



SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Technology

An Autonomous Institute Permanently Affiliated to the University of Mumbai

7th AC Agenda
No. 4.B.2
Dated 5th July 2024

Autonomy Syllabus Scheme III (2023-24)

(As per NEP 2020 Guidelines)

for

Four Year Multidisciplinary

Bachelors of Technology (B.Tech.) Program

in

Computer Engineering

with

Multiple Entry and Multiple Exit Options

Levels 4.5 - 6

**(First Year Effective from A.Y. 2023-24,
Second Year Effective from A.Y. 2024-25,
Third Year Effective from A.Y. 2025-26,
Last Year Effective from A.Y. 2026-27)**

From the Principal's Desk:

To address the changing demands of the digital era, it is required to create a future-ready workforce that can navigate the complexities of an interconnected world, drive innovation, and contribute to the nation's growth. The **National Educational Policy 2020 (NEP 2020)** framed by the Government of India recommends a holistic, inclusive, and flexible approach to ensure equitable access to quality education across all levels, promote multidisciplinary research, and impart skill-based education with integration of technology. As per guidelines by the Department of Higher and Technical Education, Government of Maharashtra, the salient features of NEP 2020 aligned curriculum should include:

- Major (Core) Mandatory and Elective Courses
- Open Elective Courses
- Vocational and Skill Enhancement Courses
- Ability Enhancement Courses, Indian Knowledge System, and Value Education Courses
- Co-curricular Courses and Field Projects / Community Engagement Projects / Internship
- Multidisciplinary Minor Courses
- Option for Bachelor's Degree with Honours (based on Additional Credits)
- Option for Bachelor's Degree – Honours with Research (based on Additional Credits)
- Option for Bachelor's Degree with Double Minors (based on Additional Credits)
- Multiple Entry and Multiple Exit Options

Being an **autonomous institute** since the Academic Year 2021-22, **K. J. Somaiya Institute of Technology (KJSIT)**, has well-adapted newer approaches to reach higher levels of excellence in engineering education. Ahead of its time, the academic reforms at KJSIT have already addressed majority of these NEP 2020 aspects through its existing **Syllabus Scheme I, II, and II B** implemented under the academic autonomy. For a complete alignment with NEP 2020, the **KJSIT Autonomy Syllabus Scheme III** is introduced, to be effective from Academic Year 2023-24 across all the branches, progressively from First Year Engineering.

Specifically, the existing curriculum already comprise state-of-the-art **Major (Core) courses** in theory and practical. With an ideology that the root of innovation is 'interest', the curriculum offers wide range of Elective courses — grouped into **Major-related Electives** and **Inter-disciplinary / Open Electives**. At par with international engineering education, it follows a learner-centric approach as well as promotes MOOCs, where the students can choose to study courses concerning areas of their interests, and the same is continued in Scheme III.

Further, under the theme of "Learning by Doing", the existing curriculum includes 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 are practiced across the first three years of engineering, focusing on responsibilities towards society, problem-solving abilities, communication skills, ethics, leadership and teamwork, motivation for life-long learning, skills on emerging areas of technology, skills on different languages, etc. In the Syllabus Scheme III, these SAT courses are now aligned and offered as **Vocational Skill - SAT (VS - SAT) courses**, **Skill Enhancement - SAT (SE - SAT) courses**, **Ability Enhancement - SAT (AE - SAT) courses**, and **Value Education - SAT (VE - SAT) courses**.

Further, **Indian Knowledge System - SAT (IKS - SAT) course** is newly introduced in Scheme III that emphasizes on drawing insights from ancient wisdom to address modern challenges. Also, as an extension to the induction program for the First Year students, the introduced **Co-curricular - SAT (CC - SAT) course** aims to induct incumbents with the institutional practices, culture, and values, as well as encourage participation in co-curricular activities.

The component of **Project-Based Learning (PBL)** included in the Syllabus Scheme II is carried forward to Scheme III, wherein the students develop **Community Engagement / Field Projects** in Second, Third, and Last Year as Mini, Minor, and Major Projects respectively. Scheme III also retains the **Internship** component, offered with credits, to equip graduates with the industry trends, practices, and skills required at national and global level. The duality of PBL and Internship enables student involvement in research, innovation, and entrepreneurship, which are the fulcrums of higher education.

As a new introduction in line with NEP 2020, the Syllabus Scheme III incorporates mandatory **Multidisciplinary Minor courses** in Innovation and Entrepreneurship, Biotechnology, IoT and Cloud Computing, Geographical Information System, Very Large Scale Integration (VLSI) and Artificial Intelligence. These courses promote interdisciplinary thinking and broaden the career prospects, enabling students to develop solutions to real-world problems by combining expertise from multiple domains.

Aligned with NEP 2020, the Scheme III retains the initiative taken through Scheme II / II B of offering **Honours courses** 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. These Honours courses correspond to high-end industry standards and offer multi-fold opportunities of specialization.

As per NEP 2020, the above curricular aspects of Four Years UG Engineering Programme shall be offered with **Multiple Entry and Multiple Exit options**, leading to the conferment of:

- **One Year UG Certificate in Technology:** Awarded after completing First Year of Engineering and acquiring additional 08 credits immediately after First Year.
- **Two Years UG Diploma in Technology:** Awarded after completing Second Year of Engineering and acquiring additional 08 credits immediately after Second Year.
- **Three Years Bachelor's Degree in Vocation (B.Voc.):** Awarded after completing Third Year of Engineering and acquiring additional 08 credits immediately after Third Year.
- **Four Years Bachelor's Degree in Technology (B.Tech.) with Multidisciplinary Minor:** Awarded after completing Fourth Year of Engineering.
- **Four Years Bachelor's Degree in Technology (B.Tech.) Honors with Multidisciplinary Minor:** Awarded after completing Fourth Year of Engineering and acquiring additional 18 credits through Honours courses in respective major discipline over Third & Fourth Year of Engineering.
- **Four Years Bachelor's Degree in Technology (B.Tech.) Honors with Research and Multidisciplinary Minor:** Awarded after completing Fourth Year of Engineering and acquiring additional 18 credits through a research project in respective major discipline during Fourth Year of Engineering.
- **Four Years Bachelor's Degree in Technology (B.Tech.) with Double Minors (Multidisciplinary & Specialization):** Awarded after completing Fourth Year of Engineering and acquiring additional 18 credits through additional courses in another Engg. / Tech. discipline during Second to Fourth Year of Engineering.

Through the implementation of Autonomy Syllabus Scheme III (as per NEP 2020 Guidelines), strategic planning, and joint efforts of all stakeholders, KJSIT is endeavouring to enhance the quality of engineering education and set a benchmark for all the autonomous institutes nationwide.

Dr. Vivek Sunnapwar
Principal and Chairman - Academic Council

Chairperson BoS Computer Engineering:

The National Education Policy 2020 (NEP 2020) introduced by the Government of India, aims to ensure that quality education is accessible to all, while fostering multidisciplinary research and integrating skill-based learning with advanced technology. The Department of Higher and Technical Education, Maharashtra, emphasizes key elements for an NEP 2020-aligned curriculum includes, Core and Elective Courses, Vocational and Skill Enhancement Courses, Ability Enhancement Courses, Indian Knowledge System and Value Education, Co-curricular Activities and Projects, Multidisciplinary Minor Courses and Flexible Degree Options.

Since attaining autonomy in the academic year 2021-22, the computer engineering department at KJSIT has proactively implemented progressive educational reforms. Our existing Syllabus Schemes I, II, and II B have already integrated many NEP 2020 principles, focusing on robust core courses and a diverse array of electives that cater to both major-related and interdisciplinary interests. To achieve full alignment with NEP 2020, KJSIT has introduced the Autonomy Syllabus Scheme III, effective from the Academic Year 2023-24 starting from first year. According to this it is my privilege to present the revised autonomy scheme-III as per NEP implementation and detailed syllabus of Bachelor of Technology, BTech in computer engineering from academic year 2024-25, for second year students i.e. semester III and IV. The syllabus introduces mandatory Multidisciplinary Minor courses in critical areas such as Innovation and Entrepreneurship, Biotechnology, IoT and Cloud Computing, GIS and VLSI. These courses encourage interdisciplinary collaboration and equip students to tackle complex challenges through innovative solutions.

The curriculum includes Skill-Based Learning (SBL), Activity-Based Learning (ABL), and Technology-Based Learning (TBL) courses, collectively known as exposure (SAT) courses. We have enhanced these offerings by aligning SAT courses into specialized categories like Vocational Skill (VS-SAT), Skill Enhancement (SE-SAT), Ability Enhancement (AE-SAT), and Value Education (VE-SAT), catering to varied student interests and career aspirations.

Apart from this, scheme III maintains the robust Project-Based Learning (PBL) framework from Scheme II, with students engaging in Community Engagement and Field Projects throughout their academic journey.

Moreover, institute continues its initiative of offering Honours courses aligned with emerging technologies recognized by AICTE, including IoT, AI & ML, Cyber Security, AR & VR, Data Science, and Blockchain. These specialized tracks are designed to meet industry standards and provide students with extensive opportunities for specialization and career advancement.

The board of studies appreciates the excellent work and contributions of the Coordinators and Members of the committee. They have given many inputs and guidelines for making the syllabi what it is now.

In conclusion, KJSIT's proactive approach to integrating NEP 2020 guidelines not only enhances educational quality but also prepares students to excel in a competitive global landscape, fostering innovation, leadership, and societal impact through robust, forward-thinking curricular frameworks.

Dr. Sarita P. Ambadekar

HOD Computer Engineering Department

Dr. Sarita Ambadekar

Chairperson BoS, Head of the Department

Two Experts in the subject from outside the parent University to be nominated by the Academic Council

1. Dr. Ratnadeep Deshmukh

Professor & Head, Dept of CS & IT, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

2. Dr. Preeti Patil

Associate Professor and Head of IT dept.

D. Y. Patil Pratishthans D.Y. Patil College of Engineering, Pune

One expert to be nominated by the Vice-Chancellor from a panel of six recommended by the College Principal.

1. Dr. Sangita Chaudhari

Professor & Head Information Technology,

Ramrao Adik Institute of Technology. Dr D Y Patil Vidyanagar, Nerul Navi Mumbai

Spatial invitee, Representative from Industry/Corporate Sector/Allied Area relating to Placement

1. Mr. Pankaj Kumar Bhagat

Program Head-Intellectual Property (IP) at Mastek Limited

Chennai, Tamil Nadu, India

The entire faculty members of each specialization

Dr. Shyamal Virnodkar,

Ms. Mrunali Desai,

Ms. Kavita Bathe,

Dr. Jyoti Wadmare

Ms. Chitra Bhole,

Ms. Nisha Vanjari,

Ms. Shubhada Labde,

Dr. Madar Bivalkar,

Dr. Dhanshree Toradmalle,

Ms. Aarti Sahitya,

Ms. Pradnya Patil,

Dr. Madhura Phadke,

Dr. Shreya Patankar,

Ms. Pradnya Bhangale,

Ms. Minal Sonkar,

Mr. Abhijit Patil,

Dr. Nilesh Yadav,

Dr. Surekha Janrao

Nomenclature and Alignment of Verticals and Components

Verticals as per NEP 2020 Guidelines	Components Aligning with KJSIT Autonomy Syllabus Scheme I / II / II B	Nomenclature for KJSIT Autonomy Syllabus Scheme III Aligned with NEP 2020 Guidelines
Basic and Engineering Science Courses	Basic Science (BS) Course	Basic Science (BS) Courses
	Engineering Science (ES) Course	Engineering Science (ES) Courses
Major Courses	Professional Core (PC) Courses	Major / Professional Core (PC) Courses
	Professional Elective - Department-level (PE-DLC) Courses	Major / Professional Elective - Department-level (PE-DLC) Courses
Generic / Open Elective Courses	Open Elective - Institute-level (OE-ILC) Courses	Open Elective - Institute-level (OE-ILC) Courses
Multidisciplinary Minor Courses	-	Multidisciplinary Minor (MM) Courses
Vocational Skill Courses	Workshop I; Workshop II; SAT Courses – TBL	Vocational Skill - SAT (VS-SAT) Courses
Skill Enhancement Courses	SAT Courses – SBL (Program Specific)	Skill Enhancement - SAT (SE-SAT) Courses
Ability Enhancement Courses	Professional Communication Skills; SAT Course – SBL (Foreign and/or Indian Modern Languages)	Ability Enhancement - SAT (AE - SAT) Courses
Indian Knowledge System Courses	-	Indian Knowledge System - SAT (IKS - SAT) Courses
Value Education Courses	SAT Course – ABL (National, Global, Societal and Environmental Aspects); Business Communication & Ethics	Value Education - SAT (VE - SAT) Courses
Field Projects / Community Engagement Projects	PBL – Mini, Minor, Major	Community Engagement – Project-Based Learning (PBL)
Internship / Apprenticeship	Internship	Internship (INT)
Co-curricular Courses	Student Induction Program	Co-curricular - SAT (CC - SAT) Courses

Other Abbreviations:

- SAT – Skill/Activity/Technology-Based Learning (Exposure Courses)
- TH – Theory
- P – Practical
- TUT – Tutorial
- T1 – Test 1
- T2 – Test 2
- CA – Continuous Assessment Test (T = T1 + T2)
- ESE – End Semester Exam
- TW – Term Work
- O – Oral Exam
- P – Practical Exam
- P&O – Practical & Oral
- MM- Multidisciplinary Minor

Programs Offered with Multiple Entry Multiple Exit Options

Level 4.5: UG Certificate in Technology

Disciplines:	<ul style="list-style-type: none">• Information Technology• Computer Engineering• Artificial Intelligence & Data Science• Electronics and Telecommunication
Years of Study:	01 Year
Semesters:	1 and 2
Credits:	42
Additional Requirements:	08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major during Summer Vacation after 1 st Year

Level 5: UG Diploma in Technology

Disciplines:	<ul style="list-style-type: none">• Information Technology• Computer Engineering• Artificial Intelligence & Data Science• Electronics and Telecommunication
Years of Study:	02 Years
Semesters:	1, 2, 3, 4
Credits:	85
Additional Requirements:	08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major during Summer Vacation after 2 nd Year

Level 5.5: Bachelor's Degree in Vocation (B. Voc.)

Disciplines:	<ul style="list-style-type: none">• Information Technology• Computer Engineering• Artificial Intelligence & Data Science• Electronics and Telecommunication
Years of Study:	03 Years
Semesters:	1, 2, 3, 4, 5, 6
Credits:	130
Additional Requirements:	08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major during Summer Vacation after 3 rd Year

Level 6: B.Tech. in Technology with Multidisciplinary Minor

Major Disciplines with Offered Multidisciplinary Minors:	Minor	Innovation and Entrepreneurship	Biotechnology	IoT and Cloud Computing	Geographical Information System	VLSI
	Major					
	Information Technology	√	√	√	√	√
	Computer Engineering	√	√	√	√	√
	Artificial Intelligence & Data Science	√	√	√	√	√
Electronics & Telecommunication	√	√	√	√	√	
Years of Study:	04 Years					
Semesters:	Major – 1, 2, 3, 4, 5, 6, 7, 8 Multidisciplinary Minors – 4, 5, 6					
Credits:	174					

Level 6: B.Tech. in Technology - Honors and Multidisciplinary Minor

Major Disciplines with Offered Honors and Multidisciplinary Minors:	Honors	Internet of Things*	Artificial Intelligence & Machine Learning	Cyber Security	Virtual and Augmented Reality	Data Science	Blockchain
	Major						
	Information Technology	√	√	√	√	√	√
	Computer Engineering	√	√	√	√	√	√
	Artificial Intelligence & Data Science	√		√	√		√
	Electronics and Telecommunication	√	√	√	√	√	√
	Minor	Innovation and Entrepreneurship	Biotechnology	IoT and Cloud Computing*	Geographical Information System	VLSI	
	Major						
	Information Technology	√	√	√	√	√	√
	Computer Engineering	√	√	√	√	√	√
Artificial Intelligence & Data Science	√	√	√	√	√	√	
Electronics & Telecommunication	√	√	√	√	√	√	
* Can be chosen for either Honors or Minors, not both							
Years of Study:	04 Years						
Semesters:	Major – 1, 2, 3, 4, 5, 6, 7, 8 Multidisciplinary Minors – 4, 5, 6 Honors – 5, 6, 7, 8						
Credits:	192 (= Major with Multidisciplinary Minors: 174 + Honors: 18)						

Level 6: B.Tech. in Technology - Honors with Research and Multidisciplinary Minor

Major Disciplines with Offered Honors and Multidisciplinary Minors:	Major		Honors with Research			
	Information Technology		√			
	Computer Engineering		√			
	Artificial Intelligence & Data Science		√			
	Electronics and Telecommunication		√			
	Minor	Innovation and Entrepreneurship	Biotechnology	IoT and Cloud Computing*	Geographical Information System	VLSI
	Major					
	Information Technology	√	√	√	√	√
	Computer Engineering	√	√	√	√	√
	Artificial Intelligence & Data Science	√	√	√	√	√
Electronics & Telecommunication	√	√	√	√	√	
Years of Study:	04 Years					
Semesters:	Major – 1, 2, 3, 4, 5, 6, 7, 8 Multidisciplinary Minors – 4, 5, 6 Honors with Research – 7, 8					
Credits:	192 (= Major with Multidisciplinary Minors: 174 + Honors with Research: 18)					

Level 6: B.Tech. in Technology with Double Minors (Multidisciplinary & Specialization)

Major Disciplines with Multidisciplinary Minors and Specialization Minors:	Multidisciplinary Minors:					
	Minor	Innovation and Entrepreneurship	Biotechnology	IoT and Cloud Computing*	Geographical Information System	VLSI
	Major					
	Information Technology	√	√	√	√	√
	Computer Engineering	√	√	√	√	√
	Artificial Intelligence & Data Science	√	√	√	√	√
	Electronics & Telecommunication	√	√	√	√	√
	Specialization Minors:					
	06 additional courses (of minimum 12 week each), in another Engg. / Tech. discipline / Emerging Areas through MOOC – SWAYAM					
	Years of Study:	04 Years				
Semesters:	Major – 1, 2, 3, 4, 5, 6, 7, 8 Multidisciplinary Minors – 4, 5, 6 Specialization Minors – 3, 4, 5, 6, 7, 8					
Credits:	192 (= Major with Multidisciplinary Minors: 174 + Specialization Minors: 18)					

Credit Distribution Structure for Four Year Multidisciplinary B.Tech. Degree Program
with Multiple Entry Multiple Exit Options

Level	Semester	Faculty: Science and Technology					Faculty: Any	Vocational Skills (VS) & Skill Enhancement (SE) Courses		Ability Enhancement (AE), Indian Knowledge System (IKS), Value Education (VE) Courses			Field Projects / Community Engagement (CE) Projects, Internship (INT), and Co-curricular (CC) Courses			Credits	Cumulative Credits
		Basic Science (BS) Courses	Engineering Science (ES) Courses	Major / Professional Core (PC) Courses	Major / Professional Elective - Department-level (PE-DLC) Courses	Multi-disciplinary Minor (MM) Courses	Open Elective - Institute-level (OE-ILC) Courses	VS - SAT Courses	SE - SAT Courses	AE - SAT Courses	IKS - SAT Courses	VE - SAT Courses	CE - Project-Based Learning (PBL)	INT	CC - SAT Courses		
Level 4.5	I	9	8					1				1			2	21	42
	II	9	8					1		2	1					21	
Exit Option with UG Certificate in Technology with Additional 08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major																	
Level 5.0	III	4		15					1				1			21	85
	IV	4		11		4			1	1			1			22	
Exit Option with UG Diploma in Technology with Additional 08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major																	
Level 5.5	V			11	4	3			1			2	1			22	130
	VI			8	4	3	3	2					3			23	
Exit Option with Bachelor's Degree in Vocation (B. Voc.) with Additional 08 Credit Bridge Course Corresponding to Skill-Based Courses / Internship / Mini Projects in Major																	
Level 6.0	VII			8	7		3						6			24	174
	VIII			8										12		20	
Total		26	16	61	15	10	6	4	3	3	1	3	12	12	2	174	

SEMESTER III: COMPUTER ENGINEERING

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
CEC301	Applications of Mathematics in Engineering-I	3 – 0 – 1	04	3 – 0 – 1	04	BS
CEC302	Data Structure	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC303	Database Management System	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC304	Digital Logic & Computer Architecture	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC305	Discrete Structures and Graph Theory	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEL302	Data Structure Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL303	Database Management System 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
CEPR31	Community Engagement PBL – Mini Project I	0 – 2 – 0	02 ^{\$}	0 – 1 – 0	01	PBL
CEXS37	Skill Enhancement - SAT VII: Skill-Based Learning: Object Oriented Programming with JAVA	0 – 2* – 0	02	0 – 1 – 0	01	SE-SAT
Total		15 – 10 – 1	26	15 – 5 – 1	21	

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

^{\$}Load of learner, not the faculty.

EXAMINATION SCHEME

Course Code	Course Name	CA Marks			ESE		TW / O / P Marks				Total Marks
		T1	T2	T = T1 + T2	Marks	Duration (in Hrs)	TW	O	P	P&O	
CEC301	Applications of Mathematics in Engineering-I	20	20	40	60	2.5	25	-	-	-	125
CEC302	Data Structure	20	20	40	60	2.5	-	-	-	-	100
CEC303	Database Management System	20	20	40	60	2.5	-	-	-	-	100
CEC304	Digital Logic & Computer Architecture	20	20	40	60	2.5	-	-	-	-	100
CEC305	Discrete Structures and Graph Theory	20	20	40	60	2.5	-	-	-	-	100
CEL302	Data Structure Lab	-	-	-	-	-	25	-	-	25	50
CEL303	Database Management System Lab	-	-	-	-	-	25	-	-	25	50
CEL304	Digital Logic & Computer Architecture Lab	-	-	-	-	-	25	-	-	-	25
CEPR31	Community Engagement PBL – Mini Project I	-	-	-	-	-	25	-	-	25	50
CEXS37	Skill Enhancement - SAT VII: Skill-Based Learning: Object Oriented Programming with JAVA	-	-	-	-	-	25	-	-	-	25
Total		100	100	200	300	-	150	-	-	75	725

SEM IV: TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
CEC401	Applications of Mathematics in Engineering-II	3 – 0 – 1	04	3 – 0 – 1	04	BS
CEC402	Analysis of Algorithms	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC403	Operating System	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC404	Theory of Computer Science	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC405	Multidisciplinary Minor Course	3 – 0 – 0	03	3 – 0 – 0	03	MM
CEL402	Analysis of Algorithms Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL403	Operating System Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL404	Multidisciplinary Minor Lab	0 – 2 – 0	02	0 – 1 – 0	01	MM
CEPR42	Community Engagement PBL – Mini Project II	0 – 2 – 0	02 ^s	0 – 1 – 0	01	PBL
CEXS48	Skill Enhancement – SAT VIII: Skill-Based Learning: Python Programming	0 – 2* – 0	02	0 – 1 – 0	01	SE-SAT
CEXA49	Ability Enhancement – SAT IX: Skill-Based Learning: Indian/Foreign Modern language	0 – 2* – 0	02	0 – 1 – 0	01	AE-SAT
Total		15 – 12 – 1	28	15 – 6 – 1	22	

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

^sLoad of learner, not the faculty.

EXAMINATION SCHEME

Course Code	Course Name	CA Marks			ESE		TW / O / P Marks				Total Marks
		T1	T2	T = T1 + T2	Marks	Duration (in Hrs)	TW	O	P	P&O	
CEC401	Applications of Mathematics in Engineering-II	20	20	40	60	2.5	25	-	-	-	125
CEC402	Analysis of Algorithms	20	20	40	60	2.5	-	-	-	-	100
CEC403	Operating System	20	20	40	60	2.5	-	-	-	-	100
CEC404	Theory of Computer Science	20	20	40	60	2.5	-	-	-	-	100
CEC405	Multidisciplinary Minor Course	-	-	-	-	-	50	50	-	-	100
CEL402	Analysis of Algorithms Lab	-	-	-	-	-	25	-	-	25	50
CEL403	Operating System Lab	-	-	-	-	-	25	-	25	-	50
CEL404	Multidisciplinary Minor Lab	-	-	-	-	-	25	-	-	-	25
CEPR42	Community Engagement PBL – Mini Project II	-	-	-	-	-	25	-	-	25	50
CEXS48	Skill Enhancement – SAT VIII: Skill-Based Learning: Python Programming	-	-	-	-	-	25	-	-	-	25
CEXA49	Ability Enhancement – SAT IX: Skill-Based Learning: Indian/Foreign Modern language	-	-	-	-	-	25	-	-	-	25
Total		80	80	160	240	-	225	50	25	50	750

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	Total
		CEC301	Applications of Mathematics in Engineering-I	03	0
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	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 e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$.		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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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)	<ol style="list-style-type: none"> 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. <p>The distribution of Term Work marks will be as follows –</p> <ul style="list-style-type: none"> <input type="checkbox"/> Class Tutorials on entire syllabus: 20 marks <input type="checkbox"/> Assignment: 05 marks
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Assessment:	
Continuous Assessment for 40 marks: <ol style="list-style-type: none"> 1. Test 1 – 20 marks 2. Test 2 – 20 marks 	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)		
CEC302	Data Structure	3 - 0 - 0		
Prerequisite:	C programming			
Course Objectives:	<ol style="list-style-type: none"> To discuss types of different data structures and concept of Abstract Data Type To discuss the concept of stack and queue and apply them to various applications. To describe the concept of link list and apply it to various applications To introduce the different kinds of trees. To discuss graph related concepts and traversals along with application. To teach various searching techniques. 			
Course Outcomes:	<p>After successful completion of this course, learner will be able to:</p> <ol style="list-style-type: none"> Describe types of data structure and write ADT. Implement stack and different types of queues using array and their applications Perform various types of link list operations and their applications Perform operations on Binary Search Tree, AVL tree, Btree and B+Tree Implement Graph traversals BFS, DFS and application of Graph in topological sorting 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	Total Hrs/Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	-	01	01
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	02	04
	Collision Resolution Techniques		02	
ii. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--		01
Total Hours				42
Books:				
Textbooks:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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 			

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 – 20 marks	
2. Test 2 – 20 marks	
End Semester Theory Examination will be of 60 marks of 02 hrs min 30 duration.	

Course Code	Course Title	Credits (TH+P+TUT)		
CEC303	Database Management System	3 - 0 - 0		
Prerequisite:	Data Structures			
Course Objectives:	<ol style="list-style-type: none"> 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:	<p>After completion of the course students will be able to..</p> <ol style="list-style-type: none"> 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	-	01	01
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	07
	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		04	
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, Silberchatz, 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, 5 th Edition. 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– 20 marks 2. Test 2 – 20 marks				
End Semester Theory Examination will be of 60 marks for 02 hrs 30 min duration.				

Course Code	Course Name	Credits (TH+P+TUT)
CEC304	Digital Logic & Computer Architecture	3-0-0
Prerequisite:	Knowledge on number systems	
Course Objectives:	<ol style="list-style-type: none"> To have the rough understanding of the basic structure and operation of basic digital circuits and a digital computer. To discuss in detail arithmetic operations in digital systems. To discuss generation of control signals and different ways of communication with I/O devices. To study the hierarchical memory and principles of advanced computing. 	
Course Outcomes:	<p>After the successful completion of this course, learner will be able to:</p> <ol style="list-style-type: none"> Learn different number systems and basic structure of computer systems. Demonstrate the arithmetic algorithms. Describe the basic concepts of digital components and processor organization. Explain the generation of control signals of computers. Demonstrate the memory organization. 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	06
	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		02	
Data Representation and Arithmetic Algorithms	Binary Arithmetic: Addition, Subtraction, Multiplication.	CO1,	01	08
	Division using Sign Magnitude, 1's and 2's compliment		02	
	BCD and Hex Arithmetic Operation	CO2	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	<ol style="list-style-type: none"> 1. R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4th Edition. 2. William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10TH Edition. 3. John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3RD Edition. 4. Dr. M. Usha and T. S. Shrikanth, "Computer system Architecture and Organization", Wiley publication. 			
Reference Books	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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
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Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 20 marks
2. Test 2 – 20 marks

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

Course Code	Course Name	Credits (TH)		
CEC305	Discrete Structures and Graph Theory	3		
Prerequisite:	1. Basic Mathematics			
Course Objectives:	1. Cultivate clear thinking and creative problem solving. 2. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies. 3. To apply graph theory in solving practical problems. 4. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses.			
Couse Outcomes:	On successful completion, of course, learner will be able to: 1. Analyze the Problems and its statements logically. 2. Apply the relations, functions, Diagraph and Lattice. 3. Apply the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. 4. Identify problems concepts of graph theory in solving real world problems 5. Examine the groups and codes in Encoding-Decoding. 6. Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions			
Module No	Topics	CO mapped	Hrs /Subtopic	Total Hrs/Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction	-	01	01
1. Logic	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers	CO1	03	06
	Normal Forms, Inference Theory of Predicate Calculus, First order logic, Mathematical Induction.		03	
2.Relations and Functions	Basic concepts of Set Theory	CO2	01	06
	Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations		02	
	Warshall's algorithm, Equivalence relations and Equivalence Classes		01	
	Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function		02	
3.. Posets and Lattice	Partial Order Relations, Poset, Hasse Diagram	CO3	02	05
	Chain and Antichains, Lattice, Types of Lattice, Sub lattice		03	
4. Counting	Basic Counting Principle- , Product Rule, Inclusion-Exclusion Principle, Pigeon hole Principle	CO4	03	06
	Recurrence relations, Solving recurrence relations, types		03	
5. Algebraic Structures	Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism.	CO5	06	08
	Algebraic structures with two binary operations: Ring.		02	
	Coding Theory: Coding, binary information and error detection, decoding and error correction.		02	

6. Graph Theory	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit	CO6	04	08
	Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs,		02	
	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 Hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1 Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem -ur Rehman, "Discrete Mathematical Structures", Pearson Education. 2 C.L.Liu" Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company. Reprinted 2000. 3 K.H.Rosen," Discrete Mathematics and applications", fifth edition2003,Tata McGraw Hill Publishing Company 			
Reference Books	<ol style="list-style-type: none"> 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				
Test (T1& T2):				
Two tests must be conducted of which should cover at least 80% of syllabus.				
Continuous Assessment for 40 marks:				
<ol style="list-style-type: none"> 1. Test 1 – 20 marks 2. Test 2 – 20 marks 				
End Semester Theory Examination will be of 60 marks of 02 hrs 30 min duration.				

Lab Code	Lab Name	Credits (P+TUT)	
CEL302	Data Structures Lab	0-1-0	
Lab Prerequisite:	C Programming		
Lab Objectives:	<ol style="list-style-type: none"> 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):	<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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. 		
Expt. 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: a) 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			

Lab Code	Lab Name	Credits (P+TUT)	
CEL303	Database Management System Lab	0-1-0	
Prerequisite:	Data structures		
Lab Objectives:	<ol style="list-style-type: none"> 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):	<p>At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> 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

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. 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 CEC303 and CEL303

Term Work:

Term work should consist of 10 experiments.

Journal must include at least 2 assignments on content of theory and practical of “Database Management System”

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Lab Code	Lab Name	Credits(P+TUT)	
CEL304	Digital Logic & Computer Architecture Lab	0-1-0	
Lab Prerequisite:	C Programming Language		
Lab Objectives:	<ol style="list-style-type: none"> 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):	<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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
Notes:			
<ol style="list-style-type: none"> 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: http://cse10-iitkgp.virtual-labs.ac.in/			
Term work:			
<ol style="list-style-type: none"> 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)

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.

A cover page will be attached stating the aims and objectives. This will be considered towards 10 marks

Course code	Course Name	Credits
CEPR31	Community Engagement//Field Project- Mini Project -I	0-1-0
PBL Objectives:	<ol style="list-style-type: none"> 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):	<p>At the end of the course, the student will be able to:</p> <ol style="list-style-type: none"> 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.

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, <ul style="list-style-type: none"> 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. First shall be for finalization of problem and proposed solution

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

Course Code	Course Name	Credits	
CEXS37	Skill Enhancement - SAT VII: Skill Based Learning Value Education : Object Oriented Programming with JAVA	0-1-0	
Prerequisite:	Structured Programming Approach		
Skill Objectives:	<ol style="list-style-type: none"> 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):	<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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	<p>Title: Write a program to implement basic programming constructs like branching and looping.</p> <p>Concepts: Introduction to Java, Object Oriented Concepts, Java Virtual Machine, Basic programming constructs: variables, data types, and operators, expressions, branching and looping.</p>	SO1, SO6	02
2	<p>Write a program to demonstrate different ways of accepting user input in Java.</p> <p>Concepts: Class, object, data members, member functions, Command Line Argument, Input and output functions in Java, Buffered reader class, Scanner class.</p>	SO1, SO6	02
3	<p>Write a program to implement the concept of</p> <ol style="list-style-type: none"> 1. Method overloading 2. Constructor overloading. <p>Concepts: Method, how to pass parameters, Method overloading, static members and functions, Introduction to Constructors, Constructor types, Constructor overloading.</p>	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. Dietland 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>