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 University of Mumbai.

Somaiya TRUST

AC No:
Item No:

Autonomy Syllabus Scheme-II (B)

for

Bachelor of Technology

in

Computer Engineering (CE)

Second Year
(Semester III and IV)
Including
Intership Policy Manual

with effect from A.Y. 2023-24

Four Year Undergraduate Programmes leading to Bachelor of Technology (B Tech) Degree in Computer Engineering implemented from in Academic Year 2021-22 for SY, TY, LY

Somaiya Ayurvihar Complex, Eastern Express Highway, Sion (East), Mumbai. 400 022, India
Telephone: (91-22)24061404, 24061403 email: principal.tech@somaiya.edu, Web:www.somaiya.edu/kjsieit

Principal's Desk:

The challenges and demands of the dynamic industry increasingly require technocrats to be skilled, adaptive, and innovative. The National Educational Policy 2020 (NEP 2020) framed by the Government of India intends to induce a paradigm shift by re-conceptualising the higher education. Recent academic reforms recommended by the AICTE and UGC have also effectually upscaled the higher education system in India. It is further the role of HEIs to offer high-quality educational opportunities and enable the next generation to succeed globally. Hence, to adhere to the status quo, and enhance the academic standards and quality of engineering education further, it is essential to assimilate innovation and recurrent revision in curriculum, teaching-learning methodology, examination, and assessment system.

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

K. J. Somaiya Institute of Engineering and Information Technology (KJSIEIT), being an autonomous institute possesses more flexibility in adapting newer approaches to reach higher levels of excellence in engineering education. The Syllabus Scheme – I implemented under the academic autonomy conferred to KJSIEIT w.e.f. A.Y. 2021-22 already comprises of state-of-the-art courses and laboratory sessions on emerging areas of technology. With an ideology that the root of innovation is 'interest', the curriculum offered a wide range of elective courses — grouped into core and inter-disciplinary domains.At par with international engineering education, it followed a learner-centric approach, where the students could choose to study courses concerning areas of their interests.

This curriculum introduces Skill-Based Learning (SBL), Activity-Based Learning (ABL), and Technology-Based Learning (TBL) as eXposure (SAT) courses — that assure X factor in all the students of the institute. The SAT courses were practiced across the first three years of engineering, focusing on graduate attributes like work responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. that could not be copiously imbibed through regular engineering courses. The inclusion of induction program for the First Year students is deliberated as per the guidelines of AICTE and helps students belonging to diverse backgrounds to adjust in the new academic environment.

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

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

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

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

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

Dr. S. K. Ukarande

Principal and Chairman - Academic Council

Preamble by Member Secretary, Academic Council:

K J Somaiya Institute of Engineering and Information Technology (KJSIEIT) has been grantedacademic 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

Chairperson BoS Computer Engineering:

With a view to promoting academic excellence, the autonomous institutes have the freedom tomodernize their curricula. For the institutes having potential to offer programmes of a higher standard and create an environment to develop the intellectual climate of our country, academic freedom is the crucial requirement. Unless such a climate prevails, it is tough to reach excellence in higher technical education system.

It is my privilege to present the revised autonomy scheme-II and detailed syllabus of Bachelor of Technology, B Tech in Computer Engineering from academic year 2022-23, with inclusion of cutting-edge technology. The proposed syllabus is with the view to enhance the existing syllabus of University of Mumbai and make it more contextual, industry affable and suitable to cater the needs of society and nation in present day context. After numerous brainstorming sessions from industry expert, senior faculty from other institute, alumni, faculty from other departments and Computer Engineering faculty, their views and opinions were included in this curriculum. The committee analysed the current technologies and the curricula of leading institutes in terms of content, significance, need and applications before shaping this syllabus. The syllabus is peer reviewed by experts from industries and as per their suggestions it also covers future trends in IT industries and research opportunities available due to these trends.

A holistic approach to inculcates software skills, nurture online courses, handle real time projects, internships and industry training via was adopted in the scheme. Skill based Learning, Activity based learning and Technology based learning eXposure (SAT) courses are added in Second year (semester III and IV) and Third year (semester V and VI) syllabus which satisfies most of the graduate attributes. Students have the apportunity to do courses of Foreign and Indian Regional Languages in second year which helps them for masters or job locations as per the requirement.

Evaluation scheme include 60:40 examination pattern which comprises internal assessment of 10 marks for each course. Project Based Learning (PBL) is included from semester III onwards which allow students to work in coordination as a team and develop projects using latest technologies. Further, the syllabus offers choice of elective from fifth semester onwards, which is in line with the NEP, so that students have option to become expert in a particular domain. Based on the AICTE internship policies, Internships are considered in the curriculum from sem II to sem VIII having total credits= 18 for 600-700 hrs, which will be applicable from A.Y. 2022-23 for FY students.

Total six Honours Dergee programs are introduced in schem-II at institute level for all third-year students based on emerging areas which help students to get specialization degree with credits.

The board of studies expresses its appreciation at the fine work done and the contribution made by Coordinators/Members of the committee, who have adhered to the guidelines provided and enabled the detailed framing of the Syllabi and also thanks them for their excellent cooperation and mature/learned inputs. The assistance received from the stakeholders in this assignment is also gratefully acknowledged.

Dr. Sarita P. Ambadekar
HOD Computer Engineering Department

Program Structure for Second Year Computer Engineering
Semester- III-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC301	Applications of Mathematics in Engineering-I	3– 0 – 1	04	3 – 0 – 1	04	BS
CEC302	Discrete Structures and Graph Theory	2– 0 – 0	02	2 – 0 – 0	02	ES
CEC303	Data Structure	3– 0 – 0	03	3 – 0 – 0	03	PC
CEC304	Digital Logic & Computer Architecture	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC305	Computer Graphics	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEL303	Data Structure Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL304	Digital Logic & Computer Architecture Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL305	Computer Graphics Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEPR31	Project Based Learning: Mini Project Lab-I	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
CEXS33	Skill Based Learning: Object Oriented Programming with Java (SAT-III)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
CEXS34	Skill Based Learning: (SAT-IV) (Interdisciplinary Informatics)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
INT31	Internship-II	2 to 3 Weeks		--	-	INT
Total		**14– 12 –1**	**27**	**14 - 6– 1**	**21**	**--**

*Load of learner, not the faculty $SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Mini Project I and II: Students can form groups with minimum 2 (Two) andmaximum 4(Four) **Faculty Load:** 1 hour per week per four groups

Semester- III-Examination Scheme

Course Code	Course Name	Marks										
		CA				ESE	ESE duration(Hrs)	TW	O	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA							
CEC301	Applications of Mathematics in Engineering-I	30	30	30	10	60	2.30	25	--	--	--	125
CEC302	Discrete Structures and Graph Theory	20	20	20	10	45	2	--	--	--	--	75
CEC303	Data Structure	30	30	30	10	60	2.30	--	--	--	--	100
CEC304	Digital Logic & Computer Architecture	30	30	30	10	60	2.30	--	--	--	--	100
CEC305	Computer Graphics	30	30	30	10	60	2.30	--	--	--	--	100
CEL303	Data Structure Lab	--	--	--	--	--	--	25	--	--	25	50
CEL304	Digital Logic & Computer Architecture Lab		--	--	--	--	--	25	--	--	--	25
CEL305	Computer Graphics Lab	--	--	--	--	--	--	25	--	--	25	50
CEPR31	Project Based Learning: Mini Project Lab-I	--	--	--	--	--	--	25	--	--	25	50
CEXS33	Skill Based Learning: Object Oriented Programming with Java (SAT-III)	--	--	--	--	--	--	25	--	--	--	25
CEXS34	Skill Based Learning (SAT-IV) (Foreign and Indian Regional Languages-I)	--	--	--	--	--	--	25	--	--	--	25
INT31	Internship-II	--	--	--	--	--		--	--	--	--	--
Total		**140**	**140**	**140**	**50**	**285**	**--**	**175**	**--**	**--**	**75**	**725**

Program Structure for Second Year Computer Engineering
Semester-IV-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC401	Applications of Mathematics in Engineering-II	3– 0 – 1	04	3 – 0 – 1	04	BS
CEC402	Analysis of Algorithm	3– 0 – 0	03	3 – 0 – 0	03	PC
CEC403	Database Management System	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC404	Operating Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC405	Microprocessor	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEL402	Analysis of Algorithm Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL403	Database Management System Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL404	Operating Systems Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEPR42	Project Based Learning- Mini Project Lab-II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
CEXS45	Skill Based Learning: Python Programming (SAT -V)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
CEXS46	Skill Based Learning (SAT-VI) (Foreign and Indian Regional Languages-II)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
INT41	Internship-III	2 to 3 Weeks		--	--	INT
Total		**15-12-01**	**28**	**15 - 06 – 1**	**22**	

*
Load of learner, not the faculty $SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Mini Project I and II: Students can form groups with minimum 2 (Two) andmaximum 4(Four) **Faculty Load:** 1 hour per week per four groups

Semester-IV Examination Scheme

Course Code	Course Name	Marks										
		CA				ESE	ESE duration(Hrs)	TW	O	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA							
CEC401	Applications of Mathematics in Engineering-II	30	30	30	10	60	2.30	25	--	--	--	125
CEC402	Analysis of Algorithms	30	30	30	10	60	2.30	--	--	--	--	100
CEC403	Database Management System	30	30	30	10	60	2.30	--	--	--	--	100
CEC404	Operating System	30	30	30	10	60	2.30	--	--	--	--	100
CEC405	Microprocessor	30	30	30	10	60	2.30	--	--	--	--	100
CEL402	Analysis of Algorithm Lab	--	--	--		--	--	25	--	--	25	50
CEL403	Database Management System Lab	--	--	--	--	--	--	25	--	--	25	50
CEL404	Operating System Lab	--	--	--	--	--	--	25	--	--	25	50
CEPR42	Project Based Learning- Mini Project Lab-II	--	--	--	--	--	--	25	--	--	25	50
CEXS45	Skill Based Learning: Python Programming (SAT -V)	--	--	--	--	--	--	25	--	--	--	25
CEXS46	Skill Based Learning (SAT-VI) (Foreign and Indian Regional Languages-II)	--	--	--	--	--	--	25	--	--	--	25
INT41	Internship-III	--	--	--	--	--	--	--	--	--	--	--

Total	**150**	**150**	**150**	**50**	**300**		**175**	**--**	**--**	**100**	**775**

Courses Common with all Programs

Semester	Course Name	B.Tech Programs			
		COMP	AIDS	IT	EXTC
III	Applications of Mathematics in Engineering-I	√	√	√	-
III	Discrete Structure and Graph Theory	√	√	-	-
III	Digital Logic and Computer Architecture	√	√	-	-
III	Computer Graphics	√	√	-	-
IV	Applications of Mathematics in Engineering-II	√	√	√	-
IV	Analysis of Algorithms	√	√	-	-
IV	Database Management Systems	√	√	-	-
IV	Operating Systems	√	√	-	-
V	Software Engineering	√	√	-	-
VI	Artificial Intelligence	√	√	√	-

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	Total
CEC301	Applications of Mathematics in Engineering-I	03	-	01	04

Prerequisites:	1. Engineering Mathematics-I 2. Engineering Mathematics-II
Course Objectives:	1. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications. 2. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills. 3. To understand the concept of complex variables, C-R equations with applications. 4. To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning and AI. 5. To understand some advanced topics of probability, random variables with their distributions and expectations.
Course Outcomes:	**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. & Name	Sub Topics	CO Mapped	Hrs/ Sub topic	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction	**-**	**02**	**02**
1. Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform.	**CO1**	**01**	**07**
	Laplace Transform (L) of Standard Functions like eat, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and tn, $n \geq 0$.		**02**	
	Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof).		**02**	
	Evaluation of integrals by using Laplace Transformation.		**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 transform.		**02**	

	Inverse Laplace transform using Convolution theorem (without proof).		**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 and $2l$.		**02**	
	Fourier series of even and odd functions.		**02**	
	Fourier Transform-Fourier sine transform and Fourier cosine transform.		**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).		**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.		**02**	
	Harmonic function, Harmonic conjugate and orthogonal trajectories.		**02**	
5.Statistical Techniques	Karl Pearson's coefficient of correlation (r)	**CO5**	**01**	**06**
	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)		**01**	
	Lines of regression		**02**	
	Fitting of first- and second-degree curves.		**02**	
6.Probability	Definition and basics of probability, conditional probability.	**CO6**	**01**	**06**
	Total Probability theorem and Bayes' theorem.		**01**	
	Discrete and continuous random variable with probability distribution and probability density function.		**02**	
	Expectation, Variance, Moment generating function, Raw and central moments up to 4th order.		**02**	
ii. **Course Conclusion**	Recap of Modules, Outcomes, Applications, and Summarization.	**-**	**01**	**01**
Total Hours				**42**

Text Books:	1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication. 2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited . 3. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
Reference Books:	1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication. 2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education. 3. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.
Useful Links:	1. e-PGPathshala (inflibnet.ac.in) 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)	1. Each Student has to write at least 6 class tutorials on entire syllabus. 2. Journal must include at least 2 assignments on content of theory of the course. The distribution of Term Work marks will be as follows – • Class Tutorials on entire syllabus:15 marks • Assignment: 10 marks
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment - 10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEC302	Discrete Structures and Graph Theory	2-0-0

Prerequisite:	Basic Mathematics
Course Objectives:	1. Cultivate clear thinking and creative problem solving. 2. Thoroughly train in the construction and understanding of mathematical proofs. 3. Exercise common mathematical arguments and proof strategies. 4. To apply graph theory in solving practical problems. 5. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Have an ability to reason logically. 2. Solve problems on relations and functions techniques. 3. Emphasize the concept of Posets and Lattice 4. Use counting techniques to representation and characterization of relational concept. 5. Use groups and codes in Encoding-Decoding 6. Apply concepts of graph theory in solving real world problems.

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

	Coding Theory: Coding, binary information and error detection, decoding and error correction		**03**	
6. Graphs	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components	**CO6**	**03**	**05**
	Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, Applications		**02**	
ii. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hrs				**28**

Books:	
Textbooks	1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education. 2. C. L. Liu "Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company. Reprinted 2000. 3. K. H. Rosen, "Discrete Mathematics and applications", fifth edition 2003, Tata McGraw Hill Publishing Company
Reference Books	1. Y N Singh, "Discrete Mathematical Structures", Wiley-India. 2. J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India. 3. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publishing Company 4. Seymour Lipschutz, Marc Lars Lipson, "Discrete Mathematics" Schaum"s Outline, McGraw Hill Education. 5. Narsing Deo, "Graph Theory with applications to engineering and computer science", PHI Publications. 6. P. K. Bisht, H. S. Dhami, "Discrete Mathematics", Oxford press.

Useful Links:

1. https://www.edx.org/learn/discrete-mathematics
2. https://www.coursera.org/specializations/discrete-mathematics
3. https://nptel.ac.in/courses/106/106/106106094/
4. https://swayam.gov.in/nd1_noc19_cs67/preview

Assessment:

Continuous Assessment for 40 marks:

4. Test 1 – 20 marks
5. Test 2 – 20 marks
6. Internal assessment - 10 marks

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

End Semester Theory Examination will be of 45 marks of 2 hrs duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC303	**Data Structure**	3 - 0 – 0

Prerequisite:	C programming
Course Objectives:	1. To discuss types of different data structures and concept of Abstract Data Type 2. To discuss the concept of stack and queue and apply them to various applications. 3. To describe the concept of link list and apply it to various applications 4. To introduce the different kinds of trees. 5. To discuss graph related concepts and traversals along with application. 6. To teach various searching techniques.
Course Outcomes:	**After successful completion of this course, learner will be able to:** 1. Describe types of data structure and write ADT. 2. Implement stack and different types of queues using array and their applications 3. Perform various types of link list operations and their applications 4. Perform operations on Binary Search Tree, AVL tree, Btree and B+Tree 5. Implement Graph traversals BFS, DFS and application of Graph in topological sorting 6. Describe various Hashing functions, Collision techniques and compare various searching techniques Linear Search, Binary Search and Hashing

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Introduction to Data Structures	Introduction to Data Structures, Concept of ADT,	**CO1**	**01**	**02**
	Types of Data Structures-Linear and Nonlinear, Operations on Data Structures.		**01**	
2.Stack and Queues	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack	**CO2**	**01**	**09**
	Applications of Stack-Well formedness of Parenthesis		**01**	
	Infix to Postfix Conversion		**01**	
	Postfix Evaluation		**01**	
	Recursion		**01**	
	Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue		**01**	
	Implementation of circular and Double Ended Queue, Priority Queue, Applications of Queue		**03**	
3. Linked List	Introduction, Representation of Linked List, Linked List v/s Array	**CO3**	**01**	**10**

	Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List		**06**	
	Stack and Queue using Singly Linked List		**01**	
	Singly Linked List Application-Polynomial Representation and Addition		**02**	
4. Trees	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation,Types of Binary Tree	**CO4**	**01**	**11**
	Binary Tree Traversals		**02**	
	Binary Search Tree, Operations on Binary Search Tree		**04**	
	Applications of Binary Tree-Expression Tree, Huffman Encoding		**01**	
	Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree		**03**	
5. Graphs	Introduction, Graph Terminologies, Representation of Graph	**CO5**	**01**	**04**
	Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS)		**02**	
	Graph Application- Topological Sorting		**01**	
6. Searching Techniques	Linear Search, Binary Search, Hashing-Concept, Hash Functions	**CO6**	**01**	**03**
	CollisionResolution Techniques		**02**	
ii. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**		**01**
Total Hours				**42**

Books:

Textbooks:

1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, “Data Structures Using C”, Pearson Publication.
2. Reema Thareja, “Data Structures using C”, Oxford Press.
3. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2ndEdition, CENGAGE Learning.
4. Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and Its Applications”, McGraw-Hill Higher Education
5. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.

Reference Books:

1. Prof. P. S. Deshpande, Prof. O. G. Kakde, “C and Data Structures”, DreamTech press.
2. E. Balagurusamy, “Data Structure Using C”, Tata McGraw-Hill Education India.
3. Rajesh K Shukla, “Data Structures using C and C++”, Wiley-India
4. GAV PAI, “Data Structures”, Schaum’s Outlines.
5. Robert Kruse, C. L. Tondo, Bruce Leung, “Data Structures and Program

	Design in C", Pearson Edition
Useful Links:	
1. https://nptel.ac.in/courses/106/102/106102064/ 2. https://www.coursera.org/specializations/data-structures-algorithms 3. https://www.edx.org/course/data-structures-fundamentals 4. https://swayam.gov.in/nd1_noc19_cs67/preview	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment - 10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60 marks of 02 hrs min 30 duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEC304	Digital Logic & Computer Architecture	3-0-0
Prerequisite:	Knowledge on number systems	
Course Objectives:	1. To have the rough understanding of the basic structure and operation of basic digital circuits and a digital computer. 2. To discuss in detail arithmetic operations in digital systems. 3. To discuss generation of control signals and different ways of communication with I/O devices. 4. To study the hierarchical memory and principles of advanced computing.	
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Learn different number systems and basic structure of computer systems. 2. Demonstrate the arithmetic algorithms. 3. Describe the basic concepts of digital components and processor organization. 4. Explain the generation of control signals of computers. 5. Demonstrate the memory organization. 6. Describe the concepts of parallel processing and different Buses.	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Computer Fundamentals	Introduction to Number System and Codes Number Systems: Binary, Octal, Decimal, Hexadecimal	**CO1**	**01**	**05**
	Codes: Grey, BCD, Excess-3, ASCII, Boolean Algebra		**02**	
	Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR		**01**	
	Overview of computer organization and architecture. Basic Organization of Computer and Block Level functional Units, Von- Neumann Model		**01**	
2. Data Representation and Arithmetic algorithms	Binary Arithmetic: Addition, Subtraction, Multiplication	**CO1, CO2**	**01**	**08**
	Division using Sign Magnitude, 1's and 2's compliment		**02**	
	BCD and Hex Arithmetic Operation		**01**	
	Booths Multiplication Algorithm, Restoring and Non-restoring Division Algorithm. IEEE-754 Floating point Representation		**04**	

3.Processor Organization and Architecture	Introduction: Half adder, Full adder, MUX, DMUX, Encoder, Decoder(IC level)	**CO3**	**02**	**06**
	Introduction to Flip Flop: SR, JK, D, T (Truth table)		**02**	
	Register Organization, Instruction Formats, Addressing modes, Instruction Cycle, Interpretation and sequencing		**02**	
4. Control Unit Design	Hardwired Control Unit: State Table Method, Delay Element Methods	**CO4**	**03**	**06**
	Microprogrammed Control Unit: Micro Instruction-Format, Sequencing and execution, Micro operations, Examples of microprograms		**03**	
5. Memory Organization	Introduction and characteristics of memory, Types of RAM and ROM, Memory Hierarchy, 2-level Memory Characteristic	**CO5**	**03**	**06**
	Cache Memory: Concept, locality of reference, Design problems based on mapping techniques, Cache coherence and write policies. Interleaved and Associative Memory		**03**	
6. Principles of Advanced Processor and Buses	Basic Pipelined Data path and control, data dependencies	**CO6**	**02**	**08**
	Data hazards, branch hazards, delayed branch, and branch prediction, Performance measures-CPI, Speedup, Efficiency, throughput		**02**	
	Amdhal's law. Flynn's Classification, Introduction to multicore architecture		**02**	
	Introduction to buses: ISA, PCI, USB. Bus Contention and Arbitration		**02**	
ii.Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
Textbooks	1. R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4thEdition. 2. William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10TH Edition. 3. John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3RD Edition. 4. Dr. M. Usha and T. S. Shrikanth, "Computer system Architecture and Organization", Wiley publication.
Reference Books	1. Andrew S. Tanenbaum, "Structured Computer Organization", Pearson Publication. 2. B. Govindarajalu, "Computer Architecture and Organization", McGraw-Hill Publication. 3. Malvino, "Digital computer Electronics", McGraw-Hill Publication, 3rd edition.

	4. Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw-Hill Publication.

Useful Links:

1. https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical- aspect-9824
2. https://nptel.ac.in/courses/106/103/106103068/
3. https://www.coursera.org/learn/comparch
4. https://www.edx.org/learn/computer-architecture

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

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

End Semester Theory Examination will be of 60 marks of 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC305	**Computer Graphics**	3 - 0 - 0

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

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub topics	Total Hrs / Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Introduction and Overview of Graphics System	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Rasterization and Rendering	**CO1**	**01**	**03**
	Raster scan & Random scan displays, Architecture of Raster graphics system with display processor, Architecture of Random scan systems. Self-learning topics: Display devices like Plasma Display, 3D Display		**02**	
2. Output Primitives	Scan conversions of point, line, circle and ellipse: DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	**CO2**	**08**	**12**
	Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing)		**01**	

	Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm		**03**	
3. Two Dimensional Geometric Transformations	3D Object representation methods, Basic transformations: Translation, Scaling, Rotation	**CO3**	**02**	**04**
	Matrix representation and Homogeneous Coordinates		**01**	
	Composite transformation, Other transformations: Reflection and Shear		**01**	
4. Two-Dimensional Viewing and Clipping	Viewing transformation pipeline and Window to Viewport coordinate transformation	**CO4**	**02**	**06**
	Clipping operations: Point clipping, Line clipping algorithms: Cohen-Sutherland, Liang: Barsky, Polygon Clipping Algorithms: Sutherland- Hodgeman, Weiler-Atherton		**04**	
5. Three Dimensional Geometric Transformations, Curves and Fractal Generation	3D Transformations: Translation, Rotation, Scaling and Reflection.	**CO5**	**01**	**08**
	Composite transformations: Rotation about an arbitrary axis		**01**	
	Projections – Parallel, Perspective. (Matrix Representation)		**02**	
	Bezier Curve, B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve. **Self-learning topics**: Piano Curve, Hilbert Curve		**04**	
6. Visible Surface Detection and Animation	Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method	**CO6**	**03**	**06**
	Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture		**03**	
i. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**
Books:				
Textbooks	1. Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication 2. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2ndEdition, Pearson Publication 3. Samit Bhattacharya, "Computer Graphics", Oxford publication			
Reference Books	1. D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications. 2. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum"s Outlines McGraw-Hill Education 3. Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.			

	4. F. S. Hill, “Computer Graphics using OpenGL”, Third edition, Pearson Publications.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs111/preview
2. https://nptel.ac.in/courses/106/106/106106090/
3. https://www.classcentral.com/course/interactivegraphics-2067

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment - 10 marks

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

End Semester Theory Examination will be of 60 marks for 2hr 30min duration.

Lab Code	Lab Name	Credits (P+TUT)
CEL303	**Data Structures Lab**	1- 0

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

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

Useful Links:

1. www.leetcode.com

2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com
5. https://learndsa.kjsieit.in/

Term work:

1. Term work should consist of 10 experiments.
2. **star (*) marked experiments are compulsory**.
3. Journal must include at least 2 assignments.
4. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral & Practical Exam:

Oral & Practical Exam will be based on the entire syllabus of CEC303 and CEL303

Lab Code	Lab Name	Credit(P+TUT)
CEL304	**Digital Logic & Computer Architecture Lab**	**1-0**

Lab Prerequisite:	C Programming Language
Lab Objectives:	1. To implement operations of the arithmetic unit using algorithms. 2. Design and simulate different digital circuits. 3. To design memory subsystems including cache memory. 4. To demonstrate CPU and ALU design.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Describe the basics of digital components 2. Design the basic building blocks of a computer: ALU, registers, CPU and memory 3. Recognize the importance of digital systems in computer architecture 4. Implement various algorithms for arithmetic operations. 5. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Prerequisite	**-**	**02**
1	To verify the truth table of various logic gates using ICs.	**LO1, LO5**	**02**
2	To realize the gates using universal gates	**LO1, LO5**	**02**
3	Code conversion.	**LO1, LO5**	**02**
4	To realize half adder and full adder.	**LO2, LO5**	**02**
5	To implement logic operation using MUX IC.	**LO3, LO5**	**02**
6	To implement logic operation decoder IC.	**LO3, LO5**	**02**
7	Study of flip flop IC.	**LO3, LO5**	**02**
8	To implement ripple carry adder.	**LO3, LO5**	**02**
9	To implement carry look ahead adder.	**LO3, LO5**	**02**
10	To implement Booth's algorithm.	**LO4, LO5**	**02**
11	To implement a restoring division algorithm.	**LO4, LO5**	**02**
12	To implement non restoring division algorithm.	**LO4, LO5**	**02**
13	To implement ALU design.	**LO2, LO5**	**02**
14	To implement CPU design.	**LO2, LO5**	**02**
15	To implement memory design.	**LO2, LO5**	**02**
16	To implement cache memory design.	**LO2, LO5**	**02**

Note:

1. Any Four experiments from Exp. No. 1 to Exp. No. 7 using hardware.
2. Any Six experiments from Exp. No. 8 to Exp. No. 16 using Virtual Lab, expect Exp. No. 10,11 and 12.
3. Exp. No. 10 to Exp. No. 12 using Programming language.

Useful Link:

Link http://cse10-iitkgp.virtual-labs.ac.in/

Term work:

1. Term work should consist of minimum 10 experiments

2. Journal must include at least 2 assignments on content of theory and practical of the course “Digital Logic &Computer Organization and Architecture”
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Lab Code	Lab Name	Credits (P)
CEL305	**Computer Graphics Lab**	**01**
Lab Prerequisite:	C Programming Language	
Lab Objectives:	1. Understand the need of developing graphics application 2. Learn algorithmic development of graphics primitives like line, circle, polygon etc. 3. Learn the representation and transformation of graphical images and pictures	
Lab Outcomes (LOs):	**At the end of the lab, students will be able to:** 1. Implement various output and filled area primitive algorithms 2. Apply transformation, projection and clipping algorithms on graphical objects 3. Perform curve and fractal generation methods 4. Develop a Graphical application/Animation based on learned concept 5. Apply ethical principles like timeliness and adhere to the rules of the laboratory.	

Content:

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation Curves Visible surface determination. Simple animations Application of these through exercises in C/C++/OpenGL

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	**-**	**02**
1	Implement DDA Line Drawing algorithm (dotted/dashed/thick)	**LO1, LO5**	**02**
2	Implement Bresenham's Line algorithm(dotted/dashed/thick)	**LO1, LO5**	**02**
3	Implement midpoint Circle algorithm.	**LO1, LO5**	**02**
4	Implement midpoint Ellipse algorithm.	**LO1, LO5**	**02**
5	Implement Area Filling Algorithm: Boundary Fill, Flood Fill.	**LO1, LO5**	**02**
6	Implement Scan line Polygon Filling algorithm.	**LO1, LO5**	**02**
7	Implement Curve: Bezier for n control points, B Spline (Uniform)(at least one)	**LO3, LO5**	**02**
8	Implement Fractal generation method (anyone)	**LO3, LO5**	**02**
9	Character Generation: Bit Map method and Stroke Method	**LO1, LO5**	**02**
10	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.	**LO2, LO5**	**02**
11	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.	**LO2, LO5**	**02**
12	Implement polygon clipping algorithm (at least one)	**LO2, LO5**	**02**
13	Program to perform 3D transformation.	**LO2, LO5**	**02**
14	Perform projection of a 3D object on Projection Plane: Parallel and Perspective.	**LO2, LO5**	**02**
15	Perform Animation (such as Rising Sun, Moving Vehicle, Smileys, Screen saver etc. using C/C++/Java/OpenGL/Blender/ any other tool)	**LO1, LO2, LO3, LO4, LO5**	**02**

16.	Case Study: Virtual Reality and Sample program using VRML	**LO4, LO5**	**02**

Virtual Lab Links:

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

Term work:

1. Term work should consist of 10 experiments.
2. Journal must include at least 2 assignments
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral & Practical exam:

Oral & Practical Exam will be based on the entire syllabus of **CEC305** and **CEL305**

Course code	Course Name	Credits
CEPR31	**Project Based Learning: Mini Project Lab-I**	**01**

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

Guidelines for Mini Project

1	Project based learning Mini Project Lab-1 should be implemented preferably using Java programming (CEXS33)
2	Students shall form a group of 2 to 3 students, while forming a group shall not be allowed less than two or more than three students, as it is a group activity.
3	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/internal committee of faculties.
4	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
5	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
8	Students shall convert the best solution into working model using Java programming.
9	The solution to be validated with proper justification and report to be compiled in standard format of the college.

10	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV.
11	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Term Work:

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

Continuous Assessment:

In continuous assessment focus shall also be on each individual student, log book maintained and weekly meeting based on the same..

Distribution of Term work marks for both semesters shall be as below:	**Practical Marks**
Marks awarded by guide/supervisor based on implementation	10
Peer assessment by team members	5
Marks awarded by review committee	5
Quality of Project report	5

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

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

	b. Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on following criteria:

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

Guidelines for Assessment of Mini Project Practical/Oral Examination:

Report should be prepared as per the guidelines issued by the college.
Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of examiners.
Students shall be motivated to participate in poster & project competition on the work in students' competitions.

Mini Project shall be assessed based on following points;

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

Assessment:

Term Work for 25 Marks:

Term work will be based on assessment of Project Implementation and a Logbook which is filled by students on weekly basis as per their weekly progress.

Oral and Practical Exam for 25 Marks:

Based on Project Implementation

Course Code	Course Name	Credits
CEXS33	Skill Based Learning: Object Oriented Programming with Java (SAT-III)	01

Prerequisite:	Structured Programming Approach
Skill Objectives:	1. To learn the basic concepts of object-oriented programming 2. To study JAVA programming language 3. To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc. 4. To explain components of GUI based programming.
Skill Outcomes (SOs):	**At the end of the course, the student will be able to** 1. Apply fundamental programming constructs. 2. Implement the concept of classes and objects, inheritance and interfaces. 3. Implement the concept of strings, arrays, vectors and packages 4. Implement the concept of exception handling and multithreading. 5. Develop GUI based application. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No.	Experiment Title	SO mapped	Hrs /Lab
1	**Title:** Write a program to implement basic programming constructs like branching and looping. **Concepts:** Introduction to Java, Object Oriented Concepts, Java Virtual Machine, Basic programming constructs: variables, data types, and operators, expressions, branching and looping.	**SO1, SO6**	**02**
2	Write a program to demonstrate different ways of accepting user input in Java. **Concepts:** Class, object, data members, member functions, Command Line Argument, Input and output functions in Java, Buffered reader class, Scanner class.	**SO1, SO6**	**02**
3	Write a program to implement the concept of 1. Method overloading 2. Constructor overloading. **Concepts:** Method, how to pass parameters, Method overloading, static members and functions, Introduction to Constructors, Constructor types, Constructor overloading.	**SO2, SO6**	**02**
4	Write a program implement the concept of 2D array and String Manipulation functions in Java. **Concepts:** Array, Strings, String Buffer	**SO3, SO6**	**02**
5	Write a program to implement the concept of Inheritance. **Concepts:** Inheritance, Types of inheritance, extends keyword , super keyword, Access Modifiers	**SO2, SO6**	**02**

6	Write a program to implement the concept of Method Overriding. **Concepts:** Inheritance, Method Overriding.	**SO2, SO6**	**02**
7	Write a program to implement the concept of abstract class and abstract method. **Concepts:** Abstract class and abstract method	**SO2, SO6**	**02**
8	Write a program to implement the concept of package. **Concepts:** Introduction to Packages, Types of Packages-Built-in packages, User defined packages	**SO3, SO6**	**02**
9	Write a program to implement the concept of Exception handling **Concepts:** Exception handling using try, catch, finally, throw and throws, Multiple try and catch blocks, User Defined Exceptions	**SO4, SO6**	**02**
10	Write a program to implement the concept of Multithreading **Concepts:** Introduction to Multithreading, Thread lifecycle, thread class methods, creating threads using extends and implements keyword.	**SO4, SO6**	**02**
11	Design form for Admission process management application system using AWT or Java Swing **Concepts:** Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and color class. Event handling using event class AWT: working with windows, using AWT controls for GUI design Swing class in JAVA.	**SO5, SO6**	**02**
12	Study and Implement the concept of JDBC and Perform CRUD Operation on the form created in 11 using Java Database Connectivity **Concepts:** Introduction to JDBC, JDBC-ODBC connectivity, JDBC architecture.	**SO5, SO6**	**02**

Textbooks

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. E. Balagurusamy, 'Programming with Java', McGraw Hill Education.

Reference Books

1. "JAVA Programming", Black Book, Dreamtech Press
2. Dietaland Dietal, "Java: How to Program", 8th Edition, PHI
3. Ivor Horton, "Beginning JAVA", Wiley India
4. "Learn to Master Java programming", Staredu Solutions

Useful Links:

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

Virtual Lab Link:

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/bots_with_dots/labs/index.html

Assessment:

Term Work for 25 Marks:

Programming labs to be conducted as 2hrs continuous theory + hands-on session. The assessment will be

- An online quiz conducted at the end of every 2-hr session consisting of 5 questions for a total of 10 marks. The average of best 10 quizzes will be considered toward 10 marks out of 25.

- Students should perform minimum 12 experiments. The programs performed along with the screenshot of output have to be submitted within two days. A cover page will be attached stating the aims and objectives. This will be considered towards 10 marks

	Quiz	**Lab Submission**	**Total**
Marks Allotted	10	15	25

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
CEXS34	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 ActivityBased 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.				

	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.

Internship Code	Internship Name	Hours/Duration	Credits
INT32	**Internship-II**	**80-120 hrs (2 -3 Weeks)**	

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/ IPR/ Entrepreneurship	**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
	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 2. 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.

Program Structure for Second Year Computer Engineering
Semester-IV-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC401	Applications of Mathematics in Engineering-II	3– 0 – 1	04	3 – 0 – 1	04	BS
CEC402	Analysis of Algorithm	3– 0 – 0	03	3 – 0 – 0	03	PC
CEC403	Database Management System	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC404	Operating Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC405	Microprocessor	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEL402	Analysis of Algorithm Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL403	Database Management System Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL404	Operating Systems Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEPR42	Project Based Learning- Mini Project Lab-II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
CEXS45	Skill Based Learning: Python Programming (SAT -V)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
CEXS46	Skill Based Learning (SAT-VI) (Foreign and Indian Regional Languages-II)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
INT41	Internship-III	2 to 3 Weeks		--	--	INT
Total		**15-12-01**	**28**	**15 - 06 – 1**	**22**	

*Load of learner, not the faculty $SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Mini Project I and II: Students can form groups with minimum two and maximum four. **Faculty Load:** 1 hour per week per four groups

Semester-IV Examination Scheme

Course Code	Course Name	Marks										
		CA				ESE	ESE duration(Hrs)	TW	O	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA							
CEC401	Applications of Mathematics in Engineering-II	30	30	30	10	60	2.30	25	--	--	--	125
CEC402	Analysis of Algorithms	30	30	30	10	60	2.30	--	--	--	--	100
CEC403	Database Management System	30	30	30	10	60	2.30	--	--	--	--	100
CEC404	Operating System	30	30	30	10	60	2.30	--	--	--	--	100
CEC405	Microprocessor	30	30	30	10	60	2.30	--	--	--	--	100
CEL402	Analysis of Algorithm Lab	--	--	--		--	--	25	--	--	25	50
CEL403	Database Management System Lab	--	--	--	--	--	--	25	--	--	25	50
CEL404	Operating System Lab	--	--	--	--	--	--	25	--	--	25	50
CEPR42	Project Based Learning- Mini Project Lab-II	--	--	--	--	--	--	25	--	--	25	50
CEXS45	Skill Based Learning: Python Programming (SAT -V)	--	--	--	--	--	--	25	--	--	--	25
CEXS46	Skill Based Learning (SAT-VI) (Foreign and Indian Regional Languages-II)	--	--	--	--	--	--	25	--	--	--	25
INT41	Internship-III	--	--	--	--	--	--	--	--	--	--	--
Total		**150**	**150**	**150**	**50**	**300**		**175**	**--**	**--**	**100**	**775**

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	Total
CSC401	Applications of Mathematics in Engineering-II	03	-	1	04

Prerequisites:	1. Engineering Mathematics-I 2. Engineering Mathematics-II 3. Applications of Mathematics in Engineering-I
Course Objectives (COBs):	1. Matrix algebra to understand engineering problems. 2. Line and Contour integrals and expansion of a complex valued function in a power series. 3. To understand the concepts of vector spaces used in the field of machine learning and engineering problems. 4. The concepts of probability distributions and sampling theory for small samples. 5. Linear and Non-linear programming problems of optimization.
Course Outcomes (COs):	**Upon completion of the course, the learners will be able to:** 1. Apply the concepts of eigenvalues and eigenvectors in engineering problems. 2. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals. 3. Apply the concept of vector spaces and orthogonalization process in Engineering Problems. 4. Use the concept of probability distribution and sampling theory to engineering problems. 5. Apply the concept of Linear Programming Problems to optimization. 6. Solve Non-Linear Programming Problems for optimization of engineering problems.

Module No. & Name	Sub-Topics	CO Mapped	Hrs / Sub Topics	Total Hrs/ module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Induction.	**-**	**02**	**02**
1. Linear Algebra (Theory of Matrices)	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (Without proof)	**CO1**	**02**	**06**
	Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		**02**	
	Similarity of matrices, diagonalizable and non-diagonalizable matrices. Self-learning Topics: Derogatory and non-derogatory matrices, functions of Square Matrix, Linear Transformations, Quadratic forms. Singular Value Decomposition		**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)		**03**	

	Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof) Self-learning Topics: Application of Residue Theorem to evaluate real integrations.		**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.		**02**	
	Vector spaces over real field, subspaces. Self-Learning Topics: - Linear combinations, linear Dependence and Independence, QR decomposition.		**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.		**02**	
	Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: test of goodness of fit and independence of attributes, Contingency table. Self-learning Topics: Test significance for large samples, Estimate parameters of a population, Yate's Correction. Binomial distribution, F- distribution.		**02**	
5. Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.	**CO5**	**02**	**06**
	Artificial variables, Big-M method (Method of penalty)		**02**	
	Duality, Dual of LPP and Dual Simplex Method. Self-learning Topics: Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method. Error minimizing LPP.		**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		**02**	
	NLPP with inequality constraint: Kuhn-Tucker conditions. Self-learning Topics: Problems with two inequality constraints, Unconstrained optimization: One-dimensional search method (Golden Search method, Newton's method). Gradient Search method		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**	**01**	**01**
Total Hours				**42**

<table>
<tr><td colspan="2"></td></tr>
<tr><td>Text Books:</td><td>1. E. Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited.
2. R. Jain and S. Iyengar, Advanced Engineering Mathematics, Narosa publication.
3. Brown and Churchill, Complex Variables and Applications, McGraw-Hill Education.</td></tr>
<tr><td>Reference Books:</td><td>1. T. Veerarajan, Probability, Statistics and Random Processes, McGraw-Hill Education.
2. H. Taha, Operations Research: An Introduction, Pearson.
3. S. Rao, Engineering Optimization: Theory and Practice, Wiley-Blackwell.
4. Hira and Gupta, Operations Research, S. Chand Publication</td></tr>
<tr><td>Useful Links:</td><td>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</td></tr>
<tr><td>Term work:</td><td>1. Term work should consist of 6 batch wise tutorials.
2. Journal must include at least 2 assignments on content of theory of the course.
The distribution of term work marks will be as follows
<table><tr><td>1</td><td>Tutorials</td><td>15</td></tr><tr><td>2</td><td>Assignment</td><td>10</td></tr></table></td></tr>
<tr><td>Assessment :</td><td>Continuous Assessment for 40 marks:
1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment – 10 marks
Internal assessment will be based on assignments/quizzes/case study/activity conducted by thefaculty</td></tr>
<tr><td colspan="2">End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration</td></tr>
</table>

Course Code	Course Name	Credits (TH+P+TUT)
CEC402	Analysis of Algorithms	3 - 0 - 0

Prerequisite:	1. Data structure concepts 2. Discrete structures
Course Objectives:	1. To provide mathematical approaches for Analysis of Algorithms 2. To understand and solve problems using various algorithmic approaches 3. To analyze algorithms using various methods
Course Outcomes:	**At the end of the course, the students should be able to** 1. Analyze the running time and space complexity of algorithms 2. Describe, apply and analyze the complexity of divide and conquer strategy. 3. Describe, apply and analyze the complexity of greedy strategy. 4. Describe, apply and analyze the complexity of dynamic programming strategy. 5. Explain and apply backtracking, branch and bound. 6. Explain and apply string matching techniques.

Module No. & Name	Sub-Topics	CO mapped	Hrs / Sub Topics	Total Hrs /Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction	Performance analysis, space and time complexity, Growth of function, Big- Oh, Omega Theta notation. Mathematical background for algorithm analysis.	**CO1**	**02**	**08**
	Complexity class: Definition of P, NP, NP-Hard, NP-Complete		**01**	
	Analysis of selection sort, insertion sort		**02**	
	Recurrences: The substitution method, Recursion tree method, Master method		**03**	
2. Divide and Conquer Approach	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	**CO2**	**05**	**05**
3. Greedy Method Approach	General Method, Single source shortest path: Dijkstra Algorithm Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms	**CO3**	**06**	**06**
	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm All pair shortest path: Floyd Warshall Algorithm	**CO4**	**05**	**10**

4. Dynamic Programming Approach	Assembly-line scheduling Problem, 0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence		**05**	
5. Backtracking and Branch and bound	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring	**CO5**	**03**	**06**
	Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem		**03**	
6. String Matching Algorithms	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	**CO6**	**04**	**04**
ii. Course Conclusion	Recap of Modules, Outcomes, Application and Summarization.	-	**01**	**01**
Total Hours				**42**

Books:

Text Books	1. T. H. Cormen, C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005. 2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.
Reference Books	1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition. **2.** S. K. Basu, "Design Methods and Analysis of Algorithm", PHI**.**

Useful Links:

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

Assessment:

Continuous Assessment for 40 marks:

4. Test 1 – 30 marks
5. Test 2 – 30 marks
6. Internal assessment – 10 marks

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

End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration

Course Code	Course Title	Credits (TH+P+TUT)
CEC403	**Database Management System**	**3 - 0 - 0**
Prerequisite:	Data Structures	
Course Objectives:	1. Develop entity relationship data model and its mapping to relational model 2. Learn relational algebra and Formulate SQL queries 3. Apply normalization techniques to normalize the database 4. Understand the concept of transaction, concurrency control and recovery techniques.	
Course Outcomes:	**After completion of the course students will be able to..** 1. Recognize the need of database management system 2. Design ER and EER diagram for real life applications 3. Construct relational models and write relational algebra queries. 4. Formulate SQL queries 5. Apply the concept of normalization to relational database design. 6. Describe the concept of transaction, concurrency and recovery.	

Module No. & Name	Sub-Topics	CO mapped	Hrs / Sub Topics	Hrs/ module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction	**-**	**02**	**02**
1. Introduction Database Concepts	Introduction, Characteristics and applications of databases, File system v/s Database system,	**CO1**	**01**	**03**
	Data abstraction and data Independence, DBMS system architecture, Database Administrator		**02**	
2. Entity–Relationship Data Model	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys	**CO2**	**03**	**06**
	Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation		**03**	
3. Relational Model and relational Algebra	Introduction to the Relational Model, relational schema and concept of keys.	**CO3**	**02**	**08**
	Mapping the ER and EER Model to the Relational Model		**03**	
	Relational Algebra-operators, Relational Algebra Queries		**03**	
4. Structured Query Language (SQL)	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints	**CO4**	**02**	**06**
	Data Manipulation commands, Data Control commands		**01**	

	Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers, PL/SQL		**03**	
5. Relational-Database Design	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies	**CO5**	**03**	**06**
	First Normal Form, 2NF, 3NF, BCNF, 4NF (Conversion of Normalization forms)		**03**	
6. Transactions Management and Concurrency and Recovery	Transaction concept, Transaction states, ACID properties, Transaction Control Commands	**CO6**	**02**	**10**
	Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based		**04**	
	Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling		**04**	
ii. Course Conclusion:	Recap of Modules, Outcomes, Applications and Summarization.	**-**	**01**	**01**
Total Hrs				**42**

Textbooks:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5thEdition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Useful Links

1.https://nptel.ac.in/courses/106/105/106105175/

2.https://swayam.gov.in/nd1_noc19_cs46/preview

3.https://www.classcentral.com/course/swayam-database-management-system-9914

4.https://www.mooc-list.com/tags/dbms

Assessment:

Continuous Assessment for 40 marks:

1. Test 1– 30 marks
2. Test 2 – 30 marks
3. Internal assessment--10 marks

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

End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC404	Operating Systems	3+0+0

Prerequisite:	1. Data structures 2. Computer architecture
Course Objectives:	1. To introduce basic concepts and functions of operating systems. 2. To understand the concept of process, thread and resource management. 3. To understand the concepts of process synchronization and deadlock. 4. To understand various Memory, I/O and File management techniques.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Describe the objectives, functions and structure of OS 2. Analyze the concept of process management and evaluate performance of process scheduling algorithms. 3. Apply the concepts of synchronization and deadlocks 4. Evaluate performance of Memory allocation and replacement policies 5. Explain the concepts of file management. 6. Apply concepts of I/O management and analyze techniques of disk scheduling.

Module No & Name	Sub-Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisite	Prerequisites concepts and course introduction	--	**02**	**02**
1. Operating system Overview	Introduction, Objectives, Functions and Evolution of Operating System	**CO1**	**01**	**04**
	Operating system structures: Layered, Monolithic and Microkernel		**01**	
	Linux Kernel, Shell and Shell Programming, System Calls		**02**	
2. Process and Process Scheduling	Concept of a Process, Process States, Process Description, Process Control Block.	**CO2**	**02**	**09**
	Uniprocessor Scheduling-Types: Preemptive and Non-preemptive , scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)		**04**	
	Threads: Definition and Types, Concept of Multithreading		**03**	
3. Process Synchronization and Deadlocks	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization	**CO3**	**02**	**09**
	Mutual Exclusion: Requirements Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem		**03**	

	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm		**02**	
	Deadlock Detection and Recovery, Dining Philosophers Problem		**02**	
4. Memory Management	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, DynamicPartitioning	**CO4**	**02**	**09**
	Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit		**02**	
	Paging and Segmentation, TLB		**02**	
	Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing		**03**	
5. File Management	Overview, File Organization and Access	**CO5**	**02**	**04**
	File Directories		**01**	
	File Sharing		**01**	
6. IO Management	I/O devices, Organization of the I/O Function, Disk Organization	**CO6**	**01**	**04**
	I/O management		**01**	
	Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK		**02**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:

Text Books	1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913, ISBN-13: 9780133805918. 2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
Reference Books	1. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition. 2. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition 3. Maurice J. Bach, "Design of UNIX Operating System", PHI 4. Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4th Edition

Useful Links:

1. https://swayam.gov.in/nd1_noc19_cs50/preview
2. https://nptel.ac.in/courses/117/106/117106113/
3. https://nptel.ac.in/courses/117/106/117106113/
4. https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559
5. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/CRUX/labs/exp1/theory.html

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment –10 marks

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

End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC405	**Microprocessor**	3 +0 +0

Prerequisite:	Digital Logic and Computer Architecture.
Course Objectives:	1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors. 2. To emphasize on instruction set and logic to build assembly language programs 3. To prepare students for higher processor architectures and embedded systems.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Describe core concepts of 8086 microprocessor. 2. Interpret the instructions of 8086 and write assembly language programs. 3. Identify the specifications of peripheral chip 4. Design 8086 based system using memory and peripheral chips. 5. Explain the architecture of advanced processors 6. Describe hyper threading technology

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and course outlines	Prerequisite Concept and Introduction	**--**	**02**	**02**
1. The Intel Microprocessors 8086 Architecture	8086CPU Architecture, Programmer's Model, Functional Pin Diagram	**CO1**	**02**	**08**
	Memory Segmentation Banking in 8086, Demultiplexing of Address /Data bus		**02**	
	Functioning of 8086 in Minimum mode and Maximum mode		**02**	
	Timing diagrams for Read and Write operations in minimum and maximum mode, Interrupt structure and its servicing		**02**	
2. Instruction Set and Programming	Addressing Modes, Instruction set-Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions	**CO2**	**03**	**06**

	Assembler Directives and Assembly Language Programming, Macros, Procedures. Simulation of small program on different instruction set.		**03**	
3. Memory and Peripherals interfacing	Memory Interfacing - RAM and ROM Decoding, Techniques – Partial and Absolute 8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086	**CO3**	**03**	**08**
	8257-DMAC-Block diagram, DMA operations and transfer modes		**02**	
	Programmable Interrupt Controller 8259-Block Diagram, Interfacing the 8259 in single and cascaded mode		**03**	
4. Intel 80386DX Processor	Architecture of 80386 microprocessor	**CO4**	**01**	**07**
	80386 registers–General purpose Registers, EFLAGS and Control registers		**02**	
	Real mode, Protected mode, virtual 8086 mode		**02**	
	80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism		**02**	
5. Pentium Processor	Pentium Architecture, Superscalar Operation,	**CO5**	**02**	**06**
	Integer &Floating-Point Pipeline Stages, Branch Prediction Logic		**02**	
	Cache Organization and MESI protocol		**02**	
6. Pentium 4 and ARM Processor	Comparative study of 8086, 80386, Pentium I, Pentium II and Pentium III, Pentium 4: Net burst micro architecture	**CO6**	**02**	**04**
	Instruction translation look aside buffer and branch prediction, Hyper threading technology and its use in Pentium 4, Application and Features of ARM processors		**02**	
ii. Course Conclusion	Recap of modules, Outcomes, Applications and summarization.		**01**	**01**
Total Hours				**42**
Books:				
Text Books:	1. John Uffenbeck, "8086/8088 family: *Design Programming and Interfacing",* PHI. 2. Yu-Cheng Liu, Glenn A. Gibson, *"Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design",* Prentice Hall 3. Walter A. Triebel, *"The 80386DX Microprocessor: hardware, Software and Interfacing",* Prentice Hall *4.* Tom Shanley and Don Anderson, *"Pentium Processor System*			

	Architecture", Addison-Wesley.
Reference Books	1. Barry B. Brey*, "Intel Microprocessors",* 8thEdition, Pearson Education India 2. Intel Manual Peter Abel*, "IBM PC Assembly language and Programming",* 5th Edition, PHI 3. James Antonakons, *"The Pentium Microprocessor*", Pearson Education 4. K. M. Bhurchandani and A. K. Ray*, "Advanced Microprocessors and Peripherals",* McGraw Hill 5. Douglas Hall, *"Microprocessor and Interfacing"*, Tata McGraw Hill.

Useful Links:

1. https://swayam.gov.in/nd1_noc20_ee11/preview
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4. https://www.mooc-list.com/tags/microprocessors

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment –10 marks

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

End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration.

Lab Code	Lab Name	Credits (P+TUT)
CEL402	Analysis of Algorithms Lab	1+ 0

Prerequisite:	Basic knowledge of programming and data structure
Lab Objectives:	1. To introduce the methods of designing and analyzing algorithms 2. Design and implement efficient algorithms for a specified application 3. Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem. 4. Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Implement the algorithms using different approaches 2. Analyze the complexities of various algorithms 3. Compare the complexity of the algorithms for specific problems 4. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Lab Prerequisites	**-**	**02**
1	**Introduction:(Implement any 2)** Selection sort, Insertion sort	**LO1, LO2, LO3, LO4**	**04**
2	**Divide and Conquer Approach :(Implement any 2)** Finding Minimum and Maximum, Merge sort, Quick sort, Binary search	**LO1, LO2, LO3, LO4**	**04**
3	**Greedy Method Approach :(Implement any 2)** Single source shortest path-Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm	**LO1, LO3, LO4**	**04**
4	**Dynamic Programming Approach:(Implement any 2)** Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall , 0/1 knapsack, Travelling salesperson problem Longest common subsequence	**LO1, LO4**	**04**
5	**Backtracking and Branch and bound:(Implement any 2)** N-queen problem Sum of subsets Graph coloring	**LO1, LO4**	**04**
6	**String Matching Algorithms:(Implement any 2)** The Naïve string-matching Algorithms The Rabin Karp algorithm The Knuth-Morris-Pratt algorithm	**LO1, LO4**	**06**

Text Books	1. T. H. Cormen, C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005. 2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.
Reference Books	1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition. **2.** S. K. Basu, "Design Methods and Analysis of Algorithm", PHI**.**

Useful Links:

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

Term work:

1. Term work should consist of at least 10 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Analysis of Algorithms"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral & Practical Exam:

Oral & practical examination will be based on entire syllabus of CEC402 and CEL402

Lab Code	Lab Name	Credits (P+TUT)
CEL403	**Database Management System Lab**	**1-0**
Prerequisite:	Data structures	
Lab Objectives:	1. To explore design and develop of relational model 2. To present SQL and procedural interfaces to SQL comprehensively 3. To introduce the concepts of transactions and transaction processing	
Lab Outcomes (LOs):	**At the end of the course, the students will be able to** 1. Design ER /EER diagram and convert it to a relational model for the real world application. 2. Apply DDL, DML, DCL and TCL commands 3. Write simple and complex queries 4. Use PL / SQL Constructs. 5. Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.	

Suggested List of Experiments		**LO Mapped**	**Hrs /Lab**
Lab No.	**Title of Experiment**		
0	Prerequisite	**-**	**02**
1	Identify the case study and detailed statement of the problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.	**LO1, LO6**	**02**
2	Mapping ER/EER to Relational schema model.	**LO1, LO6**	**02**
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System	**LO2, LO6**	**02**
4	Apply DML Commands for the specified system	**LO2, LO6**	**02**
5	Perform Simple queries, string manipulation operations and aggregate functions.	**LO3, LO6**	**02**
6	Implement various Join operations.	**LO3, LO6**	**02**
7	Perform Nested and Complex queries	**LO3, LO6**	**02**
8	Perform DCL and TCL commands	**LO2, LO6**	**02**
9	Implement procedure and functions	**LO4, LO6**	**02**
10	Execution of CRUD operations from front end using Database connectivity.	**LO5, LO6**	**02**
11	Implementation of Views and Triggers.	**LO4, LO6**	**02**
12	Implementation and demonstration of Transaction and Concurrency control techniques using locks.	**LO5, LO6**	**02**

Term Work:

1. Term work should consist of 10 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of "Database Management System"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral & Practical Exam:

Oral & Practical Exam will be conducted based on the entire syllabus of CEC403 and CEL403

Lab Code	Lab Name	Credits (P+TUT)
CEL404	**Operating Systems Lab**	**1-0**

Prerequisite:	1. Computer Organization 2. Data Structures and Algorithms
Lab Objectives:	1. To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment. 2. To familiarize students with the architecture of Linux OS. 3. To provide necessary skills for developing and debugging programs in Linux environment. 4. To learn programmatically to implement simple operation system mechanisms
Lab Outcomes (LOs):	**At the end of the course, the student will be able to:** 1. Demonstrate basic Operating system Commands, Shell scripts, System Calls and API with respect to Linux 2. Implement various process scheduling algorithms and evaluate their performance. 3. Implement and analyze concepts of synchronization and deadlocks. 4. Implement various Memory Management techniques and evaluate their performance. 5. Implement and analyze concepts of virtual memory, concepts of file management and I/O management techniques. 6. Apply ethical principles like timeliness and adhere to rules of laboratory.

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	**-**	**02**
1	**<u>Explore Linux Commands</u>** **Explore usage of basic Linux Commands and system calls for file, directory and process management.** Commands: mkdir, chdir, cat, ls, chown, chmod, chgrp, ps etc. System Calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. sort, grep, awk, etc.	**LO1, LO6**	**02**
2	**<u>Linux shell script</u>** Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. e. Display current shell, home directory, operating system type, current path setting, current working directory	**LO1, LO6**	**02**

3	**<u>Linux- API</u>** Implement any one basic commands of Linux like ls, cp, mv and others using kernel APIs.	**LO1, LO6**	**02**
4	**<u>Linux- Process</u>** a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. b. Explore wait and waitpid before termination of process.	**LO2, LO6**	**02**
5	**Process Management: Scheduling** a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms	**LO2, LO6**	**02**
6	**Process Management: Synchronization** a. Write a C program to implement solution of Producer consumer problem through Semaphore b. Write a C program to implement solution of Reader's Writer's problem through Semaphore	**LO3, LO6**	**02**
7	**<u>Process Management: Deadlock</u>** a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm b. Write a program demonstrate the concept of Dining Philosopher's Problem c. Simulate deadlock detection using CPU-OS Simulator	**LO3, LO6**	**02**
8	**<u>Memory Management</u>** a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e., Best Fit, First Fit, Worst-Fit etc.	**LO4, LO6**	**02**
9	**<u>Memory Management: Virtual Memory</u>** a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.	**LO5, LO6**	**02**
10	**<u>File Management & I/O Management</u>** a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. c. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN	**LO5, LO6**	**02**
Virtual Lab Links:			
1. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/CRUX/labs/exp1/theory.html			

Term work:

1. Term work should consist of a minimum of 10 experiments covering all modules.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Operating Systems"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Practical & Oral Exam:

Oral & Practical Exam will be conducted based on the entire syllabus of CEC404 and CEL404

Course code	Course Name	Credits
CEPR42	Project Based Learning: Mini Project Lab-II	01

Objectives:	1. To acquaint yourself with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint yourself with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.
Outcome:	**After successful completion of this course learner will be able to…** 1. Identify problems based on societal /research needs. 2. Design solutions or system components or processes that meet the specified needs 3. Select appropriate tools to implement the project. 4. Develop interpersonal skills to work as a member of a group or leader 5. Excel in written and oral communication. 6. Demonstrate project management principles during project work. 7. Demonstrate capabilities of investigation and self-learning by oneself or as a team gaining life skills

Guidelines for Mini Project

1	Project based learning Mini Project Lab-1 should be implemented preferably using Python programming (CEXS45)
2	Students shall form a group of 2 to 3 students, while forming a group shall not be allowed less than two or more than three students, as it is a group activity.
3	Students should do survey and identify needs, which shall be converted into problem statements for mini project in consultation with faculty supervisor/internal committee of faculties.
4	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
5	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
8	Students shall convert the best solution into working model using Python Programming.
9	The solution to be validated with proper justification and report to be compiled in standard format of the college.

10	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV.
11	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Term Work

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

Continuous Assessment

In continuous assessment focus shall also be on each individual student, log book maintained and weekly meeting based on the same.

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

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

Project:

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

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria:

1	Quality of survey and identification of problem statement
2	Innovativeness in solutions
3	Implementation

4	Team work
5	Project report
Guidelines for Assessment of Mini Project Practical/Oral Examination:	
1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
Mini Project shall be assessed based on following points:	
1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

Total Marks = Term work +Oral & Practical = (25+25)

25 marks of Term work will be given on the basis of evaluation of project practical marks and Log book which is filled weekly by students as per their weekly progress.

25 marks of Oral and practical will be based on a project implementation.

Course Code	Course Name	Credits (TH+P+TUT)
CEXS45	Skill Based learning: Python Programming (SAT-V)	0 + 1 + 0

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

Module	Sub Topics	SO mapped	Hrs / Sub topics	Total Hrs / Module
i. Prerequisites and Course Outline	**Introduction to python, Features, Applications, Comparison with C and Java**			**02**
1. Python basics	Data types in python, Operators in python, Input and Output	**SO1, SO6**	**01**	**04**
	Control statement, Arrays in python		**01**	
	String and Character in python, Functions, List and Tuples, Dictionaries Exception		**01**	
	Introduction to OOP, Classes, Objects, Interfaces, Inheritance		**01**	
2. Advanced Python	Files in Python, Directories	**SO2, SO6**	**01**	**04**
	Building Modules		**01**	
	Packages, Text Processing		**01**	
	Regular expression in python		**01**	
3. Data Structure in Python	Link List, Stack	**SO3, SO6**	**02**	**04**
	Queues, Dequeues		**02**	
4. Python Integration Primer	Graphical User interface, Networking in Python	**SO4, SO6**	**01**	**04**
	Python database connectivity		**01**	
	Introduction to Django		**02**	
5.Multithreading	Thread and Process, Starting a thread	**SO5, SO6**	**01**	**04**
	Threading module, Synchronizing threads		**02**	
	Multithreaded Priority Queue		**01**	

6. NumPy and Pandas	Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types	**SO4, SO6**	**02**	**06**
	Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O		**02**	
	Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames		**02**	
Total Hours				**28**

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

Suggested experiments using Python:

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

9	Programs on Threading using python.
10	Exploring basics of NumPy Methods.
11	Program to demonstrate use of NumPy: Array objects.
12	Program to demonstrate Data Series and Data Frames using Pandas.
13	Program to send email and read content of URL.

Term Work for 25 Marks:

Programming labs to be conducted as 2 hrs continuous (theory + hands-on) session.
The assessment will be

- An online quiz conducted at the end of every 2-hr session consisting of 5 questions for a total of 10 marks. The average of best 10 quizzes will be considered toward 10 marks.

- Students should perform minimum 10 experiments. The programs performed along with the screenshot of output have to be submitted within two days. A cover page will be attached stating the aims and objectives. This will be considered towards 10 marks.
- Attendance= 05 marks

	Quiz	**Lab Submission**	**Total**
Marks Allotted	10	10	25

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
CEXS46	SAT – VI: Skill-Based Learning (Foreign and/or Indian Regional Languages-II)	-	01	-	01
SBL Objectives (SOBs):	1. Acquire reading and writing proficiency in the target language 2. Understand the common heritage of, and diversity among, countries that speak the target language. 3. Communicate and interact effectively with citizens of the target cultures.				
SBL Outcome (SOs):	Upon completion of the course, the learners will be able to: 1. Demonstrate 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 suggestive given list of course but are not limited to the list as it's a learner's choice for the interested course in the given semester time frame.				

Sr No.	Suggestive list of Courses-
1	Introduction to Japanese Language and Culture
2	German – 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

Online Resources:

Sr No	Suggestive Courses Link but are not limited to following resources 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 https://www.coursera.org/learn/spanish-vocabulary-cultural-experience https://www.coursera.org/learn/spanish-vocabulary-sports-travel-home https://www.coursera.org/learn/spanish-vocabulary-careers https://www.coursera.org/learn/spanish-vocabulary-project
5	https://www.coursera.org/learn/korean-beginners https://www.coursera.org/learn/learn-korean https://www.coursera.org/learn/learn-speak-korean1 https://www.coursera.org/learn/the-korean-alphabet-an-introduction-to-hangeul
6	https://www.udemy.com/course/complete-french-course/
7	https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/
8	https://www.udemy.com/course/spanish-101-beginning-spanish-spanish-for-beginners/
9	https://www.udemy.com/course/complete-japanese-course-learn-japanese-for-beginners-lvl-1/
10	https://www.udemy.com/course/complete-korean-course-learn-korean-for-beginners-level-1/
11	https://www.udemy.com/course/the-complete-russian-language-course/
12	https://onlinecourses.nptel.ac.in/noc22_hs114/preview
13	https://onlinecourses.nptel.ac.in/noc22_hs85/preview
14	https://onlinecourses.nptel.ac.in/noc22_hs139/preview

Internship Code	Internship Name	Hours/Duration	Credits
INT43	**Internship-III**	**80-120 hrs (2 - 3 Weeks)**	

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.

	Mining Social-Network Graphs Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities, Case study on social network graphs.		**02**	
6. **Data Analytics with R**	Introduction to basics of R, Introduction toRStudio, Working directories in RStudio, datatypes, operators in R, Pipe operator		**01**	**06**
	Basic Expressions in R, Variables in R, Working with Vectors, Storing and Calculating Values in R, Creating and using Objects, Interacting with users,		**02**	
	Handling data in R workspace, Executing Scripts, Creating Plots, Accessing help and documentation in R,		**01**	
	Reading datasets and Exporting data from R, Manipulating and Processing Data in R, Using functions instead of script, built-in functions in R,		**01**	
	Data Visualization: Types, Applications		**01**	
ii. Course Conclusion	Recap of Modules, Outcomes, Application and Summarization	**--**		**01**
Total Hours				**42**

Books:	
Text Books	1. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press. 2. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press. 3. Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press 4. Dr. Bharti Motwani “Data Analytics with R”, Wiley
Reference Books	1. Bill Franks “Taming the Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley 2. Chuck Lam, “Hadoop in Action”, Dreamtech Press 3. Jared Dean, “Big Data, Data Mining and Machine Learning: Value Creation for Business Leaders and Practitioners”, Wiley India Private Limited, 2014. 4. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd ed, 2010. 5. Lior Rokach and Oded Maimon, “Data Mining and Knowledge Discovery Handbook”, Springer 2nd Edition, 2010 6. Ronen Feldman and James Sanger, “The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”, Cambridge University Press, 2006

	7. Vojislav Kecman, “Learning and Soft Computing”, MIT Press, 2010. 8. Tom White “Hadoop: The Definitive Guide”, O'Reilly Media, Inc., June 2009
Useful Links:	
1. https://hadoop.apache.org 2. https://hadoop.apache.org/docs/r2.8.0/hadoop-project-dist/hadoop-common/core-default.xml	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks Average of 2 tests out of 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 minutes duration.	

SOMAIYA

VIDYAVIHAR

K J Somaiya Institute of Engineering and Information Technology

An Autonomous Institute affiliated to 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 from FY students)

SOMAIYA
VIDYAVIHAR

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

FY: (Sem II)			
Internship Code	**Course Name**	**Hours/Duration**	**Credits**
INT21	Internship-I	80-120 hrs (2-3 Weeks) Winter Vacation **After SEM-I & during SEM-II of FY**	02

Prerequisite:	**Fundamental knowledge of Engineering and Technology**
Internship Objectives:	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.
Internship Outcomes:	**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.
Activity- Inter/Intra Institutional Activities	**Supporting Activities to be completed under Internship**
	• Attending Industry Workshops organised by departments
	• Working in consultancy or research project initiated by department
	• Technical festival (participation)
	• Working in IIC Cell, Entrepreneurship Cell, NISP, IPR cell and/or any other technical professional body/cell/committee/club of the institute
	• Activities related to Incubation or Innovation
	• Learning in departmental Labs, Tinkering Lab

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. 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/ IPR/ Entrepreneurship	**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		
	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.		
	Supporting Activities to be completed under Internship		

Activity- 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.		
	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		

Activity- PBL Major Project B Work/Conference Presentation	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