SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Technology
Formerly known as K J Somaiya Institute of Engineering and Information Technology
An Autonomous Institute Permanently Affiliated to the University of Mumbai

Item No.: 4.A.3
A.C.: 07/07/2023

Autonomy Syllabus Scheme – II B

for

Bachelor of Technology (B.Tech.)

in

Information Technology

(Second Year - Semester III and IV)

and Internship Policy Manual

(With Effect from A.Y. 2023-24)

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 Technology (KJSIT), 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 KJSIT 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 offers a wide range of elective courses — grouped into core and inter-disciplinary domains. At par with international engineering education, it follows 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. These SAT courses, practiced across the first three years of engineering, focus on graduate attributes like work responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. which cannot 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, KJSIT Syllabus Scheme – II was introduced with 03 newer dimensions to Scheme – I: Internship, SBL of Foreign and Indian Languages, and Honours Degree — for implementation 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 mandatory Internship for all the students, which 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 KJSIT 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 comprises 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. Such SBL and TBL courses shall also acquaint students with skills of digital age learning from online platforms, along with time management ability, ethics, and professionalism.

The KJSIT Syllabus Scheme II B introduced here represents a minor revision of Scheme II. Specifically, it includes a new Activity-based Learning (ABL) course on Interdisciplinary Informatics, to expose learners to opportunities and effectiveness by integrating informatics with diverse disciplines such as biotechnology, healthcare, agriculture, nanotechnology, earth sciences, and more. This SAT course aims to promote interdisciplinary Research and Development, which has been one of the major goals of the institute.

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

Dr. Suresh 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

Preface by Chairperson – Board of Studies (BoS):

Data is the proverbial new oil of the digital economy and Information Technology is the lifeblood for innovation and digital transformation – the contemporary watchwords of almost all the organizations. But innovation and digital transformation not only imply improving older processes and products, but reimagining them to deliver more value to the stakeholders. It also includes how businesses operate, automate, speed up processes, create new revenue streams, develop cost-effective and feasible alternatives, and more. Information Technology and its corresponding technologies like Artificial Intelligence, Data Science, Internet of Things, Blockchain, Image Processing, etc. play a vital role in solving these challenges.

With immense aspirations to produce Information Technology engineers who can contribute in achieving such development goals for various organizations, businesses, and society at large, we initially designed the Scheme – I, and further revised it to Scheme II syllabus of Bachelor of Technology in Information Technology – B.Tech. (Information Technology) programme. The revision reflects reorganization and inclusion of some state-of-the-art courses with an objective to empower students in achieving better employability, start-ups and other avenues for higher education. Furthermore, with minor revision to Scheme II, we hereby present Scheme II B, which shall be effective for Second Year from Academic Year 2023-24, and progressively thereafter.

The syllabus covers the core as well as cutting-edge technology courses in Information Technology, designed with consideration of current and futuristic trends in the industries. It focuses on outcome-based education, with precise outcomes defined for each course — those that map to the programme outcomes. The curriculum allows students to choose elective courses at the institute-level from multi-disciplinary courses, and prominently choose elective courses at department-level, which are grouped into 04 major domains: a) Artificial Intelligence, b) Network & Security, c) Multimedia, and d) Optimization. This domain-wise grouping of electives provides students with opportunities to have in-depth knowledge in the emerging areas concerning their own choice.

For the holistic development of students and to assure that all the programme outcomes are attained, the curriculum also offers additional SAT courses. It comprises Skill-Based Learning (SBL) for imparting technical as well other co-scholastic skills required for graduates, Activity-Based Learning (ABL) focusing on learning by doing, and Technology-Based Learning (TBL) to engage students in life-long learning.

The curriculum further offers a Project-Based Learning (PBL) component in all the semesters of Second Year, Third Year, and Last Year with different technologies applied at frontend and backend to prepare students for varied needs of projects at the workplace. In congruence to the AICTE Internship Policy, students are also encouraged to take up Internships during their under-graduation, and the guidelines for the same are included in the curriculum. The learning from PBL and Internships shall help students in developing need-based or live projects to address the real-world issues of the society and/or industry — which is majorly emphasized by the Department of Information Technology. The amalgamation of all these learning components in the curriculum will nurture vast potential of the youths and contribute to the national development process in field of Information Technology.

The curriculum is the culmination of the efforts and meticulous work of all the members of the Board of Studies, subject-expert faculty members from other departments of the institute, external experts from academia, experienced professionals from IT companies, as well as the alumni working in IT companies across India and abroad. I appreciate and thank all these members to have contributed in making the contents truly superior through their knowledge and valuable time.

We, the Board of Studies in Information Technology believe that the curriculum will meet the expectations of all the stakeholders and they shall take the advantage of the dynamic features of the curriculum — making the teaching-learning process an exalted experience for all.

Dr. Radhika Kotecha
Head – Department of Information Technology and Chairperson – BoS in Information Technology

SEMESTER III - B.TECH. (INFORMATION TECHNOLOGY)

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
ITC301	Applications of Mathematics in Engineering – I	3 – 0 – 1	04	3 – 0 – 1	04	BS
ITC302	Data Structures and Analysis	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC303	Database Management System	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC304	Java Programming	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC305	Foundations of Software Engineering	2 – 0 – 0	02	2 – 0 – 0	02	PC
ITL302	Data Structures Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL303	SQL Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL304	Java Programming Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITPR31	PBL – Mini Project Lab I (Web App Development Mini Project)	0 – 2 – 0	02[$]	0 – 1 – 0	01	PBL
ITXS33	SAT – III: Skill-Based Learning (Go Programming)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
ITXA34	SAT – IV: Activity-Based Learning (Interdisciplinary Informatics)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
Total		**14 – 12 – 1**	**27**	**14 – 6 – 1**	**21**	

[*]SAT can be conducted as TH or P or both as required.

[$]Load of learner, not the faculty.

EXAMINATION SCHEME

Course Code	Course Name	CA Marks				ESE		TW / O / P Marks				Total Marks
		T1	T2	Avg. of T1 & T2	IA	Marks	Duration (in Hrs)	TW	O	P	P&O	
ITC301	Applications of Mathematics in Engineering - I	30	30	30	10	60	2.5	25	-	-	-	125
ITC302	Data Structures and Analysis	30	30	30	10	60	2.5	-	-	-	-	100
ITC303	Database Management System	30	30	30	10	60	2.5	-	-	-	-	100
ITC304	Java Programming	30	30	30	10	60	2.0	-	-	-	-	100
ITC305	Foundations of Software Engineering	20	20	20	10	45	2.5	-	-	-	-	75
ITL302	Data Structures Lab	-	-	-	-	-	-	25	-	-	25	50
ITL303	SQL Lab	-	-	-	-	-	-	25	-	-	25	50
ITL304	Java Programming Lab	-	-	-	-	-	-	25	-	-	-	25
ITPR31	PBL – Mini Project Lab I (Web App Development Mini Project)	-	-	-	-	-	-	25	-	-	25	50
ITXS33	SAT – III: Skill-Based Learning (Go Programming)	-	-	-	-	-	-	25	-	-	-	25
ITXA34	SAT – IV: Activity-Based Learning (Interdisciplinary Informatics)	-	-	-	-	-	-	25	-	-	-	25
Total		**140**	**140**	**140**	**50**	**285**	**-**	**175**	**-**	**-**	**75**	**725**

Abbreviations: TH – Theory, P – Practical, TUT – Tutorial, BS – Basic Science Course, PC – Professional Core Course, PBL – Project-Based Learning, SAT – Skill/Activity/Technology-Based Learning (Exposure Course), CA – Continuous Assessment, T1 – Test 1, T2 – Test 2, IA – Internal Assessment, ESE – End Semester Exam, TW – Term Work, O – Oral Exam, P – Practical Exam, P&O – Practical & Oral Exam.

SEMESTER IV - B.TECH. (INFORMATION TECHNOLOGY)

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
ITC401	Applications of Mathematics in Engineering – II	3 – 0 – 1	04	3 – 0 – 1	04	BS
ITC402	Computer Network and Network Design	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC403	Operating Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC404	Automata Theory	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC405	Computer Organization and Architecture	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITL402	Network Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL403	Unix Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL405	Microprocessor & Microcontroller Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITPR42	PBL – Mini Project Lab II (Python-based Mini Project)	0 – 2 – 0	02[$]	0 – 1 – 0	01	PBL
ITXS45	SAT – V: Skill-Based Learning (Python Programming)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
ITXS46	SAT – VI: Skill-Based Learning (Foreign / Indian Modern Languages)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
Total		**15 – 12 – 1**	**28**	**15 – 6 – 1**	**22**	

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EXAMINATION SCHEME

Course Code	Course Name	CA Marks				ESE Marks		TW/O/P Marks				Total
		T1	T2	Avg. of T1 & T2	IA	Marks	Duration (in Hrs)	TW	O	P	P&O	
ITC401	Applications of Mathematics in Engineering – II	30	30	30	10	60		25	-	-	-	125
ITC402	Computer Network and Network Design	30	30	30	10	60		-	-	-	-	100
ITC403	Operating Systems	30	30	30	10	60		-	-	-	-	100
ITC404	Automata Theory	30	30	30	10	60		-	-	-	-	100
ITC405	Computer Organization and Architecture	30	30	30	10	60		-	-	-	-	100
ITL402	Network Lab	-	-	-	-	-		25	-	-	25	50
ITL403	Unix Lab	-	-	-	-	-		25	-	25	-	50
ITL405	Microprocessor & Microcontroller Lab	-	-	-	-	-		25	-	25	-	50
ITPR42	PBL – Mini Project Lab II (Python-based Mini Project)	-	-	-	-	-		25	-	-	25	50
ITXS45	SAT – V: Skill-Based Learning (Python Programming)	-	-	-	-	-		25	-	-	-	25
ITXS46	SAT – VI: Skill-Based Learning (Foreign / Indian Modern Languages)	-	-	-	-	-		25	-	-	-	25
Total		**150**	**150**	**150**	**50**	**300**		**175**	**-**	**50**	**50**	**775**

Abbreviations: TH – Theory, P – Practical, TUT – Tutorial, BS – Basic Science Course, PC – Professional Core Course, PBL – Project-Based Learning, SAT – Skill/Activity/Technology-Based Learning (Exposure Course), CA – Continuous Assessment, T1 – Test 1, T2 – Test 2, IA – Internal Assessment, ESE – End Semester Exam, TW – Term Work, O – Oral Exam, P – Practical Exam, P&O – Practical & Oral Exam.

SEMESTER III - B.TECH. (INFORMATION TECHNOLOGY)

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
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ITC302	Data Structures and Analysis	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC303	Database Management System	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC304	Java Programming	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC305	Foundations of Software Engineering	2 – 0 – 0	02	2 – 0 – 0	02	PC
ITL302	Data Structures Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL303	SQL Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL304	Java Programming Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITPR31	PBL – Mini Project Lab I (Web App Development Mini Project)	0 – 2 – 0	02[$]	0 – 1 – 0	01	PBL
ITXS33	SAT – III: Skill-Based Learning (Go Programming)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
ITXA34	SAT – IV: Activity-Based Learning (Interdisciplinary Informatics)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
Total		**14 – 12 – 1**	**27**	**14 – 6 – 1**	**21**	

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EXAMINATION SCHEME

Course Code	Course Name	CA Marks				ESE		TW / O / P Marks				Total Marks
		T1	T2	Avg. of T1 & T2	IA	Marks	Duration (in Hrs)	TW	O	P	P&O	
ITC301	Applications of Mathematics in Engineering - I	30	30	30	10	60	2.5	25	-	-	-	125
ITC302	Data Structures and Analysis	30	30	30	10	60	2.5	-	-	-	-	100
ITC303	Database Management System	30	30	30	10	60	2.5	-	-	-	-	100
ITC304	Java Programming	30	30	30	10	60	2.0	-	-	-	-	100
ITC305	Foundations of Software Engineering	20	20	20	10	45	2.5	-	-	-	-	75
ITL302	Data Structures Lab	-	-	-	-	-	-	25	-	-	25	50
ITL303	SQL Lab	-	-	-	-	-	-	25	-	-	25	50
ITL304	Java Programming Lab	-	-	-	-	-	-	25	-	-	-	25
ITPR31	PBL – Mini Project Lab I (Web App Development Mini Project)	-	-	-	-	-	-	25	-	-	25	50
ITXS33	SAT – III: Skill-Based Learning (Go Programming)	-	-	-	-	-	-	25	-	-	-	25
ITXA34	SAT – IV: Activity-Based Learning (Interdisciplinary Informatics)	-	-	-	-	-	-	25	-	-	-	25
Total		**140**	**140**	**140**	**50**	**285**	**-**	**175**	**-**	**-**	**75**	**725**

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Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC301	Applications of Mathematics in Engineering – I	03	-	01	04

Prerequisites:	Engineering Mathematics.
Course Objectives (COBs):	1. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications. 2. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills. 3. To understand the concept of Complex Variables, C-R equations with applications. 4. To understand the basic techniques of statistics like Correlation, Regression, and Curve Fitting for Data Analysis, Machine learning, and AI. 5. To understand some advanced topics of Probability, Random Variables with their Distributions and Expectations.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Solve the real integrals in engineering problems using the concept of Laplace Transform. 2. Analyze engineering problems through the application of inverse Laplace transform of various functions. 3. Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems. 4. Solve the problems of obtaining orthogonal trajectories and analytic functions by means of complex variable theory and application of harmonic conjugate. 5. Apply the concept of Correlation and Regression to the engineering problems in Data Science, Machine Learning, and AI. 6. Analyze the spread of data and distribution of probabilities by the concepts of probability and expectation.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	01	01
1. Laplace Transform	Definition of Laplace Transform, Condition of Existence of Laplace Transform.	CO1	01	07
	Laplace Transform *(L)* of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and t^n, $n \geq 0$.	CO1	02	
	Properties of Laplace Transform: Linearity, First Shifting Property, Second Shifting Property, Change of Scale Property, Multiplication by t, Division by t, Laplace Transform of Derivatives and Integrals (Properties without proof).	CO1	02	
	Evaluation of Integrals by using Laplace Transformation.	CO1	02	
2. Inverse Laplace Transform	Definition of Inverse Laplace Transform, Linearity Property, Inverse Laplace Transform of Standard Functions, Inverse Laplace Transform using Derivatives.	CO2	02	06
	Partial Fractions Method to find Inverse Laplace	CO2	02	

	Transform.			
	Inverse Laplace Transform using Convolution Theorem (without proof).	CO2	02	
3. Fourier Series	Dirichlet's Conditions, Definition of Fourier Series and Parseval's Identity (without proof).	CO3	01	07
	Fourier Series of Periodic Function with Period 2π & $2l$.	CO3	02	
	Fourier Series of Even and Odd Functions.	CO3	02	
	Fourier Transform-Fourier Sine Transform and Fourier Cosine Transform.	CO3	02	
4. Complex Variables	Function *f(z)* of Complex Variable, Limit, Continuity and Differentiability of *f(z)*, Analytic Function: Necessary and Sufficient Conditions for *f(z)* to be Analytic (without proof).	CO4	01	07
	Cauchy-Riemann Equations in Cartesian Coordinates (without proof).	CO4	02	
	Milne-Thomson Method to determine Analytic Function *f(z)* when Real Part *(u)* or Imaginary Part *(v)* or its combination *(u+v or u-v)* is given.	CO4	02	
	Harmonic Function, Harmonic Conjugate and Orthogonal Trajectories.	CO4	02	
5. Statistical Techniques	Karl Pearson's Coefficient of Correlation *(r)*.	CO5	01	07
	Spearman's Rank Correlation Coefficient *(R)* (with repeated and non-repeated Ranks).	CO5	01	
	Lines of Regression.	CO5	02	
	Fitting of First and Second-Degree Curves.	CO5	02	
6. Probability	Definition and Basics of Probability, Conditional Probability.	CO6	01	07
	Total Probability Theorem and Bayes' Theorem.	CO6	01	
	Discrete and Continuous Random Variable with Probability Distribution and Probability Density Function.	CO6	02	
	Expectation, Variance, Moment Generating Function, Raw and Central Moments up to 4^{th} order.	CO6	02	
Text Books:	1. B. Grewal, Higher Engineering Mathematics, Khanna Publications. 2. E. Kreyszig, Advanced Engineering Mathematics, Wiley. 3. T. Veerarajan, Probability, Statistics and Random Processes, McGraw Hill.			
Reference Books:	1. R. Jain and S. Iyengar, Advanced Engineering Mathematics, Narosa Publication. 2. J. Brown and R. Churchill, Complex Variables and Applications, McGraw Hill. 3. M. Spiegel, Theory and Problems of Fourier Analysis with applications to BVP, Schaum's Outline Series.			
Useful Links:	1. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25 2. https://nptel.ac.in/noc/courses/111/ 3. https://www.coursera.org/courses?query=mathematics 4. https://ndl.iitkgp.ac.in/			

Term Work (TW):	• Term work shall consist of 06 batch wise tutorials. • Journal must include at least 02 assignments on content of theory of the course. • Term work evaluation shall be for Total 25 Marks based on Tutorials (15 Marks) and Assignments (10 Marks).
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC302	Data Structures and Analysis	03	-	-	03

Prerequisites:	Computer Programming (C / C++).
Course Objectives (COBs):	1. To introduce the concepts of data structures and analysis procedure. 2. To conceptualize linear data structures and its implementation for various real-world applications. 3. To provide the understanding of non-linear data structures and its applications in developing solutions to real-world problems. 4. To impart knowledge of sorting and searching algorithms. 5. To develop an ability to design and analyze algorithms using various data structures. 6. To design and implement various data structure algorithms for solving real-world problems.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the fundamental concepts of data structures, analyse a given problem to identify suitable data structures applicable for solving it, and describe the complexities of algorithms designed for the same. 2. Apply the concepts of stacks and queues to develop real-world problem solutions. 3. Apply the concepts of singly, circular, or doubly linked list as per the requirements for solving real-world problems. 4. Apply the concepts of trees to develop real-world problem solutions. 5. Apply the concepts of graphs to develop real-world problem solutions. 6. Apply appropriate sorting/searching techniques for real-world problem-solving.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Data Structures and Analysis	Introduction to Data Structures, Need of Data Structures, Types of Data Structures: Linear and Non-linear Data Structures, Static and Dynamic Data Structures.	CO1	02	04
	Introduction to Analysis, Algorithms, Characteristics of Algorithms, Time and Space Complexities, Order of Growth Functions, Asymptotic Notations.	CO1	02	
2. Stacks and Queues	Introduction to Stack, Stack as ADT, Operations on Stack, Polish Notation: Infix, Prefix, and Postfix Expressions, their Evaluation and Conversions.	CO2	04	10
	Applications of Stack: Reversal of a String, Checking Validity of Expressions with Nested Parenthesis.	CO2	01	
	Introduction to Queue, Queue as ADT, Operations on Queue, Linear Representation of Queue, Circular Queue, De-queue.	CO2	03	
	Priority Queue, Applications of Queues: Scheduling.	CO2	01	
	Analysis of Stack and Queue Complexities and their Suitability for Solving Different Real-world Problems.	CO1	01	

3. Linked List	Introduction to Linked Lists, Singly Linked Lists, Circular Linked Lists, Insertion, Deletion, and Update Operations with Singly and Circular Linked Lists.	CO3	04	09
	Doubly Linked Lists, Insertion, Deletion, and Update Operations with Doubly Linked Lists.	CO3	03	
	Linked List Representation of Stack and Queue, Analysis of Linked Lists and its Suitability for Solving Different Real-world Problems.	CO3, CO1	01	
	Applications of Linked Lists.	CO3	01	
4. Trees	Introduction to Trees, Tree Terminologies.	CO4	01	06
	Binary Tree Representation, Operations on Binary Trees, Traversal of Binary Trees, Threaded Binary Trees, Analysis of Trees and its Suitability for Solving Different Real-world Problems.	CO4, CO1	03	
	Application-oriented Introduction: Binary Search Trees, B-Trees, B+ Trees, Decision Trees, Expression Trees, etc.	CO4	01	
	Application of Trees: Huffman Encoding.	CO4	01	
5. Graphs	Introduction to Graphs, Graph Terminologies, Graph Representation, Type of Graphs.	CO5	01	05
	Graph Traversal: Depth First Search (DFS), Breadth First Search (BFS), Analysis of Graphs and its Suitability for Solving Different Real-world Problems.	CO5, CO1	02	
	Minimum Spanning Tree: Prim's & Kruskal's Shortest Path Algorithm, Applications of Graphs: Traversal.	CO5	02	
6. Sorting and Searching	Introduction to Sorting, Sorting Techniques: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Comparison of Sorting Technique Performances.	CO6, CO1	03	05
	Searching: Sequential Search, Binary Search, Hashing: Hash Functions – Truncation, Mid-square Method, Folding Method, Division Method.	CO6	01	
	Collision Resolution: Open Addressing - Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining, Bucket Hashing, Analysis of all Searching Techniques.	CO6	01	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
Text Books:	1. J. Tremblay and P. Sorenson, Introduction to Data Structure and its Applications, McGraw Hill. 2. R. Thareja, Data Structures using C, Oxford. 3. S. Srivastava, D. Srivastava, Data Structures through C in Depth, BPB Publications.			
Reference Books:	1. Y. Langsam, M. Augenstein, and A. Tenenbaum, Data Structures using C and C++, Pearson. 2. E. Horowitz and S. Sahni, Fundamentals of Data Structures, Galgotia Publications. 3. R. Shukla, Data Structures using C and C++, Wiley.			
Useful Links:	1. https://learndsa.kjsieit.in/ 2. https://nptel.ac.in/courses/106/102/106102064/ 3. https://www.coursera.org/learn/data-structures 4. https://www.codechef.com/			

Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes —
	  ○ Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks),
	  ○ Internal Assessment: 10 Marks.
	• Duration of each Test shall be 1 Hour and 15 Minutes.
	• Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.

End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC303	Database Management System	03	-	-	03

Prerequisites:	Computer Programming (C / C++), Basic Knowledge of Computer File System.
Course Objectives (COBs):	1. To learn the basics and understand the need of a Database Management System. 2. To construct conceptual data model for real world applications. 3. To build a Relational Model from ER/EER. 4. To introduce the concept of SQL to store and retrieve data efficiently. 5. To demonstrate notions of Normalization for Database Design. 6. To understand the concepts of Transaction Processing - Concurrency Control & Recovery Procedures.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe the basics and need of a database management system. 2. Design conceptual models for real life applications. 3. Create a Relational model from ER/EER. 4. Apply queries using SQL commands for databases. 5. Design normalized database by applying normalization process. 6. Explain the concept of transaction, concurrency and recovery.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Database System Concepts and Architecture	Introduction, Characteristics of Databases, File System v/s Database System, Data Abstraction and Data Independence.	CO1	03	05
	DBMS System Architecture, Database Administrator (DBA), Role of DBA.	CO1	02	
2. Entity Relationship Model	Conceptual Modelling of a Database, Entity Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets.	CO2	03	06
	Weak Entity Types, Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model.	CO2	03	
3. Relational Model & Relational Algebra	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Key, Secondary Key, Foreign Key, Mapping the ER and EER Model to Relational Model.	CO3	03	05
	Introduction to Relational Algebra, Relational Algebra Expressions for Unary Relational Operations, Set Theory Operations, Binary Relational Operation, Relational Algebra Queries.	CO3	02	
4. Structured Query Language	Overview of SQL, Data Definition Commands, Set Operations, Aggregate Function, Null Values, Data Manipulation Commands, Data Control Commands,	CO4	03	09

(SQL) & Indexing	Complex Retrieval Queries using Group by.			
	Recursive Queries, Nested Queries, All Types of Joins, Introduction to PL-SQL, Integrity Constraints in SQL. Database Programming with JDBC, Security and Authorization: Grant & Revoke in SQL. Functions and Procedures in SQL and Cursors.	CO4	04	
	Indexing: Basic Concepts, Ordered Indices, Index Definition in SQL.	CO4	02	
5. Relational Database Design	Design Guidelines for Relational Schema, Functional Dependencies, Database Tables and Normalization, The Need for Normalization, The Normalization Process, Improving the Design.	CO5	05	07
	Definition of Normal Forms- 1NF, 2NF, 3NF & The Boyce-Codd Normal Form (BCNF), 4NF.	CO5	02	
6. Transactions Management, Concurrency and Recovery	Transaction Concepts, State Diagram, ACID Properties, Transaction Control Commands, Concurrent Executions, Serializability – Conflict and View.	CO6	04	07
	Concurrency Control: Lock-based-protocols, Deadlock Handling, Timestamp-Based Protocols, Recovery System: Recovery Concepts, Log Based Recovery.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01

Text Books:	1. H. Korth, A. Silberchatz, S. Sudarshan, Database System Concepts, McGraw Hill. 2. R. Elmasri and S. Navathe, Fundamentals of Database Systems, Pearson. 3. R. Ramkrishnan and J. Gehrke, Database Management Systems, McGraw Hill.
Reference Books:	1. P. Rob and C. Coronel, Database Systems Design, Implementation and Management, Thomson Learning. 2. P. Deshpande, SQL & PL/SQL for Oracle 11g Black Book, Dreamtech Press. 3. G. Gupta, Database Management Systems, McGraw Hill.
Useful Links:	1. https://onlinecourses.nptel.ac.in/noc19_cs46/preview 2. https://onlinecourses.nptel.ac.in/noc21_cs04/preview 3. https://www.coursera.org/learn/database-management
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC304	Java Programming	03	-	-	03

Prerequisites:	Basics of Computer Programming.
Course Objectives (COBs):	1. To understand the concepts of object-oriented paradigm in the Java programming language. 2. To understand the importance of Classes & objects along with constructors, Arrays, Strings and vectors 3. To learn the principles of inheritance, interface and packages and demonstrate the concept of reusability for faster development. 4. To recognize usage of Exception Handling, Multithreading, Input Output streams in various applications 5. To learn designing, implementing, testing, and debugging graphical user interfaces with database connectivity in Java using Swings and AWT components that can react to different user events. 6. To develop graphical user interfaces using JavaFX controls.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the fundamental concepts of Java Programing. 2. Use the concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem. 3. Demonstrate how to extend java classes and achieve reusability using Inheritance, Interface and Packages. 4. Construct robust and faster programmed solutions to problems using concept of Multithreading, exceptions and file handling 5. Develop Graphical User Interface using Abstract Window Toolkit and Swings along with response to the events and database connectivity. 6. Develop Graphical User Interface by exploring JavaFX framework based on MVC architecture.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Java Fundamentals	Features of Java Language, Introduction to the principles of object-oriented programming: Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism.	CO1	01	06
	Constants, variables and data types, Operators and Expressions, Types of variables and methods.	CO1	02	
	Control Statements: If Statement, If-else, Nested if, switch Statement, break, continue. Iteration Statements: for loop, while loop, and do-while loop.	CO1	03	
2. Classes, objects, Arrays and	Classes & Objects: Reference Variables, Passing parameters to Methods and Returning parameters from the methods, Static members, Non-Static members	CO2	03	08

Strings	Nested and Inner Classes. Static Initialization Block (SIB), Instance Initialization Block(IIB)			
	Constructors: Parameterized Constructors, chaining of constructor, finalize() Method, Method overloading, Constructors Overloading. Recursion, Command-Line Arguments. Wrapper classes, InputBufferReader, OutputBufferReader, String Buffer classes, String functions.		03	
	Arrays & Vectors: One and Two Dimensional arrays, Irregular arrays, dynamic arrays, Array List and Array of Object.	CO2	02	
3. Inheritance, Packages and Interfaces.	Inheritance: Types of Inheritance in Java, member access, using Super- to call superclass Constructor, to access member of super class (variables and methods), creating multilevel hierarchy, Constructors in inheritance, method overriding, Abstract classes and methods, using final.	CO2	02	05
	Packages: Defining packages, creating packages and Importing and accessing packages	CO3	01	
	Interfaces: Defining, implementing and extending interfaces, variables in interfaces, Default Method in Interface, Static Method in interface, Abstract Classes vs Interfaces.	CO3	02	
4. Exception Handling, Multithreading, Input Output streams	Exception Handling: Exception-Handling Fundamentals, Exception Types, Exception class Hierarchy, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally , Java's Built-in Exceptions, Creating Your Own Exception Subclasses.	CO4	02	07
	Multithreaded Programming: The Java Thread Model and Thread Life Cycle, Thread Priorities, Creating a Thread, Implementing Runnable, Extending Thread, Creating Multiple Threads,	CO4	02	
	Synchronization: Using Synchronized Methods, The synchronized Statement	CO4	01	
	I/O Streams: Streams, Byte Streams and Character, The Predefined Streams, Reading Console Input, Reading Characters, Reading Strings, Writing Console Output, Reading and Writing Files.	CO4	02	
5. GUI programming-I & Database Connectivity(AWT, Event Handling, Swing, JDBC)	Designing Graphical User Interfaces in Java: Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features	CO5	02	09
	Event-Driven Programming in Java: Event-Handling Process, Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling.	CO5	02	
	Introducing Swing: AWT vs Swings, Components and	CO5	03	

	Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, TablesScroll pane Menus and Toolbar.			
	Database connectivity using JDBC: Introduction to JDBC, JDBC Drivers & Architecture.	CO5	02	
6. GUI Programming-II (JavaFX)	JavaFX Basic Concepts, JavaFX application skeleton, Compiling and running JavaFX program,	CO6	02	04
	Simple JavaFX control: Label, Using Buttons and events, Drawing directly on Canvas	CO6	02	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
Text Books:	1. H. Schildt, Java-The Complete Reference, Tenth Edition, Oracle Press, Tata McGraw Hill Education. 2. E. Balguruswamy, Programming with Java A primer, Fifth edition, Tata McGraw Hill Publication 3. A. Seth, B. Juneja, Java One Step Ahead, oxford university press.			
Reference Books:	1. D. Editorial Services, Java 8 Programming Black Book, Dreamtech Press. 2. Learn to Master Java, Star EDU Solutions 3. Y. Kanetkar, Let Us Java, BPB Publications.			
Useful Links:	1. https://onlinecourses.nptel.ac.in/noc21_cs03/preview 2. https://onlinecourses.swayam2.ac.in/aic20_sp13/preview 3. https://www.coursera.org/projects/introduction-to-java-programming-java-fundamental-concepts 4. https://www.udemy.com/course/core-java-from-scratch/ 5. https://java-iitd.vlabs.ac.in/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC305	Foundations of Software Engineering	02	-	-	02

Prerequisites:	Fundamentals of Programming.
Course Objectives (COBs):	1. To provide the knowledge of software engineering discipline. 2. To describe requirements and analyse it. 3. To do planning and apply scheduling. 4. To apply analysis, and develop software solutions using Behavioural diagrams. 5. To apply analysis, and develop software solutions using Structured diagrams. 6. To apply testing and assure quality in software solution.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain basic concepts of software engineering. 2. Explain various software development models. 3. Analyse the requirements to prepare software. 4. Prepare plan, schedule, and track the progress of the projects. 5. Design UML diagrams as per requirements of software solutions. 6. Test the quality of software solutions.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Software Engineering	Nature of Software, Software Engineering Myths, Software Process, Generic Process Model, SDLC.	CO1	02	06
	Prescriptive Process Models: The Waterfall Model, Incremental Models, Evolutionary Process Models: RAD and Spiral Model.	CO2	04	
2. Requirement Analysis	Software Requirements: Functional & Non-Functional	CO3	01	03
	Software Documentation: Analysis and Modelling, Software Requirement Specification (SRS).	CO3	02	
3. Software Estimation and Scheduling	Software Project Estimation: LOC, FP, and Cost Estimation Techniques.	CO1, CO4	02	04
	Project Scheduling & Tracking, Gantt Chart, PERT/CPM	CO1, CO4	02	
4. UML Diagrams - I	Design Concepts, Data Flow Diagram,	CO5	02	04
	Use Case Diagrams, Activity Diagrams.	CO5	02	
5. UML Diagrams - II	State Charts, Sequence Diagrams.	CO5	02	04
	Class and Component Diagrams.	CO5	02	
6. Software Testing	Software Quality Testing: Strategic Approach, Strategies for Conventional Software.	CO1, CO6	02	04
	Types of Dynamic Testing: White Box and Black Box Testing, Alpha and Beta Testing	CO1, CO6	02	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01

Text Books:	1. R. Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill. 2. R. Mall, Fundamentals of Software Engineering, PHI.
Reference Books:	1. P. Jalote, An Integrated Approach to Software Engineering, Narosa Publication. 2. I. Sommerville, Software Engineering, Addison-Wesley.
Useful Links:	1. https://nptel.ac.in/courses/108/102/108102120/ 2. https://nptel.ac.in/courses/108/105/108105132/ 3. https://www.udemy.com/course/analog-communication/ 4. https://www.udemy.com/course/digital-communication-information-theory/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 20 Marks (where each Test shall be of 20 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 45 Marks. • Duration of End Semester Exam shall be 2 Hours.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL302	Data Structures Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Turbo / Borland C Complier / Online C Compiler.
Prerequisites:	Computer Programming (C / C++).
Lab Objectives (LOBs):	1. To introduce the concepts of data structures and analysis procedure. 2. To conceptualize linear data structures and its implementation for various real-world applications. 3. To provide the understanding of non-linear data structures and its applications in developing solutions to real-world problems. 4. To impart knowledge of sorting and searching algorithms. 5. To develop an ability to design and analyze algorithms using various data structures. 6. To design and implement various data structure algorithms for solving real-world problems.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Apply the concepts of stacks for real-world applications. 2. Apply the concepts of queues for real-world applications. 3. Apply the concepts of singly, circular, and doubly linked list for real-world applications. 4. Implement tree and graph data structure for real-world applications. 5. Implement sorting and searching techniques for real-world applications. 6. Develop solutions to real-world problems and challenges in Data Structures in team as well as an individual.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites	-	02
1	Implementation of Stack using Array for real-world application.	LO1	02
2	Implementation of Queue using Array for real-world application.	LO2	02
3	Implementations of Infix to Postfix Expression for real-world application.	LO1	02
4	Implementation of Double-ended Queue using Array for real-world application.	LO2	02
5	Implementation of Singly Linked List / Circular Singly Linked List and various operations for real-world.	LO3	02
6	Implementation of Doubly Linked List and various operation for real-world application.	LO3	04
7	Implementation of Binary Tree and its Traversal for real-world application.	LO4	02
8	Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, etc.	LO4	02
9	Implementation of any one Graph Traversal Technique for real-world application.	LO4	02
10	Implementation of any one Sorting Technique considering a real-world application.	LO5	02
11	Advancement through Data Structures: a. Creation of Git profile for source code management. b. Solving problems of Data Structures using HackerRank, etc. platforms.	LO6	04

Virtual Lab Links:	1. http://cse01-iiith.vlabs.ac.in/ 2. https://ds1-iiith.vlabs.ac.in/data-structures-1/ 3. https://ds2-iiith.vlabs.ac.in/data-structures-2/
Term Work (TW):	• Term work should consist of a minimum of 08 experiments, to be performed in C / C++ / Java / Python. • Journal must include at least 02 assignments on content of theory course "Data Structures and Analysis" and "Data Structures Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL303	SQL Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	MySQL / Online SQL Editor, JDK.
Prerequisites:	Computer Programming (C / C++).
Lab Objectives (LOBs):	1. To identify and define problem statements for real life applications. 2. To construct conceptual data model for real life applications. 3. To build Relational Model from ER/EER and use relational algebra. 4. To apply SQL to store and retrieve data efficiently. 5. To implement database connectivity using JDBC. 6. To understand the concepts of transaction processing- concurrency control & recovery procedures.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Construct conceptual model for real-world applications. 2. Create and populate a RDBMS using SQL. 3. Implement efficient information retrieval using SQL. 4. Implement view, triggers and procedures to demonstrate specific event handling. 5. Implement database connectivity using JDBC. 6. Demonstrate the concept of concurrent transactions.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Identify real world problems and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.	LO1	02
2	Mapping ER / EER to Relational schema model.	LO1	02
3	Create a database using DDL and apply integrity constraints.	LO2, LO3	02
4	Perform data manipulations operations on populated databases.	LO3	02
5	Perform Authorization using Grant and Revoke.	LO2, LO3	02
6	Implement Basic and complex SQL queries.	LO3, LO4	02
7	Implementation of Views and Triggers.	LO4	02
8	Demonstrate database connectivity by preparing a simple form in any scripting language.	LO5	04
9	Execute TCL commands.	LO4	02
10	Implement Functions and Procedures in SQL.	LO3, LO4	02
11	Implementation of Cursor.	LO3, LO4	02
12	Implementation and demonstration of Transaction and Concurrency Control techniques using Locks.	LO6	02

Virtual Lab Links:	1. http://vlabs.iitb.ac.in/bootcamp/labs/dbms/exp8/index.php 2. http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php 3. https://dev.mysql.com/doc/refman/8.0/en/sql-data-definition-statements.html
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory course "Database Management Systems" and "SQL Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL304	Java Programming Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	JDK, NetBeans, Eclipse
Prerequisites:	Basics of Computer Programming
Lab Objectives (LOB):	1. To understand the concepts of object-oriented paradigm in the Java programming language. 2. To understand the importance of Classes & objects along with constructors, Arrays, Strings and vectors 3. To learn the principles of inheritance, interface and packages and demonstrate the concept of reusability for faster development. 4. To recognize usage of Exception Handling, Multithreading, Input Output streams in various applications 5. To learn designing, implementing, testing, and debugging graphical user interfaces in Java using Swings and AWT components that can react to different user events. 6. To develop graphical user interfaces using JavaFX controls.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Apply the fundamental concepts of Java Programing. 2. Apply the concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem. 3. Apply the concepts of Inheritance, Interface and Packages. 4. Construct robust and faster programmed solutions to problems using concept of Multithreading, exceptions and file handling 5. Develop Graphical User Interface using Abstract Window Toolkit and Swings along with response to the events and database connectivity. 6. Develop Graphical User Interface by exploring JavaFX framework based on MVC architecture.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Implement a Java program to various ways to accept data through keyboard	LO1	02
2	Implement a menu driven Java program which will read a number and should implement the methods using controlled structures.	LO1	02
3	Implement a program that using Class and Object.	LO2	02
4	Implement program for constructor in Java.	LO2	02
5	Implement a Java program for Vector and strings	LO2	02
6	Implement a Java program for Inheritance.	LO3	02
7	Implement a Java program for Interface.	LO3	02
8	Implement a Java program for package.	LO3	02
9	Implement a Java program for Exception.	LO4	02
10	Implement a Java program for Multithreading.	LO4	02
11	Implement a Java program for file handling.	LO4	02

12	Implement a Java program to create a simple calculator using Java AWT elements.	LO5	02
13	Implement a Java Program to simulate traffic signal light using AWT and Swing Components	LO5	02
14	Implement a Java program for database connectivity.	LO5	02
15	Implement a Java program to design a Login Form using JavaFX Controls	LO6	02
Virtual Lab Links:	1. https://java-iitd.vlabs.ac.in/ 2. http://vlabs.iitb.ac.in/vlabs-dev/labs/java-iitd/index.html		
Term Work (TW):	• Term work should consist of a minimum of 08 experiments, to be performed in Java. • Journal must include at least 02 assignments on content of theory of course "Java Programming Fundamentals" and "Java Programming Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.		

PBL Course Code	PBL Course Name	Credits			
		TH	P	TUT	Total
ITPR31	PBL – Mini Project Lab I (Web App Development Mini Project)	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	JDK, MySQL.
Prerequisites:	Basics of Computer Programming.
PBL Objectives (PROBs):	1. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used. 2. To practice the process of identifying the needs and converting it into a problem statement. 3. To apply engineering knowledge and modern tools/technologies for deriving solutions to the real-world problems. 4. To inculcate the process of self-learning and research. 5. To be acquainted with solving the problem in a group. 6. To improve communication, management and report-writing skills of the students.
PBL Outcomes (PROs):	Upon completion of the course, the learners will be able to: 1. Identify societal / research needs, formulate problem statements, review research literature, and analyze complex engineering problems. 2. Design suitable solutions for the problems including scope, objectives, timeline, system flow, user interface, algorithms, etc. 3. Gather, analyze, and interpret data — and apply knowledge of engineering fundamentals, modern tools / technologies for development of solutions. 4. Analyze sustainability and scalability of the developed solution and its impact in terms of environmental, societal, safety, legal, cultural, health, etc. aspects. 5. Apply ethical principles, excel in written and oral communication, and engage in independent and life-long learning. 6. Interact efficiently and effectively as an individual with the team members or leader for timely and professional management of projects.
Guidelines for Project-Based Learning (PBL):	1. Students have to form a team of minimum 02 and maximum 04 members, based on their area of interest and size of project. Interdisciplinary (inter-branch) teams are encouraged. 2. Students should develop a Desktop / Web / Mobile Application with a proper user interface using any suitable technology like HTML5, CSS, etc. for front end and Java / Go at backend. 3. Students should carry out a survey and identify needs, which shall be converted into problem statement for Mini Project in consultation with Faculty Guide, Internal committee of faculties, and the Head of Department. 4. Projects should compulsorily be based on societal contribution (healthcare, agriculture, etc.) and reflecting role of engineer in the society. Students should try to take up need-based live projects so as to get exposure to communication with beneficiaries and skills for understanding client requirements. 5. Based on the idea presentation as well as discussion on feasibility, novelty, and contribution of the idea, a project definition will be finalized. 6. Students shall submit their implementation plan in the form of Gantt / PERT / CPM chart, which will cover weekly activity of the Mini project. 7. A log book is to be prepared by each group, wherein the group can record weekly work progress and the Faculty Guide can verify and record notes / comments.

	8. Faculty Guide may give inputs to students during Mini Project activity; however, focus shall be on self-learning. 9. Students in a group shall understand the problem effectively, propose multiple solutions, and select the best possible solution in consultation with their guide. 10. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate. 11. The solution is to be validated with proper justification and report to be compiled in standard format of the Department. 12. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Minor Projects, if the problem statement is huge and significant, a same problem statement can be worked upon for 02 semesters, i.e., same Minor Project in Semesters V and VI. Projects with a very large scope can also be taken forward to higher semesters, in consultation with the Head of the Department. 13. Students are encouraged to participate in Technical Paper Presentation competitions. 14. The students' group shall complete a project in all aspects including: Identification of need / problem, proposed final solution, Procurement of components / systems / data, Building prototype and testing. 15. Three reviews will be conducted for continuous assessment: one shall be for finalisation of the problem and proposed solution, second shall be for evaluation of work progress, and third shall be for evaluation of implementation and testing of solutions. 16. Mini Project shall be assessed based on following parameters: • Attainment of Course Outcomes. • Technical efficiency and quality of developed solution. • Innovativeness in solutions. • Impact on environment. • Cost effectiveness. • Sustainability analysis. • Societal impact. • Effective use of standard engineering norms. • Contribution of an individual as member or leader. • Clarity in written and oral communication. 17. Students are encouraged to publish a paper based on the work in Conferences / Student competitions.
Useful Learning Links:	1. https://onlinecourses.nptel.ac.in/noc21_cs56/preview 2. https://www.coursera.org/specializations/core-java 3. https://www.udemy.com/course/java-se-programming/
Term Work (TW):	• Term Work shall be granted based individual's contribution in group activity, their understanding and response to questions. • Term Work evaluation shall be for Total 25 Marks — based on the following evaluation: o Presentation in Review 1 o Presentation in Review 2 o Presentation in Review 3 o Project Report and Log Book
Practical & Oral (P&O):	P&O examination will be of Total 25 Marks and shall be based on the Project Demonstration, Presentation, and Report.

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
ITXS33	SAT – III: Skill-Based Learning (Go Programming)	-	02	-	02

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	go1.18.3.linux-amd64.tar.gz, Ubuntu Operating System.
Skill Prerequisites:	Computer Programming (C / C++).
Skill Objectives (SOBs):	1. To learn and understand the basic Go language syntax and features. 2. To understand use of Go language in concurrent Programming. 3. To learn Go from the ground up to gain a hands-on approach. 4. To use fundamental of Go Lang to build web application. 5. To create concise, efficient, and clean applications using Go Lang 6. To use Pointer, Array, Slice & Struct to build application.
Skill Outcomes (SOs):	Upon completion of the course, the learners will be able to: 1. Apply Go Programming language fundamentals 2. Develop Go code using variables and types. 3. Use control & operator for writing go code. 4. Understand use of Array, Map, Pointer for developing application. 5. Develop function to solve problems. 6. Develop web application using Golang

Module No. and Name	Subtopics	SOs Mapped	Hours / Subtopic	Total Hours / Module
1. Introduction to Go Language	Go installation. Why Go? Basic Syntax Program Command-Line Arguments, Setting up Go ecosystem and IDE	SO1	02	02
2. Types and Variables	What is a Data Type, Static vs Dynamic Typed Languages, Kind of Data Types.	SO1	01	04
	Variables: Declaring Variable, Assigning, Variables Demo, Comment, Printing Variables, Declaring Variables. Variable Scope, Zero Values, User Input, Find the type of variable, Converting between types, Lab: Data types and Variables	SO2	01	
	String: Concatenating Strings, String to Numeric, Numeric to String, String Parser, Check String Data Length, Copy Data, Upper and Lower Case Characters.	SO2	02	
3. Control Statement & Operator	Operators: Comparison Operators, Arithmetic Operators. Logical Operators, Assignment Operators, Bitwise Operators	SO3	02	04
	Control Statement: if-else and else if statements, Switch Statement, Looping with for, Switch Case, While, Break, Continue & defer.	SO3	02	

4. Arrays, Slices and Maps	Array: Introduction, Syntax.	SO4	02	04
	Slice: Introduction, Syntax.	SO4	01	
	Map: Introduction, Syntax.	SO4	01	
5. Packages & Function, Pointer, Struct	Function: Syntax, Return Types - Multiple, Named, Recursive Functions, Anonymous Functions, High Order Functions.	SO5	01	04
	Pointer: Introduction, Address and Dereference Operator, Declaring and Initializing a Pointer.	SO5	01	
	Struct: Declaring and Initialising a Struct, Accessing Fields, Passing Structs to functions.	SO5	01	
	Packages: Introduction, use and importance of packages.	SO5	01	
6. Web Development	Basic Web Development: HTML Tag, CSS, HTTP Server Request, Routing Handling requests	SO6	04	10
	MySQL Database Connectivity, Go Templates, Assets and Files, Forms, Middleware	SO6	04	
	Introduction to Concurrent Programming in Cloud Environment.	SO6	02	

Text Books:	1. A. Alan. Donovan, The Go Programming Language. 2. Introducing Go, O'Reilly Media. 3. A Torres, Go Programming Cookbook.
Reference Books:	1. M. Andrawos, Cloud Native Programming with Golang: Develop Microservice-based High Performance Web Apps for the Cloud with Go. 2. M. Tsoukalos, Mastering Go: Create Golang Production Applications Using Network Libraries, Concurrency, Machine Learning, and Advanced Data Structures. 3. S. Agarwal, Learning Go Programming Build Scalable Next-Gen Web Application Using Golang
Useful Learning Links:	1. https://go.dev/doc/tutorial/getting-started 2. https://www.udemy.com/course/go-programming-language-crash-course/ 3. https://gowebexamples.com/basic-middleware/
Guidelines for Skill-Based Learning (SBL):	• Programming labs shall be conducted as 02 Hours of blended theory and 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 implementation of programs involving the concepts mentioned will be performed during the assigned lab hours.
Term Work (TW):	• Term Work evaluation shall be for Total 25 Marks based on Practical Performance. • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
ITXA34	SAT – IV: Activity-Based Learning (Interdisciplinary Informatics)	-	01	-	01

ABL Objectives (AOBs):	1. To expose learners to the opportunities, effectiveness and benefits of integrating informatics with diverse disciplines such as biotechnology, healthcare, agriculture, nanotechnology, earth sciences, etc. 2. To introduce the approaches for integrating informatics with different disciplines. 3. To explore real-world applications of interdisciplinary informatics, relevant data and tools for its development. 4. To acquaint learners with recent trends and research in interdisciplinary informatics. 5. To enhance critical thinking, research, communication and presentation skills. 6. To promote interdisciplinary research and development.
ABL Outcomes (AOs):	Upon completion of the course, the learners will be able to: 1. Understand the fundamental concepts and interdisciplinary nature of informatics. 2. Analyze literature, case studies and successful solutions related to interdisciplinary informatics applications. 3. Analyze and interpret the data for interdisciplinary informatics. 4. Identify real-world problems that can be addressed through interdisciplinary informatics. 5. Demonstrate effective communication skills to bridge the gap between disciplinary jargons and develop interdisciplinary collaborations. 6. Demonstrate a life-long motivation to engage in hands-on projects, research and practices in sustainable interdisciplinary informatics.
Guidelines for Activity-Based Learning (ABL):	1. Students shall work in team of 03-04 members, which shall remain for this entire course. 2. Student teams shall choose, survey and study any 01 of the following informatics using the Internet / Library Resources / Research Articles / Case Study Reports / etc.: i. Bioinformatics ii. Agro Informatics iii. Health Informatics iv. Weather Informatics v. Nano Informatics vi. Geo Informatics 3. Students are also required to study the recent Research and Development in the interdisciplinary informatics, focusing on need-based real-world applications. 4. During the contact hours, each student team is required to provide a weekly report of their progress — orally and as written summaries of approximately 01-02 pages, accompanied by a list of references. 5. During the contact hours across the entire semester, each student team is also required to deliver 02 Seminars (Power Point Presentations) of 15-20 minutes each, which reflect their learning outcomes. 6. At the end of the term, each student team has to present a synthesis of their work in a final documented report of approximately 10-15 pages. 7. Faculties shall act as facilitators: Observe students as they work on the activity and provide guidance as well as support wherever required.
Term Work (TW):	Term Work evaluation shall be for Total 25 Marks based on the 02 Seminars (50%), Final Report (20%), Weekly Participation and Reporting (30%) and contents covered therein.

SEMESTER IV - B.TECH. (INFORMATION TECHNOLOGY)

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
ITC401	Applications of Mathematics in Engineering – II	3 – 0 – 1	04	3 – 0 – 1	04	BS
ITC402	Computer Network and Network Design	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC403	Operating Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC404	Automata Theory	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITC405	Computer Organization and Architecture	3 – 0 – 0	03	3 – 0 – 0	03	PC
ITL402	Network Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL403	Unix Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITL405	Microprocessor & Microcontroller Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
ITPR42	PBL – Mini Project Lab II (Python-based Mini Project)	0 – 2 – 0	02[$]	0 – 1 – 0	01	PBL
ITXS45	SAT – V: Skill-Based Learning (Python Programming)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
ITXS46	SAT – VI: Skill-Based Learning (Foreign / Indian Modern Languages)	0 – 2[*] – 0	02	0 – 1 – 0	01	SAT
Total		**15 – 12 – 1**	**28**	**15 – 6 – 1**	**22**	

[*]SAT can be conducted as TH or P or both as required.

[$]Load of learner, not the faculty.

EXAMINATION SCHEME

Course Code	Course Name	CA Marks				ESE Marks		TW/O/P Marks				Total
		T1	T2	Avg. of T1 & T2	IA	Marks	Duration (in Hrs)	TW	O	P	P&O	
ITC401	Applications of Mathematics in Engineering – II	30	30	30	10	60		25	-	-	-	125
ITC402	Computer Network and Network Design	30	30	30	10	60		-	-	-	-	100
ITC403	Operating Systems	30	30	30	10	60		-	-	-	-	100
ITC404	Automata Theory	30	30	30	10	60		-	-	-	-	100
ITC405	Computer Organization and Architecture	30	30	30	10	60		-	-	-	-	100
ITL402	Network Lab	-	-	-	-	-		25	-	-	25	50
ITL403	Unix Lab	-	-	-	-	-		25	-	25	-	50
ITL405	Microprocessor & Microcontroller Lab	-	-	-	-	-		25	-	25	-	50
ITPR42	PBL – Mini Project Lab II (Python-based Mini Project)	-	-	-	-	-		25	-	-	25	50
ITXS45	SAT – V: Skill-Based Learning (Python Programming)	-	-	-	-	-		25	-	-	-	25
ITXS46	SAT – VI: Skill-Based Learning (Foreign / Indian Modern Languages)	-	-	-	-	-		25	-	-	-	25
Total		**150**	**150**	**150**	**50**	**300**		**175**	**-**	**50**	**50**	**775**

Abbreviations: TH – Theory, P – Practical, TUT – Tutorial, BS – Basic Science Course, PC – Professional Core Course, PBL – Project-Based Learning, SAT – Skill/Activity/Technology-Based Learning (Exposure Course), CA – Continuous Assessment, T1 – Test 1, T2 – Test 2, IA – Internal Assessment, ESE – End Semester Exam, TW – Term Work, O – Oral Exam, P – Practical Exam, P&O – Practical & Oral Exam.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC401	Applications of Mathematics in Engineering – II	03	-	01	04

Prerequisites:	Engineering Mathematics, Basics of Applications of Mathematics in Engineering
Course Objectives (COBs):	1. To analyze characteristics of matrices. 2. To determine the value of line integral. 3. To study the concepts of *n* dimensional vector spaces and orthonormal basis. 4. To introduce concepts of probability distributions and sampling theory 5. To use the theory of Linear and Non-linear programming in engineering problems.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Determine eigenvalues, eigenvectors of matrices and study diagonalization. 2. Evaluate line integrals using Cauchy's theorems. 3. Apply the concept of vector spaces and orthogonalization process in engineering problems of higher dimensions. 4. Use probability distribution and sampling theory in decision making problems. 5. Apply techniques of Linear Programming to solve optimization problems. 6. Solve optimization problems using techniques of Non-Linear Programming.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	01	01
1. Linear Algebra: Theory of Matrices	Characteristic Equation, Eigenvalues and Eigenvectors, and Properties (without proof).	CO1	02	07
	Cayley-Hamilton Theorem (without proof), Verification and Reduction of Higher Degree Polynomials.	CO1	02	
	Similarity of Matrices, Diagonalizable and Non-Diagonalizable Matrices.	CO1	02	
2. Complex Integration	Line Integral, Cauchy's Integral theorem for Simple Connected and Multiply Connected Regions (without proof), Cauchy's Integral Formula (without proof).	CO2	02	07
	Taylor's and Laurent's Series (without proof).	CO2	03	
	Definition of Singularity, Zeroes, Poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof).	CO2	02	
3. Linear Algebra: Vector Spaces	Vectors in n-dimensional Vector Space, Norm, Dot Product, The Cauchy-Schwarz inequality (with proof), Unit Vector.	CO3	02	06
	Orthogonal Projection, Orthonormal Basis, Gram-Schmidt Process for Vectors.	CO3	02	
	Vector Spaces over Real-field, Subspaces.	CO3	02	
4. Probability Distribution and Sampling Theory	Probability Distribution: Poisson and Normal Distribution	CO4	03	07
	Sampling Distribution, Test of Hypothesis, Level of Significance, Critical Region, One-tailed, and Two-tailed Test, Degree of Freedom.	CO4	02	
	Students' t-distribution (Small Sample), Test	CO4	02	

	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.			
5. Linear Programming Problems	Types of Solutions, Standard and Canonical of LPP, Basic and Feasible solutions, Slack Variables, Surplus Variables, Simplex Method.	CO5	02	07
	Artificial Variables, Big-M Method (Method of Penalty).	CO5	02	
	Duality, Dual of LPP and Dual Simplex Method.	CO5	02	
6. Nonlinear Programming Problems	NLPP with One Equality Constraint (Two or Three Variables) using the Method of Lagrange's Multipliers.	CO6	02	07
	NLPP with Two Equality Constraints.	CO6	02	
	NLPP with Inequality Constraint: Kuhn-Tucker Conditions.	CO6	03	

Text Books:	1. E. Kreyszig, Advanced Engineering Mathematics, Wiley. 2. R. Jain and S. Iyengar, Advanced Engineering Mathematics, Narosa Publication. 3. J. Brown and R. Churchill, Complex Variables and Applications, McGraw Hill.
Reference Books:	1. T. Veerarajan, Probability, Statistics and Random Processes, McGraw Hill. 2. H. Taha, Operations Research: An Introduction, Pearson. 3. S. Rao, Engineering Optimization: Theory and Practice, Wiley. 4. D. Hira and P. Gupta, Operations Research, S. Chand and Sons.
Useful Links:	1. https://nptel.ac.in/courses/111/108/111108066/ 2. https://nptel.ac.in/courses/111/103/111103070/ 3. https://nptel.ac.in/courses/111/104/111104071/ 4. https://nptel.ac.in/courses/111/105/111105041/ 5. https://www.coursera.org/learn/complex-analysis
Term Work (TW):	• Term work shall consist of 06 batch wise tutorials. • Journal must include at least 02 assignments on content of theory of the course. • Term work evaluation shall be for Total 25 Marks based on Tutorials (15 Marks) and Assignments (10 Marks).
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC402	Computer Network and Network Design	03	-	-	03

Prerequisites:	Fundamentals of Communication.
Course Objectives (COBs):	1. To explain the division of network functionalities into layers. 2. To describe the types of transmission media along with data link layer concepts, design issues and protocols. 3. To analyze the strength and weaknesses of routing protocols and gain knowledge about IP addressing. 4. To evaluate the data transportation, issues and related protocols for end-to-end delivery of data. 5. To examine the data presentation techniques used in presentation layer & client/server model in application layer protocols. 6. To design a network for an organization using networking concepts.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe the functionalities of each layer of the models and compare the models. 2. Categorize the types of transmission media and explain data link layer concepts, design issues and protocols. 3. Analyze the routing protocols and assign IP address to networks. 4. Explain the data transportation and session management issues and related protocols used for end-to-end delivery of data. 5. Explain the data presentation techniques and illustrate the client/server model in application layer protocols. 6. Apply networking concepts of IP address, routing, and application services to design a network for an organization.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Computer Networks	IT Infrastructure, Use of Computer Networks, Network Devices, Network Software, Protocol Layering.	CO1	02	04
	Reference Models: OSI, TCP/IP, Comparison of OSI & TCP/IP.	CO1	02	
2. Physical Layer & Data Link Layer	Physical Layer: Guided Media, Unguided Media, Wireless Transmission: Electromagnetic Spectrum, Switching: Circuit-Switched Networks, Packet Switching, Structure of a Switch.	CO2	04	10
	DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, Parity, CRC, Checksum), Elementary Data Link protocols: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), Piggybacking, HDLC.	CO2	04	
	Medium Access Protocols: Random Access, Controlled Access, Channelization, Ethernet Protocol: Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10-	CO2	02	

	Gigabit Ethernet.			
3. Network Layer	Network Layer Services, Packet Switching, Network Layer Performance, IPv4 Addressing (Classful and Classless), Subnetting, Supernetting, IPv4 Protocol, DHCP, Network Address Translation (NAT).	CO3	03	08
	Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing.	CO3	02	
	Protocols – RIP, OSPF, BGP.	CO3	02	
	Next Generation IP: IPv6 Addressing, IPv6 Protocol, Transition from IPV4 to IPV6.	CO3	01	
4. Transport Layer & Session Layer	Transport Layer: Transport Layer Services, Connectionless & Connection-Oriented Protocols.	CO4	01	07
	Transport Layer Protocols: User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers.	CO4	04	
	Session Layer: Session Layer Design Issues, Session Layer Protocol - Remote Procedure Call (RPC).	CO4	02	
5. Presentation Layer & Application Layer	Presentation Layer: Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Image Compression – GIF, JPEG.	CO5	03	05
	Application Layer: Standard Client-Server Protocols: World Wide Web, HTTP, FTP, Electronic Mail, Domain Name System (DNS), SNMP.	CO5	02	
6. Network Design Concepts	Introduction to VLAN, VPN.	CO6	02	05
	Case Study to Design a Network for an Organization Meeting the following Guidelines: Networking Devices, IP Addressing: Subnetting, Supernetting, Routing Protocols to be used, Services to be used: TELNET, SSH, FTP Server, Web Server, File Server, DHCP Server and DNS Server.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
Text Books:	1. A. Tanenbaum, Computer Networks, Pearson. 2. B. Forouzan, Data Communications and Networking, McGraw Hill.			
Reference Books:	1. S. Keshav, An Engineering Approach to Computer Networks, Pearson. 2. B. Forouzan, TCP/IP Protocol Suite, McGraw Hill. 3. R. Bose, Information Theory, Coding and Cryptography, McGraw Hill. 4. K. Sayood and M. Kaufman, Introduction to Data Compression, Elsevier.			
Useful Links:	1. https://nptel.ac.in/courses/106/105/106105183/ 2. https://nptel.ac.in/courses/106/105/106105080/ 3. https://www.coursera.org/learn/tcpip 4. https://www.coursera.org/learn/fundamentals-network-communications			

Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes —
	  o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks),
	  o Internal Assessment: 10 Marks.
	• Duration of each Test shall be 1 Hour and 15 Minutes.
	• Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.

End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC403	Operating Systems	03	-	-	03

Prerequisites:	Computer Programming (C / C++), Basic of Hardware i.e., ALU, RAM, ROM, HDD, etc., Computer-System Organization
Course Objectives (COBs):	1. To understand the major components of Operating System & their functions. 2. To introduce the notion of a process and its management like transition, scheduling, etc. 3. To understand basic concepts related to Inter-Process Communication (IPC) like mutual exclusion, deadlock, etc. and role of Operating System in IPC. 4. To understand the concepts and implementation of memory management policies and virtual memory. 5. To understand functions of Operating System for storage management and device management. 6. To study the need and fundamentals of special-purpose Operating System with the advent of new emerging technologies.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the basic concepts related to Operating System. 2. Describe the process management policies and illustrate the scheduling of processes by CPU. 3. Apply synchronization primitives and evaluate deadlock conditions as handled by Operating System. 4. Explain the memory allocation and management functions of Operating Systems. 5. Explain the services provided by Operating System for storage management. 6. Compare the functions of various special-purpose Operating Systems.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Fundamentals of Operating System	Introduction to Operating Systems, Operating System Structure and Operations, Functions of Operating Systems.	CO1	01	03
	Operating System Services and Interface, System Calls and its Types, System Programs, Operating System Structure, System Boot.	CO6	02	
2. Process Management	Basic Concepts of Process, Operation on Process, Process State Model and Transition, Process Control Block, Context Switching.	CO2	04	10
	Introduction to Threads, Types of Threads, Thread Models.	CO2	01	
	Basic Concepts of Scheduling, Types of Schedulers, Scheduling Criteria, Scheduling Algorithms.	CO2	05	
3. Process Coordination	Basic Concepts of Inter-process Communication and Synchronization, Race Condition, Critical Region and Problem, Peterson's Solution, Synchronization Hardware	CO3	04	08

	and Semaphores, Classic Problems of Synchronization, Message Passing.			
	Introduction to Deadlocks, System Model, Deadlock Characterization, Deadlock Detection and Recovery, Deadlock Prevention, Deadlock Avoidance.	CO3	04	
4. Memory Management	Basic Concepts of Memory Management, Swapping, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation.	CO4	05	09
	Basic Concepts of Virtual Memory, Demand Paging, Copy-on Write, Page Replacement Algorithms, Thrashing.	CO4	04	
5. Storage Management	Basic Concepts of File System, File Access Methods, Directory Structure, File System Implementation, Allocation Methods, Free Space Management.	CO5	03	06
	Overview of Mass-Storage Structure, Disk Structure, Disk Scheduling, RAID Structure, Introduction to I/O Systems.	CO5	03	
6. Special-Purpose Operating Systems	Open-source and Proprietary Operating System, Fundamentals of Distributed Operating System, Network Operating System, Embedded Operating Systems, Cloud and IoT Operating Systems, Real-Time Operating System, Mobile Operating System, Multimedia Operating System.	CO6	02	03
	Comparison between Functions of various Special-purpose Operating Systems.	CO6	01	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01

Text Books:	1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, Wiley. 2. W. Stallings, Operating Systems: Internal and Design Principles, Pearson. 3. A. Tanenbaum, Modern Operating Systems, Pearson.
Reference Books:	1. N. Chauhan, Principles of Operating Systems, Oxford University Press. 2. A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, Pearson. 3. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform.
Useful Links:	1. https://nptel.ac.in/courses/106/106/106106144/ 2. https://onlinecourses.nptel.ac.in/noc21_cs44/preview 3. https://www.coursera.org/learn/os-power-user
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC404	Automata Theory	03	-	-	03

Prerequisites:	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.
Course Objectives (COBs):	1. To learn fundamentals of Regular and Context Free Grammars and Languages. 2. To understand the relation between Regular Language and Finite Automata and Machines. 3. To learn how to design Automata as Acceptors, Verifiers and Translators. 4. To understand the relation between Regular Languages, Contexts Free Languages, PDA and TM. 5. To learn how to design PDA as acceptor and TM as Calculators. 6. To learn applications of Automata Theory.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain, analyze and design Regular languages, Expression and Grammars. 2. Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator. 3. Analyze and design Context Free languages and Grammars. 4. Design different types of Push down Automata as Simple Parser. 5. Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine. 6. Explain applications of various Automata.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction and Regular Languages	Languages: Alphabets and Strings, Regular Languages: Regular Expressions, Regular Languages.	CO1	03	06
	Regular Grammars, RL and LL Grammars.	CO1	02	
	Closure Properties.	CO1	01	
2. Finite Automata	Finite Automata: FA as Language Acceptor or Verifier.	CO2	02	09
	NFA (with and without ε).	CO2	01	
	DFA, RE to NFA, NFA to DFA, Reduced DFA, NFA-DFA equivalence, FA to RE.	CO2	04	
	Finite State Machines with output: Moore and Mealy Machines. Moore and Mealy M/C Conversion. Limitations of FA.	CO2	02	
3. Context Free Grammars	Context Free Languages: CFG.	CO2	03	08
	Leftmost and Rightmost derivations, Ambiguity.	CO3	02	
	Simplification and Normalization (CNF & GNF) and Chomsky Hierarchy (Types 0 to 3).	CO3	03	
4. Push Down Automata	Push Down Automata: Deterministic (Single Stack) PDA.	CO4	04	06
	Equivalence between PDA and CFG. Power and Limitations of PDA.	CO4	02	

5. Turing Machine	Turing Machine: Deterministic TM.	CO5	04	07
	Variants of TM, Halting problem, Power of TM.	CO5	03	
6. Applications of Automata	Applications of FA.	CO2	01	03
	Applications of CFG.	CO3	01	
	Applications of PDA.	CO4		
	Applications of TM.	CO5	01	
	Introduction to Compiler & Its phases.	CO6		
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01

Text Books:	1. J. Martin, Introduction to languages and the Theory of Computation, McGraw Hill. 2. K. Mahesh, Theory of Computation: A Problem-Solving Approach, Wiley. 3. A. Aho, R. Shethi, M. Lam and J. Ulman, Compilers Principles, Techniques and Tools, Pearson.
Reference Books:	1. J. Hopcroft, R. Motwani and J. Ullman, Introduction to Automata Theory, Languages and Computation, Pearson. 2. D. Cohen, Introduction to Computer Theory, Wiley. 3. V. Kulkarni, Theory of Computation, Oxford University Press. 4. N. Chandrashekhar, K. Mishra, Theory of Computer Science, Automata Languages & Computations, PHI. 5. J. Donovan, Systems Programming, McGraw Hill. 6. S. Agrawal, Theoretical Computer Science, Vikas Publications.
Useful Links:	1. https://nptel.ac.in/courses/111/103/111103016/ 2. https://online.stanford.edu/courses/soe-ycsautomata-automata-theory 3. http://www.jflap.org/

Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes —
	  ○ Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks),
	  ○ Internal Assessment: 10 Marks.
	• Duration of each Test shall be 1 Hour and 15 Minutes.
	• Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.

End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ITC405	Computer Organization and Architecture	03	-	-	03

Prerequisites:	Basics of Logic Design.
Course Objectives (COBs):	1. To conceptualize the basics of organizational and features of a digital computer. 2. To study microprocessor architecture and assembly language programming. 3. To study processor organization and parameters influencing performance of a processor. 4. To analyze various algorithms used for arithmetic operations. 5. To study the function of each element of memory hierarchy and various data transfer techniques used in digital computer. 6. To study microcontroller architecture and C language programming.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe basic organization of computer and the architecture of 8086 microprocessor and implement assembly language programming for 8086 microprocessors. 2. Describe different control unit design methods and conceptualize instruction level parallelism. 3. Apply fundamentals of digital logic design to solve problem & perform various arithmetic operations using various algorithms. 4. Describe concept of memory organization and explain the function of each element of a memory hierarchy. 5. Explain different methods for computer I/O mechanism. 6. Describe the architecture of 8051 microcontroller and implement C language programming for 8051 microcontrollers.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Overview of Computer Architecture & Organization	Introduction of Computer Organization and Architecture, Basic Organization of Computer and Block Level Description of the Functional Units, Evolution of Computers, Von Neumann Model, Performance Measure of Computer Architecture.	CO1	03	05
	Architecture of 8086 Family, Instruction Set, Addressing Modes.	CO1	02	
2. Processor Organization and Architecture	CPU Architecture, Instruction Formats, Basic Instruction Cycle with Interrupt Processing. Instruction Interpretation and Sequencing.	CO2	02	07
	Control Unit: Soft Wired (Microprogrammed) and Hardwired Control Unit.	CO2	03	
	Microinstruction Sequencing and Execution, Micro Operations, Concepts of Nano Programming, Introduction to Parallel Processing Concepts, Flynn's Classifications, Instruction Pipelining, Pipeline Hazards.	CO2	02	
3. Data Representation	Number Systems: Introduction to Number Systems, Binary Number Systems, Signed Binary Numbers,	CO3	02	09

and Arithmetic Algorithms	Binary, Octal, Decimal and Hexadecimal Number and their Conversions, 1's and 2's Complement			
	Basics of Digital Circuits: NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR Gates, Introduction to K-Mal	CO3	03	
	Booth's Algorithm, Division of Integers: Restoring and Non-Restoring Division, Signed Division.	CO3	04	
	Floating-Point Representation: IEEE 754 Floating Point (Single & Double Precision) Number Representation.	CO3	01	
4. Memory Organization	Introduction to Memory and Memory Parameters, Classifications of Primary and Secondary Memories, Types of RAM and ROM, Allocation Policies, Memory Hierarchy and Characteristics.	CO4	03	07
	Cache Memory: Concept, Architecture (L1, L2, L3), Mapping Techniques. Cache Coherency, Interleaved and Associative Memory.	CO4	04	
5. I/O Organization	Input/Output Systems, I/O Module-Need & Functions.	CO5	02	05
	Types of Data Transfer Techniques: Programmed I/O, Interrupt Driven I/O and DMA.	CO5	03	
6. Overview of 8051 Microcontroller	Introduction to Microcontroller, Difference between Microcontroller and Microprocessor.	CO6	04	08
	Architecture of 8051 Microcontroller, Pin Diagram of 8051, Instruction Set of 8051, C Language Programming, Interfacing of Ports.	CO6	04	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
Text Books:	1. C. Hamacher, Z. Vranesic and S. Zaky, Computer Organization, McGraw Hill. 2. W. Stallings, Computer Organization and Architecture: Designing for Performance, Pearson. 3. J. Uffenbeck, 8086/8088 family: Design Programming and Interfacing, (Pearson Education. 4. M. Mazidi, J. Mazidi and R. McKinlay, The 8051 Microcontroller & Embedded systems using Assembly and C, Pearson. 5. R. Jain, Modern Digital Electronic, McGraw-Hill Publication.			
Reference Books:	1. L. Das, Embedded systems an integrated approach, Pearson. 2. B. Govindarajulu, Computer Architecture and Organization: Design Principles and Applications. 3. J. Hayes, Computer Architecture and Organization, McGraw Hill.			
Useful Links:	1. https://nptel.ac.in/courses/106/105/106105163/ 2. https://www.udemy.com/course/computer-organization-and-architecture-j/ 3. https://www.udemy.com/course/computer-fundamental-computer-architecture/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes — o Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), o Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 15 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			

End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL402	Network Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	TCL, NS2.35, Ubuntu Operating System, Protocol Analyzer like Wireshark.
Prerequisites:	Computer Programming (C / C++).
Lab Objectives (LOBs):	1. To get familiar with the basic network administration commands. 2. To install and configure network simulator and learn basics of TCL scripting. 3. To understand the network simulator environment and visualize a network topology and observe its performance. 4. To implement client-server socket programs. 5. To observe and study the traffic flow and the contents of protocol frames. 6. To design and configure a network for an organization.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Execute and evaluate network administration commands and demonstrate their use in different network scenarios. 2. Demonstrate the installation and configuration of network simulator. 3. Demonstrate and measure different network scenarios and their performance behavior. 4. Implement the socket programming for client server architecture. 5. Analyze the traffic flow of different protocols. 6. Design a network for an organization using a network design tool.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Execute and analyze basic networking commands: ifconfig, ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, hostname, curl or wget, mtr, whois, tcpdump.	LO1	02
2	Installation and configuring of NS-2 simulator and introduction to TCL using Hello program.	LO2	02
3	Write TCL scripts to create topologies.	LO2	02
4	Analysis of network performance for quality-of-service parameters such as packet-delivery-ratio, delay and throughput by plotting xgraph.	LO3	02
5	Implement Distance Vector Routing Protocols.	LO3	02
6	Implement Link State Routing Protocols.	LO3	02
7	Installation and configuring of Graphical Network Simulator GNS- 3.	LO2	02
8	Implement Topology in GNS - 3.	LO3	02
9	Implement Socket Programming using TCP with C/Java/python: TCP Client, TCP Server.	LO4	02
10	Implement Socket Programming using UDP with C/Java/python: UDP Client, UDP Server.	LO4	02
11	Install one of the Network Protocol Analyser Tools and Analyse the Traffic.	LO5	02
12	Network Design for an organization using the following concepts: 1. Addressing (IP Address Assignment) 2. Naming (DNS) 3. Routing	LO6	04

Virtual Lab Links:	1. http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/ 2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/comp_networks_sm/
Term Work (TW):	1. Term work should consist of a minimum of 08 experiments. 2. Journal must include at least 02 assignments on content of theory course "Computer Network & Network Design" and "Network Lab". 3. Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). 4. The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL403	Unix Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Unix / Ubuntu, Editor, VirtualBox.
Prerequisites:	Computer Programming (C / C++).
Lab Objectives (LOB):	1. To understand architecture and installation of Unix Operating System. 2. To learn Unix general purpose commands and programming in Unix editor environment. 3. To understand file system management and user management commands in Unix. 4. To understand process management and memory management commands in Unix. 5. To learn basic shell scripting. 6. To learn scripting using Awk and Perl languages.
Lab Outcomes (LO):	Upon completion of the course, the learners will be able to: 1. Explain the functioning of Unix, and use various PC OS alternatives like CPU OS Simulator, Cloud OS, etc. 2. Apply the Unix general purpose commands. 3. Apply Unix commands for system administrative tasks such as file system management and user management. 4. Apply Unix commands for system administrative tasks such as process management and memory management. 5. Implement basic shell scripts for different applications. 6. Implement advanced scripts using Awk & Perl languages and grep, sed, etc. commands for performing various tasks.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	a. Case Study: Brief History of Unix, Unix Architecture; Installation of Unix Operating System. b. Installation and hands-on alternates for execution of Unix utilities: VirtualBox, VMware, etc.	LO1	02
2	Study and hands-on with various editors like Vi, Vim, nano, pico, etc.	LO1	02
3	Execution of Unix General Purpose Utility Commands like echo, clear, exit, date, time, uptime, cal, cat, tty, man, which, history, id, pwd, whoami, ping, ifconfig, pr, lp, lpr, lpstat, lpq, lprm, cancel, mail, etc.	LO2	02
4	a. Study of Unix file system (tree structure), file and directory permissions, single and multiuser environment. b. Execution of File System Management Commands like ls, cd, pwd, cat, mkdir, rmdir, rm, cp, mv, chmod, wc, piping and redirection, grep, tr, echo, sort, head, tail, diff, comm, less, more, file, type, wc, split, cmp, tar, find, vim, gzip, bzip2, unzip, locate, etc.	LO3	02
5	Execution of User Management Commands like who, whoami, su, sudo, login, logout, exit, passwd, useradd/adduser, usermod, userdel, groupadd, groupmod, groupdel, gpasswd, chown, chage, chgrp, chfn, etc.	LO3	02
6	a. Execution of Process Management Commands like ps, pstree, nice, kill,	LO4	02

	pkill, killall, xkill, fg, bg, pgrep, renice, etc. b. Execution of Memory Management Commands like free, /proc/meminfo, top, htop, df, du, vmstat, demidecode, sar, pagesize, etc.		
7	Implementation of Scheduling Algorithms using CPU OS Simulator.	LO1, LO4	02
8	a. Study of Shell, Types of Shell, Variables and Operators b. Execute the following Scripts (at least 6): i) Write a shell script to perform arithmetic operations. ii) Write a shell script to calculate simple interest. iii) Write a shell script to determine the largest among three integer numbers. iv) Write a shell script to determine if a given year is leap year or not. v) Write a shell script to print the multiplication table of given numbers using while statement. vi) Write a shell script to search whether an element is present in the list or not. vii) Write a shell script to compare two strings. viii) Write a shell script to read and check if the directory / file exists or not, if not make the directory / file. ix) Write a shell script to implement a menu-driven calculator using case statements. x) Write a shell script to print following pattern: * * * * * * xi) Write a shell script to perform operations on directory like: display name of current directory, display list of directory contents, create another directory — write contents on that and copy it to a suitable location in your home directory, etc.	LO5	06
9	Execute the following scripts using grep / sed commands: i) Write a script using grep command to find the number of words character, words and lines in a file. ii) Write a script using egrep command to display a list of specific types of files in the directory. iii) Write a script using sed command to replace all occurrences of a particular word in a given file. iv) Write a script using sed command to print duplicate lines in input.	LO5	04
10	a. Execute the following scripts using Awk / Perl languages: i) Write an Awk script to print all even numbers in a given range. ii) Write an Awk script to develop a Fibonacci series (take user input for number of terms). iii) Write a Perl script to sort elements of an array. b. Write a Perl script to check a number is prime or not.	LO6	02
Virtual Lab Links / Learning	1. https://www.ee.iitb.ac.in/~vlabsync/ 2. http://www.ee.surrey.ac.uk/Teaching/Unix/unix2.html 3. https://www.hackerrank.com/domains/shell		

Resources:	4. S. Das, Unix Concepts and Applications, McGraw Hill. 5. R. Michael, Mastering Unix Shell Scripting, Wiley. 6. D. Ambawade, D. Shah, Linux Labs and Open-Source Technologies, Dreamtech Press. 7. Y. Kanetkar, Unix Shell Programming, BPB Publications. 8. B. Forouzan and R. Gilberg, Unix and Shell Programming, Cengage Learning.
Term Work (TW):	1. Term work should consist of a minimum of 08 experiments. 2. Journal must include at least 02 assignments on content of the theory course "Operating Systems" and "Unix Lab". 3. Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). 4. The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.
Practical (P):	Practical Examination will be based on the experiment list for Total 25 Marks.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
ITL405	Microprocessor and Microcontroller Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Tasm, Keil / Crossware.
Prerequisites:	Computer Programming (C / C++).
Lab Objectives (LOBs):	1. To get hands-on experience with Assembly Language Programming. 2. To study interfacing of peripheral devices with 8086 microprocessors. 3. To realize techniques for faster execution of instructions and improve speed of operation and performance of microprocessors. 4. To write and debug programs in TASM / hardware kits / Crossware / Keil. 5. To get hands on experience with C Language Programming with controller. 6. To study interfacing of peripheral devices with 8051 microcontrollers.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Execute the selected instructions to understand addressing modes of 8086. 2. Execute assembly language programs on microprocessor using arithmetic and logical instructions of 8086 microprocessors. 3. Execute assembly language programs using loop instructions of 8086 microprocessors. 4. Execute the selected instructions to understand addressing modes of 8051. 5. Implement C language programs using instruction set of 8051. 6. Implement C language programs for interfacing different devices with 8051.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Simulation of selected instructions to understand the addressing modes and instruction set of 8086 microprocessors.	LO1	02
2	Implementation of Arithmetic and Logical operations using Assembly Language Programming. a. Program to perform arithmetic operations on 16-bit data. b. Program to evaluate given logical expression. c. Convert two-digit Packed BCD to Unpacked BCD.	LO2	02
3	Implementations of loop operations using Assembly Language Programming. a. Program to move set of numbers from one memory block to another. b. Program to count number of 1's and 0's in a given 8-bit number. c. Program to find even and odd numbers from a given list. d. Program to search for a given number.	LO3	02
4	Implementation of String Operations using Assembly Language Programming. a. Check whether a given string is a Palindrome or not. b. Compute the factorial of a positive integer 'n' using procedure. c. Generate the first 'n' Fibonacci numbers.	LO3	02
5	Simulation of selected instructions to understand the addressing modes and instruction set of 8051 Microcontroller.	LO4	02
6	Implementation of Arithmetic and Logical operations using C Language	LO5	02

	Programming. a. Program to perform arithmetic operations on 16-bit data. b. Program to evaluate given logical expression. c. Convert two-digit Packed BCD to Unpacked BCD.		
7	Implementations of loop operations using C Language Programming. a. Program to move set of numbers from one memory block to another. b. Program to count number of 1's and 0's in a given 8-bit number. c. Program to find even and odd numbers from a given list. d. Program to search for a given number.	LO5	02
8	Interfacing of 8051 Microcontroller. a. Program to toggle bits of port P0, P1, P2, P3. b. Program to interface Stepper Motor. c. Program to perform serial communication.	LO6	06
9	Implementation of interfacing of LCD with the 8051 Microcontroller using C language programming.	LO6	02
10	Interfacing with 8051 Microcontroller. a. Interfacing Seven Segment Display. b. Interfacing Keyboard Matrix. c. Interfacing DAC.	LO6	04

Virtual Lab Links:	http://vlabs.iitkgp.ac.in/coa/
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory course "Computer Organization and Architecture" and "Microprocessor and Microcontroller Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 20 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation.
Practical (P):	Practical examination will be based on the experiment list for Total 25 Marks.

PBL Course Code	PBL Course Name	Credits			
		TH	P	TUT	Total
ITPR42	PBL – Mini Project Lab II (Python-based Mini Project)	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Python, MySQL.
Prerequisites:	Computer Programming (C / C++), Fundamentals of Python.
PBL Objectives (PROBs):	1. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used. 2. To practice the process of identifying the needs and converting it into a problem statement. 3. To apply engineering knowledge and modern tools/technologies for deriving solutions to the real-world problems. 4. To inculcate the process of self-learning and research. 5. To be acquainted with solving the problem in a group. 6. To improve communication, management and report-writing skills of the students.
PBL Outcomes (PROs):	Upon completion of the course, the learners will be able to: 1. Identify societal / research needs, formulate problem statements, review research literature, and analyze complex engineering problems. 2. Design suitable solutions for the problems including scope, objectives, timeline, system flow, user interface, algorithms, etc. 3. Gather, analyze, and interpret data — and apply knowledge of engineering fundamentals, modern tools / technologies for development of solutions. 4. Analyze sustainability and scalability of the developed solution and its impact in terms of environmental, societal, safety, legal, cultural, health, etc. aspects. 5. Apply ethical principles, excel in written and oral communication, and engage in independent and life-long learning. 6. Interact efficiently and effectively as an individual with the team members or leader for timely and professional management of projects.
Guidelines for Project-Based Learning (PBL):	1. Students have to form a team of minimum 02 and maximum 04 members, based on their area of interest and size of project. Interdisciplinary (inter-branch) teams are encouraged. 2. Students should develop a Web / Mobile Application with a proper user interface using any suitable technology like HTML5, CSS, etc. for front end and Python at backend. 3. Students should carry out a survey and identify needs, which shall be converted into problem statement for Mini Project in consultation with Faculty Guide, Internal committee of faculties, and the Head of Department. 4. Projects should compulsorily be based on societal contribution (healthcare, agriculture, etc.) and reflecting role of engineer in the society. Students should try to take up need-based live projects so as to get exposure to communication with beneficiaries and skills for understanding client requirements. 5. Based on the idea presentation as well as discussion on feasibility, novelty, and contribution of the idea, a project definition will be finalized. 6. Students shall submit their implementation plan in the form of Gantt / PERT / CPM chart, which will cover weekly activity of the Mini project. 7. A log book is to be prepared by each group, wherein the group can record weekly work progress and the Faculty Guide can verify and record notes / comments. 8. Faculty Guide may give inputs to students during Mini Project activity; however, focus

	shall be on self-learning. 9. Students in a group shall understand the problem effectively, propose multiple solutions, and select the best possible solution in consultation with their guide. 10. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate. 11. The solution is to be validated with proper justification and report to be compiled in standard format of the Department. 12. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Minor Projects, if the problem statement is huge and significant, a same problem statement can be worked upon for 02 semesters, i.e., same Minor Project in Semesters V and VI. Projects with a very large scope can also be taken forward to higher semesters, in consultation with the Head of the Department. 13. Students are encouraged to participate in Technical Paper Presentation competitions. 14. The students' group shall complete a project in all aspects including: Identification of need / problem, proposed final solution, Procurement of components / systems / data, Building prototype and testing. 15. Three reviews will be conducted for continuous assessment: one shall be for finalization of the problem and proposed solution, second shall be for evaluation of work progress, and third shall be for evaluation of implementation and testing of solutions. 16. Mini Project shall be assessed based on following parameters: • Attainment of Course Outcomes. • Technical efficiency and quality of developed solution. • Innovativeness in solutions. • Impact on environment. • Cost effectiveness. • Sustainability analysis. • Societal impact. • Effective use of standard engineering norms. • Contribution of an individual as member or leader. • Clarity in written and oral communication. 17. Students are encouraged to publish a paper based on the work in Conferences / Student competitions.
Useful Learning Links:	1. https://onlinecourses.nptel.ac.in/noc21_cs75/preview 2. https://www.coursera.org/specializations/python 3. https://www.udemy.com/course/the-complete-python-course/
Term Work (TW):	• Term Work shall be granted based individual's contribution in group activity, their understanding and response to questions. • Term Work evaluation shall be for Total 25 Marks — based on the following evaluation: o Presentation in Review 1 o Presentation in Review 2 o Presentation in Review 3 o Project Report and Log Book
Practical & Oral (P&O):	P&O examination will be of Total 25 Marks and shall be based on the Project Demonstration, Presentation, and Report.

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
ITXS45	SAT – V: Skill-Based Learning (Python Programming)	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Python, MySQL.
Skill Prerequisites:	Computer Programming (C / C++, Java).
Skill Objectives (SOBs):	1. To understand basics of Python including data types, operator, conditional statements, looping statements, input and output functions in Python. 2. To understand list, tuple, set, dictionary, string, array and functions in Python. 3. To impart knowledge of Object-Oriented Programming concepts in Python. 4. To explain concepts of modules, packages, multithreading and exception handling. 5. To understand knowledge of File handling, GUI & Database Programming. 6. To learn data visualization using Matplotlib, Data Analysis using Pandas and Web Programming using Flask.
Skill Outcomes (SOs):	Upon completion of the course, the learners will be able to: 1. Describe the structure, syntax, and semantics of the Python language. 2. Interpret advanced data types and functions in Python. 3. Illustrate the concepts of object-oriented programming as used in Python. 4. Develop Python applications using modules, packages, multithreading and exception handling. 5. Create solution with suitable GUI, File Handling functionalities and suitable database operations. 6. Develop cost-effective robust applications using the latest Python trends and technologies.

Module No. and Name	Subtopics	SOs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Basics of Python	Introduction, Features, Python building blocks – Identifiers, Keywords, Indention, Variables and Comments, Basic Data types (Numeric, Boolean, Compound).	SO1	01	03
	Operators: Arithmetic, Comparison, Relational, Assignment, Logical, Bitwise, Membership, Identity Operators, Operator Precedence.	SO1	01	
	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. Input / Output Functions, Decorators, Iterators and Generators.	SO1	01	

2. Advanced Datatypes and Functions	Lists: a) Defining lists, accessing values in List, deleting Values in List, Updating Lists b) Basic List Operations c) Built-in List Functions.	SO2	01	07
	Tuples: a) Accessing values in Tuples, deleting values in Tuples and updating Tuples b) Basic Tuple Operations c) Built-in Tuple Functions.	SO2	01	
	Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary and updating Dictionary. b) Basic Dictionary Operations c) Built-in Dictionary Functions.	SO2	01	
	Sets: a) Accessing values in Set, deleting values in Set, updating Sets b) Basic Set Operations. c) Built-in Set Functions.	SO2	01	
	Strings: a) String Initialization, Indexing, Slicing, Concatenation, Membership & Immutability b) Built-in String Functions.	SO2	01	
	Arrays: a) Working with Single dimensional Arrays: Creating, Importing, Indexing, Slicing, Copying and Processing Arrays. b) Working with Multi-Dimensional Arrays using Numpy: Mathematical Operations, Matrix Operations, Aggregate and other Built-in Functions.	SO2	01	
	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).	SO2	01	
3. Object-Oriented Programming	Overview of Object-oriented Programming, Creating Classes and Objects, Self-Variable, Constructors, Inner class, Static method, Namespaces.	SO3	01	03
	Inheritance: Types of Inheritance (Single, Multiple, Multi -level, Hierarchical), super() Method, Constructors in Inheritance, Operator Overloading, Method Overloading, Method Overriding.	SO3	01	
	Abstract Class, Abstract Method, Interfaces in Python.	SO3	01	
4. Modules, Packages, Multithreading and Exception Handling	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	01	04
	Packages: Creating User Defined Packages and Importing Packages.	SO4	01	
	Multi -Threading: Process Vs Thread, use of Threads, Types of Threads, Creating Threads in Python, Thread Synchronization, Deadlock of Threads.	SO4	01	
	Exception Handling: Compile Time Errors, Runtime Errors, Exceptions, Types of Exception, Try Statement, Except Block, Raise Statement, Assert Statement, User - Defined Exceptions.	SO4	01	

5. File Handling, GUI & Database Programming	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 a File, File Exceptions, Pickle in Python.	SO5	01	03
	Graphical User Interface (GUI): Different GUI Tools in Python (Tkinter, Pyqt, Kivy, etc.), Working with Containers, Canvas, Frame, Widgets (Button, Label, Text, Scrollbar, Check Button, Radio Button, Entry, Spinbox, Message, etc.) Connecting GUI with Databases to Perform CRUD Operations. (On Supported Databases Like Sqlite, Mysql, Oracle, Postgresql, etc.).	SO5	02	
6. Data Visualization, Analysis and Web Programming using Python	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.	SO6	01	05
	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.	SO6	02	
	Scipy: Linear Algebra Functions using Numpy & Scipy.	SO6	01	
	Web Programming: Introduction to Flask, creating a Basic Flask Application, build a Simple REST API using Flask.	SO6	01	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
Text Books:	1. R. Nageswara Rao, Core Python Programming, Dreamtech Press, Wiley. 2. M. Savaliya, R. Maurya, Programming through Python, StarEdu Solutions. 3. E. Balagurusamy, Introduction to Computing and Problem-solving using Python, McGraw Hill.			
Reference Books:	1. Z. Shaw, Learn Python 3 the Hard Way, Zed Shaw's Hard Way Series. 2. M. Brown, Python: The Complete Reference, McGraw Hill. 3. P. Barry, Head First Python, 2nd Edition, O'Reilly Media.			
Useful learning Links:	1. https://docs.scipy.org/doc/numpy/user/quickstart.html 2. https://matplotlib.org/tutorials/ 3. https://pandas.pydata.org/docs/getting_started/ 4. https://www.geeksforgeeks.org/python-build-a-rest-api-using-flask/ 5. https://python-iitk.vlabs.ac.in/			
Guidelines for Skill-Based Learning (SBL):	• Programming labs shall be conducted as 02 Hours of blended theory and 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 implementation of programs involving the concepts mentioned will be performed during the assigned lab hours.			

Term Work (TW):	• Term Work evaluation shall be for Total 25 Marks based on Practical Performance. • The final certification and acceptance of term work will be based on attendance in Theory and Lab sessions, satisfactory performance of laboratory work, and minimum passing marks in term work evaluation

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
ITXS46	SAT – VI: Skill-Based Learning (Foreign / Indian Modern Languages)	-	01	-	01

Skill 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
Skill 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 has to complete any one Foreign and/or Indian Language MOOC course from NPTEL / Coursera / Udemy, etc. sites referring the given suggestive list of courses, but not limited to the list as it is a learner's choice for the interested course, to be completed during the semester time frame.

Sr. No.	Suggestive List of Courses
1	Introduction to Japanese Language and Culture
2	German – I, II, III
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

Learning Resources (Suggestive Courses Links but not limited to these only):	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 5. https://www.coursera.org/learn/spanish-vocabulary-cultural-experience 6. https://www.coursera.org/learn/spanish-vocabulary-sports-travel-home 7. https://www.coursera.org/learn/spanish-vocabulary-careers 8. https://www.coursera.org/learn/spanish-vocabulary-project 9. https://www.coursera.org/learn/korean-beginners 10. https://www.coursera.org/learn/learn-korean 11. https://www.coursera.org/learn/learn-speak-korean1

	12. https://www.coursera.org/learn/the-korean-alphabet-an-introduction-to-hangeul 13. https://www.udemy.com/course/complete-french-course/ 14. https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/ 15. https://www.udemy.com/course/spanish-101-beginning-spanish-spanish-for-beginners/ 16. https://www.udemy.com/course/complete-japanese-course-learn-japanese-for-beginners-lvl-1/ 17. https://www.udemy.com/course/complete-korean-course-learn-korean-for-beginners-level-1/ 18. https://www.udemy.com/course/the-complete-russian-language-course/ 19. https://onlinecourses.nptel.ac.in/noc22_hs114/preview 20. https://onlinecourses.nptel.ac.in/noc22_hs85/preview 21. https://onlinecourses.nptel.ac.in/noc22_hs139/preview
Term Work (TW):	Term Work evaluation shall be for Total 25 Marks based on progress and completion of the course.

Item No.: 4.2
A.C.: 09/07/2022

SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Engineering and Information Technology
An Autonomous Institute Permanently Affiliated to the University of Mumbai

Autonomy Scheme-II

Internship Manual

(Prepared based on the Guidelines of AICTE and University of Mumbai)

(With effect from AY 2022-2023)

SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Engineering and Information Technology
An Autonomous Institute Permanently Affiliated to the University of Mumbai

Academic Year 2022-23

INTERNSHIP MANUAL

AICTE-INTERNSHIP POLICY STATES THAT:

- The rise in global competition has prompted organizations to devise strategies to have a talented and innovative workforce to gain a competitive edge.
- Developing an internship policy is an impactful strategy for creating a future talent pool for the industry.
- The Internship program not only helps fresh pass-outs in gaining professional know-how but also benefits, corporate on fresh perspectives on business issues and even discovering future business leaders.
- Competition in the job sector is rising exponentially and securing entry-level jobs is getting very difficult, as the students passing out from technical institutions lack the experience and skills required by industry.
- The main aim of this initiatives is enhancement of the employability skills of the students passing out from Technical Institutions.

OBJECTIVES & EXPECTED OUTCOMES:

Following are the intended objectives of internship training:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the 'Industrial Internship' in the classroom will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations.
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize yourself with various materials, processes, products and their applications along with relevant aspects of quality control.
10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving

BENEFITS OF INTERNSHIP:

Benefits to Students:

1. An opportunity to get hired by the Industry/ organization.
2. Practical experience in an organizational setting.
3. Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
4. Helps them decide if the industry and the profession is the best career option to pursue.
5. Opportunity to learn new skills and supplement knowledge.
6. Opportunity to practice communication and teamwork skills.
7. Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.
8. Opportunity to meet new people and learn networking skills.
9. Makes a valuable addition to their resume.
10. Enhances their candidacy for higher education.
11. Creating networks and social circles and developing relationships with industry people.
12. Provides opportunity to evaluate the organization before committing to a full time position.

Benefits to the Institute:

- Build industrial relations.
- Makes the placement process easier.
- Improve institutional credibility & branding.
- Helps in retention of the students.
- Curriculum revision can be made based on feedback from Industry/ students.
- Improvement in teaching learning process.

Benefits to the Industry:

- Availability of ready to contribute candidates for employment.
- Year round source of highly motivated pre-professionals.
- Students bring new perspectives to problem solving.
- Visibility of the organization is increased on campus.
- Quality candidate’s availability for temporary or seasonal positions and projects.
- Freedom for industrial staff to pursue more creative projects.
- Availability of flexible, cost-effective work force not requiring a long-term employer commitment.
- Proven, cost-effective way to recruit and evaluate potential employees.
- Enhancement of employer’s image in the community by contributing to the educational enterprise.

STANDARD OPERATING PROCEDURE (SOP) FOR INTERNSHIP:

The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email from the Dean, IIIC/ HOD and/or IIIC members of resp. depts. of the college shall be send to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students to Dean, IIIC/ HOD and/or IIIC members of resp. depts. Based on the number of slots agreed to by the Industry, Dean, IIIC/ HOD and/or IIIC members will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the Dean or other members of the IIIC who are particularly looking after the Internship of the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted to Department IIIC Member with the consent of Industry persons/ Trainers.

Step 5: Students will submit a training report after completion of internship.

Step 6: Training Certificate to be obtained from industry.

Step 7: List of students who have completed their internship successfully certificate will be issued by Departments, Sections, Professional bodies, Cells, Committees in collaboration with IIIC cell.

Step 8: In addition to Step 1 to Step 7, Departments, Sections, Professional bodies, Cells, Committees of KJSIEIT may organize in house / Industry collaborated internship of 1/2/3/4 weeks duration for students with the same procedure as stated above, with in Principal approval from Principal.

GUIDELINES FOR THE STUDENTS:

Internship/ Placement is a student centric activity. Therefore, the major role is to be played by the students. Deans, IIIC/HOD may also include involvement of the student in the following activities:

- Design and Printing of Internship / Placement Brochure – Soft copy as well as Hard copy.
- Preparing list of potential recruiters / Internship providers and past recruiters.
- Internship/ Placement Presentation at various organizations, if required.
- For allotment of internship slots all the students will be required to submit “student internship program application” before the prescribed date

SOP FOR INTERNSHIP REPORT :

STUDENT’S DIARY/ DAILY LOG:

The main purpose of writing a daily diary is to cultivate the habit of documenting and to encourage the students to search for details. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should

contain the sketches & drawings related to the observations made by the students. The diary should also be shown to the Faculty Mentor from time to time. Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed, if any. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

After completion of Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The training report should be signed by the Internship Supervisor (from Industry/Organisation, if applicable), Faculty Incharge and HOD. The Internship report will be evaluated on the basis of following criteria:

- Originality.
- Adequacy and purposeful write-up.
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience.
- Practical applications, relationships with basic theory and concepts taught in the course. The industrial training of the students will be evaluated in three stages:
- Evaluation by Industry
- Evaluation by faculty supervisor on the basis of site visit(s).
- Evaluation through seminar presentation/viva-voce at the Institute.

EVALUATION BY INDUSTRY:

The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

EVALUATION THROUGH SEMINAR PRESENTATION/VIVA-VOCE AT THE INSTITUTE:

The student will give a seminar based on his/her internship/ training report, as decided by the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report. Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students.

EXAMINATION AND EVALUATION FOR AWARD OF INTERNSHIP COMPLETION CERTIFICATE

Internship Completion certificate will be awarded to graduating students on completion of minimum 5 Internship modules from Semester 2 to Semester 8 as per the internship policy document.

COMPLIANCES FOR INTERNSHIP COMPLETION CERTIFICATION :

1. Completion of 1 internship module will reflect addition of 2 credits so total credits earned will be 2 credits x 7 internship modules = 14 credits across Semester 2 to Semester 8.
2. Mandatory to complete minimum 5 internship modules across Semester 2 to Semester 8 for award of Internship Certificate.
3. On completion of 5 Internship modules credit earned = 10
4. On completion of 6 Internship modules credit earned = 12
5. On completion of 7 Internship modules credit earned =14
6. No credits will be awarded AND / OR No Internship Completion Certificate will be issued for less than 10 credits earned throughout the degree.
7. Internship evaluation will be as per Internship module assessment process defined in Internship Manual course contents, for every individual student across Semester 2 to Semester 8.
8. Departments will submit Internship completion report and credits assigned sheet of every student signed by Department internship coordinator, Class teachers and Head of the Department to Exam Cell during 8th Semester ESE time duration of respective batch to generate the internship completion certificate along with the regular grade sheet.
9. No further queries will be entertained if not meeting above compliances and not following the internship modules designed under the guidelines of AICTE Internship policy.

Internship Scheme & Structure under KJSIEIT Autonomy Scheme-II wef 2022-23
for Bachelor of FY/SY/TY/LY (CE/IT/AI/ET Technology)
Semester- II-VIII

Note:

As per guidelines and suggestions by AICTE-Internship policy

- 1 Credit = 40 - 45 hours of Internship
- Total 600-700 hour of spending under Internship module courses to be completed for award of Internship Completion Certification along with regular passing gradesheet. (e.g. Total 15 weeks of 5 days/week of 8 hrs/day spent=600hrs for complete degree duration)
- Total weeks of Internship shall be considered based on Hrs spent/Day
- For Internship course, No load to be allotted for mentors in faculty load distribution sheet.

Internship Modules & Contents Across Semester 2 to Semester 8

<table>
<tr><td colspan="4">FY: (Sem II)</td></tr>
<tr><td>Internship Code</td><td>Course Name</td><td>Hours/Duration</td><td>Credits</td></tr>
<tr><td>INT21</td><td>Internship-I</td><td>80-120 hrs
(2-3 Weeks)
Winter Vacation
After SEM-I
& during
SEM-II of FY</td><td>02</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Prerequisite:</td><td colspan="3">Fundamental knowledge of Engineering and Technology</td></tr>
<tr><td>Internship Objectives:</td><td colspan="3">1. To get acquainted with institute level technical activities and initiatives.
2. To participate in department/Institute level technical learning and training initiatives through Professional cells/clubs/committees/bodies.</td></tr>
<tr><td>Internship Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to:
1. Get practical experience of institutional setting.
2. Meet and interact with new people and learn networking, innovation and entrepreneurial skills.
3. Promote academic, professional and/or personal development.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="7">Activity-
Inter/Intra Institutional Activities</td><td colspan="3">Supporting Activities to be completed under Internship</td></tr>
<tr><td colspan="3">• Attending Industry Workshops organised by departments</td></tr>
<tr><td colspan="3">• Working in consultancy or research project initiated by department</td></tr>
<tr><td colspan="3">• Technical festival (participation)</td></tr>
<tr><td colspan="3">• Working in IIC Cell, Entrepreneurship Cell, NISP, IPR cell and/or any other technical professional body/cell/committee/club of the institute</td></tr>
<tr><td colspan="3">• Activities related to Incubation or Innovation</td></tr>
<tr><td colspan="3">• Learning in departmental Labs, Tinkering Lab</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Term Work Assessment:
Duration to be considered for assessment:
Week Ends/ Semester Break/End of Semester (After ESE & Before Next Term Start)</td></tr>
<tr><td>Guidelines:</td><td colspan="3">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</td></tr>
</table>

	authenticated by Dean Students Welfare. 4. HODs will circulate the student list to all faculty mentors for consideration of Hours spends under mentioned department activities. 5. For department Lab learning, FY HOD will circulate Term End report to all faculty mentors with list of student's undergone innovative learning, verified by department academic coordinator. 6. Students will submit evaluation sheet by attaching Xerox copies of Internship & other participation certificates & faculty mentor will verify the Xerox from original copy for assessment purpose.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics :** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** Internship and Activity Completion/Participation Certificates and Evaluating Report

SY (Sem III)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**
INT32	Internship-II	80-120 hrs (2 -3 Weeks) Summer Vacation **After SEM-II & during SEM-III of SY**	02
Prerequisite:	**Fundamental knowledge of program specific tools, instruments, devices and programming languages etc.**		
Internship Objectives:	1. To get the exposure to Innovation/IPR/ Entrepreneurship/ Startup initiatives 2. To participate & experience Incubation, Innovation & Business development culture		
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. Learn innovation and entrepreneurial skills to supplement engineering knowledge. 2. Integrate theoretical aspects learned in classes with the practical world 3. Develop an innovative idea to be processed as a start-up		
Activity- Innovation/	**Supporting Activities to be completed under Internship**		
	1. Participation in Innovation related competitions e.g. Hackathons etc.		
	2. Awareness & knowledge sessions about Development of new product/Business Plan/Registration of Start-up		

IPR/ Entrepreneurship	3. Participation in all activities of IIC Cell, E-Cell, NISP, IPR Cell like ● IPR workshop/ ● Leadership Talk ● Idea Design ● Innovation/Business Competition
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. HODs 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.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** Internship and Activity Completion /Participation Certificates and Evaluating Report

SY (Sem IV)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**
INT43	Internship-III	80-120 hrs (2 - 3 Weeks) Winter Vacation After **SEM-III** **& during** **SEM-IV of SY**	02
Prerequisite:	**Skill sets of engineering and technology specific tools, instruments, devices and programming languages etc.**		

Internship 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.
Internship 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.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** Internship and Activity Completion/Participation Certificates and Evaluating Report

TY (Sem V)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**

INT54	Internship-IV	80-160 hrs (2 - 4 Weeks) Summer Vacation After **SEM-IV & during SEM-V of TY**	02

Prerequisite:	**List of probable industries and organizations offering internships in Engineering and Technology. Awareness about problem areas in rural India**
Internship Objectives:	1. To get the awareness about engineer's responsibilities and ethics. 2. Opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. Get an opportunity to practice communication and teamwork skills. 2. Get an opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.

Activity- Rural Internships &/ Internships	**Supporting Activities to be completed under Internship**
	1. Long Term Goal under Rural Development Internships or
	2. Mandatory internship for developing project with:
	● Industries
	● Government Sector
	● Non-governmental Organization (NGO)
	● MSMEs

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.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks

	& Internship and Activity Completion/Participation Certificates and Evaluating Report

TY (Sem VI)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**
INT65	Internship-V	80-160 hrs (2-4 Weeks) Winter Vacation **After SEM-V & during SEM-VI of TY**	02
Prerequisite:	**List of probable industries and organizations offering internships on live projects. Awareness about probable solutions for identified problem areas in rural India**		
Internship Objectives:	1. To understand the social, economic and administrative considerations of working environment in industries, government, NGOs and private organizations. 2. Learn to apply the Technical knowledge for solving real life problems.		
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. Get an opportunity to get hired by the Industry/ organization. 2. Decide if working in the industry or set up a start-up would be best career option to pursue.		
Activity- Rural Internships & Internships	**Supporting Activities to be completed under Internship**		
	1. Long Term Goal under Rural Development Internships or		
	2. Mandatory internship for developing project with:		
	● Industries		
	● Government Sector		
	● Non-governmental Organization (NGO)		
	● MSMEs		
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. HODs 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.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** Internship and Activity Completion/Participation Certificates and Evaluating Report

LY (Sem VII)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**
INT76	Internship-VI	80-160 hrs (2-4 Weeks) **Summer Vacation of TY** and during **SEM-VII of LY**	02

Prerequisite:	**In depth knowledge about societal/research/innovation/entrepreneurial problems and appropriate applicable solutions available through use of technology.**
Internship Objectives:	1. To gain the experience in preparing and writing Technical documentation/ reports for product/projects. 2. To Identify and analyse the societal/research/entrepreneurial problem in detail to define its scope with problem specific data. 3. To develop clarity of presentation based on communication, teamwork and leadership skills.
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. Apply the engineering and technical knowledge for problem identification, analysis, design and developing solutions. 2. Present and demonstrate the real time problem solution across national/international project competitions and conference.

Activity- PBL-Major Project A-Work/ Seminars	**Supporting Activities to be completed under Internship**
	For Sem VII PBL Course-Major Project-A, selected topic: 1. Review literature through reference papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old.
	2. Participate in multiple Project Competitions presenting the Project A solution
	3. Participation in International Conferences presenting the literature

	review and/or hypothesis for innovative solution.
	4. Participation at institute annual International Conference on Advances in Science and Technology-ICAST & other Conferences /Journals.
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. 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 4. 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.
TW Marks (25) **&** **Certificate :**	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** **Certificate Based on :** 1.Project Competition certificate, 2. Participation in Conferences/Publications and/or proof of ICAST participation & presentation.

LY (Sem VIII)			
Internship Code	**Internship Name**	**Hours/Duration**	**Credits**
INT87	Internship-VII	80-160 hrs (2-4 Weeks) **Winter Vacation of Sem VII** and During SEM-VIII of LY	02
Prerequisite:	**In depth knowledge about filling IPR/ copywriting a product/solution.**		
Internship Objectives:	1. To gain the knowledge of filling patent and Copy write. 2. Presenting technology solutions across worldwide problems through competitions and publications.		
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. National and international recognition through IPR and/or copy writes and paper publications.		

	2. Convert problem solution as a business plan for entrepreneurial product.
Activity- PBL Major Project B Work/Conference Presentation	**Supporting Activities to be completed under Internship**
	For Sem VIII PBL Course-Major Project-B, selected topic: 1. File for Project solution Copyright and/or File for Project topic IRP/Patent
	2. Participate at Institute Annual Project Competition-INTECH
	3. Publish the project solution at reputed International Journals, preference should be given to UGC care list and/or SCI indexed journals.
Term Work Assessment: **Duration to be considered for assessment:** Week Ends and during Semester	
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. 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 4. 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.
TW Marks (25) & Certificate :	**Assessment & evaluation based on rubrics:** Hours Spent for Internship: max 20 marks Achievement/Recognition: max 05 marks **&** **Certificate Based on :** 1.Project Copyright/ Project IRP 2. Project Competition certificate (INTECH) 3.International Journal Publication proof

Dr. S.K Ukarande
Principal