regimens as per unique constitution of each person (their nutritional, exercise, social interaction and hygiene needs) – with the goal of maintaining a balance that prevents illness. 3.2 Meaning, Importance, Definition and dimensions of Health and Wellness (WHO/Yoga) 3.3 Factors affecting Fitness and Wellness 3.4 Role of Physical Activities and Recreational Games in maintaining physiological and psychological wellbeing. 3.5 Different Methods to Maintain Health, Wellness and to enhance mood 3.6 Nutrition for Health & Wellness, Relationship between Diet and Fitness Components of Balance Diet and its importance – Carbohydrates, Protein, Fat, Vitamins & Minerals, Water, Healthy Lifestyle through Diet and Fitness 3.7 Anxiety, Stress and Aging-Meaning of Anxiety, Stress and Aging, Types and Causes of Stress,	**CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.8 Stress, anxiety and depression reduction with exercise, yoga and meditation 3.9 Energy Continuum and Recovery Process, Metabolism and exercise, Recovery from exercise, Replenishment of energy stores during recovery process, Removal of excess lactic acid produced during exercise	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400008

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Perform various sports activities for overall growth and development *LSO 1.2.* Select suitable sport activities as per your need.	1.	Track & Field: Running, Jumping, walking and Throwing, Cycling Event to develop Endurance, Speed, Strength, Agility, Flexibility etc	CO1
	2.	Aerobics and Gymnastics to develop Strength, Agility and Flexibility	
	3.	Net/Wall Sports – Volleyball and Basketball to develop Endurance, Speed, Strength, Agility and Flexibility	
	4.	Striking & Fielding sports like Cricket, bowling, Hockey, Football Baseball etc. to develop Endurance, Speed, Strength, Agility, Flexibility and Coordination	
	5.	Racket Game- Tennis, Badminton, Table tennis etc to develop Endurance, Speed, Strength, Agility and Flexibility	
	6.	Outdoor games: Kho-Kho and Kabaddi and cycling develop Endurance, Speed, Strength, Agility and Flexibility	
	7.	Indoor games: Chess and Carrom, Swimming, Boxing, Karate Weightlifting, Power Lifting, Physique Training, Archery, Roller Skating etc to develop concentration.	
	8.	Prepare and organize Adapted Sports for various levels of physically challenged and impairments.	
LSOs 2.1 Perform various yogic techniques for internal purification and development.	9.	Shat Karmas: Tratakam, Jala-Neti, Sutra-Neti, Vamana Dhauti, Danda Dhauti, Agnisara, Nauli	CO2
	10.	Perform following asanas with correct posture: Ardha-Padmasana [virasana], Ardha-Halasana, Pavana-Muktasana, Naukasana, Ardha-shalabhasana, Shalabhasana, Makarasan, Bhujangasana, Dhanurasana	
	11.	Perform following asnas with correct posture: Vakrasana,Chakrasana,Paschimottanasana,Ugrasana,Gomukh asana, Padmasana, Siddhasana, Bhadrasana, Swastikkasana, Vajrasana, Supta-Vajrasana, Yoga-Mudra	
	12.	MUDRAS & SURIYANAMASKAR Brahma-Mudra, Simha-Mudra, Shanmugi Mudra, Viparithakarani-Mudra, Ashwsini-Mudra, Suriyanamaskar	
	13.	BANDHAS: Jalandhara-Bandha, Jihva-Banda, Uddiyana Bandha, Moola-Bandha	
	14.	PRANAYAMAS : Nadi-Shuddhi, Nadi-Shodhana, Suryabhadana, Ujjayi, Bhastrika Pranayama, Bhramari Pranayama, Sitkari , Sitali , Kapalabhati	
	15.	MEDITATION -Silent Meditation	
	16.	MEDITATION – Mantra Meditation	

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 3.1. Prepare diet chart for optimal health and wellbeing	17.	Prepare a diet chart for the given sport.	CO3
LSO 3.2. Use health monitoring device	18.	Measure heart rate and heart function with health monitoring device	
	19.	Measure blood sugar and blood pressure	
LSO 3.3. Use different equipment's	20.	Use massage therapy equipment, Hot and cold therapy equipment, Ultrasound therapy equipment	
LSO 3.4. Identify your own threshold and identification level for different taste Stimulations	21.	Determine the taste threshold for three different sensations-sweet salty and sour	
LSO 3.5. Check the given sample for conformance to the standard for moisture content.	22.	Determine the moisture content in the given sample of oil/fat	
LSO 3.6. Purity tests of oils/fats	23.	Determine the impurities in the given sample of oil.	
LSO 3.7. Acidity test in given sample of fat/oil	24.	Determines the acid value and free fatty acids in the given sample of oil/fat.	
LSO 3.8. Check whether any given samples of oils/fats conform to the standard.	25.	Determine the peroxide value in the given sample of fat or oil.	

L) Suggested Term Work/ Activities and Self Learning: S2400008 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

i. Calculate your Body Composition (BMI) and Cardiovascular Assessment
ii. Assessment for Muscular Endurance, Muscular Strength,
iii. Flexibility, Cardio-respiratory Endurance, Body Composition
iv. Rules and Regulations of different indoor and outdoor games.

b. Micro Projects:

i. Identify and synthesize the factors that influence health in various situations (05 situations). Prepare a report with details of situations and solutions to remove the factors.
ii. Visit different sports club, gyms, and schools and identify various measure taken by them for Fitness and wellness of students/ members
iii. Visit different sports club, gyms, and schools and identify various measure taken by them for Fitness and wellness of physically challenged students/ members
iv. Identify which type of stress, anxiety and depression students are facing and steps and solutions to overcome this.

c. Other Activities:

1. Seminar Topics:

- Identify the health-related challenges in current time and able to apply the preventive measures.
- Role of peers, community and media in health and wellbeing in each level
- Knowledge and skills required to preserve community health and well-being
- Effect of yoga and meditation in maintaining fitness.

- Methods to involve physically challenged students /members in all levels in sports, yoga and meditation in community.
- Counselling techniques to counsel players in matters of handling success and failure.

2. Visits: Visit nearby sports complex, Gyms, stadium etc and prepare a report on hygiene maintenance, medical facilities available, facilities available for physically challenged members, facilities available for old aged members, tools and equipment available and training facilities.

3. **Self-Learning Topics:**

- Anatomy and physiology of human being
- Role of Yoga and Meditation in Purificatory Process, in character building, developing concentration, will power and discipline
- Mindfulness
- Different Methods to Maintain Health, Wellness and to enhance mood
- Diet and Nutrition
- Metabolic adaptations to exercise
- Cardio-respiratory changes

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1, CO-4	-	-	35%	35%	35%	35%	35%
CO-2, CO-4	-	-	35%	35%	35%	35%	35%
CO-3, CO-4	-	-	30%	30%	30%	30%	30%
Total Marks	-	-	10	10	05	10	15
			25				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Track & Field: Running, Jumping, walking and Throwing, Cycling Event to develop Endurance, Speed, Strength, Agility, Flexibility etc	CO1	30	60	10
2.	Aerobics and Gymnastics to develop Strength, Agility and Flexibility		30	60	10
3.	Net/Wall Sports – Volleyball and Basketball to develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
4.	Striking & Fielding sports like Cricket, bowling, Hockey, Football Baseball etc. to develop Endurance, Speed, Strength, Agility, Flexibility and Coordination		30	60	10
5.	Racket Game- Tennis, Badminton, Table tennis etc to develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
6.	Outdoor games: Kho-Kho and Kabaddi and cycling develop Endurance, Speed, Strength, Agility and Flexibility		30	60	10
7.	Indoor games: Chess and Carrom, Swimming, Boxing, Karate Weightlifting, Power Lifting, Physique Training, Archery, Roller Skating etc to develop concentration.		30	60	10
8.	Prepare and organize Adapted Sports for various levels of physically challenged and impairments.		30	60	10
9.	Shat Karmas : Tratakam, Jala-Neti, Sutra-Neti, Vamana Dhauti, Danda Dhauti, Agnisara, Nauli	CO2	40	50	10
10.	Perform following asanas with correct posture: Ardha-Padmasana [virasana], Ardha-Halasana, Pavana-Muktasana, Naukasana, Ardha-shalabhasana, Shalabhasana, Makarasan, Bhujangasana, Dhanurasana		40	50	10
11.	Perform following asnas with correct posture: Vakrasana, Chakrasana, Paschimottanasana, Ugrasana, Gomukhasana, Padmasana, Siddhasana, Bhadrasana, Swastikkasana, Vajrasana, Supta-Vajrasana, Yoga-Mudra		40	50	10
12.	MUDRAS & SURIYANAMASKAR Brahma-Mudra, Simha-Mudra, Shanmugi Mudra, Viparithakarani-Mudra, Ashwsini-Mudra, Suriyanamaskar		40	50	10
13.	BANDHAS: Jalandhara-Bandha, Jihva-Banda, Uddiyana Bandha, Moola-Bandha		40	50	10
14.	PRANAYAMAS Nadi-Shuddhi, Nadi-Shodhana, Suryabhadana, Ujjayi, Bhastrika Pranayama, Bhramari Pranayama, Sitkari , Sitali , Kapalabhati		40	50	10
15.	MEDITATION -Silent Meditation		40	50	10
16.	MEDITATION - Mantra Meditation		40	50	10
17.	Prepare a diet chart for the given sport.	CO3	40	50	10
18.	Measure heart rate and heart function with health monitoring device		40	50	10
19.	Measure blood sugar and blood pressure		40	50	10
20.	Use massage therapy equipment, Hot and cold therapy equipment, Ultrasound therapy equipment		40	50	10
21.	Determine the taste threshold for three different sensations- sweet salty and sour		40	50	10
22.	Determine the moisture content in the given sample of oil/fat		40	50	10
23.	Determine the impurities in the given sample of oil.		40	50	10
24.	Determines the acid value and free fatty acids in the given sample of oil/fat.		40	50	10
25.	Determine the peroxide value in the given sample of fat or oil.		40	50	10

Note: -All the above Games can be selected from the list of SGFI/AIU/IOA

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	High end computers for record keeping	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Aerobics and Gymnastic	Basic facilities and equipment's – Balance Beams, Gymnastic Ball, Gymnastic Chalk, Gymnastic, Clubs, Flex Floor Systems, High Bars, Hoops, Horizontal Bars, Leotards, Music, Parallel Bar, Pommel Horses, Ribbons, Rings, Ropes, Sigle Bar Trainer, Spotting Blocks, Streamers, Trampoline, Tumble Track, Uneven Bar, Vault, Vault Spring Board Gymnastic Accessories – Chalk, Grips, Wrist Supports, Mat, Tape, Socks Singlets, Pants Shoes, Shorts Aerobics- Resistance bands, Jump rope, Step bench or box, Abdominal wheel, Exercise mat, Gliding discs, dumbbells, fitness trampolines, hoops	2
3.	Striking & Fielding sports	Complete Cricket Kit, Football Kit, Bowling Kit, Hockey Kit	4
4.	Net/Wall Sports	Complete Volley Ball and basketball kit	3
5.	Racket Game	Complete Tennis Kit, Table Tennis Kit and badminton kit	5
6.	Outdoor games	Complete Kho-Kho and Kabaddi and cycling kit	6
7.	Indoor games	Complete Chess kit, Carrom kit, Swimming kit, Boxing kit, Karate kit, Weightlifting kit, Power Lifting kit, Archery kit and Roller-Skating kit	7
8.	Physique Training	Cardio Machines- Treadmills, Elliptical Trainers, Exercise Bikes, Rowing Machines, Indoor Bikes, Vibration Machines, Steppers Recumbents Dumbbells, Multi-Purpose Bench, power rack, Adjustable Dumbbell Set 2 x 3-10 kg, Exercise mat, resistance band, balance trainer	7
9.	Sports and wellbeing equipment's for physically challenged and impairments.	Fusion Wheel – all-in-one portable wheelchair gym, Pedal exerciser, Deluxe hand exerciser, Greeper sports shoelaces, Active Hands, Ramble Tag Guidance Aid, Cat Tongue Grip Tape **Adaptive Cycling**- Straps, Leg/ Foot Adapters, Prosthetics, Steering Dampener, Handlebar Adapters, HANDCYCLING- Wheelchairs, Bike-On Handcycles, Trikes, Racing Wheelchairs, Trikes, Recumbent Bikes, All-terrain Handcycles, Mono Cycling, Hand Bikes - Off-Road, Cross Country, Racing, Downhill **Archery -** Field Tripod and Quad Mounts (Archery & Gun), In-Line Draw-Loc, Mounts (Archery & Gun), Stands (Gun), Mounts	8

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
		(Archery & Gun) Binoculars and Rests (Gun), Crossbows (Archery), Wheelchair Platform Stabilizing Crutch Poles, Dampeners, Crossbows (Archery), Hands free shooting rest (Gun) Bowling: ramp, roll assist **Fitness**: Anti-Gravity Treadmill, LapMat for Wheelchairs, Strike Assist, Adaptive Treadmill	
10.	Yoga	Yoga Mats, Yoga Rollers, Yoga Blocks, Aero Yoga Clothing Blankets, cloth Straps, Bolsters, Wheels	9-16
11.	Fitness and wellbeing equipment's	Health monitoring devices for overall healt- Personal health monitor for heart health, Blood sugar monitoring device, Wireless blood pressure device, Smart watch to track heart function, Hot and cold therapy equipment, Massage therapy equipment, Ultrasound therapy equipment	18-20
12.	Taste kit -To test three different sensations- sweet salty and sour	Salt solution (%) -0.5, 0.8, 1.0, 1.2, 1.5, Sugar solution (%) - 0.05, 0.5, 0.7, 1.0, 1.2, Citric acid (%) - 0.02, 0.04, 0.1, 0.5, 1.0 Spoons, Bowls, Beakers, Plain distilled water	21
13.	Test kit to measure peroxide value in the oil	Reagents: Acetic acid-chloroform solution, Saturated potassium iodide solution, Sodium thiosulphate solution- 0.1 N, Starch solution (1%) Apparatus: Pipette 1ml capacity, Conical flask	25
14.	Test kit to measure acid value and free fatty acids in the oil	Sample of oil/fats namely any refined oil or hydrogenated fat. Reagents - ethyl alcohol (95%), phenolphthalein indicator solution, standard aqueous sodium or potassium hydroxide solution (0.1 N or 0.5 N), Pipette (10 ml), Conical flask	24
15.	Test kit to measure impurities in the oil	Sample of Oil/fat, Oven-electric, maintained at 100 ± 1°C., Desiccator, Weighing balance, Filter paper	23
16.	Test kit to measure moisture content in the oil	Sample of oil/fat, Moisture dish-made of porcelain, silica, glass or aluminum, Oven-electric, maintained at 105 ± 1°C., Desiccator Weighing balance	22

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher with ISBN
1.	Practical Applications in Sports Nutrition	Heather Hedrick Fink, Alan E. Mikesky	Jones & Bartlett Learning (2020) ISBN No: 978-1284181340
2.	Massage and Medical Gymnastics,	Lace, M. V.	London: J & A Churchill Ltd. ASIN: B000RY4YB0
3.	ACSM's Guidelines for Exercise Testing and Prescription	Gary Liguori	LWW; (2021) ISBN-13: 1975150198-978
4.	Essentials of Strength Training and Conditioning	Javair Gillett	Human Kinetics, (2021) ISBN-13: 1718210868-978
5.	Practical Applications in Sports Nutrition	Heather Hedrick Fink, Alan E. Mikesky	Jones & Bartlett Learning, (2017) ISBN-13: 1284101393-978
6.	Health Fitness Management	Mike Bates, Mike Spezzano, Guy Danhoff	Human Kinetics, (2019) ISBN-13: 1450412230-978
7.	Yoga for Every Body: A beginner's guide to the practice of yoga postures, breathing exercises and meditation	Luisa Ray, Angus Sutherland	Vital Life Books (2022) ISBN-13: 1739737009-978
8.	Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice	Ann Swanson	DK Publisher, (2019) ISBN-13: 1465479358-978
9.	Mudras for Modern Living: 49 inspiring cards to boost your health, enhance your yoga and deepen your meditation Cards	Swami Saradananda	Watkins Publishing (2019) ISBN-13: 1786782786-978

S. No.	Titles	Author(s)	Publisher with ISBN
10.	Principles and Methods of Adapted Physical Education & Recreation	Kristi Roth, Laurie Zittel, Jean Pyfer, David Auxter	Jones & Bartlett Learning, (2016) ISBN-13: 1284077810-978
11.	Adapted Physical Education and Sport Sixth Edition	Joseph P. Winnick, David L. Porretta	Human Kinetics, (2016) ISBN-13: 1492511533-978
12.	Counselling Skills in Applied Sport Psychology: Learning How to Counsel	Paul McCarthy, Zoe Moffat	Routledge, (2023) ISBN-13: 1032592589-978
13.	Basic Counselling Skills: A Helper's Manual	Richard Nelson Jones	Sage Publication 2012, New Delhi.
14.	Advancements in Mental Skills Training (ISSP Key Issues in Sport and Exercise Psychology)	Maurizio Bertollo, Edson Filho, Peter Terry	Routledge, (2020) ISBN-13: 0367111588-978
15.	The Relaxation and Stress Reduction Workbook	Martha Davis, Elizabeth Robbins, Matthew McKay, Eshelman MSW	A New Harbinger Self-Help Workbook (2019)
16.	Patanjalis Yoga Sutras	Swami Vivekananda	Fingerprint Publishing (2023) Prakash Books India Pvt Ltd, New Delhi, ISBN-13: 9354407017-978

(b) Online Educational Resources:

1. https://onlinecourses.swayam2.ac.in/aic19_ed28/preview- introduction to Yoga and Applications of Yoga
2. https://onlinecourses.swayam2.ac.in/aic23_ge09/preview- Yoga for Creativity
3. https://onlinecourses.swayam2.ac.in/aic23_ge05/preview- Yoga for concentration
4. https://onlinecourses.swayam2.ac.in/aic23_ge06/preview- yoga for memory development
5. https://onlinecourses.nptel.ac.in/noc21_hs29/preview-Psychology of Stress, Health and Well-being
6. https://onlinecourses.swayam2.ac.in/nce19_sc04/preview- Food Nutrition for Healthy Living - Course – Swayam
7. https://www.classcentral.com/course/swayam-fitness-management-17608- Fitness Management from Swayam
8. https://onlinecourses.swayam2.ac.in/nce19_sc04/preview-Food Nutrition for Healthy Living
9. https://onlinecourses.swayam2.ac.in/cec21_ed02/preview Health Education and Recreation
10. https://onlinecourses.swayam2.ac.in/cec22_ed31/preview Sports Administration and Management

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(c) Others:

1. https://www.yogajournal.com/yoga-101/philosophy/good-read
2. http://hdl.handle.net/123456789/38171- Yoga Philosophy
3. https://yoga.ayush.gov.in

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A) Course Code : **2400111(T2400111)**

B) Course Title : Principles of Management
(CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)

C) Pre- requisite Course(s) :

D) Rationale :

The course is designed to provide students with an overview of the management functions and its role in organizations and society. The course aims to provide students with the basic managerial knowledge necessary for engineering students in the world of work. The course focuses on providing students with analytical, developmental, managerial, and technical skills that relate to managerial positions in organizations. This course is an introduction to the critical management skills involved in planning, organizing, controlling, leading and decision making in an organization. It provides a framework for understanding issues involved in both managing and being managed, and it will help you to be a more effective contributor to organizations that you join.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Design strategic plan for various types of organizations.
- **CO-2** Take decisions to handle world of work situations.
- **CO-3** Formulate organizational hierarchy for different situations.
- **CO-4** Identify various leadership styles.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	1	-	-	-	-	3	1		
CO-2	1	2	2	-	-	3	1		
CO-3	1	-	3	-	-	3	1		
CO-4	1	2	-	-	1	3	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)				
		Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
		L	T			
2400111	Principles of Management	01	-	-	01	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture(L), Tutorial(T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400111	Principles of Management	25	-	-	-	-	-	25

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400111

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the nature of management *TSO 1b.* List the steps of evolution of management. *TSO 1c.* Differentiate between different plans. *TSO 1d.* Design Strategic plan for the given world of work situation. *TSO 1e.* Take decisions in the given situation with justification.	**Unit-1.0 Introduction to Management and Planning** 1.1 Nature and Purpose. 1.2 Evolution of Management Thoughts. 1.3 System approach to Management Process. 1.4 Types of Plans: Missions or Purpose, Objective or Goals, Strategies, Policies, Procedures. 1.5 Decision Making.	**CO1, CO2**
TSO 2a. Differentiate formal and informal organizations. *TSO 2b.* Identify the levels of hierarchy in the given organization. *TSO 2c.* List the staffing principles.	**Unit-2.0 Organizing and Staffing** 2.1 Nature of Organizing 2.2 Formal and Informal Organization 2.3 Principles of Organizing, Organizational Hierarchy, Authority, and Power. 2.4 Staffing, Recruitment, Selection, Performance Appraisal.	**CO3**
TSO 3a. Explain the theories of motivation *TSO 3b.* Differentiate between leadership styles	**Unit-3.0 Motivation and Leadership** 3.1 Motivation 3.2 McGregor Theory of X and Y 3.3 Maslow Hierarchy of Needs Theory 3.4 Herzberg's Motivation- Hygiene Theory 3.5 Leadership: Definition, Ingredients, Styles, theories	**CO4**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Term Work and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

- Describe about adopting the systems approach in any organization.
- Write in brief about grapevine communication.
- Compare the traits Theory of X and Y as proposed by McGregor

b. **Micro** Projects:

- Apply Maslow's need hierarchy theory in workplace.

c. Other Activities:

1. Seminar Topics:
   - Importance of management theories in the corporates.
   - The hierarchy levels crate smoothness in functioning of any organization.
   - Leadership practices that are popular in current scenario.

2. Visits:
   - Visit nearby corporate setup and report
   - Interview leaders in the organization and identify leadership style'

3. Self-Learning Topics:
   - Herzberg's Motivation- Hygiene Theory
   - Leadership theories
   - Motivation for efficient productivity

L) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

M) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

N) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fundamentals of Management: Essential Concepts and Applications	Robbins S.P. and DeCenzo David A	Pearson Education
2.	Koontz Essentials of Management	Koontz	Tata McGraw Hill Latest Edition
4.	Principles and Practices of Management	Shejwalkar and Ghanekar	Tata McGraw Hill Latest Edition
5.	Fundamentals of Management	Robbins and Dinzo	2002, Pearson India.
6.	Organization Theory, Structure, Design and Application	Stephen P. Robbins	PHI, New Delhi, 2005

(b) Online Educational Resources:

1. https://www.coursera.org/learn/principles-of-management
2. https://alison.com/course/an-introduction-to-the-principles-of-management
3. https://www.udemy.com/course/principles-of-management-j/
4. https://lumenlearning.com/courses/principles-of-management/
5. https://www.mygreatlearning.com/academy/learn-for-free/courses/principles-of-management

6. https://onlineprogrammes.insead.edu/leadership-programme-for-senior-executives
7. implilearn.com/general-management-certification-training-course?utm_source=google&utm_medium=cpc&utm_term
8. https://discovery.ucl.ac.uk/id/eprint/10115948/1/Educational-Resource-Management.pdf
9. https://libraries.etsu.edu/research/guides/management/oer
10. https://www.cmu.edu/teaching/designteach/syllabus/checklist/learningresources.html

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(c) Others: -

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