SOMAIYA
VIDYAVIHAR

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A.C. Date: 09/07/2022

K J Somaiya Institute of Engineering and Information Technology
An Autonomous Institute affiliated to University of Mumbai

Autonomy Syllabus Scheme-II

for

Bachelor of Technology

in

Artificial Intelligence and Data Science (AI & DS)

(SY-Semester-IV)

With effect from A.Y. 2022-23

Four Year Undergraduate Programmes leading to Bachelor of Technology (B.Tech.) Degree in Artificial Intelligence and Data Science Engineering implemented from in Academic Year 2021-22 for SY.

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From the Principal's Desk:

The challenges and demands of the dynamic industry increasingly require technocrats to be skilled, adaptive, and innovative. The National Educational Policy 2020 (NEP 2020) framed by the Government of India intends to induce a paradigm shift by re-conceptualising the higher education. Recent academic reforms recommended by the AICTE and UGC have also effectually upscaled the higher education system in India. It is further the role of HEIs to offer high-quality educational opportunities and enable the next generation to succeed globally. Hence, 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 (KJSIEIT), being an autonomous institute possesses more flexibility in adapting newer approaches to reach higher levels of excellence in engineering education. The Syllabus Scheme-I implemented under the academic autonomy conferred to KJSIEIT w.e.f. A.Y. 2021-22 already comprises of state-of-the-art courses and laboratory sessions on emerging areas of technology. With an ideology that the root of innovation is 'interest', the curriculum offered a wide range of elective courses grouped into core and inter-disciplinary domains. At par with international engineering education, it followed a learner-centric approach, where the students could choose to study courses concerning areas of their interests.

This 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 were practiced across the first three years of engineering, focusing on graduate attributes like work responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. that could not be copiously imbibed through regular engineering courses. The inclusion of induction program for the First Year students is deliberated as per the guidelines of AICTE and helps students belonging to diverse backgrounds to adjust in the new academic environment.

However, sustained initiatives are required to assure efficiency, academic excellence, and growth. Hence, KJSIEIT Syllabus Scheme –II introduces 03 newer dimensions to Scheme – I: Internship, SBL of Foreign and Indian Languages, and Honours Degree that shall be implemented w.e.f. from A.Y. 2022-23 across all the branches and all 04 years of engineering.

1. **Internship:** Firstly, the redesigned Scheme-II incorporates 14 Credits for Internship (cumulative 600-700 Hours), which shall be mandatory for all the students and is to be pursued during all 04 years of graduation. Based on the AICTE Internship Policy, this initiative shall enable graduates to respond to the current needs of the industry and equip them with skills required at national and global level. The students shall gain practical understanding and training on cutting-edge technologies and industry practices in a suitable industry or organization. While innovation and entrepreneurship are emerging as fulcrums of higher education, the internship will also provide an exposure to innovation, entrepreneurial, and incubation opportunities through various related activities, and instill a start-up spirit in the students.

Further, the students of KJSIEIT already have an exposure to the work culture and trends in industries through live / collaborative projects / product developments, etc. and they often contribute significantly to the society through various projects. Under autonomy too, through the component of Project-Based Learning included in the syllabus, the students develop Mini, Minor, and Major projects in Second, Third, and Last Year respectively concerning healthcare, agriculture, societal / industrial need-based problems, etc. Through duality of Major Project development and newly introduced activities / components as a part of Internship, the students shall learn about research methodology, IP and IPR — resulting into generation of quality research articles, copyrights, and patents.

2. **Honours Program**: Another major initiative through the Scheme–II is the introduction of B.Tech. with Honours program for students who are desirous of pursuing focused interest in 06 emerging areas of technology recognized by AICTE: Internet of Things, Artificial Intelligence & Machine Learning, Cyber Security, Virtual and Augmented Reality, Data Science, and Blockchain. This Honours program is of high-end industry standards and shall offer multi-fold opportunities for the learners such as additional credits, specialization in the chosen domain, job-ready skills, multidisciplinary knowledge, etc.
3. **Foreign and Indian Languages**: As another initiative, the Skill-Based Learning (SBL) in Scheme – II shall also comprise of developing verbal and written communication skills in Foreign and Indian Languages, which is a blooming trend and future necessity for various career prospects. The students shall acquire these skills through MOOC courses, giving them opportunities to learn the target language from beginners to advanced level. These SBL and the TBL courses shall acquaint students with skills of digital age learning from online platforms, along with time management ability, ethics, and professionalism.

Through joint efforts of all stakeholders, newer initiatives, strategic planning, and efficient execution of neoteric educational practices with hi-tech wizardry, KJSIEIT is endeavouring to become a role model for all autonomous institutes across the nation.

Dr. S. K. Ukarande
Principal and Chairman - Academic Council

Preamble by Member Secretary, Academic Council:

K J Somaiya Institute of Engineering and Information Technology (KJSIEIT) has been granted academic autonomy by University Grants Commission (UGC) from Academic Year 2021-22 for 10 years. 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'.

We, autonomous KJSIEITs Board of Studies in Computer Engineering (CE), Artificial Intelligence and Data Science (AI-DS), Electronics and Telecommunication (ET) and Information Technology (IT) had prepared Autonomy Scheme-I curricula from Academic Year 2021-22 for 4 years undergraduate (UG) and 2 years of post-graduation (PG) in Engineering and Technology disciplines, exercising academic freedom, meeting the needs of Industry 4.0, addressing the world wide challenges and providing globally required exposure to our UG and PG learners, focusing sound theoretical background supported by practical experiences in the relevant areas of engineering and technology.

Industry 4.0 demands modern and 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 professionals, ability to work in teams on multidisciplinary projects, etc from engineering graduates. KJSIEITs autonomy Scheme-I syllabus was framed looking at the overall demands of Industry 4.0 and society to successfully acquaint learners with life-long experiential learning, professional ethics with universal human values, needed skill sets, 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 and innovations.

It provides unique learning experiences to learners through extracurricular activities, innovations, and research with the introduction of Skill Based, Activity Based, Technology based and Project Based learning, showcasing learners' creativity, interest and talent by developing additional skill sets, social involvement and contributions through activities, case studies, field visits, internships, creative learning, innovative mini, minor and major project developments. This helped in strengthening learners' profile with increased chances of employability and avenues for start-ups. It is also provided with Value addition learning through MOOCs platforms such as IBM-ICE, Coursera, NPTEL, SWAYAM, Spoken Tutorial, Udemy etc.
We are happy to present the additional exposure to our learners under the Autonomy Academic Scheme-II, implemented w.e.f academic year 2022-23 for developing the intellectual climate of our country, bringing academic excellence in higher education system with the introduction of additional credit and audit courses for
1. Internships,
2. Skill Based Learning and
3. Honours Degree Programs in 6 emerging areas of technologies.

These additions are targeted for promoting academic, professional and personal development of learners through hands-on working experience under internships, exposure to foreign and Indian Regional Languages through MOOCs and award of specialisation through Honours Degree Program. Internships will channelize learners' working experience with Industries, Government Sectors, NGO, MSMEs, Long term Rural Developments, and Research, Innovation, IPRs and Entrepreneurial setup. Two innovative courses on skill based implementing NEP 2020 guidelines and Honours Degree Program along with Regular B.Tech degree will boost the knowledge of graduating engineers in emerging areas of technologies contributing largely for industrial and personal automation, cyber, digitization, digital currency, security and artificial intelligence sector.

We are sure that with Scheme-I in academic year 2021-22 and Scheme-II from Academic Year 2022-23, the blend of innovative learning components in the curriculum shall strengthen the research and entrepreneurial culture of the institute benefitting the graduating engineers immensely.
We would like to place on record our gratitude to the faculty, alumni, students, industry experts, academicians and stakeholders, helping continuously strengthen the academics, making KJSIEIT as one of best engineering colleges across nation and top most choice of engineering aspirants.

Dr. Sunita R Patil
Member Secretary, Academic Council and Vice Principal, KJSIEIT, Sion, Mumbai.

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 (AI-DS) are very happy to present Autonomy Syllabus Scheme-II of Second Year and Third Year of B. Tech in Artificial Intelligence with effect from the Academic Year 2022-23. We are assured that you will discover this syllabus interesting and challenging.

AI-DS is one of the newest programme amongst engineering students. 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 AI-DS. It aims at creating skilled engineers who can successfully acquaint with the demands of the industry worldwide. We have included internships under Autonomy Syllabus Scheme-II from SEM-II to SEM-VIII of B.Tech AI-DS. Also honor degree courses introduced in this Syllabus Scheme-II of AI-DS. 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. For holistic development of students Foreign and Regional Indian language and other skill-based courses introduced first time in this new scheme. 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)	11	Prof. Vrinda Ullas	Member
2	Dr. Michel Mistry	Experts from outside parent university nominated by Academic council	12	Prof. Vidya Sagvekar	Member
3	Dr. Sanjay Shitole		13	Prof. Sejal Shah	Member
4	Dr. Madhav Chandane	One expert to be nominated by the Vice-Chancellor	14	Prof. G. R. Phadke	Member
5	Mr. Akhil Hada	One Representative from Industry /Corporate Sector/ Allied area relating to Placement	15	Prof. Sarika Mane	Member
6	Dr. Vaishali Wadhe	Member	16	Prof. Sheetal Jagtap	Member
7	Prof. Pankaj Deshmukh	Member	17	Prof. Devanand Bathe	Member
8	Prof. Medha Asurlekar	Member	18	Prof. Ganesh Wadmare	Member
9	Dr. Sunita Patil	Other Member	19	Dr. Hariram Chavan	Other Member
10	Dr. Namrata Gharat	Other member	20	Dr. Radhika Kotecha	Other member

Program Structure for Second Year UG Technology (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
AIC401	Applications of Mathematics in Engineering-II	3–0-1	04	3–0-1	04	BS
AIC402	Analysis of Algorithm	3–0-0	03	3–0-0	03	PC
AIC403	Database Management Systems	3–0-0	03	3–0-0	03	PC
AIC404	Operating System	3–0-0	03	3–0-0	03	PC
AIC405	Microprocessor	3–0-0	03	3–0-0	03	PC
AIL402	Analysis of Algorithm Lab	0–2-0	02	0–1–0	01	PC
AIL403	Database Management Systems Lab	0–2-0	02	0–1–0	01	PC
AIL404	Operating System Lab	0–2-0	02	0–1–0	01	PC
AIPR42	Project Based Learning- Mini Project Lab-2	0–2-0	02	0–1–0	01	PBL
AIXS45	Skill Based Learning-V	0–2*-0	02	0–1–0	01	SAT
AIXS46	Skill Based Learning-VI	0–2*-0	02	0–1–0	01	SAT
INT43	Internship-III	--	--	--	--	INT
Total		**15–12-1**	**28**	**15-6-1**	**22**	

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

PBL - Mini Project Lab 1 and 2:

- Students can form groups with minimum 2 (Two) and not more than 4 (Four)
- Faculty Load: 1 hour per week per four groups

Semester- IV-Examination Scheme

Course Code	Course Name	Examination Scheme									
		Marks									
		CA				ESE	TW	O	P	P&O	Total
		T1	T2	Average (T-1 & T-2)	IA						
AIC401	Applications of Mathematics in Engineering-II	30	30	30	10	60	25	--	--	--	125
AIC402	Analysis of Algorithm	30	30	30	10	60	--	--	--	--	100
AIC403	Database Management Systems	30	30	30	10	60	--	--	--	--	100
AIC404	Operating System	30	30	30	10	60	--	--	--	--	100
AIC405	Microprocessor	30	30	30	10	60	--	--	--	--	100
AIL402	Analysis of Algorithm Lab	--	--	--	--	--	25	--	--	25	50
AIL403	Database Management Systems Lab	--	--	--	--	--	25	--	--	25	50
AIL404	Operating System Lab	--	--	--	--	--	25	--	--	25	50
AIPR42	Project Based Learning- Mini Project Lab-2	--	--	--	--	--	25	--	--	25	50
AIXS45	Skill Based Learning-V	--	--	--	--	--	25	--	--	--	25
AIXS46	Skill Based Learning-VI	--	--	--	--	--	25	--	--	--	25
INT43	Internship-III	--	--	--	--	--	--	--	--	--	--
Total		**--**	**--**	**150**	**50**	**300**	**150**	**--**	**--**	**100**	**775**

Course Code	Course Name	Credits (TH+P+TUT)
AIC401	**Applications of Mathematics in Engineering-II**	**(3+0+1)**

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

Continuous Assessment:

- Test-1, Test-2 and Average of T-1 and T-2 (30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each.
- Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus).
- Average marks of T-1 and T-2 will be considered.
- Internal Assessment (10 Marks): Internal assessment will be based on quizzes /case study/activity conducted by the faculty

End Semester Examination (ESE):

- End Semester Exam shall be conducted for Total 60 Marks.
- Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Course Code	Course Name	Credits (TH+P+TUT)
AIC402	**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	2.1 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	3.1 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	4.1 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, Genetic Algorithm	CO6	03	04
	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

Continuous Assessment:

- Test-1, Test-2 and Average of T-1 and T-2 (30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each.
- Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus).
- Average marks of T-1 and T-2 will be considered.
- Internal Assessment (10 Marks): Internal assessment will be based on quizzes /case study/activity conducted by the faculty

End Semester Examination (ESE):

- End Semester Exam shall be conducted for Total 60 Marks.
- Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Lab Code	Lab Name	Credits (P+TUT)
AIL402	**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	LO3, LO4, LO5	02

	Graph coloring		
	Travelling Salesperson problem		
	15 Puzzle problem		
6.	6.1 String Matching Algorithms	LO2, LO4, LO5	02
	The Naïve string-matching Algorithms		
	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". 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:-20 marks, Assignments:-05 marks)			
P&O: P&O examination will be based on experiment list and performance of experiment.			

Course Code	Course Name	Credits (TH+P+TUT)
AIC403	**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	2.1 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	5.1 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			
I. 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

Continuous Assessment:

- Test-1, Test-2 and Average of T-1 and T-2 (30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each.
- Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus).
- Average marks of T-1 and T-2 will be considered.
- Internal Assessment (10 Marks): Internal assessment will be based on quizzes /case study/activity conducted by the faculty

End Semester Examination (ESE):

- End Semester Exam shall be conducted for Total 60 Marks.
- Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Lab Code	Lab Name	Credits (P+TUT)
AIL403	**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:-20 marks, Assignments:-05 marks)

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

Course Code	Course Name	Credits (TH+P+TUT)
AIC404	**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: Pre-emptive and Non-pre-emptive 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	5.1 Overview, File Organization and Access, File Directories, File Sharing	CO5	04	04
6.I/O management	6.1 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

Continuous Assessment:

- Test-1, Test-2 and Average of T-1 and T-2 (30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each.
- Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus).
- Average marks of T-1 and T-2 will be considered.
- Internal Assessment (10 Marks):Internal assessment will be based on quizzes /case study/activity conducted by the faculty

End Semester Examination (ESE):

- End Semester Exam shall be conducted for Total 60 Marks.
- Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Lab Code	Lab Name	Credits (P+TUT)
AIL404	**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.	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.	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, and current working directory.	LO2	02
3.	Linux- API Implement any one basic commands of Linux like ls, cp, mv and others using kernel APIs.	LO1	02
4.	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	LO2	02

	using getpid and getppid system calls. b.Explore wait and waitpid before termination of process		
5.	Process Management: Scheduling a. Write a program to demonstrate the concept of non-pre-emptive scheduling algorithms. b. Write a program to demonstrate the concept of pre-emptive scheduling algorithms	LO2	02
6.	Process Management: Synchronization a. Write a C program to implement solution of Producer consumer problem through Semaphore	LO3	02
7.	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.	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.	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.	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:-20 marks, Assignments:-05 marks)

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

Course Code	Course Name	Credits (TH+P+TUT)
AIC405	**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	2.1 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	3.1 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	4.1 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	5.1 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	6.1 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	

Continuous Assessment:

- Test-1, Test-2 and Average of T-1 and T-2 (30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each.
- Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus).
- Average marks of T-1 and T-2 will be considered.
- Internal Assessment (10 Marks): Internal assessment will be based on quizzes /case study/activity conducted by the faculty

End Semester Examination (ESE):

- End Semester Exam shall be conducted for Total 60 Marks.
- Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Project Based Learning Code	Project Based Learning	Credits (P+TUT)
AIPR42	**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 (AIXS45)	
2.	Students shall form a group of 2 to 4 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.	
Term Work:	
Term work 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. 5. Term work of 25 marks	

Exposure (Skill Based Learning-V) Code	Exposure (Skill Based Learning-V)	Credits (P+TUT)
AIXS45	**Skill Based learning: Python Programming**	**(1 + 0)**

Skill Prerequisite:	Knowledge of some programming language like C, Java
Skill Objectives:	1. Basics of Python programming. 2. Decision Making, Data structure and Functions in Python. 3. Object Oriented Programming using Python. 4. Web framework for developing.
Skill Outcomes (SOs):	1. To understand basic concepts in python. 2. To explore contents of files, directories and text processing with python 3. To develop program for data structure using built in functions in python. 4. To explore django web framework for developing python-based web application and basics of NumPy and Pandas. 5. To understand Multithreading concepts using python. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Module No. & Name	Sub Topics	SO mapped	Hrs/Sub topics
I. Prerequisites and Course Outline	Introduction to python, Features, Applications, Comparison with C and Java	--	--
1.Python basics	1.1Data types in python, Operators in python, Input and Output	SO1, SO6	01
	1.2Control statement, Arrays in python		01
	1.3String and Character in python, Functions, List and Tuples, Dictionaries Exception		01
	1.4Introduction to OOP, Classes, Objects, Interfaces, Inheritance		01
2.Advanced Python	2.1 Files in Python, Directories	SO2, SO6	01
	2.2 Building Modules		01
	2.3 Packages, Text Processing		01
	2.4 Regular expression in python.		01
3.Data Structure in Python	3.1 Link List, Stack	SO3, SO6	02
	3.2 Queues, Dequeues		02
4. Python Integration Primer.	4.1 Graphical User interface, Networking in Python	SO4, SO6	01
	4.2 Python database connectivity		01
	4.3Introduction to Django		02
5. Multithreading	5.1Thread and Process, Starting a thread	SO5, SO6	01
	5.2Threading module, Synchronizing threads		02
	Multithreaded Priority Queue		01
6. NumPy and Pandas	6.1Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types	SO4, SO6	02
	6.2Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O		02

	6.3 Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames		02

Textbooks:	
	1. Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press
	2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
	3. Anurag Gupta, G. P. Biswas, "Python Programming", McGraw-Hill.
	4. E. Balagurusamy, "Introduction to computing and problem-solving using python",McGraw Hill Education.
References:	
	1. Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series.
	2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication.
Digital material:	
	"The Python Tutorial",http://docs.python.org/release/3.0.1/tutorial/
	Beginning Perl,https://www.perl.org/books/beginning-perl/
	http://spoken-tutorial.org
	https://starcertification.org/Certifications/Certificate/python

Suggested experiments using Python:

Sr. No.	Title of Experiments
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3	Exploring Files and directories a. Python program to append data to existing file and then display the entire file b. Python program to count number of lines, words and characters in a file. Python program to display file available in current directory
4	Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5	Menu driven program for data structure using built in function for link list, stack and queue.
6	Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/ MySQL) using python.
7	Creation of simple socket for basic information exchange between server and client.
8	Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).
9	Programs on Threading using python.
10	Exploring basics of NumPy Methods.
11	Program to demonstrate use of NumPy: Array objects.
12	Program to demonstrate Data Series and Data Frames using Pandas.
13	Program to send email and read content of URL.

Term Work:	
1	An online quiz conducted at the end of every 2-hr session 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	Students should perform minimum 15 experiments. 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.

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
AIXS46	SAT – VI: Skill-Based Learning (Foreign and Indian Regional Languages-II)	-	01	-	01

SBL Objectives (SOBs):	1. Acquire reading and writing proficiency in the target language 2. Understand the common heritage of, and diversity among, countries that speak the target language. 3. Communicate and interact effectively with citizens of the target cultures.
SBL Outcomes (SOs):	Upon completion of the course, the learners will be able to: 1. Demonstrate of communicative proficiency in the target language. 2. Write the target language in formal expository prose that impede communication. 3. Learn through MOOC online courses to adopt hybrid mode of learning.
Guidelines for Skill-Based Learning (SBL):	Each student have to complete any one MOOC course from NPTEL/Coursera/Udemi sites as given in the list.

Sr No.	Courses offered
1	Introduction to Japanese Language and Culture
2	German - II
3	The Psychology Of Language
4	Spanish Vocabulary: Meeting People , Cultural Experience, Sports, Travel, and the Home, Careers and Social Events, Spanish Vocabulary Project
5	A Bridge to the World: Korean Language for Beginners, First Step Korean, Learn to Speak Korean 1, The Korean Alphabet: An Introduction to Hangeul
6	Complete French Course: Learn French for Beginners
7	Complete German Course: Learn German for Beginners
8	Spanish 1-4: Beginner, Elementary, Intermediate and Advanced
9	Complete Japanese Course: Learn Japanese for Beginners
10	Complete Korean Course: Learn Korean for Beginners
11	The Complete Russian Language Course
12	Spoken Sanskrit: Basic and Intermediate Levels
13	Applied Linguistics
14	Fundamental Concepts in Sociolinguistics
15	Introduction to Basic Spoken sanskrit and intermediate level to Basic Spoken Sanskrit

Online Resources:

Sr No.	Courses Link
1	https://onlinecourses.nptel.ac.in/noc22_hs84/preview
2	https://onlinecourses.nptel.ac.in/noc22_hs89/preview
3	https://onlinecourses.nptel.ac.in/noc22_hs123/preview
4	https://www.coursera.org/learn/spanish-vocabulary-meeting-people_ https://www.coursera.org/learn/spanish-vocabulary-cultural-experience https://www.coursera.org/learn/spanish-vocabulary-sports-travel-home

	https://www.coursera.org/learn/spanish-vocabulary-careers https://www.coursera.org/learn/spanish-vocabulary-project
5	https://www.coursera.org/learn/korean-beginners https://www.coursera.org/learn/learn-korean https://www.coursera.org/learn/learn-speak-korean1 https://www.coursera.org/learn/the-korean-alphabet-an-introduction-to-hangeul
6	https://www.udemy.com/course/complete-french-course/
7	https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/
8	https://www.udemy.com/course/spanish-101-beginning-spanish-spanish-for-beginners/
9	https://www.udemy.com/course/complete-japanese-course-learn-japanese-for-beginners-lvl-1/
10	https://www.udemy.com/course/complete-korean-course-learn-korean-for-beginners-level-1/
11	https://www.udemy.com/course/the-complete-russian-language-course/
12	https://onlinecourses.nptel.ac.in/noc22_hs114/preview
13	https://onlinecourses.nptel.ac.in/noc22_hs85/preview
14	https://onlinecourses.nptel.ac.in/noc22_hs139/preview

Course Code	Course Name	Hours/Duration
INT43	**Internship-III**	**2 - 3 Weeks**
Prerequisite:	Skill sets of engineering and technology specific tools, instruments, devices and programming languages etc.	
Course Objectives:	1. To get the industrial environment expose for creating competent professionals for the industry. 2. To understand the psychology of the workers and their habits, attitudes and approach to problem solving.	
Couse Outcomes:	Upon completion of the course, students will be able to: 1. Get an expose to work with the future employers. 2. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control in product development lifecycle.	
Activity- Internship	Supporting Activities to be completed under Internship	
	Internships in the field of:	
	● Industries	
	● Government Sector	
	● Non-governmental Organization (NGO)	
	● MSMEs	
	● Rural Internship	
Term Work Assessment: **Duration to be considered for assessment:** Week Ends/ Semester Break/End of Semester (After ESE & Before Next Term Start)		
Guidelines:	1. Batch wise Faculty Supervisor who is the proctor (mentor) of the batch will be allotted as in-charge for the course, at start of the Academic year. 2. Students will submit the participation certificate of the activities to the faculty mentors. 3. For working in cells related activities, Cell coordinator will submit list of actively involved & participated students of each department, semester wise to all department HODs, verified and authenticated by Dean Students Welfare. 4. HOD will circulate the student list to all faculty mentors for consideration of Hours spends under mentioned department activities. 5. Department IIIC Cell coordinator will collect, maintain each student proofs/reports from all faculty mentors, department internship analysis report will be prepared & submitted to Dean, IIIC for AICTE-CII survey data 6. Students will submit evaluation sheet by attaching Xerox copies of all participation/ IPR/ Copyright certificates & faculty mentor will verify it with original copies, for assessment purpose.	