



**D Y PATIL**  
COLLEGE *of*  
ENGINEERING & TECHNOLOGY  
(AN AUTONOMOUS INSTITUTE)  
KASABA BAWADA, KOLHAPUR

# **D. Y. Patil College of Engineering and Technology**

Kasaba Bawada, Kolhapur

**(An Autonomous Institute)**

**Accredited by NAAC with 'A' Grade**

## **Structure and Syllabus of S.Y. B. Tech in CSE (Artificial Intelligence and Machine Learning)**

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**Department of Computer Science and Engineering  
(AI-ML)  
2023-24**

**D Y Patil College of Engineering & Technology, Kasaba Bawada, Kolhapur**  
**Department of Computer Science & Engineering**  
**Curriculum Structure for B. Tech in CSE ( Artificial Intelligence and Machine Learning)**

**Second Year B. Tech. Program in Computer Science & Engineering ( AI and ML) Semester – III**

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201AIMLL201	BSC	Linear Algebra	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201AIMLL202	BSC	Discrete Mathematics and Graph Theory	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201AIMLL203	ESC	Computer Architecture and Microprocessors	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201AIMLL204	PCC	Data Structures	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201AIMLL205	PCC	Computer Networks	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
6	201AIMLP206	PCC	Java Programming Laboratory	2	-	4	2	100	ISE	50	20	40
									ESE-POE	50	20	
7	201AIMLP207	PCC	Data Structure Laboratory	-	-	2	1	75	ISE	25	10	30
									ESE-POE	50	20	
8	201AIMLP208	PCC	Computer Networks Laboratory	-	-	2	1	50	ISE	25	10	20
									ESE-OE	25	10	
9	201AIMLMC209	MC	Environmental Studies (Mandatory Course-I)	2	-	-	-	50	ESE	50	20	20
Total				19	1	8	20	775	-	-	-	310
				28								

**ISE: In Semester Evaluation**

**MSE: Mid Semester Examination**

**ESE: End Semester Examination**

**Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students**

**Note 2 : ESE will be conducted for 100 marks and converted to 50 marks**

**Second Year B. Tech. Program in Computer Science & Engineering ( AI and ML) Semester – IV**

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201AIMLL210	BSC	Probability and Statistics	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201AIMLL211	PCC	Operating Systems	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201AIMLL212	PCC	Computer Algorithms	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201AIMLL213	PCC	Fundamentals of Artificial Intelligence	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201AIMLL214	PCC	Formal Automata and Applications	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
6	201AIMLP215	PCC	Python Programming Laboratory	2	-	2	3	50	ISE	25	10	20
									ESE-POE	25	10	
7	201AIMLP216	PCC	Artificial Intelligence Laboratory	-	-	2	1	75	ISE	25	10	30
									ESE-POE	50	20	
8	201AIMLP217	HMCS	Soft Skill Laboratory	-	-	2	1	50	ISE	25	10	20
									ESE-OE	25	10	
9	201AIMLMC218	MC	Economics and Management for IT (Mandatory Course-II)	2	-	-	-	50	ESE	50	20	20
Total				19	2	6	22	725	-	-	-	290
				27								

*ISE: In Semester Evaluation*

*MSE: Mid Semester Examination*

*ESE: End Semester Examination*

**Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.**

**Note 2 : ESE will be conducted for 100 marks and converted to 50 marks.**

**\*\*\* 4 to 6 weeks Internship is mandatory in summer vacation of SEM-IV or SEM-VI (Credits will be considered in VII semester)**

**Summer Internship**

The students are expected to undergo **4 to 6 weeks Internship** in the industry and work on the relevant area as assigned by the Industry. The work done should be monitored and evaluated by the concerned industry expert based on the report prepared by the student. The department has to assign faculty mentors to a student who has to communicate with the industry and monitor the entire internship related work periodically.

The scheme of evaluation will be as under:-

**a) Industry expert/ supervisor: - 70%**

**b) Department & Faculty mentor: - 30%**

Faculty mentor includes "Presentation and Submission of Report", to the Department at the beginning of the subsequent semester.

- 1) The Internship can be availed by the students during the summer vacations after completion of semester IV or VI.
- 2) The Credit of the Internship will be considered in semester VII.
- 3) The Industry experts/ supervisor are expected to assign the work worth minimum 100 to 120 hours for 4 weeks duration and should monitor and evaluate periodically.
- 4) At the completion of Internship work, the student is expected to prepare a report on the work done and get it certified from the industry expert.

**Course Plan**

<b>Course Title: Linear Algebra</b>	
<b>Course Code:201AIMLL201</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE + MSE: 20+30</b>	<b>ESE Marks:50</b>

**Course Description:**

This course introduces vector spaces, subspace properties, linear transformations and applications, Inner Product Spaces, Fuzzy sets and Fuzzy arithmetic.

**Course Objectives:**

1. To understand basic concepts of linear algebra to illustrate its power and utility through applications to computer science and engineering.
2. To apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. To understand the fundamentals of fuzzy logics

**Course Outcomes COs:**

At the end of this course students will be able to

<b>C201.1</b>	Calculate base and dimension of vector spaces
<b>C201.2</b>	Recognize and use basic properties of subspace and vector space.
<b>C201.3</b>	Interpret the properties of vector spaces and subspaces using linear transformations
<b>C201.4</b>	Determine the orthogonality in inner product space with the properties of inner product space
<b>C201.5</b>	Explain the fundamental concepts of fuzzy sets, knowledge representation of fuzzy rules and fuzzy logics.
<b>C201.6</b>	Apply arithmetic operations on fuzzy numbers, Addition and Multiplication

<b>Prerequisite</b>	Set Theory, Matrix, Eigen Values and Eigen Vectors
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C201.1</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
<b>C201.2</b>	3	2	-	-	2	-	-	-	-	-	-	2	-	-	3
<b>C201.3</b>	3	2	-	-	2	-	-	-	-	-	-	2	-	-	3
<b>C201.4</b>	3	2	-	-	2	-	-	-	-	-	-	-	1	-	3
<b>C201.5</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3

C201.6	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
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Contents	Hours.
<b>Unit 1 Vector Spaces</b> The Euclidean space and vector space, subspace, linear combination, span, linearly dependent, independent, bases, dimensions, finite dimensional vector space.	<b>06</b>
<b>Unit 2 Subspace Properties</b> Row and column spaces, rank and nullity, bases for subspace, invertibility, application in interpolation.	<b>06</b>
<b>Unit 3 Linear Transformations and applications</b> Linear transformations, basic properties, invertible linear transformation, matrices of linear transformations, vector space of linear transformations, change of bases.	<b>06</b>
<b>Unit 4 Inner Product Spaces</b> Dot products and inner products, the lengths and angles of vectors, matrix representations of inner products, Gram-Schmidt orthogonalization, applications of inner product spaces- QR factorization, projection, orthogonal projections.	<b>06</b>
<b>Unit 5 Introduction to Fuzzy sets</b> Crisp set and Fuzzy set, basic concepts of fuzzy sets, basic operations on fuzzy sets, properties of fuzzy sets.	<b>06</b>
<b>Unit 6 Fuzzy Arithmetic</b> Fuzzy numbers, fuzzy cardinality, arithmetic operations on fuzzy numbers, solutions of fuzzy equations of type $A + X = B$ and $A.X = B$ .	<b>06</b>

**Text Books:**

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004).(Unit- 1,2, 3,4)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R.Hill, 9th Edition Pearson Education, 2011.
3. Fuzzy Sets and Fuzzy Logic: Theory and Applications, by George J. Klir and Bo Yuan (Unit- 5, 6)

**Reference Books:**

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, GuterPilz, 2nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003.
4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

**Course Plan**

<b>Course Title: Discrete Mathematics and Graph Theory</b>	
<b>Course Code: 201AIMLL202</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE + MSE Marks: 20 + 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

The objective of this course is to teach students how to think logically and mathematically. The course stresses on mathematical reasoning and describes different ways in which mathematical problems could be solved. This Course consists of concepts of Discrete Mathematical Structures such as Set Theory, Algebraic systems, Lattices & Probability. The course also aims the study of Graphs, its basics & applications.

**Course Objectives:**

1. To develop logical thinking and its application to computer science.
2. To understand Relations & Functions.
3. To expose the students to the concepts of Lattices.
4. To introduce basic concepts of Graph and its Applications.
5. To understand the concepts of Permutations, Combinations, Probability & Discrete Random Variables.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

<b>C202.1</b>	Write an argument using logical notation and determine if the argument is valid or invalid.
<b>C202.2</b>	Identify different types of binary relations on the basis of its properties.
<b>C202.3</b>	Identify the appropriate lattice and minimize the Boolean function.
<b>C202.4</b>	Understand Graph Theory and apply it to computer science application.
<b>C202.5</b>	Solve the problems using Permutations, Combinations, and Probability & learn concepts of Discrete Random Variables.

<b>Prerequisite:</b>	Mathematics - Probability theory, Set theory.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C202.1	2	-	1	-	-	-	-	-	-	-	-	1	-	-	5
C202.2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	3
C202.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C202.4	2	-	-	-	1	-	-	-	-	-	-	-	2	-	3
C202.5	2	-	-	-	-	-	-	-	-	-	-	1	-	-	3

Content	Hours
<p><b>Unit 1: Mathematical logic</b> Statements and Notations, Connectives – negation, Conjunction, disjunction, conditional, bi-conditional, Statement formulas and truth tables, well -formed formulas, Tautologies, Equivalence of formulas, Duality law, Tautological implications, functionally complete sets of connectives, other connective, Normal and principal normal forms, completely parenthesized infix and polish notations, Theory of Inference for statement calculus – validity using truth table, rules of inference.</p>	9
<p><b>Unit 2: Binary Relations &amp; Functions</b> Relation and ordering - properties of binary relations in a set, Relation matrix and the graph of a relation, Partition and Covering of set, Equivalence relations , Functions – types, composition of functions, Explicit &amp; Implicit equations, function notation, Intervals, Function Domains &amp; Ranges , Odd &amp; Even Functions, Power Functions.</p>	9
<p><b>Unit 3: Lattices and Boolean algebra</b> Partial ordering, POSET and Hasse diagram, Lattice as POSETs, definition, examples and properties, Lattice as algebraic systems, Special lattices. Boolean algebra definition and examples, Boolean functions, representation and minimization of Boolean functions.</p>	6



<p><b>Unit 4: Graphs &amp; Matching's</b> Introduction to Graph, Graph Terminology, Storage representation and manipulation of Graphs, PERT and related Techniques, Euler's Formula, Euler and Hamilton Paths , Non-Hamiltonian Planar Graphs ,Matching's and Coverings in Bipartite Graphs Perfect Matching's, Applications - The Personnel Assignment Problem, The Optimal Assignment Problem.</p>	5
<p><b>Unit 5. Permutations, Combinations and Probability Theory</b> Random Experiments, Sample space &amp; Events, Pigeon hole principle, Permutations and Combinations, Concept of Probability Discrete Probability, Conditional Probability.</p>	6
<p><b>Unit 6: Discrete Random Variables &amp; Expectation</b> Random variables &amp; Expectation, linearity of Expectations, Jensen's Inequality, The Bernoulli &amp; Binomial Random Variables</p>	5

**Text Books:**

1. J. P. Tremblay & R. Manohar, "Discrete Mathematical Structures with Application to Computer Science", MGH International (Unit 1 to 3).
2. J. A. Bondy and U.S.R. Murty, "Graph Theory with Applications", North-Holland, 1976.(Unit 4).
3. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, Tata McGraw-Hill, 2008, ISBN 10:0-07-066913-9.(Unit 5).
4. Michael Mitzenmacher, Eli Upfal, "Probability and Computing Randomized Algorithms & Probabilistic Analysis", Cambridge (Unit 6)

**Reference Books:**

1. Seymour Lipschutz, MarcLipson, "Discrete Mathematics", MGH Schaum's outlines.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications" AT&T Bell Labs (mhhe.com/rosen).
3. John Schiller, Murray R. Spigel, "Probability and Statistics" MGH, Schaum's outlines
4. J. M. Aldous. Graphs and Applications. Springer, LPE, 2007
5. Diestel, R. Graph Theory New York, NY: Springer-Verlag, 1997. ISBN: 3540261834.
6. Michael Baron, "Probability and Statistics for Computer Scientists", Second Edition, CRC Press publication

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**Online Resources:**

- <https://nptel.ac.in/courses/111/107/111107058/>
- <https://nptel.ac.in/courses/106/106/106106094/>
- <https://nptel.ac.in/courses/106/106/106106183/>

**Term Work:**

A] The tutorial session should consist of minimum 10-12 assignments. Out of which minimum 7 assignments will be based on the topics from unit no 1,2,3,5, unsolved exercise problems from the text books 1] J.P. Tremblay & R. Manohar, "Discrete Mathematical Structures with Application to Computer Science" MGH International (Unit 1 to 3) and 2] C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, Tata McGraw-Hill, 2008, ISBN 10:0-07-066913-9. (Unit 5). And minimum 3-4 assignments related to solving the examples on any of the following topics :

- a. Evaluation of graphs using PERT
- b. Matching's and Coverings in Bipartite graphs
- c. The Personnel Assignment Problem
- d. The Optimal Assignment Problem.
- e. Euler and Hamilton Paths Bridges
- f. The Bernoulli & Binomial Random Variables

B] To write programs in C language on any 2 of the following related topics.

1. Generating truth table of a statement
2. Application of bit representation of sets and operations on sets or relations.
3. Conversion of polish expressions.
4. Obtaining the path matrix, paths of different lengths.
5. Allocation of graphs
6. PERT related techniques

**Evaluation Guidelines:**

1. ISE-I (10 Marks = 5 + 5)  
5 Marks will be based on first 5 Tutorial assignments.  
5 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc.) by the subject incharge.
  - ISE- I will be conducted before MSE
2. ISE –II (10 Marks = 5 + 5)  
5 Marks will be based on programming assignment  
5 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc.) by the subject incharge.
  - ISE- II will be conducted after MSE

**Course Plan**

<b>Course Title: Computer Architecture and Microprocessors</b>	
<b>Course Code: 201AIMLL203</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE Marks: 20 MSE: 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

Course covers various generations of computer system. Each major components of computer system like processor, memory, I/O devices, operations and organization is discussed in detail. To understand the design principles and implementation, Intel x86 architecture processor families is illustrated. Also system performance enhancement is discussed through multiprocessor and parallel processor environment.

**Course Objectives:**

1. To introduce various generations of computers, their working and basic architecture.
2. To make aware of basic organization of memory unit.
3. To provide a basic knowledge of multi-processor organization structures.
4. To provide an understanding of Architecture of Microprocessor & Microcontroller.
5. To introduce Pentium Processor family.

**Course Outcomes (COs):**

At the end of the course, students will be able to:

<b>C203.1</b>	Explain overview of computer structure and function.
<b>C203.2</b>	Solve a problem of memory design for given specification.
<b>C203.3</b>	Describe various techniques to increase system performance.
<b>C203.4</b>	Describe the architecture of Microprocessor & Microcontroller.
<b>C203.5</b>	Summarize the Pentium processor family with their architecture.

<b>Prerequisite:</b>	Computer and Programming, Fundamentals of Electrical and Electronics Engineering
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C203.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.2	3	1	1	-	2	-	-	-	-	-	-	1	-	-	3
C203.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Contents	Hours
<p><b>Unit 1: Computer Evolution and Performance</b> Organization and Architecture, Structure and Function, A Brief History of Computers, Evolution of Computers, Designing for Performance, The Evolution of the Intel x86 architecture.</p>	5
<p><b>Unit 2: The Computer System</b> Computer Components, Computer Function, Bus Interconnection. <b>Cache Memory:</b> Cache Memory Principles, Elements of Cache Design, Pentium 4 and Power PC Cache Organization. <b>Types of Memory:</b> Internal Memory, External Memory: Optical memory <b>Input/Output:</b> External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access.</p>	7
<p><b>Unit 3: Serial/Parallel Organization</b> <b>Central Processing Unit:</b> Processor Structure and Function: Processor Organization, Register Organization, Instruction Cycle, Instruction Pipelining. <b>Parallel Processing:</b> Multiple Processor Organization, Symmetric Multiprocessors.</p>	6
<p><b>Unit 4: Intel Microprocessor Architecture &amp; Programming</b> Architecture of 8085, The Microprocessor Based Personal Computer System Internal Microprocessor Architecture, Instruction execution in 8085, Classification of Instructions, Memory Addressing <b>CASE STUDY: Specification of Intel 8085 microprocessor</b></p>	7

<p><b>Unit 5: Intel Microcontroller</b> Introduction to 8051 Microcontrollers, Microcontroller Architecture, A single chip Microcontroller, Microprocessor Vs Microcontroller, 8/16 Bit Microcontrollers <b>CASE STUDY: Learning model of 8051 microcontroller.</b></p>	5
<p><b>Unit 6: Advanced Microprocessors</b> Introduction to Pentium Microprocessor, The memory System, Special Pentium Registers , Pentium Memory Management Introduction to Pentium Pro Microprocessor, Internal Structure of the Pentium Pro, The Memory System The Pentium 4 and Core2, Pentiumi3/i5/i7.</p>	6

**Text Books:**

1. William Stallings, Computer Architecture and Organization, Pearson Education, 8<sup>th</sup> Edition, (2013), [UNIT 1, 2,3].
2. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, Pearson Education Limited, 8th Edition (2009) [UNIT 4, 5 &6].
3. Ramesh Gaonkar, Microprocessor Architecture, programming and application with 8085, PENRAM International publishing, 6th Edition (1 Oct. 2013). [UNIT4].

**Reference Books:**

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, Tata McGraw Hill, 5th Edition (January 1980).
2. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill - (MGH), 3rd Edition (January 2012).
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, PENRAM, 6th Edition (1 October 2003).
4. Douglas Hall, Microprocessors and Interfacing, Tata McGraw-Hill Education, (31 Dec. 1899).
5. John Uffenbeck, The 8086/8088 Family: Design, Programming, and Interfacing, Pearson Publication, Hardcover Edition, (1 Oct. 1986).

**Online Resources:**

1. <https://nptel.ac.in/courses/106/105/106105163/>
2. <https://nptel.ac.in/courses/106/108/106108100/>

**Course Plan**

<b>Course Title : Data Structures</b>	
<b>Course Code : 201AIMLL204</b>	<b>Semester : III</b>
<b>Teaching Scheme : L-T-P : 3-0-0</b>	<b>Credits : 3</b>
<b>Evaluation Scheme : ISE + MSE Marks : 20 + 30</b>	<b>ESE Marks : 50</b>

**Course Description:**

This course will introduce the fundamentals of data structures and will provide understanding of how to systematically organize data in a computer system. Also, includes topics which focus on searching and sorting techniques, linked list, trees and graphs. This course is helpful in many areas of electrical engineering, computational biology, computational finance etc. They are used in a variety of applications today including search engines (e.g., Google, Bing), social networking applications (e.g. Facebook, Twitter), embedded systems (e.g., cell phones, robots), and DNA analysis.

**Course Objectives:**

1. To make the students familiar with basic data structures
2. To select appropriate data structures in computer applications.
3. To provide the students with the details of implementation of various data structures.

**Course Outcomes (COs):**

At the end of the course the student should be able to:

<b>C204.1</b>	Understand the basic concepts and applications of data structures as well as algorithms that operate on them.
<b>C204.2</b>	Compare various data structures, searching and sorting techniques and recognize the advantages and disadvantages of them.
<b>C204.3</b>	Understand the details of implementation of various data structures.
<b>C204.4</b>	Select appropriate data structures, searching and sorting techniques in computer applications.

<b>Prerequisite:</b>	Basic knowledge of algorithms and C programming
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

Cos	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C204.1</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C204.2</b>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C204.3</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C204.4</b>	3	3	-	-	-	-	-	-	-	-	-	-	1	-	3

Content	Hours
<p><b>Unit 1. Basic of Data Structures</b></p> <p>Data structure- Definition, Types of data structures, Data Structure Operations, Algorithms: Complexity, Time and Space complexity.</p>	4
<p><b>Unit 2. Searching and Sorting Techniques</b></p> <p>Linear search, Binary search, Sentinel search, Fibonacci search, Hashing – Definition, hash functions, Collision, Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Radix sort, Tim sort, Complexity and analysis.</p>	7
<p><b>Unit 3. Stacks and Queues</b></p> <p>Stack: Definition, operations, Array representation of stack, applications Queue: Definition, operations, Array representation of queue, applications, Circular queue, Priority queue, Deque.</p>	7
<p><b>Unit 4. Linked Lists</b></p> <p>Definition, representation, operations, implementation and applications of singly, doubly and circular linked lists. Linked representation of stack and Queue, Dynamic memory management, Memory efficient doubly linked list, unrolled Linked List, Skip List</p>	6
<p><b>Unit 5. Trees</b></p> <p>Terminology, representation, binary tree, traversal methods, binary search tree, XOR Tree, AVL search tree, B tree, B+ tree, Heaps- Operations and their applications, Heap</p>	8

sort.	
<b>Unit 6. Graphs</b> Basic concept of graph theory, storage representation, graph traversal techniques- BFS and DFS, Graph representation using sparse matrix, Transpose of sparse matrix.	6

**Text Books:**

1. Seymour Lipschutz (MGH), Data Structures; McGraw Hill publications, Third Edition, [1 July 2017].
2. Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft , Addison-Wesley Series, Data Structures and Algorithms; [1983].
3. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python, CareerMonk Publication, [2016].

**Reference Books:**

1. Jean-Paul Tremblay, Paul. G. Soresan, “An introduction to data structures with Applications” - Tata Mc-Graw Hill International Editions, 2nd edition .
2. Richard F. Gilberg and Behrouz A., Data Structures- A Pseudo code Approach with C , 2<sup>nd</sup> Edition [15 Nov. 2007].
3. A. M. Tanenbaum, Y. Langsam, Data Structure using C; M. J. Augenstein, PHI publication, 2<sup>nd</sup> Edition, [1996].

**Online Resources:**

1. NPTEL videos: <https://nptel.ac.in/courses/106/102/106102064/>



### Course Plan

<b>Course Title: Computer Networks</b>	
<b>Course Code: 201AIMLL205</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE Marks: 20 MSE: 30</b>	<b>ESE Marks: 50</b>

#### Course Description:

This course provides a comprehensive introduction to computer networks and networking aspects which will be of help to all Computer Science Engineering Streams. Course includes computer networking fundamentals, network layered architectures, descriptive study of different layers of networking models, network protocols and tools.

#### Course Objectives:

1. To perceive fundamental concepts of Computer Networks.
2. To understand layered architecture and basic networking protocols.
3. To understand the Client server model & socket interface.

#### Course Outcomes:

Upon successful completion of this course, the student will be able to –

<b>C205.1</b>	Describe the concepts of Computer Networks and Network layered architecture.
<b>C205.2</b>	Understand the protocols, algorithms and the addressing model used in networking.
<b>C205.3</b>	Demonstrate different networking protocols using socket programming.
<b>C205.4</b>	Understand the functionality of Domain Name System in networking.

<b>Prerequisite:</b>	Basic knowledge of computers
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

Cos	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C205.1</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C205.2</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C205.3</b>	3	2	2	-	-	-	-	-	-	-	-	-	1	-	3
<b>C205.4</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Content	Hours
<p><b>Unit 1. Introduction to Computer Network:</b></p> <p>Overview of OSI layer Model and TCP/IP protocol model, Addressing, Underlying technologies for LANs, WANs, and Switched WANs</p>	5
<p><b>Unit 2. Data Link Layer:</b></p> <p>Design issues for Data Link Layers, framing methods, Error control: detection and correction, Flow control, Elementary Data Link protocols, Sliding window Protocols Go back n, Selective repeat.</p>	6
<p><b>Unit 3. Network Addressing:</b></p> <p>IPv4 Addresses: Classful Addressing Other Issues, Sub-netting and Super netting, Classless Addressing, Delivery, Forwarding and routing. IPv4: Datagram, Fragmentation, Options, Checksum. IPv6 Addressing: Introduction, IPv6 packet format: Base Header, Flow Label, Extension Headers, Transition from IPV4 to IPV6, Comparison between IPv4 and IPv6.</p>	7
<p><b>Unit 4. Routing and Congestion Control techniques:</b></p> <p>Routing methods: shortest path, Link state, Distance vector routing and broadcast routing, Congestion control algorithms: Principles, Congestion prevention policies, congestion control in datagram subnet.</p>	5
<p><b>Unit 5. Transport Layer:</b></p>	

<p>The Transport service primitives, UDP: Process to Process communication, UserDatagram Format, Operation and uses of UDP.TCP: TCP Services and Features, TCP segment format, TCP Connections.</p>	<p>6</p>
<p><b>Unit 6. Application Layer:</b></p> <p>Principles of Network Applications: Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols. The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, Web Caching. FTP, TFTP. DNS—The Internet’s Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages. DHCP. Telnet. Socket Programming: Socket Programming with UDP, Socket Programming with TCP.</p>	<p>7</p>

**Text Books:**

1. Behrouz A. Forouzan, TCP/IP protocol Suit, Tata Mag.Hill, 4thEd. [Unit 1 – 5].
2. Kurose James F., Ross Keith W., Computer Networking: A Top-Down Approach, Sixth Edition, By Pearson. [Unit 6].

**Reference Books:**

1. Peter L Dordal, An Introduction to Computer Networks, Release 1.9.15.
2. Andrew S. Tanenbaum(PHI), Computer Networks
3. W. Richard Stevens (PHI), Unix Network Programming

### Course Plan

<b>Course Title: Java Programming Laboratory</b>	
<b>Course Code :201AIMLP206</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 2-0-4</b>	<b>Credits :2</b>
<b>Evaluation Scheme: ISE Marks:50</b>	<b>ESE-POE Marks:50</b>

#### Course Description:

This course provides the object-oriented approach using Java programming constructs. The course includes basics of Java language programming, the different object-oriented features and packages, file handling and multithreading. This course enables the students to develop the GUI based applications using advanced features such as swing, database handling, networking and collection. This course provides the basics for developing android applications, games, and many more programming language applications in the different fields.

#### Course Objective:

1. To introduce the concepts of object-oriented programming using JAVA programming constructs.
2. To expose the students with the JAVA concepts using inheritance, interface, package, I/O and exception handling mechanisms.
3. To develop the problem-solving ability using GUI designing components.
4. To build the foundations of advanced java programming for application development.

#### Course Outcomes (COs):

Upon successful completion of this course, the students will be able to:

<b>C206.1</b>	Use the java programming constructs for solving the problems with object-oriented approach.
<b>C206.2</b>	Develop the reliable and user -friendly application using inheritance, interface, package, I/O and exception handling mechanisms.
<b>C206.3</b>	Create the applications using the GUI designing components with the use of modern tools.
<b>C206.4</b>	Apply the knowledge of the advanced java programming concepts for developing the applications from different domains.

<b>Prerequisite</b>	C programming and object-oriented programming.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	Pos												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C206.1</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C206.2</b>	2	2	2	-	-	-	-	-	-	-	-	-	-	-	3
<b>C206.3</b>	2	2	3	-	1	-	-	-	2	-	-	-	2	-	3
<b>C206.4</b>	3	2	2	-	-	-	-	-	2	-	-	-	1	-	3

Content	Hours
<p><b>Unit 1: Fundamental Programming in Java:</b> The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Array.</p> <p><b>Objects and Classes:</b> Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword</p>	3
<p><b>Unit 2: Inheritance, Interface and Package:</b></p> <p><b>Inheritance:</b> Definition, Super classes, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Inner Classes, garbage collection.</p> <p><b>Interfaces:</b> Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving Interfaces, and Default Methods.</p> <p><b>Packages:</b> Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and Class Files.</p>	4
<p><b>Unit 3: Exception and I/O Streams</b></p> <p><b>Exception:</b> Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, Re-throwing and Chaining Exceptions, finally clause.</p> <p><b>I/O Streams:</b> Byte Stream – InputStream, OutputStream, DataInputStream, DataOutputStream, FileInputStream, FileOutputStream, Character Streams, BufferedStream, Scanner class</p>	4

<p><b>Unit 4: Graphical User Interfaces using AWT and Swing</b> Introduction to AWT components, Frame, Applet, Introduction to the Swing, Swing components. <b>Layout Management:</b> Introduction to Layout Management, APIs for Border Layout, Flow Layout, Grid Layout <b>Event Handling:</b> Basics of Event Handling, The AWT Event Hierarchy, Semantic and Low-Level Events in the AWT, Low-Level Event Types</p>	6
<p><b>Unit 5: Multithreading, Collections</b> <b>Multithreading:</b> Processes and Threads, Runnable Interface and Thread Class, Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Thread States, Thread Properties, Synchronization <b>Collections:</b> Collection Interfaces, Concrete Collections-List, Queue, Set, Map, the Collections Framework</p>	4
<p><b>Unit 6: , Database Programming and Networking</b> <b>Database Programming:</b> The Design of JDBC, The Structured Query Language, Basic JDBC Programming Concepts, Query Execution, Scrollable and Updatable Result Sets. <b>Networking:</b> Overview of Networking, Networking Basics, Sockets, reading from and Writing to a Socket, Writing the Server Side of a Socket</p>	3

<b>List of Assignment</b>			
Ass. No.	Name of Assignment	S/O	Hours
1	Study of JAVA basics.	S	2
2	Implementation of a problem statement using class and object.	O	2
3	Design and develop the programs for different types of inheritance	O	4
4	Implementation of stack/queue operations using Interface	O	2
5	Implementation of user defined package.	O	2
6	Implementation of any type of Exception Handling	O	2
7	Implementation of different I/O operations using console and file.	O	2
8	Implementation of program for designing the GUI using swing components.	O	4
9	Demonstrate and use the any modern tools for writing the JAVA programs	O	2
10	Implementation of different types of event handling.	O	2
11	Implementation of a programs for demonstrating the different types of Layout Managers.	O	4

12	Design and develop an application for demonstration of multithreading	O	2
13	Implementation of any program using collections.	O	2
14	Implementation of different database operations using JDBC	O	4
15	Design an application using any <b>modern tools available for java programming</b> such as Eclipse IDE, NetBeans, Oracle JDeveloper, IntelliJ IDEA 13.1 etc.	O	2
16	Design and develop the <b>mini project</b> for solving the different real time problems using java language in the group of 4-5 students. Problem Statements like <ol style="list-style-type: none"> <li>1. Online quiz management system</li> <li>2. Smart city project</li> <li>3. Network packet sniffer</li> <li>4. Email client software</li> <li>5. File Compression</li> <li>6. Virtual Classroom</li> <li>7. Text Editor</li> <li>8. Advanced Payroll System</li> <li>9. Datamart Management System</li> </ol>	O	8

### S-STUDY, O-OPERATIONAL

**Note: The instructor may choose minimum fourteen assignments from assignment no. 1 to 16 & Experiment no. 9 and 16 are mandatory**

#### Text Books:

1. Cay Horstmann and Gary Cornell, Core Java- Volume I Fundamentals Pearson, Eight edition (Unit 1 to Unit 4).
2. Cay Horstmann and Gary Cornell, Core Java- Volume II Advanced Features, Pearson, Eight edition (Unit 5 and Unit 6).

#### Reference Books:

1. Herbert Schildt, JAVA-The Complete Reference, Mcgraw Hill, Ninth edition.

#### Online Resource:

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. <https://java-iiitd.vlabs.ac.in/List%20of%20experiments.html>

### Course Plan

<b>Course Title : Data Structures Laboratory</b>	
<b>Course Code : 201AIMLP207</b>	<b>Semester : III</b>
<b>Teaching Scheme : L-T-P : 0-0-2</b>	<b>Credits : 1</b>
<b>Evaluation Scheme : ISE Marks : 25</b>	<b>ESE-POE Marks: 50</b>

#### Course Description:

The course is designed to develop skills to design and analyze simple linear and non linear data structures. It strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem. It enables them to gain knowledge in practical applications of data structures.

#### Course Objectives:

1. To teach the students to identify appropriate data structures.
2. To provide the students with the details of implementation of various data structures.
3. To select appropriate data structures in computer applications.

#### Course Outcomes (COs):

At the end of the course the student should be able to:

<b>C207.1</b>	Outline the solution to the given software problem with appropriate data structure.
<b>C207.2</b>	Identify appropriate data structure for specific application.
<b>C207.3</b>	Formulate the problem statement and implement to solve that statement.
<b>C207.4</b>	Choose appropriate sorting & searching algorithms

<b>Prerequisite:</b>	C / C++ Programming Language
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C207.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
C207.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C207.3	-	3	3	-	2	-	-	-	-	-	-	-	1	-	3
C207.4	3	-	2	-	-	-	-	-	-	-	-	2	-	-	3

List of Assignments			
Ass. No.	Name of Assignment	S/O	Hours
1	Write a program to find an element in matrix using search technique.	O	2
2	Role play activity on searching techniques.	O	2
3	Programs to implement sorting techniques to sort an array of 0s, 1s and 2s.	O	2
4	Role play activity on sorting techniques.	O	2
5	Programs to implement stack using array and linked list.	O	2
6	Programs to implement queue using array and linked list.	O	2
7	Programs to implement various operations on linked list.	O	2
8	Programs to implement Memory efficient linked list.	O	2
9	Programs to implement BFS and DFS.	O	2
10	Case Study- 1. Garbage Collection. 2. Priority queue in bandwidth management. 3. Null Terminated or Cyclic Node. 4. Use of sparse matrix in Social Networks and Maps.	S	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: The instructor should take all ten experiments from list.**

**Text Books:**

1. Data Structures using C – Seymour Lipschutz (MGH), McGraw Hill publications, Revised 1<sup>st</sup>

Edition. [1 July 2017]

2. C- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein, Data Structure using; PHI publications, 2<sup>nd</sup> Edition, [2017].

**Reference Books:**

1. Ellis Horowitz, S. Sahni, D. Mehta, Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi 1995 ISBN 16782928.
2. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to data structures with Applications, Tata Mc-Graw Hill International Editions, 2nd edition 1984, ISBN-0-07-462471-7.

**Online Recourses:**

1. Virtual Lab: <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>
2. NPTEL videos: <https://nptel.ac.in/courses/106/102/106102064/>

**Course Plan**

<b>Course Title: Computer Networks Laboratory</b>	
<b>Course Code: 201AIMLP208</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 0-0-2</b>	<b>Credits: 1</b>
<b>Evaluation Scheme: ISE Marks: 25</b>	<b>ESE-OE Marks: 25</b>

**Course Description:**

This course provides a practical implementation of the computer networking theoretical aspects, studied during the lecture hours. Course includes computer networking fundamentals, demonstrations and implementation of network setup using networking tools & layered architectures, descriptive study of different layers of networking models, network protocols and algorithms.

**Course Objectives:**

1. To understand the fundamental concepts of Computer Networks.
2. To understand the different network connectivity and analyzing tools.
3. To implement the networking protocols and algorithms.
4. To implement the Client server model.

**Course Outcomes:**

Upon successful completion of this course, the student will be able to –

<b>C208.1</b>	Demonstrate use of Network Models and its Components.
<b>C208.2</b>	Implement the protocols and algorithms used in different layers of the network.
<b>C208.3</b>	Apply the principles of socket programming using TCP & UDP in the networks.
<b>C208.4</b>	Demonstrate the DNS and network analysing tools.

<b>Prerequisite:</b>	Basic knowledge of computers, C / C++ Programming Language, Linux, and Windows OS
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C208.1</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C208.2</b>	2	1	2	2	-	-	-	-	-	-	-	-	-	-	3
<b>C208.3</b>	3	2	1	1	-	-	-	-	-	-	-	-	2	-	3
<b>C208.4</b>	3	1	-	1	-	-	-	-	-	-	-	-	1	-	3
<b>C208.5</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3

**List of Experiment**

Sr. No.	Experiment Title	S/O	Hours
01	Study of various Computer Networking models and connectivity devices.	S	2
02	Implementation of cross-wired cable and straight through cable using crimping tool.	O	2
03	Study of IP address configuration & following connectivity test tools with all its options –ifconfig, arp, traceroute, nmap, netstat, finger.	O	2
04	Implementing Framing method: Bit Stuffing	O	2
05	Implementing Elementary data link protocol (Stop & wait protocol)	O	2
06	Implementation of Error detection Code (CRC / Hamming)	O	2
07	Implementation of sliding window protocol.	O	2
08	Implement the routing algorithm (any one).	O	2
09	Programs for connection oriented (TCP) client-server using socket programming	O	2
10	Programs for connection less (UDP) client-server using socket programming	O	2
11	Study of following DNS Tools with all its options. nslookup, dig, host, whois.	O	2
12	Study of network protocol analyzer (Wire-Shark) and understanding packet	O	2

formats for UDP, TCP& Application Layer protocols.		
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**S-study, O-operational**

**Instructions for practical examinations and termwork:**

It should consist of 10-12 experiments based on the syllabus and should be implemented by using Socket Programming. The study experiments should consist of some practical work and observations.

**Student's activities that can be conducted:**

1. Group-play activities for demonstration of data-link layer protocols.
2. Industrial visit to a networking-based industry.
3. Group/Individual Presentation activity after a visit to a networking-based industry or laboratory.
4. Implementation and Configuration of the TFTP / FTP Client-Server model, in a group (2-5 students per group).
5. Seminar / Webinar / Workshop for students by an Industrial expert.

**Text Books:**

1. Behrouz A. Forouzan, TCP/IP protocol Suit, Tata Mag.Hill, 4thEd.
2. W. Richard Stevens (PHI), Unix Network Programming
3. Kurose James F., Ross Keith W., Computer Networking: A Top-Down Approach, Sixth Edition, By Pearson.
4. Peter L Dordal, An Introduction to Computer Networks, Release 1.9.15.

**Reference Books:**

1. Andrew S. Tanenbaum (PHI), Computer Networks
2. D. E. Comer, David L. Stevens (Pearson Ed.), Internetworking withTCP/IP, Vol. III, Client-Server programming and applications (2<sup>nd</sup> Edition).

**Course Plan**

<b>Course Title: Environmental Studies (Mandatory Course-I)</b>	
<b>Course Code: 201AIMLMC209</b>	<b>Semester: III</b>
<b>Teaching Scheme: L-T-P: 2-0-0</b>	<b>Credits: 0</b>
<b>Evaluation Scheme: ISE+MSE-Not Applicable</b>	<b>ESE – 50 Marks</b>

**Course Description:**

Environmental Studies course enhance a student’s knowledge in a variety of currently relevant topics related to environmental awareness and pollution. The course aims to identify environmental problems, come-up with suitable solutions and create awareness for a hygienic and eco-friendly environmental.

**Course Objectives:**

- 1 Recognize the structure and functions of ecosystems with their importance.
- 2 Understand the environmental and social problems with global concern.
- 3 Understand the importance of environmental management for its protection.
- 4 Acquire problem solving skills through visits to different locations, identifying the environmental problems, proposing the solution models and exhibiting to the society and government authorities.

**Course Outcomes (COs):**

<b>COs</b>	<b>At the end of successful completion of course, the students will be able to...</b>
<b>C209.1</b>	Understand the importance of ecosystem and biodiversity in view of its conservation.
<b>C209.2</b>	Understand the concept of hazardous waste and to promote healthier environment.
<b>C209.3</b>	Explain the importance of environmental management through pollution control boards.
<b>C209.4</b>	Propose solutions for problems related with environmental well beings through location visits and model exhibitions.

<b>Prerequisite:</b>	Understanding of Environmental Education course.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C209.1</b>	-	-	-	-	-	1	3	2	-	-	-	-	-	-	2
<b>C209.2</b>	-	-	-	-	-	1	2	-	-	-	-	-	-	-	2
<b>C209.3</b>	-	-	-	-	-	1	3	-	1	1	-	-	-	-	2
<b>C209.4</b>	-	-	-	-	-	2	3	1	1	1	-	-	-	-	3

Course Content	Hours
<p><b>Unit 1. Ecology and Biodiversity</b></p> <p>Definition, types, importance and examples of ecology, types of community relationships: Symbiosis, predation and competition. Ecosystem: structure and functions, biotic and abiotic components, energy flows, ecological succession, food chain, food web &amp; ecological pyramid, types of ecosystems, degradation of ecosystems and its impact.</p> <p>Biodiversity hotspots: Western ghats, eastern Himalayas, threats to biodiversity and conservation of biodiversity, environmental ethics.</p>	8
<p><b>Unit 2. Environment and Health</b></p> <p>Air Pollution, water pollution. E-waste, waste minimization technology, Plastic waste, Population growth of the world and reduced health content of the environment, energy crisis, biofuels, Occupational health hazards, Concept of Carbon footprint.</p>	7
<p><b>Unit 3. Environmental Management</b></p> <p>Role of Central Pollution Control Board (CPCB) and Maharashtra Pollution Control Board (MPCB) in environmental protection of India. Concept of sustainability, ISO Certification.</p>	5
<p><b>Unit 4. Field Work</b></p> <p>Visit to a local area for documentation of environmental assets River/forest/grassland/hill/mountain OR Visit to a local polluted site-Urban/Rural/Industrial/Agricultural OR</p>	5

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Study of common plants, insects, birds OR Study of simple ecosystems- Ponds, Lakes, Rivers, Hill slopes, etc.	
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**Text Books:**

- 1 Trivedi R.K. and P.K Goel, Introduction to Air Pollution, Tech-science Publications.
- 2 Mhaskar A.K, Matter Hazardous, Techno-Science Publication.

**Reference Books:**

- 1 Bharucha, Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad 380013, India
- 2 Hawkins R.E., Encyclopaedia of Indian Natural History, Bombay Natural History Society, Bombay
- 3 Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I &II, Environmental Media.
- 4 Miller T.G. Jr., Environmental Science, Wadsworth Publications Co.
- 5 Sharma B.K., Environmental Chemistry, Gokel Publ. House, Meerut.



**Course Plan**

<b>Course Title: Probability and Statistics</b>	
<b>Course Code: 201AIML210</b>	<b>Semester: IV</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits:4</b>
<b>Evaluation Scheme: ISE-I+MSE: 20+30</b>	<b>ESE Marks:50</b>

**Course Description:**

This course introduces frequency distribution and measure of central tendency, hypothesis testing, correlation and regression, probability distribution functions, recurrence relation and curve Fitting.

**Course Objectives:**

1. To introduce students to understand, explain and apply the fundamental probability and statistical concepts at the core of computer science
2. To understand use of concepts of statistics, measures of dispersion
3. To learn the fundamental theory of testing hypothesis and sample tests
4. To learn the concepts of correlation, regression and curve fitting
5. To understand use of recurrence relation

**Course Outcomes COs:**

At the end of this course students will be able to

<b>C210.1</b>	Apply the knowledge to study the data given with respect to dispersion and measure of central tendency
<b>C210.2</b>	Understand tests for hypothesis and its significance
<b>C210.3</b>	Describe the statistical data numerically by using correlation, regression and curve fittings.
<b>C210.4</b>	Solve basic problems in probability theory, including problems involving the binomial, poisson, and normal distributions.
<b>C210.5</b>	Apply the recurrence relation to solve the counting problems and programme analysis problems

<b>Prerequisite</b>	Basic Probability Theory
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C210.1</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
<b>C210.2</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C210.3</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
<b>C210.4</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
<b>C210.5</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3

Contents	Hours
<b>Unit 1 Frequency distribution and measure of central Tendency</b> Frequency distribution, Continuous frequency distribution, Graphical representation of a Frequency distribution- Histogram, frequency polygon, Measure of central tendency- Arithmetic mean, median and mode, Range, Quartile deviation, Mean deviation, Standard deviation	<b>06</b>
<b>Unit 2 Testing of hypothesis</b> Introduction, Statistical hypothesis (Simple and Composite), Null hypothesis, Alternative hypothesis, Critical region, Type I and Type II errors, Level of significance, Test for goodness of fit of chi square distribution	<b>06</b>
<b>Unit 3 Correlation and Regression</b> Introduction, Types of correlation, Karl Pearson's coefficient of correlation, Interpretation of the coefficients of corrections, Computation of coefficient of correlation for ungroup data, Lines of regression, Calculations of equations of the lines of regression	<b>06</b>
<b>Unit 4 Probability Distribution Functions</b> Introduction, Elementary theory of probability, Random variables, Discrete probability distribution, Continuous probability distribution, Binomial distribution, Poisson distribution, Normal distribution.	<b>06</b>
<b>Unit 5 Recurrence Relation</b> Introduction, Definition of recurrence relation, Linear recurrence relation with constant coefficients, Construction of recurrence relation, Solution of recurrence relation- Homogeneous and non-homogeneous, Solution of homogeneous and non-homogeneous recurrence relation	<b>06</b>
<b>Unit-6 Curve Fitting</b> Fitting of curve by method of least squares, Fitting of straight lines, Fitting of exponential	<b>06</b>

curve, Fitting of second degree parabolic curve	
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<b>Sr. No</b>	<b>Assignment List</b>	<b>Contact Hr.</b>
1.	Measure of Central Tendency	1
2.	Testing of Hypothesis	1
3.	Computation of Correction	1
4.	Lines of Regression	1
5.	Probability Distribution- Binomial Distribution and Poisson Distribution	1
6.	Probability Distribution- Normal Distribution	1
7.	Recurrence Relation	1
8.	Curve Fitting	1
9.	Fitting of First and Second Degree Curve Using SCILAB/MATLAB	1
10.	Measure of Central Tendency Using SCILAB/MATLAB	1

**Text Books:**

1. Walpole, Myers, Myers, Ye, Probability and Statistics for Engineers and Scientists, Pearson Education Inc., 8<sup>th</sup> Edition, 2007, ISBN: 978-81-317-1552-9.
2. Numerical Methods in Engineering and Science, by Dr. B. S. Grewal

**Reference Books**

1. Douglas C Montgomery, George C Runger, Applied statistics and Probability for Engineers, Wiley Asia Student Edition, 4<sup>th</sup> Edition, 2007, ISBN: 978-81-265-2315
2. Richard I Levin, David S Rubin, Statistics for Management, Prentice Hall India, 7<sup>th</sup> Edition, 1997, ISBN: 9780134762920.
3. Purna Chandra Biswal, Probability and Statistics, PHI Learning Private Limited, Eastern Economy Edition, 2007, ISBN: 978-81-203-3140-2

### Course Plan

<b>Course Title : Operating Systems</b>	
<b>Course Code : 201AIMLL211</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 3-0-0</b>	<b>Credits : 3</b>
<b>Evaluation Scheme : ISE + MSE Marks : 20 + 30</b>	<b>ESE Marks : 50</b>

**Course Description:** This course provides comprehensive overview of computer operating systems. It covers the foundation components, classical internal algorithms and structures of operating systems, including process scheduling, memory management and IO management.

#### Course Objectives:

1. To learn the basic concepts of operating system, services and operations in the operating system.
2. To expose the students to various functions of the operating system and their usage.
3. To make the students understand process management, memory management and I/O device Management.
4. To provide knowledge to the students about the fundamental architecture of UNIX and operating system kernel.

#### Course Outcomes (COs):

At the end of the course the student should be able to:

<b>C211.1</b>	Understand the structure, functions and services of an operating system.
<b>C211.2</b>	Describe the methods of process management, process synchronization and deadlocks.
<b>C211.3</b>	Demonstrate the various memory management and I/O management techniques in effective execution of programs.
<b>C211.4</b>	Analyze the process scheduling, memory management and I/O management techniques.

<b>Prerequisite:</b>	Fundamental knowledge of computer, C programming, Data Structure
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C211.1</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C211.2</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>C211.3</b>	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C211.4</b>	2	3	-	-	-	-	-	-	-	-	-	-	-	-	4

Content	Hours
<p><b>Unit 1. Introduction</b></p> <p>Evolution of operating systems, Types of operating systems, Different views of the operating system, The journey of a command execution, Overview of design and implementation of operating systems.</p>	5
<p><b>Unit 2. Process Management &amp; Synchronization</b></p> <p>Process Concept, Operations on Processes, Interprocess Communication, Threads, Process Synchronization - Race Conditions, Critical Sections, Synchronization Approaches, Classic Process Synchronization Problems, Semaphores, Monitors.</p>	6
<p><b>Unit 3.Process Scheduling &amp; Deadlock</b></p> <p>Scheduling Terminology and Concepts, Nonpreemptive Scheduling Policies, Preemptive Scheduling Policies, Process Scheduling- Case Studies, Deadlocks - Deadlocks in Resource Allocation, Handling Deadlocks, Deadlock Detection and Resolution, Deadlock Prevention, Deadlock Avoidance.</p>	7
<p><b>Unit 4. Memory Management</b></p> <p>Managing the Memory Hierarchy, Static and Dynamic Memory Allocation, Memory Allocation to a Process, Contiguous Memory Allocation, Noncontiguous Memory Allocation, Paging, Segmentation, Virtual Memory-Demand Paging, Page Replacement Policies.</p>	6

<p><b>Unit 5. File Systems and I/O Management</b></p> <p>Overview of File Processing, Files and File Operations, Fundamental File Organizations and Access Methods, Directories, Layers of the Input-Output Control System, Overview of I/O Organization, I/O Devices, Device Drivers.</p>	7
<p><b>Unit 6. Unix Operating System (Case Study)</b></p> <p>System structure, User perspective, Architecture of the UNIX operating system, Introduction to system concepts, Kernel data structures, system administration, System calls for the file system-introduction, Network based Operating Systems.</p>	5

**Text Books:**

1. Milan Milenkovic, Operatingsystemsconcepts and design, McGRAW-Hill,2<sup>nd</sup>edition.[Unit 1]
2. Silberschatz, Galvin, Gagne, Operating system concept, Wiley India,8<sup>th</sup>edition.[Unit 2, 6]
3. Dhananjay M Dhamdhere, Operating systems - A Concept Based approach, Mc-Graw Hill, 3<sup>rd</sup> Edition.[Unit 3 to 5]
4. Maurice J. Bach, The design of Unix Operating System,PHI.[Unit 6]

**Reference Books:**

1. William Stallings, Operating Systems: Internals and Design Principles,Pearson,7<sup>th</sup> edition
2. Andrew S. Tanenbaum, Modern Operating Systems, Pearson Education International, 4<sup>th</sup> edition.
3. AchyutS.Godbole,Operating System with case studies in UNIX, Netware and Windows NT, TMGH.

**Online Resources:**

1. <https://nptel.ac.in/courses/106/105/106105214/#>
2. <https://nptel.ac.in/courses/106/102/106102132/>
3. <https://www.cse.iitb.ac.in/~mythili/os/>

### Course Plan

<b>Course Title :Computer Algorithms</b>	
<b>Course Code :201AIMLL212</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 3-0-0</b>	<b>Credit : 3</b>
<b>Evaluation Scheme : ISE:20,MSE Marks:30</b>	<b>ESE Marks:50</b>

**Course Description:** This course introduces basic methods for the design and analysis of efficient algorithms. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. It introduces the fundamental techniques for designing and analysing algorithms, including asymptotic analysis, divide-and-conquer algorithms, greedy algorithms, dynamic programming, traversal methods and even backtracking approach. It also provides introduction to NP-completeness.

### Course Objectives:

Sr. No.	Course Objectives
1	To introduce algorithm design methods / techniques with analysis
2	To devise algorithm for given problem statement and compute its complexity
3	To introduce complex computational problems

### Course Outcomes:

COs	Course Outcomes
	Upon successful completion of the course, student will be able to...
<b>C212.1</b>	Understand and demonstrate algorithm design methods with analysis
<b>C212.2</b>	Devise algorithm for given problem statement and analyse its space and time complexity by using recurrence relation
<b>C212.3</b>	Categorize the problem to determine polynomial and non-polynomial based on its nature.

<b>Prerequisite:</b>	Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C212.1</b>	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
<b>C212.2</b>	3	1	2	-	-	-	-	-	-	-	-	-	2	-	3
<b>C212.3</b>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4

Contents	Hours
<b>Unit 1: Divide and Conquer:</b> What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms .Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quicksort, DC Selection Algorithm, analysis of Divide and Conquer algorithms.	10
<b>Unit 2:The Greedy Method:</b> The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim’s and Kruskal’s Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths.	06
<b>Unit 3:DynamicProgramming:</b> The general method, Multistage graphs, All pair shortest paths,0/1 knapsack, Reliability design, Traveling Sales person problem.	06
<b>Unit 4:Basic Traversal and Search Techniques:</b> Techniques for Binary Trees, Game Tree; Techniques for Graphs – Breadth First Search & Traversal, Depth First Search& Traversal, AND/OR graphs; Connected components and Spanning Trees; Bi-connected components and depth first search.	06
<b>Unit 5: Backtracking:</b> The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Coloring. String Algorithms: Introduction, String Matching Algorithm, Brute Force Method, Robin -Karp String Matching algorithm, String Matching with Finite Automata	06
<b>Unit 6: NP Hard and NP Complete Problems:</b> Basic Concepts, Introduction to NP Hard Graph Problems.	05

**Text Books:**

1. Fundamentals of Computer Algorithms Ellis Horowitz, Satraj Sahani, Saguthevar Rajasekaran Universities Press, Second Edition (All Units)



**Reference Books:**

1. Data Structures and Algorithmic Thinking with PYTHON (Data Structure and AlgorithmicPuzzles) NarasimhaKarumanchi (MTech IIT Bombay)CareerMonk Publications(Refer for String Algorithms in unit 5)
2. Fundamentals of Algorithms Gilles Brassard, PaulBratley, Pearson Education.
3. Mastering Algorithms with C Kyle Loudon SPD O'Reilly.
4. Computer Algorithms-Introduction to Design andAnalysisSaraBaase, Allen VanGelder, Pearson Education.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introductionto Algorithms," Third Edition PHI 2010.

**Online Resources:**

1. <https://nptel.ac.in/courses/106/104/106104019/>

### Course Plan

<b>Course Title : Fundamentals of AI</b>	
<b>Course Code : 201AIMLL213</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 3-0-0</b>	<b>Credits : 3</b>
<b>Evaluation Scheme : ISE + MSE Marks : 20 + 30</b>	<b>ESE POE Marks : 50</b>

#### Course Description:

AI is a part of computer science based on theoretical and applied principles of that field. These principles include the data structures used in knowledge representation, the algorithms needed to apply that knowledge, and the languages and programming techniques used in their implementation. AI features include the use of computers to do reasoning, pattern recognition, learning or some other form of inference.

#### Course Objectives:

1. To expose the students to basic concepts and principles of AI.
2. To introduce the various tools for AI problem solving.
3. To make the students aware of various concepts for representing information in AI.

#### Course Outcomes (COs):

**At the end of the course the student should be able to:**

<b>C213.1</b>	Identify AI problems and their features.
<b>C213.2</b>	Use predicate calculus and propositional logic for knowledge representation.
<b>C213.3</b>	Use heuristics in search based problems.
<b>C213.4</b>	Use semantic networks, conceptual dependencies scripts and frames for information representation.

<b>Prerequisite:</b>	Knowledge of basic Computer Algorithms
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C213.1</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C213.2</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C213.3</b>	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>C213.4</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Content	Hours
<p><b>Unit 1. AI: its root and scope</b></p> <p>Early history and applications, Attitude towards intelligence, knowledge and human artifices, Overview of AI application areas, AI- A summary</p>	4
<p><b>Unit 2: Representation and Search</b></p> <p>The proportional calculus, The predicate calculus, Using inference rules to produce predicate calculus expression, Graph theory, Strategies for state space search, Introduction to heuristic search, Hill climbing and dynamic programming, Best first search algorithm, Using heuristics in games</p>	8
<p><b>Unit 3: Representation and intelligence:</b></p> <p>Issues in knowledge representation, Brief history of AI representational schemes, Introduction to conceptual graphs, Type, individuals and names, Generalization &amp; specialization</p>	6
<p><b>Unit 4: Rule based expert system:</b> Introduction, K rules as knowledge, representation, schemes, Expert system development teams, Structure, Characteristics, Forward chaining and backward chaining inference techniques., Media Advisor: A Demonstration, Conflict resolution, Advantages and disadvantages</p>	6
<p><b>Unit 5: Uncertainty management in rule based expert system :</b> Introduction, Basic probability theory, Bayesian reasoning, Forecast, Certainty factors theory and evidential</p>	6

reasoning, Comparison of Bayesian reasoning and certainty factors	
<b>Unit 6: TensorFlow- Basic Concept :</b> Machine learning and deep learning concepts, TensorFlow- general overview, Installing TensorFlow, first working session, Data Flow graph, TensorFlow Programming model, How to use TensorBoard.	8

**Text Books:**

1. Gorge F Luger, Artificial Intelligence; structures and strategies for complex problem solving. Pearson Education, 5th Edition.[Units 1, 2, 3 &6]
2. Michael Negnevistsky, Artificial Intelligence: A guide to intelligent systems, Person Education, 2nd edition. [Units 4, 5]
3. Giancarlo Zaccone, Getting started with TensorFlow, Packt Publishing, 2016.[Unit 6].

**Reference Books:**

1. Dan W. Patterson, Introduction to Artificial Intelligence, Pearson Education India, 6 January 2015

**Online Resources:**

1. <https://nptel.ac.in/courses/106/102/106102220/>
2. [https://onlinecourses.nptel.ac.in/noc21\\_ge20/preview](https://onlinecourses.nptel.ac.in/noc21_ge20/preview)

**Course Plan**

<b>Course Title: Formal Automata and Applications</b>	
<b>Course Code: 201AIMLL214</b>	<b>Semester: IV</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits:4</b>
<b>Evaluation Scheme: ISE + MSE Marks: 20+30</b>	<b>ESE Marks:50</b>

**Course Description:**

The course introduces some fundamental concepts in automata theory including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering etc. Formal systems and Automata is important because it allows scientists to understand how machines solve problems. Automata Theory is an exciting, theoretical branch of computer science. Learning how to design automata helps to improve the logical thinking capability of the student.

**Course Objectives:**

1. To expose the students to the mathematical foundations of computation, the theory of formal languages and grammars.
2. To analyze and design finite automata, pushdown automata, grammar for formal languages & Turing machines along with its applications.
3. To strengthen the students' ability to carry out formal and higher studies in computer science.
4. To Learn Markov Chains and its applications

**Course Outcomes (COs):**

At the end of the course the student should be able to:

<b>C214.1</b>	Understand the concept of abstract machines and their power to recognize the languages.
<b>C214.2</b>	Design context free grammars for formal languages and simplify using normal forms and design parsers
<b>C214.3</b>	Understand the concepts of push down automata and properties of RL and CFL
<b>C214.4</b>	Design the computational and acceptor machines using FA, PDA and Turing machines
<b>C214.5</b>	Expose to Markov chains & its application

<b>Prerequisite:</b>	Discrete Mathematical Structure
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C214.1</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C214.2</b>	-	1	1	-	-	-	-	-	-	-	-	1	-	-	3
<b>C214.3</b>	2	-	-	-	-	-	-	-	-	-	-	1	-	-	3
<b>C214.4</b>	2	2	2	-	-	-	-	-	-	-	-	1	2	-	3
<b>C214.5</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Content	Hours
<p><b>Unit 1. Introduction to Regular Languages and Finite Automata</b></p> <p><b>Regular Languages:</b> Regular Language, Recursive definition of Regular Expressions, Examples on writing Regular Expressions for Regular Languages, Closure Properties of Regular Language.</p> <p>Finite Automata Definition, Designing DFA, Union, Intersection &amp; Complement of Regular Languages and DFA, Applications of FA, Introduction to Output producing FAs: Mealy and Moore machine</p>	8
<p><b>Unit 2. Non determinism and Kleene's Theorem</b></p> <p>Nondeterministic finite automata and NFA with null transition along with corresponding extended transition function, Examples on designing NA and NFA- null, Equivalence of FA's, Kleene's Theorem Part I along with its proof, Examples on constructing NFA – null using Kleene's theorem, Kleene's Theorem Part II (only introduction to statement), Minimal State Finite Automata</p>	7
<p><b>Unit 3. Grammar Formalism</b></p> <p>Definition, Types of Grammar (Chomsky Hierarchy), Application of grammar: Derivation &amp; Reduction, Parse trees and ambiguity, Union, Concatenation and Kleene *'s of CFLs to construct Grammar, Properties of CFL: Union, Concatenation and Kleene *'s of CFLs, intersections and complements of CFLs, Simplified Forms and Normal Forms i.e.,</p>	6

Converting CFG to CNF, Introduction to GNF, BNF	
<b>Unit 4-Push Down Automata and Parsing</b> Definition and Examples of Pushdown Automata, Applications of PDA, Deterministic PDA, NPDA, Equivalence of CFG's & PDA's, Top-down parsing, Bottom-up parsing.	6
<b>Unit 5- Turing Machines</b> Definition, TM as language acceptors, Computing partial function with a TM, Variants of TM and Universal TM, Applications of Turing Machine.	5
<b>Unit 6-Markov Chains</b> Markov Chains: Definitions and Representations, Application: A Randomized Algorithm for 2-Satisfiability, Classification of States Example: The Gambler's Ruin	5

**Term work:**

- It should consist of minimum 10 assignments based on topics of syllabus which are included in exercise problems from the textbooks or reference books
- Carry out any 8 assignments from assignment no. 1 to 13 listed below.
- Assignment no. 14 and 15 are compulsory.
- Assignments can be given on the basis of following guidelines:

Sr. No.	Title	O/S
1	Examples on Regular Languages and writing regular expressions	S
2	Designing DFAs and Extended Transition function of DFA	O
3	Designing NFA, NFA-null and corresponding extended transition function	O
4	Problems on equivalence of FAs and union, intersection and complements of DFAs	O
5	Designing NFA- null using Kleene's Theorem Part I	O
6	Minimal state DFA and Examples	O
7	Writing grammar for given formal language, problems on left most and right most derivation along with parse tree, ambiguous grammar	O
8	Simplified Forms and Normal Forms: Examples on converting CFG to CNF /BNF	O
9	Examples on designing DPDA for the given language.	O
10	Parser: Examples on constructing top-down parser and bottom-up parser for the given Grammar	O

11	Designing Turing Machine as language acceptors and computable TM for the given language.	O
12	Example on Randomized Algorithm for 2-Satisfiability	O
13	Case Study on Classification of states	S
14	Use of Simulation tool to design DFA, NFA and NFA <sup>^</sup>	O
15	A group of 3 students to design a DFA and write a program to implement it in C programming Language.	O

S: Study based assignment    O: Operational assignment

**Text Books:**

1. John C. Martin, Introduction to Languages & the Theory of Computations - (Tata MGH 3<sup>rd</sup> Edition)(Unit 1 to 5)
2. Michael Mitzenmacher, Eli Upfal Probability and Computing Randomized Algorithms & Probabilistic Analysis (Cambridge)(Unit 6)

**Reference Books:**

1. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekar, 2nd edition, PHI.
2. Michael Sipser, Introduction to theory of Computations - (Thomson Books/Cole)
3. VivekKulkarni, Theory of Computation

**Online Resources:**

1. <https://nptel.ac.in/courses/111/103/111103016/>
2. <https://nptel.ac.in/courses/106/106/106106049/>
3. <https://automatonsimulator.com/>

**Evaluation Guidelines:**

1. ISE-I (10 Marks)

10 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc.) by the subject in-charge.

- ISE- I will be conducted before MSE

2. ISE –II (10 Marks)

10 Marks will be based on activity conducted (quiz, case study, problem solving based on tutorial, pedagogy activity etc.) by the subject in-charge.

- ISE- II will be conducted after MSE

Mode of conduction of ISE and ESE must be different.



### Course Plan

<b>Course Title : Python Programming Laboratory</b>	
<b>Course Code :201AIMLP215</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 2-0-2</b>	<b>Credit : 3</b>
<b>Evaluation Scheme : ISE Marks : 25</b>	<b>ESE-POE:25</b>

#### Course Description:

Python is a high-level programming language that helps in developing a wide variety of applications, including web applications, network programming, graphical user interfaces (GUIs), scientific and numeric applications. It also has a strong community around machine learning, data modeling, data analysis and artificial intelligence (AI), with extensive resources and libraries built for these purpose.

#### Course Objective:

Sr. No.	Course Learning Objectives
1	Make the student learn basics of python programming language.
2	Expose the students to various data structures.
3	Make the students aware of various Object Oriented concepts.
4	Expose the students to advanced concepts in Python.

#### Course Outcomes (COs):

Cos	Course Outcomes
	Upon successful completion of the course, student will be able to...
<b>C215.1</b>	Summarize the basic concepts in python.
<b>C215.2</b>	Identify the data structures to solve a problem.
<b>C215.3</b>	Demonstrate the use of Object Oriented concepts in problem solving.
<b>C215.4</b>	Apply Python concepts in web application using Django framework.
<b>C215.5</b>	Use networking and multithreading concepts to solve a problem.

<b>Prerequisite:</b>	Knowledge of programming language like C/C++
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

Cos	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C215.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C215.2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3
C215.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
C215.4	2	-	-	-	2	-	-	-	-	-	-	-	-	-	3
C215.5	2	-	2	-	2	-	-	-	-	-	-	-	1	-	3

Content	Hours
<p><b>Unit 1. Getting Started with Python:</b></p> <p>Basics of Python: Python Installation and Working of it, Data types in python, Operators in python, Input and Output, detail study of python blocks, control statements, Branching statements.</p>	3
<p><b>Unit 2. Basics of Python Programming:</b></p> <p>String and Character in python, List and Tuples, Dictionaries, Arrays in python, Functions.</p>	5
<p><b>Unit 3. OOP Concepts in Python:</b></p> <p>Classes and OOP Concepts: Procedural and Object-Oriented Programming, Objects, class, Method overloading, Polymorphism, Inheritance, hands on with Lambda function in python coding with the use of functions, modules and external packages.</p>	4
<p><b>Unit 4. Files in Python:</b></p> <p>Advanced Python: Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.</p>	5

<b>Unit 5. Python Integration Primer:</b> Graphical User interface, Networking in Python	4
<b>Unit 6. Advanced Python:</b> Introduction to Django, Introduction to Multithreading and security in Python.	3

**Text books:**

1. Beginning Python: Using Python 2.6 and Python 3.1., Wrox Publication
2. Anurag Gupta, G. P. Biswas, Python Programming, McGraw-Hill
3. E. Balagurusamy, Introduction to computing and problem-solving using Python, McGraw Hill Education

**Reference Books:**

1. "Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication

**Online Resources:**

1. <https://nptel.ac.in/courses/106/106/106106182/>

<b>List of Experiments</b>			
<b>Expt. No.</b>	<b>Name of Experiments</b>	<b>S/O</b>	<b>Hours</b>
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples)	O	2
2	Program for Implementation of control statements.	O	2
3	Creating functions, classes and objects using python. Demonstrate exception handling	O	2
4	Program for implementation of inheritance.	O	2
5	Python program to append data to existing file and then display the entire file	O	2

6	a. Python program to count number of lines, words and characters in a file. b. Python program to display file available in current directory	O	2
7	Creating Registration form GUI with Python.	O	2
8	Menu driven program to create a simple calculator.	O	2
9	Creation of simple socket for basic information exchange between server and client.	O	2
10	Creating web application using Django web framework to demonstrate functionality of user registration.	O	2
11	Programs on Threading using python.	O	2
12	Program to implement simple linear regression using Python	O	2

❖ **S-Study, O-Operational**

Note: Students should perform minimum 10-12 experiments based on above list

**Text Books:**

1. David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler “Python Basics: A Practical Introduction to Python 3”, Realpython
2. Samuel Dazon, AidaisBendoraitia, ArunRavindran, ”Django: Web Development with Python”.Packt>

**Online resources:**

1. Virtual Lab:- <https://python-iitk.vlabs.ac.in/>
2. <https://nptel.ac.in/courses/106/106/106106182/>

**Course Plan**

<b>Course Title: Artificial Intelligence Laboratory</b>	
<b>Course Code : 201AIMLP216</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 0-0-2</b>	<b>Credits : 1</b>
<b>Evaluation Scheme: ISE Marks: 25</b>	<b>ESE-POE Marks: 50</b>

**Course Description:** The Laboratory for AI consists of understanding and implementing the basic principles and concepts of AI using an appropriate technique. The experiments provide better understanding of various algorithms used in AI. Exposure to various case studies like expert system, MYSIN and AI SHELL is covered.

**Course Objectives:**

1. To expose the students to basic concepts and principles of AI.
2. To introduce the various algorithms of AI for problem solving.
3. To make the students aware of expert system and open source platform for implementing AI applications.

**Course Outcomes (COs):**

**At the end of the course the student should be able to:**

<b>C216.1</b>	Represent knowledge using propositional and predicate logic.
<b>C216.2</b>	Solve the problems using various searching techniques of AI.
<b>C216.3</b>	Demonstrate the use of heuristics technique for game playing.
<b>C216.4</b>	Develop simple expert system.
<b>C216.5</b>	Use tensor flow framework for implementing AI applications.

<b>Prerequisite:</b>	Data Structures
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C216.1</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>C216.2</b>	3	1	1	-	-	-	-	-	-	-	-	-	-	-	3
<b>C216.3</b>	3	1	2	-	-	-	-	-	-	-	-	-	-	-	3
<b>C216.4</b>	3	-	1	-	-	-	-	-	-	-	-	-	-	-	3
<b>C216.5</b>	3	-	2	-	2	-	-	-	-	-	-	-	-	-	3

Sr. no	Name of Experiment	Type	Hours
1	Study experiment on propositional logic and predicate logic.	S	2
2	Implementation of Best First Search (BFS)	O	2
3	Implementation of Depth First Search (DFS),	O	2
4	Implementation of Breadth First Search (BFS).	O	2
5	Implementation of Implementation of Tic Tac Toe game using heuristics.	O	2
6	Study experiment on conceptual graphs (semantic nets, conceptual dependency, and 3rd graph).	S	2
7	Case study on Expert System.	S	2
8	Development of a simple expert system	O	2
9	Installation of Tensor flow	O	2
10	Implementation of computational graph using Tensor flow core	O	2
11	Study of Tensor board.	S	2
12	Case study on MYSIN and AI SHELL	S	2

❖ **S-STUDY, O-OPERATIONAL**

Note:-The instructor may choose minimum ten experiments from experiment no. 1 to 12.

**Text Books:**

1. Artificial Intelligence: A Modern Approach,. Russell &Norvig. 1995, Prentice Hall.
2. Artificial Intelligence, Elain Rich and Kevin Knight, 1991, TMH.
3. Artificial Intelligence-A modern approach, StaurtRussel and peter norvig, 1998, PHI.
4. Artificial intelligence, Patrick Henry Winston:, 1992, Addition Wesley 3 Ed.
5. Introduction to prolog.

**Reference Books:**

1. Gorge F Luger, Artificial Intelligence; structures and strategies for complex problem solving, Pearson Education 5th Edition

**Online Resources:**

1. <https://nptel.ac.in/courses/106/106/106106126/>

**Course Plan**

<b>Course Title : Soft Skills Laboratory</b>	
<b>Course Code : 201AIMLP217</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 0-0-2</b>	<b>Credits : 1</b>
<b>Evaluation Scheme : ISE Marks: 25</b>	<b>ESE-OE Marks : 25</b>

**Course Description:**

Soft skills are character traits and interpersonal skills that characterize a person's relationships with other people. This course includes Communication skills, Writing skills, Techniques for self-development, Teamwork and group discussions, Time and stress management, Professional skills for overall development of an Engineer.

**Course Objectives:**

1. To make the engineering students aware of the importance, the role and the content of soft skills.
2. To develop and nurture soft skills of the students through individual and group activities.
3. To expose students to right attitudinal and behavioral aspects and to build the same through activities.
4. To encourage overall development of students by focusing on soft skills.

**Course Outcomes (COs):**

At the end of the course, students will be able to:

<b>C217.1</b>	Effectively use skills to communicate clearly and improve listening and writing skills.
<b>C217.2</b>	Make use of techniques for self-awareness and self-development.
<b>C217.3</b>	Understand the importance of teamwork and group discussion skills.
<b>C217.4</b>	Apply time management and stress management skills.
<b>C217.5</b>	Apply professional skills and ethics effectively being an Engineer.

<b>Prerequisite:</b>	Basic communication and writing skills in English.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>C217.1</b>	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
<b>C217.2</b>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
<b>C217.3</b>	-	-	-	-	-	-	-	-	2	2	-	-	-	-	2
<b>C217.4</b>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
<b>C217.5</b>	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3

Contents	Hours
<b>Unit 1: Getting Started with Soft Skills</b> Introduction to Soft Skills, Communication Basics, Official Communication, Online Meetings, Comprehension, Reading Research Papers.	4
<b>Unit 2: Behavioral Skills and Self Development</b> Confidence Improvement, Positive Attitude, Positive Thinking, Personal Accountability, Diversity Awareness, Empathy, Emotional Intelligence, Emotional Quotient, Self-Management: Self-Evaluation, Self-Discipline, Self-Awareness.	4
<b>Unit 3: Leadership and Team Building</b> Culture and Leadership: Salient Features of Corporate Culture, Leadership Styles, Leadership Trends. Team Building: Types of Teams, Team Development Stages, Attributes of a Successful Team, Barriers involved, Role of Team leader.	4
<b>Unit 4: Developing Writing skills</b> Writing Proposals, Project Synopsis, Report Writing, Technical Paper Writing, Writing for Employment: Job Search, Cover Letter, Functional and Chronological Resumes, Professional Correspondence.	4
<b>Unit 5: Stress and Time Management</b> Stress in Today's Time, Positive Stress, Negative Stress, Types of Stressors, Identify the Stress Source, Reasons and Effects, Identifying Stress, The four A's of Stress Management, Approaches: Action-oriented, Emotion-oriented and Acceptance-oriented.	4

Time Management, Time Management Techniques.	
<b>Unit 6: Professionalism</b>  Goal Setting, Planning and Managing Carrier, Developing Work Ethics, Presenting yourself Professionally: Dressing Etiquettes, Corporate Grooming and Dressing, Etiquette and Mannerism: All types of Etiquettes. Technology Etiquette: Email and Telephone Etiquette, Interview Etiquette. Job Interview: Types of Interviews as Telephonic, Face to Face and Online Interview.	4

**Text Books:**

1. Krishna Mohan and MeeraBanerji- Developing Communication Skills by MacMillan India Ltd., Delhi
2. Gajendra Singh Chauhan, Sangeeta Sharma- Soft Skills – An Integrated Approach to Maximize Personality, WILEY INDIA, ISBN:13:9788126556397.
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education, Edition 1, 2013.
4. PriyadarshiPatnaik- Group Discussions and Interview Skills, Cambridge University Press.

**Reference Books:**

1. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
2. Francis Sounderaj- Basics of Communication In English, MacMillan India Ltd.
3. Simon Sweeney—English for Business Communication, Cambridge University Press, ISBN13:978-0521754507.
4. Barun K. Mitra- Personality Development & Soft Skills, Oxford Publishers, Third Impression, 2017.
5. ShaliniVerma- Development of Life Skills and Professional Practice, First Edition; Sultan Chand (G/L) & Company, 2014.
6. Remesh S, Vishnu R. G.- Life Skills for Engineers, Ridhima Publications, First Edition, 2016.

<b>List of Sessions</b>			
<b>Expt. No.</b>	<b>Name of Session</b>	<b>S/O</b>	<b>Hours</b>
1	Role Play and Drama Play	O	2
2	Attitude Activity	O	2

3	Emotional Intelligence and Emotional Quotient Test Activity	O	2
4	Leadership and Team Building Activity	O	2
5	Group Discussion Activity	O	2
6	Debate Activity	O	2
7	Presentation Skills	O	2
8	Functional and Chronological Resume writing	O	2
9	Professional Correspondence	O	2
10	Stress Management Activity	O	2
11	Time Management Activity	O	2
12	Professional Etiquettes	S	2
13	Interview Activity	O	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: The instructor may choose minimum 10 Sessions from Session No. 1 to 13.**

**Term work:**

1. Various activities to be taken based on assignments like self introduction, role play, group discussions, presentations and team activity etc.
2. Multiple set of activity based assignments can be prepared to allow multiple skills exposure for team building, value sharing, leadership and role play.
3. Faculty may arrange one or more sessions from following: yoga and meditation, stress management, relaxation exercises and fitness exercises. Time management and personal planning sessions.
4. Continuous assessment of laboratory work is to be done based on overall performance and lab assignment performance of the student.

**Course Plan**

<b>Course Title : Economics and Management for IT (Mandatory Course-II)</b>	
<b>Course Code : 201AIMLMC218</b>	<b>Semester : IV</b>
<b>Teaching Scheme : L-T-P : 2-0-0</b>	<b>Credits : No Credits</b>
<b>Evaluation Scheme : ISE + MSE: Not Applicable</b>	<b>ESE Marks : 50</b>

**Course Description:** This course provides a comprehensive study of basic economics terminologies, principles and the role of ICT (Information & Communication Technologies) in modern business management. This course includes economics analysis, cost estimation, project management and value analysis including modern day tools viz. online marketplace and various search for online marketing and management.

**Course Objectives:**

1. To get the knowledge about fundamental principles of economics.
2. To understand basic principles of cost estimation, project management and value analysis.
3. To get introduced with online marketplace for marketing and business management.
4. To understand the optimization of a Web site and SEO optimization for business communications.

**Course Outcomes (COs):**

At the end of the course the students should be able to:

<b>C218.1</b>	Identify the importance of the economics for business planning.
<b>C218.2</b>	Understand and apply cash flow between actors and stakeholders including depreciation of asset.
<b>C218.3</b>	Identify digital channels, business tools used for business communication.

<b>Prerequisite:</b>	Nil
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C218.1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2
C218.2	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1
C218.3	-	-	-	-	2	-	-	-	1	2	-	-	-	-	4

Content	Hours
<p><b>Unit 1. Introduction, Elementary Economic Analysis</b></p> <p><b>Introduction:</b> Economics: Flow in an Economy, Law of Supply and Demand, Concept of Engineering Economics: Types of Efficiency, Definition and Scope of Engineering Economics, Elements of Costs <b>Frameworks and architectures:</b> Actors and stakeholders, Fundamental sales process, Technological elements.</p>	5
<p><b>Unit 2. Present and future worth method</b></p> <p><b>Present worth method:</b> Revenue-dominated Cash Flow Diagram, Cost-dominated Cash Flow Diagram, Examples. <b>Future worth method:</b> Revenue-dominated Cash Flow Diagram, Cost-dominated Cash Flow Diagram, Examples.</p>	4
<p><b>Unit 3. Project Management and value analysis</b></p> <p><b>Introduction:</b> Phases of Project Management, Guidelines for Network Construction, Critical Path Method (CPM), Gantt Chart/Time Chart, PERT. (Project Evaluation and Review Technique)</p> <p><b>Introduction:</b> When to Apply Value Analysis: Value Analysis vs. Value Engineering, Function, Aims, Value Engineering Procedure, Advantages and Application Areas.</p> <p><b>Case study:</b> ERP for project management</p>	5
<p><b>Unit 4. Online marketplace analysis &amp; macro environment</b></p> <p><b>Introduction:</b> situation analysis for digital marketing, the digital marketing environment, understanding customer journeys, online consumer behaviour and implications for marketing, business models for e-commerce.</p>	4

<p><b>Online macro environment:</b> Technological forces, economic forces, political forces, Legal forces, social forces and cultural forces.</p>	
<p><b>Unit 5: Business communication strategy and relationship marketing</b></p> <p><b>Business communication strategy development:</b> how to structure digital marketing strategy, strategy implementation.</p> <p><b>Relationship marketing using digital platforms:</b> Introduction, the challenge of customer engagement, customer lifecycle management.</p>	3
<p><b>Unit 6. Business Communications</b></p> <p><b>Digital media channels:</b> Introduction, search engine marketing, online public relations, e-mail marketing and mobile text messaging, social media and viral marketing, offline promotion techniques.</p> <p><b>Case study:</b> An industry 4.0 Case Studies.</p>	3

**Textbooks:**

1. R. Paneerselvam, Engineering Economics, PHI publication, 13<sup>th</sup> Edition (Unit 1 to 3).
2. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice, Pearson Education, 6<sup>th</sup> Edition (Unit 4 to 6).

**Reference Books:**

1. Mark Taylor, Andrew Ashwin, N. Mankiw, Business Economics by. New Delhi: Cengage Learning.
2. The Beginner's Guide to Digital Marketing (2015). Digital Marketer.
3. Pulizzi, J. (2014) Epic Content Marketing, McGraw Hill Education.

**Online Resources:**

1. <https://nptel.ac.in/courses/110/105/110105067/>