K J Somaiya Institute of Engineering and Information Technology,
Sion, Mumbai
An Autonomous Institute under University of Mumbai

Autonomy Syllabus Scheme-I (2021-22)

Bachelor of Technology

In

Artificial Intelligence and Data Science

(AI-DS)

(Second Year-Semester-III)

(With Effect From A.Y. 2021-22)

From the Principal's Desk:

The academic reforms recently recommended by the AICTE and UGC have effectually strengthened the higher education system in India. To adhere to the status quo and enhance the academic standards and quality of engineering education further, it is essential to assimilate innovation and recurrent revision in curriculum, teaching-learning methodology, examination, and assessment system.

In congruence with it, the University of Mumbai has adapted Outcome-Based Education (OBE) system and has revised the engineering curriculum thrice in the last decade — as Rev 2012, Rev 2016, and the recent Rev 2019, 'C' scheme focusing on cutting-edge technology courses.

K. J. Somaiya Institute of Engineering and Information Technology, being an autonomous institute possesses more flexibility in adapting newer approaches to reach higher levels of excellence in engineering education. This first syllabus scheme under the autonomy comprises state-of-the-art courses and laboratory sessions on emerging areas of technology. The syllabus is designed with an objective to foster the students for developing innovative solutions to real-world issues of the society and/or industry through the acquired knowledge. The induction program for the students is deliberated as per guidelines of AICTE and shall be executed over the entire First Year.

With an ideology that the root of innovation is 'interest', the curriculum offers a wide range of elective courses - grouped into core and inter-disciplinary domains. At par with international engineering education, the students can choose to study courses concerning areas of their interests.

The curriculum introduces Skill-Based Learning (SBL), Activity-Based Learning (ABL), and Technology-Based Learning (TBL) as eXposure (SAT) courses - that assure X factor in all the students of the institute. The SAT courses shall be practiced across the first three years of engineering, focusing on graduate attributes like work ethics, responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. that may not be copiously imbibed through regular engineering courses. The proficiencies acquired herein shall open huge employment and entrepreneurial opportunities for the students.

Students of the institute are already provided exposure to the work culture and trends in industries through live / collaborative projects / product developments, etc. Under autonomy too, through the component of Project-Based Learning included in the syllabus, the students shall develop Mini, Minor, and Major projects in Second, Third, and Last Year respectively concerning healthcare, agriculture, societal / industrial need-based problems, etc. as well as pursue internships at the end of each semester / year - making them industry-ready engineers. The blend of all these learning components in the curriculum shall strengthen the research and innovation ecosystem in the institute for best benefits of the students.

This first syllabus shall be effective from Academic Year 2021-22 to all four years at once. It comprises 165 credits, follows the AICTE model curriculum, focuses on learner-centric approach as well as continuous evaluation, and shall offer the ideal learning experience for the students of the institute.

In the coming years, the institute shall also offer an Honours degree for students who are desirous of pursuing their special interest areas in industry-relevant tracks like Artificial Intelligence, Internet of Things, Cyber Security, etc. Through joint efforts of all stakeholders, strategic planning, and efficient execution of neoteric educational practices with hi-tech wizardry, we shall strive to become a role model for all autonomous institutes across the nation.

Dr. Suresh Ukarande

Principal and Chairman - Academic Council

Member Secretary, Academic Council's Preamble:

We, Board of Studies in Computer Engineering (CE), Information Technology (IT), Artificial Intelligence and Data Science (AI-DS), Electronics and Telecommunication (ET) and Electronics Engineering (EX) are very happy to present 4 years of undergraduate and 2 years of post-graduation in Artificial Intelligence (AI), Engineering technology syllabus effective from the Academic Year 2021-22 under the autonomy status granted to our institute, K J Somaiya Institute of Engineering and Information Technology (KJSIEIT). We are sure you will find this syllabus interesting, challenging and meeting the needs of Industry 4.0.

UGC states the benefits of granting academic autonomy to higher education institutes as the freedom to modernize curricula, making it globally competent, locally relevant and skill oriented to promote employability'. Thus exercising academic freedom by eligible and capable institutes is the need for developing the intellectual climate of our country and bringing and promoting academic excellence in higher education system. KJSIEIT under its first autonomous syllabus scheme (KJSIEIT-Scheme I) is keen in providing globally required exposure to its learners focusing sound theoretical background supported by practical experiences in the relevant areas of engineering and technology.

Besides engineering and technology foundation, Industry 4.0 demands modern, industry-oriented education, up-to-date knowledge of analysis, interpretation, designing, implementation, validation, and documentation of not only computer software and systems but also electronics and communication systems, hardware devices and tools, trained professional, ability to work in teams on multidisciplinary projects, etc. Thus KJSIEITs autonomy Scheme-I syllabus has been designed for the learners to successfully acquaint with the demands of the industry worldwide, life-long experiential learning, professional ethics with universal human values and training for needed skillsets and in line with the objectives of higher and technical education, AICTE, UGC and various accreditation and ranking agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of KJSIEITs autonomy Scheme-I syllabus are:

1. Total 165 credits ensuring extra time for students' experiential learning through extracurricular activities, innovations, and research.
2. Introduction of Skill Based, Activity Based, Technology based and Project Based learning to showcase learners' creativity, interest and talent by developing additional skillsets, social involvement and contributions through activities, case studies, field visits, internships, creative learning, innovative mini, minor and major project developments, strengthen their profile and increasing the chances of employability.
3. Value addition learning through MOOCs platforms such as IBM-ICE, Coursera, NPTEL, SWAYAM, Spoken Tutorial etc.
4. Emerging areas of technology learning in Artificial Intelligence, Machine learning, Data Science, Internet of things, Cyber Security, Block chain, augmented and Virtual reality.

We would like to place on record our gratefulness to the faculty, alumni, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Dr. Sunita R Patil

Member Secretary, Academic Council and Vice Principal, KJSIEIT, Sion

Preface by Board of Studies in Artificial Intelligence and Data Science:

We, the members of Board of Studies of B. Tech in Artificial Intelligence and Data Science are very happy to present a syllabus of Second Year of B. Tech in Artificial Intelligence with effect from the Academic Year 2021-22. We are assured that you will discover this syllabus interesting and challenging.

Artificial Intelligence and Data Science is one of the newest programme amongst engineering students. There are nine emerging technology thrust areas declared by AICTE, Artificial Intelligence and Data Science are two areas mentioned in it. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas like human intelligence and its applications in industry, defence healthcare, agriculture and many other areas. It is envisioned to deliver a modern, industry-oriented education in Artificial Intelligence and Data Science. It aims at creating skilled engineers who can successfully acquaint with the demands of the industry worldwide. We focused on organizing in-house internship at the end of every semester on the emerging areas in the institute by calling industry persons as per the guidelines They obtain skills and experience in up-to-date knowledge to analysis, design, employ, technologies, software and systems.

In this course, the students may have career opportunities in healthcare, business, e-Commerce, social networking companies, biotechnology, genetics and other areas. At the beginning of every course we have added two theory lectures for prerequisites and course outline and at the end one theory lecture added for coverage of course conclusion which includes recap of modules, outcomes, applications, and summarization. We have mapped course outcomes, PBL outcomes, Skills outcomes, Activity outcomes and TBL outcomes module wise throughout the syllabus. Faculty in this program adopted collaborative, co-operative and online teaching learning techniques during coverage of the course; this will help students to understand each course in depth. The designed syllabus promises to achieve the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

We would like to show our appreciation to the faculties, students, industry experts and stakeholders assisting us in the design of this syllabus.

Board of Studies in Artificial Intelligence and Data Science are,

Sr. No.	Name	Designation	Sr. No.	Name	Designation
1	Dr. Milind U. Nemade	Head of the Department concerned (Chairman)	7	Prof. Pankaj Deshmukh	Member
2	Dr. Madhav Chandane	One expert to be nominated by the Vice-Chancellor	8	Prof. Sejal Shah	Member
3	Mr. Akhil Hada	One Representative from Industry /Corporate Sector/ Allied area relating to Placement	9	Prof. Vidya Sagvekar	Member
4	Dr. Vaishali Wadhe	Member	10	Prof. Vrinda Ullas	Member
5	Dr. Sunita Patil	Other member	11	Dr. Namrta Gharat	Other member
6	Dr. Hariram Chavan	Other member	12	Dr. Radhika Kotecha	Other member

Program Structure for Second Year UG (AI-DS)

Semester- III-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) (TH–P–TUT)	Total (Hrs.)	Credit Assigned (TH–P–TUT)	Total Credits	Course Category
1UAIC301	Applications of Mathematics in Engineering-I	3–0–0	03	3–0–0	03	**BS**
1UAIC302	Discrete Structures and Graph Theory	2–0–0	02	2–0–0	02	PC
1UAIC303	Data Structure	3–0–0	03	3–0–0	03	PC
1UAIC304	Digital Logic & Computer Architecture	3–0–0	03	3–0–0	03	PC
1UAIC305	Computer Graphics	3–0–0	03	3–0–0	03	PC
1UAIL303	Data Structure Lab	0–2–0	02	0–1–0	01	PC
1UAIL304	Digital Logic & Computer Architecture Lab	0–2–0	02	0–1–0	01	PC
1UAIL305	Computer Graphics Lab	0–2–0	02	0–1–0	01	PC
1UAIPR31	Project Based Learning- Mini Project Lab-I	0–2–0	02*	0–1–0	01	PBL
1UAIXS33	Skill Based Learning-III	0-2#-0	02	0-1-0	01	SAT
1UAIXA34	Activity Based Learning-IV	0-2#-0	02	0-1-0	01	SAT
Total		**14–12-0**	**26**	**14-6-0**	**20**	

***Load of learner, not the faculty**

#SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Semester- III-Examination Scheme

Course Code	Course Name	Examination Scheme								
		Marks								
		CA			ESE	TW	O	P	P&O	Total
		T1	T2	IA						
1UAIC301	Applications of Mathematics in Engineering-I	15	15	10	60	25	--	--	--	125
1UAIC302	Discrete Structures and Graph Theory	10	10	10	45	--	--	--	--	75
1UAIC303	Data Structure	15	15	10	60	--	--	--	--	100
1UAIC304	Digital Logic & Computer Architecture	15	15	10	60	--	--	--	--	100
1UAIC305	Computer Graphics	15	15	10	60	--	--	--	--	100
1UAIL303	Data Structure Lab	--	--	--	--	25	--	--	25	50
1UAIL304	Digital Logic & Computer Architecture Lab	--	--	--	--	25	--	--	--	25
1UAIL305	Computer Graphics Lab	--	--	--	--	25	--	--	25	50
1UAIPR31	Project Based Learning- Mini Project Lab-I	--	--	10	--	25	--	--	25	60
1UAIXS33	Skill Based Learning-III	--	--	20	--	--	--	--	--	20
1UAIXA34	Activity Based Learning-IV	--	--	20	--	--	--	--	--	20
Total		**70**	**70**	**100**	**285**	**125**	--	--	**75**	**725**

Mini Project Lab 1 and 2: Students can form groups with Minimum 2 (Two) and not more than 3 (Three)
Faculty Load: 1 hour per week per four groups

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC301	Applications of Mathematics in Engineering-I	(3+0+0)

Prerequisite:	1.Engineering Mathematics-I 2.Engineering Mathematics-II
Course Objectives:	1. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications. 2. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills. 3. To understand the concept of complex variables, C-R equations with applications. 4. To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning and AI. 5. To understand some advanced topics of probability, random variables with their distributions and expectations.
Couse Outcomes:	On successful completion, of course ,learner/student will be able to: 1. Solve the real integrals in engineering problems using the concept of Laplace Transform. 2. Analyze engineering problems through the application of inverse Laplace transform of various functions. 3. Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems. 4. Solve the problems of obtaining orthogonal trajectories and analytic functions by means of complex variable theory and application of harmonic conjugate. 5. Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI. 6. Analyze the spread of data and distribution of probabilities by the concepts of probability and expectation.

Module No. & Name	Sub Topics	CO mapped	Hrs./ Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Laplace Transform	1.1. Definition of Laplace transforms Condition of Existence of Laplace transform.	CO1	01	07
	1.2 Laplace Transform (L) of Standard Functions like eat, sin(at), cos(at), sinh(at), cos*h*(at) and tn, $n \geq 0$.		02	
	1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scales Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof).		02	
	1.4 Evaluation of integrals by using Laplace Transformation		02	
2.Inverse Laplace Transform	2.1 Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, Inverse Laplace Transform using derivatives.	CO2	02	06
	2.2 Partial fractions method to find inverse Laplace Transform.		02	
	2.3 Inverse Laplace transform using Convolution theorem (without proof).		02	

3. Fourier Series	3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	CO3	01	07
	3.2 Fourier series of periodic function with period 2 and 2l.		02	
	3.3 Fourier series of even and odd functions.		02	
	3.4 Fourier Transform-Fourier sine transform and Fourier cosine transform.		02	
4.Module: Complex Variables	4.1Function f(z) of complex variable, Limit, Continuity and Differentiability off(z), Analytic function: Necessary and sufficient conditions for f(z) to be analytic (without proof).	CO4	01	07
	4.2Cauchy-Riemann equations in Cartesian coordinates (without proof).		02	
	4.3Milne-Thomson method to determine analytic function f(z) when real part(u) or Imaginary part (v) or its combination (u+v or u-v) is given.		02	
	4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories.		02	
5. Statistical Techniques	5.1 Karl Pearson's coefficient of correlation (r)	CO5	01	06
	5.2 Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)		01	
	5.3 Lines of regression		02	
	5.4 Fitting of first- and second-degree curves.		02	
6.Probability	6.1Definition and basics of probability, conditional probability.	CO6	01	06
	6.2Total Probability theorem and Bayes' theorem.		01	
	6.3Discrete and continuous random variable with probability distribution and probability density function.		02	
	6.4Expectation, Variance, Moment generating function, Raw and central moments up to 4^{th} order.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. 1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication. 2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited. 3. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
Reference Books	1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication. 2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education. 3. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Each Student has to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a

presentation/problem solving of 10-15 minutes. This should be considered as mini project in engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

3. The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini Project Presentation	10 marks

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC302	Discrete Structures and Graph Theory	(3+0+0)

Prerequisite:	Discrete Mathematics
Course Objectives:	1. To cultivate clear thinking and creative problem solving. 2. To thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies. 3. To apply graph theory in solving practical problems. 4. To thoroughly prepare for the mathematical aspects of other Artificial Intelligence and Data Science courses.
Couse Outcomes:	On successful completion, of course student will be able to: 1. Analyze to the reason logically 2. Apply the relations, functions, Diagraph and Lattice. 3. Apply the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. 4. Identify problems concepts of graph theory in solving real world problems 5. Examine the groups and codes in Encoding-Decoding. 6. Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Logic	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	CO1	04	04
2. Relations and Functions	2.1 Basic concepts of Set Theory	CO2	01	04
	2.2 Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes		02	
	2.3 Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function		01	
3. Posets and Lattice	Partial Order Relations, Poset, Hasse Diagram, Chain and Antichains, Lattice, Types of Lattice, Sub lattice	CO3	04	04
4. Counting	4.1 Basic Counting Principle- , Product Rule, Inclusion-Exclusion Principle, Pigeon hole Principle	CO4	02	04
	4.2 Recurrence relations, Solving recurrence relations		02	
5. Algebraic Structures	5.1 Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism.	CO5	02	05
	5.2 Algebraic structures with two binary operations: Ring.		01	

	5.3 Coding Theory: Coding, binary information and error detection, decoding and error correction.		02	
6. Graph Theory	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Eulerand Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, Applications.	CO6	05	05
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
Total hours				28

Books:	
Text Books	1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem -ur Rehman, "Discrete Mathematical Structures", Pearson Education. 2. C.L.Liu" Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company. Reprinted 2000. 3. K.H.Rosen," Discrete Mathematics and applications", fifth edition2003,Tata McGraw Hill Publishing Company
Reference Books	1. Y N Singh," Discrete Mathematical Structures", Wiley-India. 2. J.L.Mott, A.Kandel, T.P.Baker," Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India. 3. J.P.Trembley, R.Manohar" Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publishing Company 4. Seymour Lipschutz, Marc Lars Lipson, "Discrete Mathematics" Schaum"s Outline, McGraw Hill Education. 5. Narsing Deo, "Graph Theory with applications to engineering and computer science", PHI Publications. 6. P.K. Bisht , H.S.Dhami, "Discrete Mathematics", Oxford press.
Useful Links:	
1.https://www.edx.org/learn/discrete-mathematics	
2.https://www.coursera.org/specializations/discrete-mathematics	
3.https://nptel.ac.in/courses/106/106/106106094/	
4.https://swayam.gov.in/nd1_noc19_cs67/preview	
Assessment:	
Continuous Assessment for 30 marks: 1. Test 1 – 10 marks 2. Test 2 – 10 marks 3. Internal assessment - 10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Examination will be of 45 marks for 2 hours duration.	

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC303	Data Structure	(3+0+0)

Prerequisite:	1.Computer Programming 2.Computer Programming Laboratory
Course Objectives:	1. To discuss types of different data structures and concept of Abstract Data Type 2. To discuss the concept of stack and queue and apply them to various applications. 3. To describe the concept of link list and apply it to various applications 4. To introduce the different kinds of trees. 5. To discuss graph related concepts and traversals along with application. 6. To teach various searching techniques.
Couse Outcomes:	After successful completion of the course students will be able to: 1. Describe types of data structure and write ADT. 2. Implement stack and different types of queues using array and their applications. 3. Carry out various types of link list operations and their applications. 4. Implement Binary Search Tree, its operations and describe the concepts of AVL tree, Btree and B+Tree. 5. Implement Graph traversals BFS and DFS and application of graph in topological sorting. 6. Describe various hashing functions, collision techniques and compare various searching techniques linear search, binary search and hashing.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Data Structures	1.1 Introduction to Data Structures, Concept of ADT,	CO1	01	02
	1.2 Types of Data Structures- Linear and Nonlinear, Operations on Data Structures.		01	
2. Stack and Queues	2.1 Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion.	CO2	04	08
	2.2 Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.		04	
3. Linked List	3.1 Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List,	CO3	05	09

	3.2 Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.		04	
4. Trees	4.1 Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree,	CO4	06	10
	4.2 Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.		04	
5. Graphs	5.1 Introduction, Graph Terminologies, Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS)	CO5	03	04
	5.2 Graph Application- Topological Sorting.		01	
6. Searching Techniques	Linear Search, Binary Search, Hashing-Concept, Hash Functions, Collision resolution Techniques	CO6	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication. 2. Reema Thareja, "Data Structures using C", Oxford Press. 3. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2ndEdition, CENGAGE Learning. 4. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education 5. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.
Reference Books	1. Prof. P. S. Deshpande, Prof. O. G. Kakde, "C and Data Structures", DreamTech press. 2. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India. 3. Rajesh K Shukla, "Data Structures using C and C++", Wiley-India 4. GAV PAI, "Data Structures", Schaum's Outlines. 5. Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition

Useful Links:

1.https://learndsa.kjsieit.in/

2. https://nptel.ac.in/courses/106/102/106102064/

3. https://www.coursera.org/specializations/data-structures-algorithms

4. https://www.edx.org/course/data-structures-fundamentals

5. https://swayam.gov.in/nd1_noc19_cs67/preview

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks

2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Data Structure".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC304	Digital Logic & Computer Architecture	(3+0+0)

Prerequisite:	1. Knowledge of number systems 2. Knowledge of Basic computer organizations 3. Basic electrical and electronics engineering
Course Objectives:	1. To have the basic awareness about structure and operation of digital circuits and digital computer. 2. To discuss in detail arithmetic operations in digital system. 3. To discuss generation of control signals and different ways of communication with I/O devices. 4. To study the hierarchical memory and principles of advanced computing.
Course Outcomes:	After successful completion of course student will be able to: 1. Describe the fundamentals of Digital Logic Design and basic structure of computer systems. 2. Demonstrate the data representation and arithmetic algorithms. 3. Explain the basic concepts of digital components and processor organization. 4. Demonstrate control unit operations. 5. Categories memory organization and explain the function of each element. 6. Describe the concepts of parallel processing and different Buses.

Module No. & Name	Sub Topics	CO mapped	Hrs./Subtopic	Total Hrs./Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Computer fundamentals	1.1 Introduction to Number System and Codes	CO1	01	05
	1.2 Number Systems: Binary, Octal, Decimal, Hexadecimal,		01	
	1.3 Codes: Grey, BCD, Excess-3, ASCII, Boolean Algebra.		01	
	1.4 Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR		01	
	1.5 Overview of computer organization and architecture		01	
	1.6 Basic Organization of Computer and Block Level functional Units, Von-Neumann Model.		01	
2.Data representation and Arithmetic algorithms	2.1 Binary Arithmetic: Addition, Subtraction, Multiplication, Division using Sign Magnitude, 1's and 2's compliment, BCD and Hex Arithmetic Operation.	CO2	05	08
	2.2 Booths Multiplication Algorithm, Restoring and Non-restoring Division Algorithm.		03	
	2.3 IEEE-754 Floating point Representation. (Single & Double precision.) Floating point Arithmetic: Addition, Subtraction			
3.Processor Organization and Architecture	3.1 Introduction of Combinational Logic: Half adder, Full adder, MUX, DMUX, Encoder, Decoder (IC level).	CO3	03	08
	3.2 Introduction of Sequential Logics: Introduction to Flip Flop: SR, JK, D, T, Types of counters		03	

	(Synchronous and Asynchronous)			
	3.3 Register Organization, Instruction Formats, Addressing modes, Instruction Cycle, Interpretation and sequencing.		02	
4.Control Unit Design	4.1 Hardwired Control Unit: State Table Method, Delay Element Methods.	CO4	03	06
	4.2 Microprogrammed Control Unit: Micro Instruction-Format, Sequencing and execution, Micro operations, Examples of microprograms. Introduction to RISC and CISC architectures and design issues.		03	
5.Memory organization	5.1 Introduction and characteristics of memory, Types of RAM and ROM, Memory Hierarchy, 2-level Memory Characteristic,	CO5	01	05
	5.2 Cache Memory: Concept, locality of reference, Design problems based on mapping techniques, Cache coherence and write policies. Interleaved and Associative Memory.		04	
6.Principle of Advanced Processor and Buses	6.1 Basic Pipelined Data path and control, data dependencies, data hazards, branch hazards, delayed branch, and branch prediction, Performance measures-CPI, Speedup, Efficiency, throughput, Amdhal's law.	CO6	03	07
	6.2 Flynn's Classification, Instruction pipelining, pipeline hazards, Introduction to multicore architecture.		02	
	6.3 Introduction to buses: ISA, PCI, USB. Bus Contention and Arbitration.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1. R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4th Edition. 2. William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10th Edition. 3. John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3RD Edition. 4. Dr. M. Usha and T. S. Shrikanth, "Computer system Architecture and Organization", Wiley publication. 5. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill. 6. John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, Fourth Edition (2008).			
Reference Books	1. Andrew S. Tanenbaum, "Structured Computer Organization", Pearson Publication. 2. B. Govindarajalu, "Computer Architecture and Organization", McGraw-Hill Publication. 3. Malvino, "Digital computer Electronics", McGraw-Hill Publication, 3rdEdition. 4. Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw-Hill Publication. 5. Ronald J. Tocci, Neal S. Widmer, "Digital Systems Principles and Applications", Eighth Edition, PHI (2003)			

	6. Thomas L. Floyd, "Digital Fundamentals", Pearson Prentice Hall, Eleventh Global Edition (2015).
Useful Links:	
1.https://learnabout-electronics.org/Digital/dig20.php	
2.https://nptel.ac.in/courses/117/106/117106086/	
3.https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824	
4.https://nptel.ac.in/courses/106/103/106103068/	
5.https://www.coursera.org/learn/comparch	
6.https://www.edx.org/learn/computer-architecture	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 15 marks 2. Test 2 – 15 marks 3. Internal assessment - 10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Examination will be of 60 marks for 3 hours duration.	
Term work:	
1. Term work should consist of a Minimum of 8 experiments. 2. Journal must include at least 2 assignments on content of theory and practical of the course "Digital Logic & Computer Architecture". 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work. 4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.	

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC305	Computer Graphics	(3+0+0)

Prerequisite:	Basic Mathematics
Course Objectives:	1.To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics. 2.To emphasize on implementation aspect of Computer Graphics Algorithms. 3.To prepare the student for advance areas and professional avenues in the field of Computer Graphics.
Couse Outcomes:	At the end of the course, the students should be able to, 1. Describe the basic concepts of Computer Graphics. 2. Demonstrate various algorithms for basic graphics primitives. 3. Apply 2-D geometric transformations on graphical objects. 4. Use various Clipping algorithms on graphical objects. 5. Apply 3-D geometric transformations, curve representation techniques and projections methods. 6. Explain visible surface detection techniques and Animation.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction and Overview of Graphics System	1.1 Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Rasterization and Rendering.	CO1	01	03
	1.2 Raster scan & Random scan displays, Architecture of Raster graphics system with display processor, Architecture of Random scan systems. Self-Learning Topics: Display devices like Plasma Display, 3D Display		02	
2.Output Primitives:	2.1 Scan conversions of point, line, circle and ellipse: DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	CO2	08	12
	2.2 Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing).		01	
	2.3 Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm.		03	
3.Two Dimensional Geometric Transformations	3.1 Basic transformations: Translation, Scaling, Rotation	CO3	01	04
	3.2 Matrix representation and Homogeneous Coordinates.		01	
	3.3 Composite transformation.		01	
	3.4 Other transformations: Reflection and Shear.		01	
4.Two-Dimensional Viewing and Clipping	4.1 Viewing transformation pipeline and Window to Viewport coordinate transformation.	CO4	02	06

	4.2 Clipping operations: Point clipping, Line clipping algorithms: Cohen-Sutherland, Liang: Barsky, Polygon Clipping Algorithms: Sutherland-Hodgeman, Weiler-Atherton.		04	
5.Three Dimensional Geometric Transformations, Curves and Fractal Generation	5.1 3D Transformations: Translation, Rotation, Scaling and Reflection	CO5	01	08
	5.2 Composite transformations: Rotation about an arbitrary axis		01	
	5.3 Projections – Parallel, Perspective. (Matrix Representation)		02	
	5.4 Bezier Curve, B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve. Self-learning topics: Piano Curve, Hilbert Curve.		04	
6.Visible Surface Detection and Animation	6.1 Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method.	CO6	03	06
	6.2 Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication 2. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication 3. Samit Bhattacharya, "Computer Graphics", Oxford Publication
Reference Books	1. D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications 2. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum"s Outlines McGraw-Hill Education 3. Rajesh K. Maurya, "Computer Graphics", Wiley India Publication. 4. F. S. Hill, "Computer Graphics using OpenGL", Third edition, Pearson Publications

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs97/preview
2. https://nptel.ac.in/courses/106/106/106106090/
3. https://www.classcentral.com/course/interactivegraphics-2067

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments.

2. Journal must include at least 2 assignments on content of theory and practical of the course "Computer Graphics".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
1UAIL303	**Data Structure Lab**	**(1+0)**

Lab Prerequisite:	1. Computer Programming 2. Computer Programming Laboratory
Lab Objectives:	1. To implement basic data structures such as linked lists, stacks and queues 2. To solve problem involving graphs and trees 3. To choose appropriate data structure and apply it to various problems
Lab Outcomes (LOs):	1. Implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them. 2. Implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them 3. Choose appropriate data structure and apply it in various problems 4. Select appropriate searching techniques for given problems. 5. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO mapped	Hrs. /Lab
Star (*) marked experiments are compulsory.			
I.	Lab Prerequisite	---	02
1.	Implement Stack ADT using array.	LO1, LO5	02
2.	Convert an Infix expression to Postfix expression using stack ADT.		02
3.	Evaluate Postfix Expression using Stack ADT		02
4*.	At least 2 applications of Stack from the useful links/any other given below.	LO1, LO3, LO5	02
5.	Implement Linear Queue ADT using array.	LO1, LO5	02
6.	Implement Circular/Double ended Queue ADT using array.		02
7.	Implement Priority Queue ADT using array.		02
8.	Implement Singly Linked List ADT.		02
9.	Implement Circular Linked List ADT.		02
10.	Implement Doubly Linked List ADT.		02
11.	Implement Stack / Linear Queue ADT using Linked List.		02
12*.	Implement Binary Search Tree ADT using Linked List.	LO2, LO3, LO5	02
13*.	Implement Graph Traversal techniques: a) Depth First Search b) Breadth First Search.		02
14*.	At least 2 applications of Binary Search Technique from the useful links/any other given below	LO4, LO5	02

Useful Links:

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course “Data Structure”.
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

P&O: P&O examination will be based on experiment list and performance of experiment.

Lab Code	Lab Name	Credits (P+TUT)
1UAIL304	Digital Logic & Computer Architecture Lab	(1+0)

Lab Prerequisite:	1. C Programming Language
Lab Objectives:	1. To discuss basic concepts of digital logic design. 2. To Design and simulate different digital circuits. 3. To implement operations of the arithmetic unit using algorithms. 4. To design memory subsystem including cache memory. 5. To demonstrate CPU and ALU design.
Lab Outcomes (LOs):	1. The student will be able explain the basics of digital components. 2. The student will be able implement different digital circuits. 3. The student will be able design the basic building blocks of a computer: ALU, registers, CPU and memory 4. The student will be able recognize the importance of digital systems in computer architecture. 5. The student will be able implement various algorithms for arithmetic operations. 6. The student will be able to write accurate documentation for experiments performed.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	To verify the truth table of various logic gates using ICs.	LO1,LO6	02
2.	To realize the gates using universal gates	LO2, LO6	02
3.	Code conversion.		02
4.	To realize half adder and full adder.		02
5.	To implement logic operation using MUX IC.		02
6.	To implement logic operation decoder IC.		02
7.	Study of flip flop IC.		02
8.	To implement ripple carry adder.	LO4, LO6	02
9.	To implement carry look ahead adder.		02
10.	To implement Booth's algorithm.	LO5, LO6	02
11.	To implement restoring division algorithm.		02
12.	To implement non restoring division algorithm.	LO4, LO6	02
13.	To implement ALU design.	LO3, LO6	02
14.	To implement CPU design.		02
15.	To implement memory design.		02
16.	To implement cache memory design.		02
17.	To study MASM (Micro Assembler).	LO5, LO6	02
18.	A program to simulate the mapping techniques of Cache memory. 18.1 Direct Mapped cache 18.2 Associative Mapped cache 18.3 Set Associative Mapped cache	LO3, LO6	02

Virtual Lab Links:
1. http://vlabs.iitkgp.ac.in/dec/exp3/index.html#
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/experimentlist.html
3. http://vlabs.iitkgp.ac.in/coa/
Term work:
1. Term work should consist of a Minimum of 8 experiments. 2. Journal must include at least 2 assignments on content of theory and practical of the course "Digital Logic & Computer Architecture". 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work. 4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
1UAIL305	Computer Graphics Lab	(1+0)

Lab Prerequisite:	C Programming Language**.**
Lab Objectives:	1. Understand the need of developing graphics application 2. Learn algorithmic development of graphics primitives like line, circle, polygon etc. 3. Learn the representation and transformation of graphical images and pictures
Lab Outcomes (LOs):	Students will be able to: 1. Implement various output and filled area primitive algorithms 2. Apply transformation, projection and clipping algorithms on graphical objects 3. Perform curve and fractal generation methods 4. Develop a Graphical application/Animation based on learned concept. 5. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	Implement DDA Line Drawing algorithm (dotted/dashed/thick)	LO1, LO5	02
2.	Implement Bresenham's Line algorithm (dotted /dashed/ thick)		02
3.	Implement midpoint Circle algorithm.		02
4.	Implement midpoint Ellipse algorithm.		02
5.	Implement Area Filling Algorithm: Boundary Fill, Flood Fill.		02
6.	Implement Scan line Polygon Filling algorithm.		02
7.	Implement Curve: Bezier for n control points, B Spline (Uniform) (at least one)	LO3, LO5	02
8.	Implement Fractal generation method (any one)		02
9.	Character Generation: Bit Map method and Stroke Method	LO1, LO5	02
10.	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.	LO2, LO5	02
11.	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.		02
12.	Implement polygon clipping algorithm (at least one)		02
13.	Program to perform 3D transformation.		02
14.	Perform projection of a 3D object on Projection Plane: Parallel and Perspective.		02

Virtual Lab Links:

http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/experimentlist.html

Term work:

1. Term work should consist of a minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Computer Graphics".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

P&O: P&O examination will be based on experiment list and performance of experiment.

Project Based Learning Code	Project Based Learning	Credits (P+TUT)
1UAIPR31	Mini Project Lab-I	(1+0)

PBL Prerequisites:	---
PBL Objectives:	1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.
PBL Outcomes:	At the end of the course, the student will be able to: 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Analyze the impact of solutions in societal and environmental context for sustainable development. 5. Excel in written and oral communication. 6. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. 7. Demonstrate project management principles during project work.

Guidelines for Mini Project:	
1.	Project based learning Mini Project Lab-1 should be implemented using Java programming (1UAIXS33)
2.	Students shall form a group of 2 to 3 students, while forming a group shall not be allowed less than two or more than three students, as it is a group activity.
3.	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/internal committee of faculties.
4.	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
5.	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6.	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7.	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
8.	Students shall convert the best solution into working model using Java programming.
9.	The solution to be validated with proper justification and report to be compiled in standard format of the college.
10.	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV.
11	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work

	on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Term Work:

The review/ progress monitoring committee shall be constituted by senior faculty members. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester. Assessment also considers peer review and ethics observed by faculties and participation involvement.

Distribution of Term work marks for both semesters shall be as below		**Practical Marks**
1.	Marks awarded by guide/supervisor based on implementation	10
2.	Peer assessment by team members	05
3.	Marks awarded by review committee	05
4.	Quality of Project report	05

Review / progress monitoring committee may consider following points for assessment based on project as mentioned in general guidelines

1.	Students' group shall complete project in all aspects including, a. Identification of need/problem b. Proposed final solution c. Procurement of components/system d. Building prototype and testing
2.	Continuous assessment will be weekly based on logbook. Two presentations will be conducted for review before a panel. a. First shall be for finalization of problem and proposed solution b. Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1.	Quality of survey and identification of problem statement
2.	Innovativeness in solutions
3.	Implementation
4.	Team work
5.	Project report

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1.	Report should be prepared as per the guidelines.
2.	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners.
3.	Students shall be motivated to participate in poster, project competition on the work in students' competitions.

Mini Project shall be assessed based on following points.

1.	Quality of problem and Clarity
2.	Innovativeness in solutions
3.	Cost effectiveness and Societal impact
4.	Full functioning of working model as per stated requirements
5.	Effective use of skill sets
6.	Effective use of standard engineering norms
7.	Contribution of an individual's as member or leader
8.	Clarity in written and oral communication

P&O: P&O examination will be based on mini project implementation.

Internal Assessment (IA):

IA shall be awarded based on

1. Logbook maintained by each project group and weekly meeting based on the same.
2. Students active participation in Technology learning.
3. Presenting/Showcasing Learned Technology uses in social /Outreach/ Extension activities / Events/ Competitions/ Trainings/ Internships/ Development programs etc.
4. Submission of participation/online course completion certificate with results of regular assignments / tests submission / performance and grades awarded, etc.

Assessment Rubrics (Marks)	Insufficient (1)	Poor (2)	Acceptable (3)	Good (4)	Excellent (5)
Contribution in a team(5)					
Participation in TPP/ Project/ Idea etc Competition/Preparation for technical paper (5)					

Exposure (Skill Based Learning-III) Code	Exposure (Skill Based Learning-III)	Credits (P+TUT)
1UAIXS33	**Object Oriented Programming with Java**	**(1+0)**

Skill Prerequisite:	1. Structured Programming Approach
Skill Objectives:	1. To learn the basic concepts of object-oriented programming 2. To study JAVA programming language 3. To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc. 4. To explain components of GUI based programming.
Skill Outcomes (SOs):	1. To apply fundamental programming constructs. 2. To implement the concept of classes and objects. 3. To implement the concept of strings, arrays , vectors and packages 4. To implement the concept of inheritance and interfaces 5. To implement the concept of exception handling and multithreading 6. To develop GUI based application

Module No.	Module Name	SO mapped	Hrs. /Module
1.	Introduction to Object Oriented Programming: Title: Write a program to implement basic programming constructs like branching and looping. Concepts: Introduction to Java, Object Oriented Concepts, Java Virtual Machine, Basic programming constructs: variables, data types, and operators, expressions, branching and looping. Objective: Objective of this module is to provide students an overview Object Oriented Concepts and Basic Java programming constructs.	SO1	01
2.	Class, Object, Packages and Input /output: Title: Write a program to demonstrate different ways of accepting user input in Java. Concepts: Class, object, data members, member functions, Command Line Argument, Input and output functions in Java, Buffered reader class, Scanner class. Objective: Students will learn how to use different ways to accept user input in Java. Title: Write a program to implement the concept of method overloading and Constructor overloading. Concepts: Introduction to Constructors, Constructor types, Constructor overloading, static members and functions Method overloading. Objective: Students will learn how to apply concept of constructor, constructor overloading, method overloading in Java.	SO2	02
3	Array, String, Vector and Packages: Title: Write a program implement the concept of 2D array and String Manipulation functions in Java. Concepts: Array, Strings, String Buffer	SO3	03

	Objective: Students will learn how to create and use 1D, 2D array and how to use different string manipulation functions. Title: Write a program to implement the concept of vector. Concepts: Introduction to Vector Objective: Students will learn how to create vector, how to add and delete elements in vector. Title: Write a program to implement the concept of package. Concepts: Package, User defined packages Objective: Students will learn how to use inbuilt packages and user defined packages		
4.	Inheritance and Interface: Title: Write a program to implement the concept of Inheritance. Concepts: Inheritance, Types of inheritance, extends keyword, super keyword, Access Modifiers Objective: Students will learn how to use concept of inheritance and types of inheritance in java, Multiple inheritance using interface Title: Write a program to implement the concept of Method Overriding. Concepts: Method overriding Objective: Students will learn how to implement Method overriding Title: Write a program to implement the concept of abstract class and abstract method. Concepts: Abstract class and abstract method Objective: Students will learn how to create and use Abstract class and abstract method. Title: Write a program to implement the concept of Interface Concepts: Interface, how to create interface, How to extend interface. Objective: Students will learn how to create interface, How to extend interface.	SO4	04
5.	Exception handling and Multithreading: Title: Write a program to implement the concept of Exception handling Concepts: Exception handling using try, catch, finally, throw and throws, Multiple try and catch blocks Objective: Students will learn how to apply Exception handling using try, catch, finally, throw and throws. Title: Write a program to implement the concept of user defined exception Concepts: User defined exception Objective: Students will learn how to create user defined exception Title: Write a program to implement the concept of Multithreading Concepts: Thread lifecycle, thread class methods, creating threads using extends and implements keyword. Objective: Students will learn how to create Thread by extending Thread class and Implementation Runnable interface	SO5	03
6.	GUI programming in JAVA: Title: Design form for Admission process management	SO6	02

	application system. Concepts: Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and color class. Event handling using event class AWT: working with windows, using AWT controls for GUI design Swing class in JAVA. Objective: Students will learn how to use AWT or SWING to design GUI.		
	Title: Study and Implement the concept of JDBC and Perform CRUD Operation on the form created in 6.1 using Java Database Connectivity Concepts: Introduction to JDBC, JDBC-ODBC connectivity, JDBC architecture. Objective: Objective of this module is to provide students an overview JDBC.		

Books:	
Textbooks	1.Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
	2.E. Balagurusamy, 'Programming with Java', McGraw Hill Education.
Reference Books	1."JAVA Programming", Black Book, Dream tech Press.
	2.Dietal and Dietal, "Java: How to Program", 8th Edition, PHI
	3.Ivor Horton, "Beginning JAVA", Wiley India.
	4."Learn to Master Java programming", Staredu solutions

Useful learning Links:

1. www.nptelvideos.in
2. www.w3schools.com
3. www.tutorialspoint.com
4. https://starcertification.org/Certifications/Certificate/securejava

Internal Assessment (IA):

IA shall be awarded based on

1.Students active participation in skill based learning.

2.Presenting/showcasing learned skills through Social /outreach/ extension activities/Events/ Competitions/Trainings/Internships etc;

3,Submission of Report/ act/ demonstrations/ specific participation/ Idea creation/ scope/ creativity/Case study etc.

Assessment Rubrics	Insufficient (1)	Poor (2)	Acceptable (3)	Good (4)	Excellent (5)
Active Participation(5)					
Presentation (5)					
Report Submission(5)					
Achievement/ Recognition(5)					

Exposure (Activity Based Learning-IV) Code	Exposure (Activity Based Learning-IV)	Credits (P+TUT)
1UAIXA34	**1.Study of India's top two problems**	(1+0)
	2.Study of World's top two problems	
	3. How Government Works? (Study of one department of the Central/ State Government)	

Activity Prerequisite:	Knowledge of Problems and Issues of the National, Global, Societal and Environmental Issus that need attention.
Activity Objectives:	1.To identify and describe various social, Environmental, Economic, Political, educational, Agricultural, Governance related issues and problems. 2.To plan and prepare a structured or unstructured survey or study methodology to have an in-depth analysis of the issues and problems to carry out the activity. 3.To compare and contrast social, ethical, environmental and legal issues surrounding the subject of study. 4.To analyse and suggest solutions to the existing issues, modify and improve the existing problems.
Activity Outcomes (AOs):	1.Define the areas of problems and issues by forming specific statements. 2.Analyse the collected data to propose solutions to solve the issues. 3.Demonstrate critical and innovative thinking. 4.Display competence in oral and visual communication. 5.Write accurate documentation for experiments performed. 6.Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Guidelines for Activity Based Learning:

1. Students in groups (Minimum2 and Maximum3) will attend the lectures arranged by various professional Bodies in the first week and select the area of activity to be conducted and inform and discuss with the concerned coordinators and their respective departments.
2. Selection of topics for activities with 9 /10 weeks Duration (Subject related to contemporary issues and problems in local, regional, national or Global levels and approval from concerned coordinators of professional body/ Cell/ Clubs)
3. Need to dedicate two lectures, weekly (one lecture will be of duration of 1 hour.) For the first three weeks after finalization of the activity, students will give presentation to improve and modify from peers and coordinators
4. Weekly documentation of activities and submission to the concerned coordinators.
5. If any professional body has large number of students assigned to carry out the activities, the number of students will be divided into 20 groups per batch and the various and coordinators of cells and clubs are assigned one batch each.
6. The coordinators will monitor the activities and documentation of the batch assigned to them.
7. The marks will be assigned by the coordinators according to the rubrics formed by IQAC cell.
8. Any other points related to ABL can be discussed at department level.
9. The marks are to be submitted to the respective Departments and the Departments will submit them to the Exam Section.

Module No.	Module Name	Activity Outcome mapped	Hrs./Module
1	Guest lecture to introduce Topic selected in Activity-Based learning	AO1	2
2	Selection of any Two Problems	AO2, AO6	2
3	Group Discussion with other students	AO2, AO3, AO6	2
4	Presentation	AO2, AO4, AO6	2
5	Presentation		2
6	Presentation		2
7	Find out solution for selected problem	AO3,AO6	2
8	Presentation	AO3, AO4, AO6	2
9	Presentation		2
10	Report submission	AO5,AO6	2

Internal Assessment (IA)

IA shall be awarded based on

1. Students active participation in activity based learning.
2. Presenting / showcasing / implementing / executing learned activity through Social outreach/ extension activities /Events / Competitions / Trainings / Internships etc;
3. Submission of Report/act/demonstrations/specific participation/Idea creation/scope /creativity / Case study etc.

Assessment Rubrics	Insufficient (1)	Poor (2)	Acceptable (3)	Good (4)	Excellent (5)
Identification of problem and solution (5)					
Attended Seminars/ relevant sessions (5)					
Report/demo/act etc Submission(5)					
Surveys/Case study (5)					