Course Code	EEE2005B			
Course Category	Professional Core			
Course Title	Data Structures and Algorithms			
Weekly Teaching Hrs. and Credits	L	T	Laboratory	Credits
	3	0	2	3 + 0 + 1

Pre-requisites: Programming and Problem Solving

Course Objectives:

1. Understand the concept of data structures using C.
2. Create and manipulate linear data structures like arrays, linked list, stack, and queue.
3. Create and manipulate nonlinear data structures like graphs and tress.
4. Develop the ability to write program in C for problem solving using suitable data structure.

Course Outcomes: After completion of this course students will be able to

1. Develop skills of writing and analyzing algorithms to solve problem (CL-III).
2. Identify and apply the concept of Linear Data Structures for problem solving and its applications (CL-III).
3. Demonstrate the usage and applications of stacks and queues (CL-II).
4. Apply concept of nonlinear data structure (Trees) for problem solving and its applications (CL-III).
5. Apply concept of Nonlinear data structure (Graphs) for problem solving and its applications (CL-III).

Course Contents:

Introduction to Data Structures: Data, Data Objects, and Data Structure, Classification of data structure (Primitive and Non-primitive, Linear and Non-linear, Static and dynamic), C Basics, Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.

Linked List: Introduction to Linked Lists, Dynamic memory allocation, Operations on Singly Linked List, Doubly Linked List, Circular Linked List, Case study: Polynomial addition using linked list, Garbage collection.

Stacks: Representation of Stack using Array and Linked List, Stack Applications: Reversing List, Arithmetic expressions conversion and evaluation.

Queues: Representation of Queue using Array and Linked List, Circular Queue, Application: Job scheduling in Operating System.

Non-Linear Data Structure (Trees): Binary Tree**:** Basic Terminologies, Properties of Binary Trees, Representation of Binary Trees, Binary Tree Traversal, Binary Search Trees (BST) and its operations, Reconstruction of Binary Tree, Applications of Tree.

Non-Linear Data Structure (Graph): Graph Terminologies, Sequential and Linked Representation of Graph, Creation and Traversal of Graph, Spanning Tree, Minimum Spanning Tree-Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Shortest Path Algorithm

Laboratory Exercises / Practical:

1. Searching

2. Sorting

3. Operations on linked list.

4. Palindrome using stack

5. Expression conversion

6. Circular queue.

7. Binary Search Tree creation and Traversals.

8. Graph Creation and Traversal

9. Mini project.

Learning Resources:

Text books:

1. Horowitz, S. Sahani, S. Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2008.

Reference Books:

1. Balgurusamy E., *Programming in ANSI.* New Delhi: Tata McGraw-Hill, 3rd edition.
2. ISRD Group, *Data Structures Using C.* New Delhi: Tata McGraw Hill, 2nd Edition, 2012.
3. Yedidyah Langsam, Moshe J Augenstein, and Aaron M Tenenbaum, *Data structures using C and C++.* New Delhi: PHI Publications, 2nd edition.

Supplementary Reading:

1. Peter van der Linden, *Experts C Programming.* Pearson Education

2. Seymour Lipschutz, *Data Structure with C.* New Delhi: Tata McGraw-Hill. Schaum's Outlines.

Web Resources:

www. leetcode.com
www.hackerrank.com/domains/algorithms/warmup

Web links:

www.tutorialspoint.com/data_structures_algorithms/
www.programiz.com/dsa

MOOCs:

www.edx.org/course/foundations-data-structures-iitbombayx-cs213-1x-0

Pedagogy:

- White board
- Group Activities
- Power Point Presentations, Videos
- Co-teaching

Assessment Scheme:

Class Continuous Assessment (CCA) (30 Marks)

Assignments	Class Test	Case study	Mid term
10	5	-	15

Laboratory Continuous Assessment (LCA) (30 Marks)

Practical	Oral based on practical	Any other (Problem solving though coding platform)
15	15	-

Term End Examination: Term end exam of 40 Marks will be based on entire syllabus.

Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**Introduction to Data Structures:** Data, Data Objects, and Data Structure, Classification of data structure (Primitive and Non-primitive, Linear and Non-linear, Static and dynamic), C Basics, Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.	15		-
2	**Linked List:** Introduction to Linked Lists, Dynamic memory allocation, Operations on Singly Linked List, Doubly Linked List, Circular Linked List, Case study: Polynomial addition using linked list, Garbage collection.	8		--
3	**Stacks:** Representation of Stack using Array and Linked List, Stack Applications: Reversing List, Arithmetic expressions conversion and evaluation. **Queues:** Representation of Queue using Array and Linked List, Circular Queue, Application: Job scheduling in Operating System.	8		-
4	**Non-Linear Data Structure (Trees):** Binary Tree: Basic Terminologies, Properties of Binary Trees, Representation of Binary Trees, Binary Tree Traversal, Binary Search Trees (BST) and its operations, Reconstruction of Binary Tree, Applications of Tree.	7		-

5	**Non-Linear Data Structure (Graph):** Graph Terminologies, Sequential and Linked Representation of Graph, Creation and Traversal of Graph, Spanning Tree, Minimum Spanning Tree-Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Shortest Path Algorithm	7		

Unit	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	Write a program to search a number from the given list of numbers stored in an array using linear search and binary search.		2	
2	Write a C program to create a student database using an array of structures and apply: (a) Bubble sort, (b) Insertion sort and display the output after each pass.		2	
3	Write a C program to perform the following operations on a singly linked list: (a) Create (b) Delete (c) Insert (d) Display (e) Search.		4	
4	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C program with functions a) To print original string followed by reversed string using stack		4	

	b) To check whether given string is palindrome or not			
5	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions.		**4**	
6	Pizza parlor accepting maximum M orders. Orders are served on a first come first-served basis. Order once placed cannot be canceled. Write a C program to simulate the system with a simple queue using an array. Implement the same system using Circular Queue		**2**	
7	Write a C program to perform the following operations on Binary Search Tree: (a) Create (b) Search (c) Traverse (in-order, pre-order, post-order recursive)		**4**	
8	Write a C program to create graph using adjacency matrix and traverse using BFS and DFS method.		**4**	
9	Mini Project		**4**	

Course Code	EEE2007B			
Course Category	**Professional Core**			
Course Title	**Power Systems and Protection**			
Weekly Teaching Hrs. and Credits	**L**	**T**	**Laboratory**	**Credits**
	4	**0**	**2**	**4 + 0 + 1**
Pre-requisites: Basics of electrical engineering and electrical machines				

Course Objectives:
1. To identify the basic structures and components of electrical power systems and calculate various related electrical parameters
2. To acquire knowledge requirements of mechanical and electrical design of overhead transmission lines.
3. To grasp knowledge of construction and working principles of various relays and circuit breakers
4. To understand various types of faults and protection schemes in power systems components.

Course Outcomes: After completion of this course students will be able to
1. Design of electrical and mechanical aspects in overhead transmission (CL – III)
2. Evaluate different electrical parameters of transmission line configurations (CL - III).
3. Identify, formulate and solve problems in protection of power systems (CL – IV).
4. Select and allocate proper protection scheme for the power systems (CL – IV)

Course Contents:

Power system structure: Structure of power system, evolution of power systems, power plants, national grid, factors and terms associated with the generating station, types of conductors, overhead line supports, spacing, span, sag, concept of real, reactive and complex power and their effect on power system operation.

Transmission line parameters and models: Per unit system, reactance diagram calculation of resistance, inductance and capacitance of single phase, three phase, double circuit lines, concept of GMR and GMD, skin effect, proximity effect and corona effect, transmission line models - short, medium and long lines.

Power Flow and Power System Stability: voltage and current waves, surge impedance loading, complex power flow, power transmission capability, Ferranti effect, tuned power lines, methods of voltage control, stability, dynamics of synchronous machine, swing equation, power angle equation and curve, equal area criterion.

Protection and relays: Need for protective systems, faults, causes, effects, classification of relays, zones of protection, primary and backup protection, basic trip circuit, operating principles of different relays, numerical relay's introduction, block diagram.

Circuit Breakers: Arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, circuit breaker ratings, classification of C.B.s - air break, air blast, vacuum, oil, SF6.

Protection Schemes in Power Systems: Differential and earth fault protection in transformers, Buchholz relay, protection against stator fault, ground fault, unbalanced loading in alternators, distance protection in transmission lines.

Laboratory Exercises / Practical:
1. Experiment to determine efficiency and regulation of medium transmission line and to study Ferranti effect.
2. Experiment to study capacitive VAR compensation.
3. Synchronization of alternators.
4. Simulation of the effect of line parameters on performance of transmission line.
5. Formation of bus admittance matrix using MATLAB.
6. Testing of fuse, MCB and ACB.
7. Obtaining operating characteristics of IDMT relay.
8. Using distance relays for transmission line protection.
9. Using Buchholz relay for transformer protection.
10. Using differential protection relay for transformer protection.

Learning Resources:

Reference Books:
1. Grainger John J. and W. D. Stevenson Jr, *Power System Analysis* McGraw Hill Education, 2017.
2. I. J. Nagrath, D. P. Kothari, *Modern Power System Analysis*. New Delhi: Tata McGraw Hill Publishing Co. Ltd., 4th edition, 2011
3. O. I. Elgerd, *Electrical energy systems theory: An introduction. New Delhi:* Tata McGraw Hill, 2nd Edition, 2017
4. C. Russel Mason. Art and Science of Protective Relaying, Wiley 1966
5. S. S. Rao, Ravish R. Singh. Switchgear, Protection and Power System, Khanna Publishers, 13th edition, 2008

Supplementary Reading:

1. Hadi Sadat, *Power System Analysis.* PSA Publishing LLC, 3rd Edition, 2011
2. J. D. Glover and M. Sarma, *Power System Analysis and Design*. 5th Edition, Brooks/ Cole Publishing, 2011
3. A.R. Van, C. Warrington. Protective Relays – Theory and Practice, Chapman and Hall n, 3rd Edition,

Web Resources:
    http://nptel.ac.in/courses/108102047/
    http://nptel.ac.in/courses/108105067/

Pedagogy:
- ● Power Point Presentations, Videos
- ● Co-teaching
- ● Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA) (30 Marks)

Assignments	Midterm Exam	Class Test	Students Initiatives
10	15	5	Nil

Laboratory Continuous Assessment (LCA) (30 Marks)

Understanding the Objectives	Understanding of Procedure and Initiatives	Experimental Skills	Oral	
5	5	5	15	

Term End Examination:
Term end exam of 40 Marks will be based on entire syllabus.

Syllabus:

Unit	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Power system structure:** Structure of power system, evolution of power systems, power plants, national grid, factors and terms associated with the generating station, types of conductors, overhead line supports, spacing, span, sag, concept of real, reactive and complex power and their effect on power system operation	9	4	
2	**Transmission line parameters and models:** Per unit system, reactance diagram calculation of resistance, inductance and capacitance of single phase, three phase, double circuit lines, concept of GMR and GMD, skin effect, proximity effect and corona effect, transmission line models - short, medium and long lines.	12	6	
3	**Power Flow and Power System Stability:** voltage and current waves, surge impedance loading, complex power flow, power transmission capability, Ferranti effect, tuned power lines, methods of voltage control, stability, dynamics of synchronous machine, swing equation, power angle equation and curve, equal area criterion.	12	4	
4	**Protection and relays:** Need for protective systems, faults, causes, effects, classification of relays, zones of protection, primary and backup protection, basic trip circuit, operating principles of different relays, numerical relay's introduction, block diagram.	9	4	
5	**Circuit Breakers:** Arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, circuit breaker ratings, classification of C.B.s - air break, air blast, vacuum, oil, SF6.	9	6	
6	**Protection Schemes in Power Systems:** Differential and earth fault protection in transformers, Buchholz relay, protection against stator fault, ground fault, unbalanced loading in alternators, distance protection in transmission lines.	9	6	