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-IV)

(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- IV-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credit Assigned TH – P – TUT	Total Credits	Course Category
1UAIC401	Applications of Mathematics in Engineering-II	3–0-0	03	3–0-0	03	BS
1UAIC402	Analysis of Algorithm	3–0-0	03	3–0-0	03	PC
1UAIC403	Database Management Systems	3–0-0	03	3–0-0	03	PC
1UAIC404	Operating System	3–0-0	03	3–0-0	03	PC
1UAIC405	Microprocessor	3–0-0	03	3–0-0	03	PC
1UAIL402	Analysis of Algorithm Lab	0–2-0	02	0–1–0	01	PC
1UAIL403	Database Management Systems Lab	0–2-0	02	0–1–0	01	PC
1UAIL404	Operating System Lab	0–2-0	02	0–1–0	01	PC
1UAIPR42	Project Based Learning-Mini Project Lab-2	0–2-0	02*	0–1–0	01	PBL
1UAIXS45	Skill Based Learning-V	0–2#-0	02	0–1–0	01	SAT
1UAIXA46	Activity Based Learning-VI	0–2#-0	02	0–1–0	01	SAT
Total		**15–12-0**	**27**	**15-6-0**	**21**	

***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- IV-Examination Scheme

Course Code	Course Name	Examination Scheme								
		Marks								
		CA			ESE	TW	O	P	P&O	Total
		T1	T2	IA						
1UAIC401	Applications of Mathematics in Engineering-II	15	15	10	60	25	--	--	--	125
1UAIC402	Analysis of Algorithm	15	15	10	60	--	--	--	--	100
1UAIC403	Database Management Systems	15	15	10	60	--	--	--	--	100
1UAIC404	Operating System	15	15	10	60	--	--	--	--	100
1UAIC405	Microprocessor	15	15	10	60	--	--	--	--	100
1UAIL402	Analysis of Algorithm Lab	--	--	--	--	25	--	--	25	50
1UAIL403	Database Management Systems Lab	--	--	--	--	25	--	--	25	50
1UAIL404	Operating System Lab	--	--	--	--	25	--	--	25	50
1UAIPR42	Project Based Learning-Mini Project Lab-2	--	--	10	--	25	--	--	25	60
1UAIXS45	Skill Based Learning-V	--	--	20	--	--	--	--	--	20
1UAIXA46	Activity Based Learning-VI	--	--	20	--	--	--	--	--	20
Total		**75**	**75**	**100**	**300**	**125**	**--**	**--**	**100**	**775**

Course Code	Course Name	Credits (TH+P+TUT)
1UAIC401	**Applications of Mathematics in Engineering-II**	**(3+0+0)**

Prerequisite:	1. Engineering Mathematics-I 2. Engineering Mathematics-II
Course Objectives:	1. Matrix algebra to understand engineering problems. 2. Understand line and contour integrals and expansion of a complex valued function in a power series. 3. Understand the concepts of vector spaces used in the field of machine learning and engineering problems. 4. Understand the concepts of probability distributions and sampling theory for small samples. **5.** Understand linear and Non-linear programming problems of optimization.
Couse Outcomes:	1. Apply the concepts of eigenvalues and eigenvectors in engineering problems. 2. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals. 3. Apply the concept of vector spaces and orthogonalization process in Engineering Problems. 4. Use the concept of probability distribution and sampling theory to engineering problems. 5. Apply the concept of Linear Programming Problems to optimization. 6. Solve Non-Linear Programming Problems for optimization of engineering problems.

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. Linear Algebra (Theory of Matrices)	1.1 Characteristic Equation, Eigenvalues and Eigenvectors, and properties (Without proof)	CO1	02	06
	1.2 Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		02	
	1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices		02	
2.Complex Integration	2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (Without proof).	CO2	02	07
	2.2 Taylor's and Laurent's series (without proof).		03	
	2.3Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof)		02	

3.Linear Algebra: Vector Spaces	3.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy-Schwarz inequality (with proof), and Unit vector.	CO3	02	06
	3.2 Othogonal projection, Orthonormal basis, Gram-Schmidt process for vectors.		02	
	3.3 Vector spaces over real field, subspaces.		02	
4. Probability Distribution and Sampling Theory	4.1 Probability Distribution: Poisson and Normal distribution	CO4	03	07
	4.2 Sampling distribution Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.		02	
	4.3 Students't-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: test of goodness of fit and independence of attributes, Contingency table.		02	
5. Linear Programming Problems	5.1 Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.	CO5	02	06
	5.2 Artificial variables, Big-M method (Method of penalty)		02	
	5.3 Duality, Dual of LPP and Dual Simplex Method.		02	
6. Nonlinear Programming Problems	6.1 NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers	CO6	02	07
	6.2 NLPP with two equality constraints		02	
	6.3 NLPP with inequality constraint: Kuhn-Tucker conditions.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited. 2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication. 3. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
Reference Books	1. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education. 2. Hamdy A Taha, "Operations Research: An Introduction", Pearson. 3. S.S. Rao, "Engineering Optimization: Theory and Practice", Wiley-Blackwell. 4. Hira and Gupta, "Operations Research", S. Chand Publication

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)
1UAIC402	Analysis of Algorithm	(3+0+0)

Prerequisite:	1. Discrete Structures and Graph Theory 2. Data Structure
Course Objectives:	1. To provide mathematical approaches for Analysis of Algorithms 2. To understand and solve problems using various algorithmic approaches 3. To analyze algorithms using various methods
Couse Outcomes:	1. Analyze the running time and space complexity of algorithms. 2. Describe, apply and analyze the complexity of divide and conquer strategy. 3. Describe, apply and analyze the complexity of greedy strategy. 4. Describe, apply and analyze the complexity of dynamic programming strategy 5. Apply backtracking, branch and bound. 6. Apply string matching techniques.

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	1.1 Performance analysis, space, and time complexity Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis.	CO2	04	08
	1.2 Complexity class: Definition of P, NP, NP-Hard, NP-Complete		01	
	1.3 Recurrences: The substitution method, Recursion tree method, Master method, Analysis of selection sort, insertion sort.		03	
2.Divide and Conquer Approach	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	CO1	06	06
3.Greedy Method Approach	General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Huffman Coding, Minimum cost spanning trees: Kruskal and Prim's algorithms	CO3	06	06
4.Dynamic Programming Approach	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm, All pair shortest path: Floyd Warshall Algorithm, Assembly-line scheduling Problem, 0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence	CO4	06	06
5.Backtracking and Branch & bound	5.1 General Method, Backtracking: N-queen problem, Sum of subsets, Graph colouring.	CO5	04	09
	5.2 Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem		05	
6.String Matching Algorithms	6.1 The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm,	CO6	03	04

	Genetic Algorithm			
	6.2 Parallel Algorithms: Finding the maximum, Odd-Even Merge sort Sorting on a mesh		01	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:	
Text Books	1.T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005. 2.Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.
Reference Books	1.Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw Hill Edition. 2.S. K. Basu, "Design Methods and Analysis of Algorithm", PHI 3.Sara Baase and Allen van Gelder, Computer Algorithms -Introduction to Design and analysis, Third Edition, Pearson Edition, New Delhi, 2000

Useful Links:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms
4. https://www.mooc-list.com/tags/algorithms

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 "Analysis of Algorithm".
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)
1UAIC403	Database Management System	(3+0+0)

Prerequisite:	Data Structures
Course Objectives:	1. Learn and practice data modelling using the entity-relationship and developing database designs. 2. Understand the use of Structured Query Language (SQL) and learn SQL syntax. 3. Apply normalization techniques to normalize the database 4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.
Couse Outcomes:	1. Explain the fundamentals of a database system 2. Design and draw ER and EER diagrams for the real life problem. 3. Formulate relational algebra queries. 4. Query a database using SQL. 5. Apply concepts of normalization to relational database design. 6. Explain the concept of transaction, concurrency and recovery.

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 Database Concepts	1.1 Introduction, Characteristics of databases, File system v/s Database system, Users of Database system	CO1	02	03
	1.2 Data Independence, DBMS system architecture, Database Administrator		01	
2.Entity–Relationship Data Model	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation	CO2	06	06
3.Relational Model and relational Algebra	3.1 Introduction to the Relational Model, relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model	CO3	03	06
	3.2 Relational Algebra – unary and set operations, Relational Algebra Queries.		03	
4.Structured Query Language (SQL)	4.1 Overview of SQL Data Definition Commands, Data Manipulation commands, Data Control commands, Transaction Control Commands.	CO4	03	09
	4.2 Set and string operations, aggregate function - group by, having. Views in SQL, joins, Nested and complex queries, Integrity constraint: key constraints, Domain Constraints, Referential integrity, check constraints		05	
	4.3 Triggers		01	

5.Relational–Database Design	Pitfalls in Relational-Database designs, Concept of Normalization, Function Dependencies, First Normal Form, 2nd ,3rd, BCNF, multi valued dependencies , 4NF	CO5	04	05
6.Transactions Management and Concurrency	6.1 Transaction concept, Transaction states, ACID properties, Concurrent Executions, Serializability–Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols.	CO6	10	10
	6.2 Recovery System: Failure Classification, Log based recovery. Deadlock handling			
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. G. K. Gupta "Database Management Systems", McGraw – Hill. 2. Korth, Slberchatz,Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill 3. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson education. 4. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.
Reference Books	1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press. 2. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Publication. 3. Sharaman Shah, "Oracle for Professional", SPD. 4. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc19_cs46/preview
2. https://www.edx.org/course/modeling-and-theory
3. https://www.edx.org/course/databases-5-sql
4. https://www.coursera.org/lecture/sql-data-science/introduction-to-databases-XO9Ak

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 "Database Management System".
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)
1UAIC404	Operating System	(3+0+0)

Prerequisite:	1. Data Structure 2. Digital Logic & Computer Architecture
Course Objectives:	1. To introduce basic concepts and functions of operating systems. 2. To understand the concept of process, thread and resource management. 3. To understand the concepts of process synchronization and deadlock. 4. To understand various Memory, I/O and File management techniques.
Course Outcomes:	1. Describe the objectives, functions and structure of OS 2. Analyse the concept of process management and evaluate performance of process scheduling algorithms. 3. Apply the concepts of synchronization and deadlocks 4. Evaluate performance of Memory allocation and replacement policies 5. Explain the concepts of file management. 6. Apply concepts of I/O management and analyse techniques of disk scheduling.

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.Operating system Overview	1.1 Introduction, Objectives, Functions and Evolution of Operating System	CO1	01	04
	1.2 Operating system structures: Layered, Monolithic and Microkernel		01	
	1.3 Linux Kernel, Shell and System Calls		02	
2.Process and Process Scheduling	2.1 Concept of a Process, Process States, Process Description, Process Control Block	CO2	03	09
	2.2 Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)		03	
	2.3 Threads: Definition and Types, Concept of Multithreading		03	
3. Process Synchronization and Deadlocks	3.1Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization.	CO3	03	09
	3.2Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem.		03	
	3.3Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem.		03	
4.Memory Management	4.1 Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB	CO4	05	09
	4.2 Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing		04	

5.File Management	Overview, File Organization and Access, File Directories, File Sharing	CO5	04	04
6.I/O management	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK	CO6	04	04
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, 2. Abraham Silber Schatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9th Edition, 2016,
Reference Books	1. Achyut Godbole and Atul Kahate, "Operating Systems", McGraw Hill Education, 3rd Edition 2. Andrew Tannenbaum, "Operating System Design and Implementation", Pearson, 3rd Edition. 3. Maurice J. Bach, "Design of UNIX Operating System", PHI 4. Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4th Edition

Useful Links:

1. Introduction to Operating Systems - Course (nptel.ac.in)
2. NPTEL : Electronics & Communication Engineering - Linux Programming & Scripting
3. Free Online Course: Introduction to Operating Systems from Swayam | Class Central

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 "Operating System".
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)
1UAIC405	Microprocessors	(3+0+0)

Prerequisite:	Digital Logic & Computer Architecture
Course Objectives:	1. To develop background knowledge and core expertise in microprocessor. 2. To study the concepts and basic architecture of 8086 3. To know the importance of different peripheral devices and their interfacing to 8086. 4. To know the design aspects of basic microprocessor. 5. To write assembly language programs in microprocessor for various applications.
Couse Outcomes:	After successful completion of the course students will be able to: 1. Describe theory related to 8086 processor and peripherals and the Pentium processor. 2. Apply the concepts of 8086 architecture to solve simple problems related to address generation, segmentation etc. 3. Interface peripherals to the 8086. 4. Write simple programs in assembly language. 5. Write macros, subroutines, interrupt service routines. 6. Write interesting applications using DOS interrupts.

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.The Intel 8086	1.1 Intel 8086 Architecture: The execution unit, Flags and registers, BIU, queue, segment registers, pointer and index registers, segmentation, Pins	CO1, CO2	02	04
	1.2 Assembly language, addressing modes.	CO1	02	
2.Assembly language programming	Assembly language program development tools, development and representation of programs, instruction template, program format, data transfer instructions, string instructions, logical instructions, arithmetic instructions, control instructions, directives, structured programming, debugging	CO4	07	07
3.Procedures, Macros, Interrupts	Procedures and Macros, Mixed mode Programming with C-language and assembly language, DOS interrupts- Int 21h, The microprocessor-based PC, DOS operating system, 8086 Interrupts: Interrupt types in 8086, Dedicated interrupts, Software interrupts, Programming examples related to INT 21H (DOS Interrupts)	CO5, CO6	07	07
4.Single Board Computer Design	Generating the 8086 System Clock and Reset Signals using 8284 clock generator, 8086 Minimum and Maximum Mode CPU, use of bus controller 8288, read and write timing Diagrams, address demultiplexing using latch 8282, 8286,	CO3	08	08

5.Supporting Chips	Functional Block Diagram and description of – 8087 coprocessor, Peripheral Controllers - 8255-PPI,8259- PIC and 8237-DMAC, single board computer using 8086	CO2, CO3	08	08
6.Introduction to 32-bit Intel Pentium Architecture	Introduction to 32-bit Intel Pentium Architecture: Features of Pentium Processor, Pentium Superscalar architecture, Pipelining, Branch Prediction, Instruction and Data cache.	CO1	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Douglas, V. Microprocessors and Interfacing. Tata McGraw Hill Education Private Limited, 2005. 2. Uffenbeck, John E. "The 80x86 family: design, programming, and interfacing", Prentice Hall PTR, 2001. 3. Brey, Barry B. The Intel microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor: architecture, programming, and interfacing. Prentice-Hall, Inc., 1997.
Reference Books	1. Uffenbeck, John E. The 80x86 family: design, programming, and interfacing. Prentice Hall PTR, 2001. 2. Guide, Part. "Intel® 64 and ia-32 architectures software developer's manual." Volume 3B: System programming Guide, Part 2.11 (2011).

Useful Links:

https://www.intel.in / www /support /articles / processors

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.

Lab Code	Lab Name	Credits (P+TUT)
1UAIL402	Analysis of Algorithms Lab	(1+0)

Lab Prerequisite:	1. Discrete Structures and Graph Theory 2. Data Structure 3. Basic knowledge of any programming language
Lab Objectives:	1. To introduce the methods of designing and analyzing algorithms 2. Design and implement efficient algorithms for a specified application 3. Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem. 4. Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.
Lab Outcomes (LOs):	1. Implement the algorithms using different approaches. 2. Analyze the complexities of various algorithms. 3. Compare the complexity of the algorithms for specific problem. 4. Write accurate documentation for experiments performed. 5. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Description: Implementation can be in any language.

Suggested Practical List:

Lab No.	Experiment Title	LO mapped	Hrs. /Lab
I.	Lab Prerequisites	---	02
1.	1.1 Introduction Selection sort, Insertion sort	LO1, LO4, LO5	02
2.	2.1 Divide and Conquer Approach Finding Minimum and Maximum, Merge sort, Quick sort, Binary search		02
3.	3.1 Greedy Method Approach Single source shortest path- Dijkstra Fractional Knapsack Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm		02
4.	4.1 Dynamic Programming Approach Single source shortest path-Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Travelling salesperson problem Longest common subsequence		02
5.	5.1 Backtracking and Branch & bound N-queen problem Sum of subsets Graph coloring Travelling Salesperson problem 15 Puzzle problem	LO3, LO4, LO5	02
6.	6.1 String Matching Algorithms	LO2,	02

	The Naïve string-matching Algorithms	LO4, LO5	
	The Rabin Karp algorithm		
	The Knuth-Morris-Pratt algorithm		

Virtual Lab Links:

https://de-iitr.vlabs.ac.in

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 "Analysis of Algorithms Lab".
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)
1UAIL403	**Database Management System Lab**	**(1+0)**

Lab Prerequisite:	1. Any programming language
Lab Objectives:	1. To identify, define problem statements and construct conceptual data model for real life applications. 2. To build Relational Model from conceptual model (ER/EER). 3. To apply SQL to store and retrieve data efficiently. 4. To demonstrate notions of normalization for database design.
Lab Outcomes (LOs):	1. Identify the need of database, and define the problem statement for real life applications. 2. Create relational model for real life applications 3. Formulate query using SQL for efficient retrieval of data. 4. Submit the documentation on time before deadline. 5. Write accurate documentation for experiments performed.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	**---**	**02**
1.	Identify the case study and detail statement of problem. Design an Entity-Relationship(ER) / Extended Entity-Relationship (EER) Model & Mapping ER/EER to Relational schema.	**LO1, LO4, LO5**	**02**
2.	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified case study.	**LO2, LO4, LO5**	**02**
3.	Apply DML commands for the specified system & perform simple queries, string manipulation operations and aggregate functions.		**02**
4.	Implement various join operations, nested and complex queries.	**LO3, LO4, LO5**	**02**
5.	Implementation of views and triggers.		**02**
6.	Implement procedure and functions		**02**
7.	Use of database connectivity like JDBC.		**02**
8.	Deploy the application.	**LO2, LO3, LO4, LO5**	**02**

Virtual Lab Links:

http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

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 "Database Management System".
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)
1UAIL404	Operating System Lab	(1+0)

Lab Prerequisite:	Knowledge on Operating system principles
Lab Objectives:	1. To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment. 2. To familiarize students with the architecture of Linux OS. 3. To provide necessary skills for developing and debugging programs in Linux environment. 4. To learn programmatically to implement simple operation system mechanism
Lab Outcomes (LOs):	1. Demonstrate basic Operating system Commands, Shell scripts, System Calls and API wrt Linux 2. Implement various process scheduling algorithms and evaluate their performance. 3. Implement and analyze concepts of synchronization and deadlocks. 4. Implement various Memory Management techniques and evaluate their performance. 5. Implement and analyze concepts of virtual memory. 6. Demonstrate and analyze concepts of file management and I/O management techniques.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	1.1 Explore Linux Commands Explore usage of basic Linux Commands and system calls for file, directory and process management. For eg: (mkdir, chdir, cat, ls, chown, chmod, chgrp, ps etc. system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. sort, grep, awk, etc.)	LO1	02
2.	2.1 Linux shell script Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. Display current shell, home directory, operating system type, current path setting, current working directory.	LO2	02
3.	3.1 Linux- API Implement any one basic commands of Linux like ls, cp, mv and others using kernel APIs.	LO1	02
4.	4.1 Linux- Process a.Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system calls. b.Explore wait and waitpid before termination of process	LO2	02
5.	5.1 Process Management: Scheduling a. Write a program to demonstrate the concept of non-pre-emptive scheduling algorithms.	LO2	02

	b. Write a program to demonstrate the concept of pre-emptive scheduling algorithms		
6.	6.1 Process Management: Synchronization a. Write a C program to implement solution of Producer consumer problem through Semaphore	LO3	02
7.	7.1 Process Management: Deadlock a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm b. Write a program demonstrate the concept of Dining Philosopher's Problem		02
8.	8.1 Memory Management a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.	LO4	02
9.	9.1 Memory Management: Virtual Memory a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.	LO5	02
10.	10.1 File Management & I/O Management a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. c. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN	LO6	02

Virtual Lab Links:

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/CRUX/labs/exp1/procedure.html

Term work:

1. Term work should consist of a minimum of 10 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course " Operating System"
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)
1UAIPR42	Mini Project Lab 2	(1+0)

PBL Prerequisites:	Mini Project Lab 1
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:	Learner 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 Python programming (1UAIXS45)
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-V) Code	Exposure (Skill Based Learning-V)	Credits (P+TUT)
1UAIXS45	**Python Programming**	**(1+0)**

Skill Prerequisite:	None
Skill Objectives:	1. To learn the basics of python including data types, operator, conditional statements, looping statements, input and output functions in Python. 2. To study lists, tuple, set, dictionary, string, array and functions in python programming language. 3. To study data structures and Object-Oriented Programming using Python. 4. To explain concepts of modules, packages, multithreading and exception handling. 5. To familiarise file handling, GUI and database programming, Django framework and regular expression. 6. To visualize data, analyse data using Pandas and program web
Skill Outcomes (SOs):	After successful completion of the course students will be able to: 1. To write programs applying the structure, syntax, and semantics of the Python language. 2. To implement the concept of sequence data types mappings and functions in python 3. To illustrate data structures and the concepts of object-oriented programming as used in Python 4. To create Python applications which use packages, multithreading and exception handling, files, database and GUI frameworks. 5. To develop data visualization using Matplotlib, data analysis using Pandas and Web programming using Flask 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Module No.	Module Name	SO mapped	Hrs./Module
1.	Basics of Python: 1.1 Introduction, Installation and resources. Features, Python building blocks – identifiers, keywords, indention, variables and Comments	SO1, SO6	01
	1.2 Basic data types (Numeric, Boolean, Compound) operators: Arithmetic, comparison, relational, assignment, logical, bitwise, membership, identity operators, operator precedence		01
	1.3 Control flow statements: Conditional statements (if, if-else, nested if) Looping in Python (while loop, for loop, nested loops) Loop manipulation using continue, pass, break.		01
	1.4 Input/output Functions, Decorators, Iterators and Generators		01
2.	Advanced data types and functions 2.1 Lists: a) Defining lists, accessing values in list, deleting values in list, updating lists b) Basic list operations c) Built-in list functions	SO2, SO6	01
	2.2 Tuples: a) Accessing values in Tuples, deleting values in Tuples, and updating Tuples b) Basic Tuple operations c) Built-in Tuple functions		01

	2.3 Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary b) Basic Dictionary operations c) Built-in Dictionary functions		01
	2.4 Sets: a) Accessing values in Set, deleting values in Set, updating Sets b) Basic Set operations, c) Built-in Set functions		01
	2.5 Strings: a) String initialization, Indexing, Slicing, Concatenation, Membership & Immutability b) Built-in String functions		01
	2.6 Arrays: a) Working with Single dimensional Arrays: Creating, importing, Indexing, Slicing, copying and processing array arrays. b) Working with Multi-dimensional Arrays using Numpy: Mathematical operations, Matrix operations, aggregate and other Built-in functions		01
	2.7 Functions: a) Built -in functions in python b) Defining function, calling function, returning values, passing parameters c) Nested and Recursive functions d) Anonymous Functions (Lambda, Map, Reduce, Filter)		01
3.	Object Oriented Programming: 3.1 Overview of Object -oriented programming, Creating Classes and Objects, Self-Variable, Constructors, Inner class, Static method, Namespaces	SO3, SO6	01
	3.2 Data Structure in Python: Link List, Stack, Queues, Dequeues		01
	3.3 Inheritance: Types of Inheritance (Single, Multiple, Multi -level, Hierarchical), Super () method, Constructors in inheritance.		01
	3.4 Operator overloading, Method overloading, Method overriding, Abstract class, Abstract method, Interfaces in Python		01
4.	Exploring concept of modules, packages, multithreading and exception handling: 4.1 Modules: Writing modules, importing objects from modules, Python built -in modules (e.g., Numeric and Mathematical module, Functional Programming module, Regular Expression module), Namespace and Scoping	SO4, SO6	01
	4.2 Packages: creating user defined packages and importing packages.		01
	4.3 Multi -threading: process vs thread, use of threads, types of threads, creating threads in python, thread synchronization, deadlock of threads.		01
	4.4 Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, Assert statement, User -Defined Exceptions.		01
5.	File handling, GUI & database programming: 5.1 File Handling: Opening file in different modes, closing a file, writing to a file, accessing file contents using standard library functions, reading from a file – read (), readline (), readlines (), Renaming and Deleting	SO4, SO6	01

	a file, File Exceptions, Pickle in Python.		
	5.2 Graphical user interface (GUI): different GUI tools in python (Tkinter, PyQt, Kivy etc. any one), Working with containers, Canvas, Frame, Widgets (Button, Label, Text, Scrollbar, Check button, Radio button, Entry, Spin box, Message etc.)		01
	5.3 Connecting GUI with databases to perform CRUD operations. (on supported databases like SQLite, MySQL, Oracle, PostgreSQL etc.).		01
	5.4 Django framework and Regular Expressions using python		01
6.	Data visualization, analysis and web programming using python: 6.1 Visualization using Matplotlib: Matplotlib with NumPy, working with plots (line plot, bar graph, histogram, scatter plot, area plot, pie chart etc.), working with multiple figures.	SO5, SO6	01
	6.2 Data manipulation and analysis using Pandas: Introduction to Pandas, importing data into Python, series, data frames, indexing data frames, basic operations with data frame, filtering, combining and merging data frames, Removing Duplicates. SciPy: Linear algebra functions using NumPy and SciPy.		01
	6.2 Web programming: Introduction to Flask, creating a Basic Flask application, build a Simple REST API using Flask		1
Total hours			26

Useful learning Links:

https://docs.python.org/3/

https://wiki.python.org/moin/BeginnersGuide/Programmers

https://flask.palletsprojects.com/en/2.0.x/

https://tkdocs.com/shipman/

https://riverbankcomputing.com/software/pyqt/

https://numpy.org/

https://pandas.pydata.org/

https://matplotlib.org/

https://www.djangoproject.com/

Assessment:

Programming labs to be conducted as 2hrs continuous theory + hands-on session. The classes will be conducted as a flipped classroom, where students have to attend class after reviewing the lessons provided to them beforehand. Discussion on the topics and Programs Involving the concepts mentioned will be performed during the assigned lab hours.

The assessment will be

1. An online quiz conducted at the end of every 2-hr lecture consisting of 5 questions for a total of 10 marks. The average of best 10 quizzes will be considered toward 10 marks out of 20. The MCQ's have to be submitted on the same day.
2. The programs performed along with the screenshot of output have to be submitted within two days. A cover page will be attached stating the aims and objectives. This will be considered towards 10 marks.

	Quiz	Lab Submission	Total	POs satisfied
Marks Allotted	10	10	20	PO1, PO5

Exposure (Activity Based Learning-VI) Code	Exposure (Activity Based Learning-VI)	Credits (P+TUT)
1UAIXA46	**1.Waste Segregation Surveys (Residential, hospital, Educational institute etc)**	(1+0)
	2.Mentoring of School Children	
	3.NSS activities and Camp	

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	AO1	2

	Activity-Based learning		
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	AO2, AO4, AO6	2
6	Presentation	AO2, AO4, AO6	2
7	Find out solution for selected problem	AO3,AO6	2
8	Presentation	AO3, AO4, AO6	2
9	Presentation	AO3, AO4, AO6	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)					