South Indian Education Society's

Graduate School of Technology

NAAC 'A+', NBA Accredited (EXTC, CE, IT)

Autonomous Institute Affiliated to University of Mumbai

SIES Graduate School of Technology (Autonomous)
RISE WITH EDUCATION
NAAC A+

Department of Electronics & Computer Science

Curriculum Structure FE to B.E

and

Second Year Syllabi

Board of Studies
Department of Electronics & Computer Science

Academic Council
SIES Graduate School of Technology

Effective from: AY 2025-26

PREAMBLE

Dear Students and Stakeholders,

The Electronics and Computer Science (ECS) curriculum at the SIES Graduate School of Technology is designed in alignment with the National Education Policy (NEP) 2020, which emphasizes a student-centric approach, fostering flexibility, interdisciplinary learning, and holistic development. Our curriculum is a testament to the vision of creating a future-ready workforce that is well-versed in both core technical competencies and the essential soft skills required for the ever-evolving global landscape.

The ECS syllabus offers a robust vertical of Program Core Courses (PCC) that lays a strong foundation in the essential areas of Electronics and Computer Science. Complementing this are Professional Elective Courses (PEC), which allow students to tailor their learning experience by choosing specialized subjects that align with their career aspirations and the latest industry trends. This flexibility ensures that our graduates are not only proficient in their chosen fields but are also equipped with the skills to adapt to new challenges.

In line with the multidisciplinary ethos of the NEP, the syllabus includes Open Elective (OE) courses and multidisciplinary minor (MDM) courses, providing students with opportunities to explore diverse fields, thereby broadening their knowledge base and fostering innovative thinking. Additionally, the curriculum integrates courses from the Indian Knowledge System (IKS), Humanities and Social Sciences & Management (HSSM), Value Education Courses (VEC), and Value-Added Skill Enhancement Courses (VSEC). These courses are designed to instill a deeper understanding of India's rich cultural heritage, ethical values, and essential soft skills, which are critical for the overall development of a well-rounded engineer.

To further enhance industry readiness, our curriculum integrates skill development courses through the Ability Enhancement Courses (AEC) vertical, which prepares students for real-world applications and challenges. The inclusion of Program Elective courses ensures that students can delve deeper into specialized areas of their interest, thereby gaining expertise that is directly applicable to their future careers.

Experiential learning is a cornerstone of the ECS program, with courses structured around internships, industry projects, and community engagement. These hands-on experiences are designed to bridge the gap between theoretical knowledge and practical application, thereby enhancing employability and encouraging a spirit of innovation. The inclusion of Social Service Internship and opportunities for internships abroad reflect our commitment to producing socially responsible and globally aware engineers.

Research Methodology courses are embedded within the curriculum to nurture a strong research acumen among students, equipping them with the tools and techniques necessary for conducting impactful research. This is further supported by the opportunity to undertake domain-specific projects and advanced studies through the honors degree option, preparing students for leadership roles in their careers.

For holistic development, the curriculum also incorporates courses from the Humanities, Social Sciences, and Management. These courses are aimed at nurturing well-rounded individuals who are not only technically sound but also possess strong communication skills, ethical grounding, and an appreciation for the cultural and economic context in which they operate. Additionally, the Liberal Learning vertical offers courses that stimulate creativity and critical thinking, essential for balanced cognitive development.

In essence, the Electronics and Computer Science syllabus at SIES Graduate School of Technology is meticulously crafted to produce graduates who are not just engineers, but innovators and leaders equipped to contribute meaningfully to society and the nation.

Chairman
Board of Studies
Electronics & Computer Science
SIES Graduate School of Technology

HEAD
Department of Electronics & Computer Science
S.I.E.S. Graduate School of Technology
Sri Chandrasekarendra Saraswathy Vidyapuram
Plot No.1-C & E, Sec-V, Nerul, Navi Mumbai-400706

Chairman
Academic Council
SIES Graduate School of Technology

PRINCIPAL
S.I.E.S. GRADUATE SCHOOL OF TECHNOLOGY (AUTONOMOUS)
Plot 1C/D/E, Sri Chandrasekarendra Saraswathy Vidyapuram
Sector - V, Nerul, Navi Mumbai - 400 706.

Semester wise Credit distribution structure for Four Year UG Engineering

Program - Electronics & Computer Science: One Major and One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course (BSC)	BSC/ESC	07	06		--	--	--	--	--	13
Engineering Science Course (ESC)		09	10		--	--	--	--	--	19
Programme Core Course (PCC)	Program Courses	--	--	17	11	11	11	04	--	54
Programme Elective Course (PEC)		--	--	--	--	04	04	07	--	15
Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	--	03	04	04	04	--	15
Open Elective (OE) Other than a particular program		--	--	--	--	--	--	03	03	06
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	01	01	02	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)		02	--	--	02	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--	--	02	02	--	--	--	--	04
Indian Knowledge System (IKS)		--	02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	--	02	--	--	--	--	02
Research Methodology (RM)	Experiential Learning Courses	--	--	--	--	--	--	--	03	03
Community Engagement Project (CEP) / Field Project (FP)		--	--	01	01	--	--	--	--	02
Project		--	--	--	--	01	01	02	02	06
Internship/On Job Training (OJT)		--	--	--	--	--	--	--	09	09
Co-curricular Courses (CC)	Liberal Learning Courses	04	--	--	--	--	--	--	--	04
Total Credits (Major)		**21**	**21**	**22**	**21**	**22**	**22**	**20**	**17**	**166**

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CURRICULUM STRUCTURE

SECOND YEAR ENGINEERING

(ELECTRONICS AND COMPUTER SCIENCE)

Academic Year 2025-26

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Nomenclature of the courses in the curriculum	
Abbreviation	**Title**
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Courses
MDM	Multidisciplinary Minor
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
CC	Cocurricular Courses
LLC	Liberal Learning Courses
IKS	Indian Knowledge System
ISE	In Semester Examination
MSE	Mid Semester Examination
ESE	End Semester Examination
CIAP	Continuous Internal Assessment Practical
ESEP	End Semester Examination Practical

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Multidisciplinary Minor (MDM)

Track	Minor Track	Partner Institute if any	Module	Code	Eligible
1	Machine Learning	SIES GST	Artificial Intelligence	MDMC4	IT/EXTC/CSE IOT
			Machine Learning	MDMC5012	
			Natural Language Processing	MDMC6013	
			Deep Learning	MDMC7014	
2	Data Science	SIES GST	Statistical Foundation for Data Science	MDMC4021	ECS/CE/EXTC
			Data Analytics & Visualization	MDMC5022	
			Decision Making & Business Intelligence	MDMC6023	
			Big Data Analytics	MDMC7024	
3	Embedded Systems	SIES GST	Microprocessor and Microcontrollers	MDMC4031	CE/AIDS/AIML
			RTOs and Embedded systems	MDMC5032	
			Sensor Technology	MDMC6033	
			Industrial Internet of Things	MDC7034	
4	Cyber Security	SIES GST	Computer Network	MDMC4041	AIDS/AIML
			Cryptography & System Security	MDMC5042	
			Cloud Computing and Security	MDMC6043	
			Digital Forensics	MDMC7044	
5	System Programming	SIES GST	Advance Data Structure	MDMC4051	CSEIOT/ECS/IT
			Advance Algorithm	MDMC5052	
			System Programming and Compiler Construction	MDMC6053	
			Distributed Systems	MDMC7054	
6	Management	SIESSBS	Cost Management	MDMC4061	EXTC/CE/IT/ECS/ AIDS/AIML/CSE IOT
			Supply Chain Management	MDMC5062	
			HR & Organization	MDMC6063	
			Marketing Management	MDMC7064	

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Indicative Multidisciplinary Minors
Minors sequence for ECS students

Course Category of Multidisciplinary Minor	**Sem IV MDM I**	**Sem V MDM II**	**Sem VI MDM III**	**Sem VII MDM IV**
	MDMC4021	MDMC5022	MDMC6023	MDMC7024
Data Science	Statistical Foundation for Data Science	Data Analytics & Visualization	Decision Making and Business Intelligence	Big Data Analytics

Course Category of Multidisciplinary Minor	**Sem IV MDM I**	**Sem V MDM II**	**Sem VI MDM III**	**Sem VII MDM IV**
	MDMC4051	MDMC5052	MDMC6053	MDMC7054
System Programming	Advance Data Structure	Advance Algorithm	System Programming and Compiler Construction	Distributed Systems

Course Category of Multidisciplinary Minor	**Sem IV MDM I**	**Sem V MDM II**	**Sem VI MDM III**	**Sem VII MDM IV**
	MDMC4061	MDMC5062	MDMC6063	MDMC7064
Management	Cost Management	Supply Chain Management	HR & Organization	Marketing Management

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Program Structure for First Year
W.E.F. A.Y. 2024-25
Semester I

Course Code	Course Name	Category	Teaching Scheme(Contact Hours)			Credits Assigned			
			Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
FEC101	Applied Mathematics-I	BSC	3	--	--	3	--	--	3
FEC1021/ FEC1022	Applied Physics/Applied Chemistry@	BSC	3	--	--	3	--	--	3
FEC103	Basic Electrical&Electronics Engineering	ESC	2	--	--	2	--	--	2
FEC104	C-Programming	ESC	2	--	--	2	--	--	2
FEC105	Applied Mechanics and Robot Dynamics	ESC	2	--	--	2	--	--	2
FEL1011/ FEL1012	Applied Physics Lab/Applied Chemistry Lab@	BSC	--	1	--	--	0.5	--	0.5
FEL102	Basic Electrical &Electronics Engineering Lab	ESC	--	2	--	--	1	--	1
FEL103	C-Programming Lab	ESC	--	2	--	--	1	--	1
FEL104	Applied Mechanics and Robot Dynamics Lab	ESC	--	2	--	--	1	--	1
FEL105	Engineering Workshop-I	VSEC	--	2	--	--	1	--	1
FEL106	Health,Wellness and Mindfulness	CC	--	2#+2	--	--	2	--	2
FEL107	Induction Cum Universal Human Values	CC	--	5*	--	--	2.5	--	2.5

Examination Scheme-FY Semester-I

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
FEC101	Applied Mathematics -I	20	20	60	3	--	--	100
FEC1021/ FEC1022	Applied Physics/ Applied Chemistry @	20	20	60	3	--	--	100
FEC103	Basic Electrical & Electronics Engineering	15	15	45	2	--	--	75
FEC104	C-Programming	15	15	45	2	--	--	75
FEC105	Applied Mechanics and Robot Dynamics	15	15	45	2	--	--	75
FEL1011/ FEL1012	Applied Physics Lab/ Applied Chemistry Lab@	--	--	--	--	25	--	25
FEL102	Basic Electrical & Electronics Engineering Lab	--	--	--	--	25	25	50
FEL103	C-Programming Lab	--	--	--	--	25	25	50
FEL104	Applied Mechanics and Robot Dynamics Lab	--	--	--	--	25	25	50
FEL105	Engineering Workshop-I	--	--	--	--	25	--	25
FEL106	Health, Wellness and Mindfulness	--	--	--	--	25	--	25
FEL107	Induction Cum Universal Human Values	--	--	--	--	25	--	25
Total		**85**	**85**	**255**		**175**	**75**	**675**

@Physics/Chemistry in one semester.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45. Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
*Indicates workload of a learner for UHV. Faculty Load: ½ hour per week per four groups # Two hours of practical class to be conducted for full class as demo/ discussion.
ISE: In Semester Examination**:** To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks. MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP

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Program Structure for First Year
W.E.F. A.Y. 2024-25
Semester II

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
FEC201	Applied Mathematics -II	BSC	3	--	--	3	--	--	3
FEC2021/ FEC1022	Applied Physics/ Applied Chemistry @	BSC	3	--	--	3	--	--	3
FEC203	Engineering Graphics	ESC	2	--	--	2	--	--	2
FEC204	Digital System Design	ESC	3	--	--	3	--	--	3
FEC205	Professional Communication Techniques	AEC	2	--	--	2	--	--	2
FEL2011/ FEL2012	Applied Physics Lab/ Applied Chemistry Lab @	BSC	--	1	--	--	0.5	--	0.5
FEL202	Engineering Graphics Lab	ESC	--	2	--	--	1	--	1
FEL203	Digital System Design Lab	ESC	--	2	--	--	1	--	1
FEL204	Professional Communication Techniques Lab	AEC	--	1	--	--	0.5	--	0.5
FEL205	Object Oriented Programming Methodology Lab	ESC	--	2*+2	--	--	2	--	2
FEL206	Engineering Workshop-II	VSEC	--	2	--	--	1	--	1
FEL207	Indian Knowledge System	HSSM	--	2*+2	--	--	2	--	2
	Total		**13**	**16**	--	**13**	**8**	--	**21**

Examination Scheme-FY Semester-II

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
FEC201	Applied Mathematics -II	20	20	60	03	--	--	100
FEC2021/ FEC2022	Applied Physics/ Applied Chemistry @	20	20	60	03	--	--	100
FEC203	Engineering Graphics	15	15	45	03	--	--	75
FEC204	Digital System Design	20	20	60	03	--	--	100
FEC205	Professional Communication Techniques	15	15	45	02	--	--	75
FEL2011/ FEL2012	Applied Physics Lab/ Applied Chemistry Lab @	--	--	--	--	25	--	25
FEL202	Engineering Graphics Lab	--	--	--	--	25	25	50
FEL203	Digital System Design Lab	--	--	--	--	25	25	50
FEL204	Professional Communication Techniques Lab	--	--	--	--	25	--	25
FEL205	Object Oriented Programming Methodology Lab	--	--	--	--	25	25	50
FEL206	Engineering Workshop-II	--	--	--	--	25	--	25
FEL207	Indian Knowledge System	--	--	--	--	25	--	25
Total		**90**	**90**	**270**	--	**175**	**75**	**700**

@Physics/Chemistry in one semester.
* Two hours of practical class to be conducted for full class as demo/ discussion.
# Course evaluation is an activity based which may be an individual or group of students.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45. Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
ISE: In Semester Examination: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks. MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP).

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Program Structure for Second Year
W.E.F. A.Y. 2025-26
Semester III

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut	Total
ECC301	Applied Mathematics-III	PCC	3	--	--	3	--	--	3
ECC302	Data Structure	PCC	3	--	--	3	--	--	3
ECC303	Database Management Systems	PCC	3	--	--	3	--	--	3
ECC304	Electronic Devices and Circuits	PCC	2	--	--	2	--	--	2
ECC305	Computer Organization and Architecture	PCC	3	--	--	3	--	--	3
ECC306	Engineering Economics	HSSM	2	--	--	2	--	--	2
ECL301	Data Structure Lab	PCC	--	2	--	--	1	--	1
ECL302	Database Management Systems Lab	PCC	--	2	--	--	1	--	1
ECL303	Electronic Devices and Circuits Lab	PCC	--	2	--	--	1	--	1
ECL304	Skill Lab (Python Programming)	VSEC	--	2*+2	--	--	2	--	2
ECM301	Mini Project 1A	CEP	--	2$	--	--	1	--	1
Total			**16**	**12**	**--**	**16**	**6**	**--**	**22**

Examination Scheme-ECS Semester-III

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		ESE$	Exam Duration (Hrs.)	CIAP	ESEP	Total
		ISE	MSE					
ECC301	Applied Mathematics-III	20	20	60	3	--	--	100
ECC302	Data Structure	20	20	60	3	--	--	100
ECC303	Database Management Systems	20	20	60	3	--	--	100
ECC304	Electronic Devices and Circuits	15	15	45	2	--	--	75
ECC305	Computer Organization and Architecture	20	20	60	3	--	--	100
ECC306	Engineering Economics	50	--	--	--	--	--	50
ECL301	Data Structure Lab	--	--	--	--	25	25	50
ECL302	Database Management Systems Lab	--	--	--	--	25	25	50
ECL303	Electronic Devices and Circuits Lab	--	--	--	--	25	--	25
ECL304	Skill Lab (Python Programming)	--	--	--	--	25	25	50
ECM301	Mini Project 1A		--			25	25	50
Total		145	95	285	--	125	100	750

* Two hours of practical class to be conducted for full class as demo/ discussion.

$ Indicates workload of a learner (Not faculty) for Mini Project 1A. Faculty Load: ½ hour per week per four groups

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Program Structure for Second Year
W.E.F. A.Y. 2025-26
Semester IV

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut	Theory	Pract.	Tut	Total
ECC401	Applied Mathematics-IV	PCC	3	--	--	3	--	--	3
ECC402	Controls and Instrumentation	PCC	3		--	3	--	--	3
ECC403	Linear Integrated Circuits	PCC	3	--	--	3	--	--	3
ECC404	Critical Thinking and Design	HSSM	2	--	--	2	--	--	2
MDMC40X1	Multidisciplinary Minor – I (MDM-I)	MDM	3		--	3	--	--	3
ECL401	Controls and Instrumentation Lab	PCC	--	2	--	--	1	--	1
ECL402	Linear Integrated Circuits Lab	PCC	--	2	--	--	1	--	1
ECL403	Value Education (UHV)	HSSM (VEC)	--	4	--	--	2	--	2
ECL404	Skill Lab (Linux)	VSEC	--	2*+2	--	--	2	--	2
ECM401	Mini Project 1B	CEP	--	2$	--	--	1	--	1
Total			**14**	**14**	**--**	**13**	**7**	**--**	**21**

Examination Scheme – ECS Semester-IV

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ECC401	Applied Mathematics-IV	20	20	60	3	--	--	100
ECC402	Controls and Instrumentation	20	20	60	3	--	--	100
ECC403	Linear Integrated Circuits	20	20	60	3	--	--	100
ECC404	Critical Thinking and Design	15	15	45	2	--	--	75
MDMC40X1	Multidisciplinary Minor (MDM-I)	20	20	60	3	--	--	100
ECL401	Controls and Instrumentation Lab	--	--	--	--	25	25	50
ECL402	Linear Integrated Circuits Lab	--	--	--	--	25	25	50
ECL403	Value Education (UHV)					50	--	50
ECL404	Skill Lab (Linux)	--	--	--	--	25	25	50
ECM401	Mini Project 1B	--	--	--	--	25	25	50
Total		**95**	**95**	**285**		**150**	**100**	**725**

* Two hours of practical class to be conducted for full class as demo/ discussion.
$Indicates workload of a learner (Not faculty) for Mini Project 1B. Faculty Load: ½ hour per week per four groups

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Program Structure for Third Year
W.E.F. A.Y. 2025-26
Semester V

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC501	Microprocessor and Microcontroller	PCC	3	--	--	3	--	--	3
ECC502	Computer Network	PCC	3	--	--	3	--	--	3
ECC503	Discrete Structures and Automata Theory	PCC	3	--	--	3	--	--	3
MDMC50X2	Multidisciplinary Minor (MDM-II)	MDM	3	--	--	3	--	--	3
ECPEC501X	Program Elective I	PEC	3	--	--	3	--	--	3
ECL501	Microprocessor and Microcontroller Lab	PCC	--	2	--	--	1	--	1
ECL502	Computer Network Lab	PCC	--	2	--	--	1	--	1
ECL503	Professional Communication & Ethics Lab	AEC	--	2*+2	--	--	2	--	2
MDML50X2	Multidisciplinary Minor (MDM-II) Lab	MDM	--	2	--	--	1	--	1
ECPEL501X	Program Elective I Lab	PEC	--	2	--	--	1	--	1
ECM501	Mini Project 2A	Project	--	2	--	--	1	--	1
Total			**15**	**14**	**--**	**15**	**7**	**--**	**22**

Examination Scheme - ECS Semester-V

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ECC501	Microprocessor and Microcontroller	20	20	60	3	--	--	100
ECC502	Computer Network	20	20	60	3	--	--	100
ECC503	Discrete Structures and Automata Theory	20	20	60	3	--	--	100
MDMC50X2	Multidisciplinary Minor (MDM-II)	20	20	60	3	--	--	100
ECPEC501X	Program Elective I	20	20	60	3	--	--	100
ECL501	Microprocessor and Microcontroller Lab	--	--	--	--	25	25	50
ECL502	Computer Network Lab	--	--	--	--	25	--	25
ECL503	Professional Communication & Ethics Lab	--	--	--	--	50	--	50
MDML50X2	Multidisciplinary Minor (MDM-II) Lab	--	--	--	--	25	25	50
ECPEL501X	Program Elective I Lab	--	--	--	--	25	25	50
ECM501	Mini Project 2A	--	--	--	--	25	25	50
Total		**100**	**100**	**300**		**175**	**100**	**775**

* Two hours of practical class to be conducted for full class as demo/ discussion.
$ Indicates workload of a learner (Not faculty) for Mini Project 2A. Faculty Load: ½ hour per week per four groups

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Program Elective – I

Technology Bucket			
Embedded Systems	**AIML**	**Security**	**Networking**
ECPEC5011: Sensors & Applications	**ECPEC5012:** Image processing and Pattern recognition	**ECPEC5013:** Data Compression and Cryptography	**ECPEC5014:** Information Theory & Coding

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Program Structure for Third Year
W.E.F. A.Y. 2025-26
Semester VI

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ECC601	Software Engineering & Web Technology	PCC	3	--	3	--	3
ECC602	Basics of VLSI Design	PCC	3	--	3	--	3
ECC603	Cryptography and Network Security	PCC	3	--	3	--	3
MDMC60X3	Multidisciplinary Minor (MDM-III)	MDM	3	--	3	--	3
ECPEC601X	Program Elective II	PEC	3	--	3	--	3
ECL601	Software Engineering & Web Technology Lab	PCC	--	2	--	1	1
ECL602	Basics of VLSI Design Lab	PCC	--	2	--	1	1
ECL603	Skill Lab (Cloud Computing)	VSEC	--	2*+2	--	2	2
MDML60X3	Multidisciplinary Minor (MDM-III) Lab	MDM	--	2	--	1	1
ECPEL601X	Program Elective II Lab	PEC	--	2	--	1	1
ECM601	Mini Project 2B	Project	--	2$	--	1	1
Total			**15**	**14**	**15**	**7**	**22**

Examination Scheme –ECS Semester-VI

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ECC601	Software Engineering & Web Technology	20	20	60	3	--	--	100
ECC602	Basics of VLSI Design	20	20	60	3	--	--	100
ECC603	Cryptography and Network Security	20	20	60	3	--	--	100
MDMC60X3	Multidisciplinary Minor (MDM-IIII)	20	20	60	3	--	--	100
ECPEC601X	Program Elective II	20	20	60	3	--	--	100
ECL601	Software Engineering & Web Technology Lab	--	--	--	--	25	25	50
ECL602	Basics of VLSI Design Lab	--	--	--	--	25	25	50
ECL603	Skill Lab (Cloud Computing)	--	--	--	--	25	25	50
MDML60X3	Multidisciplinary Minor (MDM-III) Lab	--	--	--	--	25	25	50
ECPEL601X	Program Elective II Lab	--	--	--	--	25	--	25
ECM601	Mini Project 2B	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	**--**	**150**	**125**	**775**

* Two hours of practical class to be conducted for full class as demo/ discussion.
$ Indicates workload of a learner (Not faculty) for Mini Project 2B. Faculty Load: ½ hour per week per four groups

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Program Elective – II

Technology Bucket			
Embedded Systems	**AIML**	**Security**	**Networking**
ECPEC6011: Robotics & Automation	**ECPEC6012:** Artificial Intelligence	**ECPEC6013:** Cyber Security	**ECPEC6014:** Advanced Networking Technologies

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Program Structure for Fourth Year
W.E.F. A.Y. 2025-26
Semester VII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ECC701	Embedded & RTOS	PCC	3	--	3	--	3
MDMC70X4	Multidisciplinary Minor (MDM-IV)	MDM	3	--	3	--	3
ECPEC701X	Program Elective-III	PEC	3	--	3	--	3
ECPEC702X	Program Elective-IV	PEC	3	--	3	--	3
OEC701X	Institute Elective-I	OE	3	--	3	--	3
ECL701	Embedded & RTOS Lab	PCC	--	2	--	1	1
MDML70X4	Multidisciplinary Minor (MDM-IV) Lab	MDM	--	2	--	1	1
ECPEL701X	Program Elective-III Lab	PEC	--	2	--	1	1
ECP701	Major Project Stage-I	Project	--	4#	--	2	2
Total			**15**	**10**	**15**	**5**	**20**

Examination Scheme – ECS Semester-VII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ECC701	Embedded & RTOS	20	20	60	3	--	--	100
MDMC70X4	Multidisciplinary Minor (MDM-IV)	20	20	60	3	--	--	100
ECPEC701X	Program Elective-III	20	20	60	3	--	--	100
ECPEC702X	Program Elective-IV	20	20	60	3	--	--	100
OEC701X	Institute Elective-I	20	20	60	3	--	--	100
ECL701	Embedded & RTOS Lab	--	--	--	--	25	25	50
MDML70X4	Multidisciplinary Minor (MDM-IV) Lab	--	--	--	--	25	25	50
ECPEL701X	Program Elective-III Lab	--	--	--	--	25	--	25
ECP701	Major Project Stage-I	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	**--**	**100**	**75**	**675**

#Indicates workload of Learner (Not faculty), for Major Project
Project Guide Load = ½ hour per week per project group

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Program Elective-III

Technology Bucket			
Embedded Systems	**AIML**	**Security**	**Networking**
ECPEC7011: Advanced VLSI	**ECPEC7012:** Deep Learning	**ECPEC7013:** Digital Forensics	**ECPEC7014:** Wireless Sensor Networks

Program Elective-IV

Technology Bucket			
Embedded Systems	**AIML**	**Security**	**Networking**
ECPEC7021: Internet of Things	**ECPEC7022:** Natural Language Processing	**ECPEC7023:** Blockchain	**ECPEC7024:** Quantum Computing

Open Elective -I

Course Code	Course Name
OEC7011	Project Management
OEC7012	Finance Management
OEC7013	Management Information System
OEC7014	Entrepreneurship Development and Management
OEC7015	Operation Research
OEC7016	Disaster Management and Mitigation Measures
OEC7017	Product Design

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Program Structure for Fourth Year
W.E.F. A.Y. 2025-26
Semester VIII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ECC801	Research Methodology	RM	3	--	3	--	3
OEC801X	Open Elective-II	OE	3	--	3	--	3
ECP801	Major Project Stage-II	Project	--	4#	--	2	2
ECINT801	Internship	Internship	--	--	--	9	9
Total			**06**	**4**	**06**	**11**	**17**

Examination Scheme – ECS Semester-VIII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ECC801	Research Methodology	20	20	60	3	--	--	100
OEC801X	Open Elective-II	20	20	60	3	--	--	100
ECP801	Major Project Stage-II	--	--	--	--	100	50	150
ECINT801	Internship	--	--	--	--	200	--	200
Total		**40**	**40**	**120**	**--**	**300**	**50**	**550**

# indicates workload of Learner (Not faculty), for Major Project
Project Guide Load = ½ hour per week per project group

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Open Elective -II

Course Code	Course Name
OEC8011	Enterprise Resource Planning
OEC8012	Cyber Security and Laws
OEC8013	Energy Audit and Management
OEC8014	IPR and Patenting
OEC8015	Environmental Management
OEC8016	Digital Business Management
OEC8017	Human Resource Management

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC301	Applied Mathematics-III	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC301	Applied Mathematics-III	20	20	60	--	--	100

Pre-requisite:

1. **FEC101: Applied Mathematics -I**
2. **FEC201: Applied Mathematics -II**

Program Outcomes addressed:

1. **PO1: Engineering knowledge**
2. **PO2: Problem analysis**
3. **PO3: Design/development of solutions**
4. **PO4: Conduct Investigation of complex problems**

Course Objectives:

1. To learn the Laplace transform of various functions and its applications.
2. To learn Inverse Laplace Transform of various functions and its applications.
3. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skill
4. To understand the concept of complex variables, C-R equations, harmonic functions and their conjugate and mapping in complex plane.
5. To familiarize with the concepts of statistics for data analysis.
6. To acquaint with the concepts of probability, random variables with their distributions and expectations.

Course Outcomes:

After successful completion of the course student will be able to

1. Find Laplace transform of functions using various properties.
2. Find inverse Laplace transform using convolution theorem and partial fraction method.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Explain the concept of complex numbers, functions, and their significance in data science and engineering.
5. Assess the strength and direction of relationships between variables using correlation and regression techniques.
6. Apply the concepts of probability and expectation for getting the spread of the data and distribution of the data.

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Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Laplace Transform**	**07**	
	1.1	Definition of Laplace transform; Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like $e^{at}, \sin(at), \cos(at), \sin h(at), \cos h(at)$ *and* $t^n, n \geq 0$		**CO1**
	1.2	Properties of Laplace Transform: Linearity, First shifting theorem, Second Shifting Transform, Change of Scale property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof).		
	1.3	Evaluation of integrals for particular value of 's' by using Laplace Transformation.		
		Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.		
2.0		**Inverse Laplace Transform**	**06**	
	2.1	Introduction of Inverse Laplace Transform, Linearity property, Use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.		**CO2**
	2.2	Partial fractions method to find inverse Laplace transform.		
	2.3	Inverse Laplace transform using Convolution theorem (without proof).		
	2.4	Applications to solve initial and boundary value problems involving ordinary differential equations		
		Self-learning Topics: Applications to solve simultaneous initial and boundary value problems involving ordinary differential equations.		
3.0		**Fourier Series**	**07**	
	3.1	Dirichlet's conditions, Definition of Fourier series		**CO3**
	3.2	Fourier series of periodic functions with period 2π and 2l.		
	3.3	Fourier series of even and odd functions. (No examples on Parseval Identity)		
	3.4	Half range Sine and Cosine Series.		
		Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.		
4.0		**Complex Variables**	**07**	
	4.1	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**
	4.2	Cauchy-Riemann equations in cartesian coordinates (without proof).		
	4.3	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.		
	4.4	Harmonic function, Harmonic conjugate, and orthogonal trajectories		
		Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross		

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		ratio, fixed points, and standard transformations.		
5.0		**Statistical Techniques**	**06**	
	5.1	Karl Pearson's Coefficient of correlation (r) and related concepts with problems		**CO5**
	5.2	Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems)		
	5.3	Lines of regression		
		Self-learning Topics: Covariance		
6.0		**Probability Theory**	**06**	
	6.1	Total Probability theorem and Bayes' theorem.		**CO6**
	6.2	Discrete and continuous random variable with probability distribution and probability density function		
	6.3	Expectation, Variance, Laws of expectation		
	6.4	Moment generating function, Raw and central moments up to 4th order.		
		Self- learning Topics: Skewness and Kurtosis of distribution (data).		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition.

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. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
4. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Serie.
5. Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications.

Online References:

Course on Advanced Engineering Mathematics

- https://nptel.ac.in/courses
- https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 05 marks attendance.

MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE is of duration 03 hours and 80 marks and will be scaled down to 60.

The question paper will comprise of 03 questions.
Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC302	Data Structure	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC302	Data Structure	20	20	60	--	--	100

Pre-requisite:
1. FEC104: C-Programming

Program Outcome:
1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems

Course Objectives:
1. To identify the need and significance of data structures as a computer professional.
2. To describe linear and Nonlinear data structures.
3. To apply various operations on data structures and select the appropriate one to solve a specific real-world problem.
4. To analyze various techniques for the representation of the data in the real world.
5. To understand various graph concepts.
6. To discuss arching and Hashing techniques

Course Outcomes:
After successful completion of the course, students will be able to:
1. Illustrate Linear and Non-Linear data structures.
2. Discuss operations on stack and queue.
3. Illustrate linked list data structures.
4. Apply operations like searching, insertion, and deletion in the tree.
5. Analyze various operations of the graph.
6. Apply various searching and hashing operations.

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Module No.	Unit No.	Topics	Hrs.	CO
1		**Introduction to Data Structures**	**02**	**CO1**
	1.1	**Introduction to Data Structures,** Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures, Applications of Data Structures		
2		**Stack and Queues**	**08**	**CO2**
	2.1	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix, Conversion and Postfix Evaluation, Recursion.		
	2.2	Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.		
		Self-Learning: Multiple queues. Variants of recursion. Case study on priority management		
3		**Linked List**	**10**	**CO3**
	3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition, Generalized linked list.		
		Self-Learning: case study on linked lists.		
4		**Tree**	**11**	**CO4**
	4.1	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.		
		Self-Learning: case study on trees. Threaded binary trees.		
5		**Graphs**	**04**	**CO5**
	5.1	Introduction, Graph Terminologies-Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting. Applications of graph.		
		Self-Learning: Data structures for web graph and google map.		
6		**Searching Techniques**	**04**	**CO6**
	6.1	Linear Search, Binary Search, Hashing-Concept, Hash Functions-division method, multiplication, mid-square and folding. Collision resolution Techniques-open addressing and chaining.		
		Self-Learning: case study on hashing and collision		
		Total	**39**	

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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",

Online References:

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

Course Assessment:
ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
MSE: To be conducted as written examination for 20 marks (on 40% - 50% syllabus)
End Semester Examination:
$ ESE of duration 03 hours are of 80 marks and scaled to 60.

Question paper will comprise of 03 questions.
Question 1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question 3(20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology

Department of Electronics and Computer Science

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC303	Database Management Systems	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC303	Database Management Systems	20	20	60	--	--	100

Pre-requisite:

1. FEC104 C- Programming

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design / Development of Solutions.
4. PO12: Lifelong learning

Course Objectives:

1. To understand the basics of database systems.
2. To develop entity relationship data model and its mapping to relational model.
3. To learn relational algebra and Formulate SQL queries.
4. To apply normalization techniques to normalize the database.
5. To understand concept of transaction, concurrency control and recovery techniques.
6. To learn and explore recent databases and their applications

Course Outcomes:

After successful completion of the course, students will be able to:

1. Recognize the need of database management system.
2. Design ER / EER diagram, relational model and write relational algebra queries.
3. Apply SQL queries on given database.
4. Apply normalization techniques for relational database design.
5. Describe the concept of transaction, concurrency and recovery.
6. Describe the fundamentals of recent databases and their uses.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Database Concepts and Data Modeling**	**08**	**CO1**
	1.1	Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Applications of databases. The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.		
		Self-Learning: Database storage structures		
2.0		**Relational Model and Relational Algebra**	**05**	**CO2**
	2.1	Introduction to the Relational Model, relational schema. Mapping the ER and EER Model to the Relational Model. Relational Algebra-operators and Relational Algebra Queries.		
		Self-Learning: Relational Calculus		
3.0		**Structured Query Language (SQL)**	**08**	**CO3**
	3.1	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers		
		Self-Learning: Stored Procedures, Introduction to PL/SQL		
4.0		**Database Normalization**	**06**	**CO4**
	4.1	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF, 4NF.		
		Self-Learning: 5NF		
5.0		**Transactions Management, Concurrency control and Recovery**	**08**	**CO5**
	5.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log-based recovery, Deadlock handling		
		Self-Learning: Deadlock handling		
6.0		**Introduction to Emerging Databases**	**04**	**CO6**

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	6.1	Limitations of conventional databases, Multimedia databases: data types, contents of multimedia databases, Cloud databases: Introduction, Design Steps, Distributed databases: types, storage methods		
		Self-Learning Object oriented database, NoSQL databases		
		Total	**39**	

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

Reference books:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Managementǁ, 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

Online References:

1. https://swayam.gov.in/nd1_noc19_cs46/preview
2. https://www.coursera.org/learn/database-design-postgresql
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. https://www.mooc-list.com/tags/dbms

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE of duration 03 hours is of 80 marks and scaled to 60.

Question paper will comprise of 03 questions.
Question 1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question 3 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC304	Electronic Devices and Circuits	2	--	--	2	--	--	3

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC304	Electronic Devices and Circuits	15	15	45	--	--	75

Course pre-requisite:
1. FEC1021: Engineering Physics-I
2. FEC2021: Engineering Physics-II
3. FEC103: Basic Electrical & Electronics Engineering

Program Outcomes addressed:
1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO11: Lifelong learning
5. PSO2: Develop innovative multidisciplinary projects

Course Objectives:
1. To understand physical operation of semiconductor devices.
2. To perform DC and AC analysis of BJT and MOSFET amplifier circuits.
3. To understand operation of power amplifiers, rectifiers, and filters.
4. To explain use of advanced nanoelectronic devices.

Course Outcomes:
After successful completion of the course, students will be able to:
1. Explain working of various electronics devices with the help of V-I characteristics.
2. Analyze dc biasing circuits of transistors (BJT, MOSFET).
3. Analyze single stage BJT, MOSFET amplifiers and derive their performance parameters.
4. Compare various large signal amplifier circuits.
5. Analyse and compare rectifier and filter circuits.
6. Describe the working of advanced nanoelectronic devices.

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Module No.	Unit No.	Topics	Hrs.	CO
1		**Introduction to Semiconductor Devices**	**04**	**CO1**
	1.1	PN junction diode characteristics, diode current equation, working of Zener diode, Application of Zener diode as voltage regulator.		
	1.2	Construction, working, characteristics of JFET, MOSFET.		
		Self Learning: Application of Diode: Clipper, Clamper (different types of configurations).		
2		**DC and small signal analysis of BJT Amplifier circuit**	**06**	**CO2, CO3**
	2.1	Concept of DC load line, Q point and regions of operations, Analysis of biasing circuits for BJT (Fixed bias & Voltage divider Bias).		
	2.2	AC load line, Introduction to hybrid-pi model.		
	2.3	Small signal analysis of CE amplifier using hybrid pi model. (Zi, Zo, Av and Ai).		
		Self-learning: BJT collector to base bias, emitter follower bias, re-model, hybrid model.		
3		**DC and small signal analysis of MOSFET Amplifier circuits**	**06**	**CO2, CO3**
	3.1	DC load line and region of operation for MOSFETs. Analysis of biasing circuits for E-MOSFET (Drain-to-Gate bias & voltage divider bias.		
	3.2	Small signal analysis of CS amplifiers using hybrid pi model (Zi, Zo, Av).		
		Self Learning: small signal analysis of CG and CD amplifiers.		
4		**Large Signal Amplifiers**	**03**	**CO4**
	4.1	Difference between small signal & large signal amplifiers.		
	4.2	Classification of Power amplifiers. Working and applications of class A and class B power amplifiers.		
		Self Learning: Analysis of power amplifiers.		
5		**Rectifiers and Filters**	**04**	**CO5**
	5.1	Rectifiers: Working & mathematical analysis of full – wave centre tapped rectifier & bridge type rectifier (mathematical analysis include expressions for the DC / average & RMS output voltage, DC / average & RMS output current & ripple factor; numerical examples included).		
	5.2	Filters: Capacitor (C), Inductor (L), Inductor – Capacitor (LC), C-L-C (π) with circuit diagram, waveforms, working / operation & expression for ripple.		
		Self learning: Analysis of filters and their applications.		

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6		Emerging Electronic Devices	03	CO6
	6.1	Single Electron Transistor (SET) & Quantum Dots (theoretical description only construction, structure & nature of operation, characteristics & applications).		
	6.2	Memristor & Spintronic devices (theoretical description only – construction, structure & nature of operation, characteristics & applications).		
		Self Learning: Applications of SET, Memristor.		
		Total	**26**	

Text books:

1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2nd Edition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications" International Version, OXFORD International Students, 6th Edition.
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.
4. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press.

Reference Books:

1. Boylestad and Nashelesky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition.
2. A. K. Maini, "Electronic Devices and Circuits," Wiley.
3. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition.
4. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.
5. Millman and Halkies, "Integrated Electronics", Tata McGraw Hill.

NPTEL/ Swayam Course:

1. Course: Analog Electronic Circuit by Prof. Shouribrata Chatterjee (IIT Delhi);
https://swayam.gov.in/nd1_noc20_ee89/preview

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks.

MSE: To be conducted as written examination for 15 marks (on 40% - 50% syllabus).

End Semester Examination

$ESE duration of 02 hours is of 60 marks and scaled to 45

Question paper will comprise of 3 questions.

Question1(15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.

Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.

Question3(15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.

All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology

Department of Electronics and Computer Science Engineering

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC305	Computer Organization and Architecture	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC305	Computer Organization and Architecture	20	20	60	--	--	100

Pre-requisite:

1. FEC204 – Digital System Design

Program Outcomes Addressed:

PO1: Engineering Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO5: Modern Tool Usage
PO6: The Engineer and Society
PO12: Life-Long Learning

Course Objectives:

1. To introduce the learner to the design aspects which can lead to maximized performance of a Computer.
2. To introduce basic concepts and functions of operating systems.
3. To understand the concepts of process synchronization and deadlock.
4. To understand various Memory, I/O and File management techniques
5. To introduce the learner to various concepts related to Parallel Processing
6. To highlight the various architectural enhancements in modern processors.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Define the performance metrics of a Computer.
2. Analyze processor architectures, instruction formats, addressing modes and arithmetic algorithms for effective instruction execution.
3. Explain the design considerations of Memory and I/O in Computer systems
4. Analyze the concept of process management and evaluate the performance of process scheduling

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algorithms
5. Evaluate the advantages and limitations of Parallelism in systems
6. Discuss the various architectural enhancements in modern processors

Module No.	Unit No.	Contents	Hrs.	CO
1		**Introduction to Computer Organization**	04	CO1
	1.1	Fundamental Units of a Computer, Basic Measures of Computer Performance -Clock Speed, CPI, MIPs and MFlops		
	1.2	Number Representation methods- Integer and Floating-point representations, IEEE 754 single precision and double precision format		
	1.3	Booth's Algorithm, Multiplication: Shift and Add method, Division: Restoring and non-restoring techniques.		
		Self-learning Topics: Floating point arithmetic: Addition, Subtraction, Multiplication, Division		
2		**Processor Organization and Architecture**	05	CO2
	2.1	CPU Architecture, Register Organization, Instruction cycle, InstructionFormats		
	2.2	Control Unit Design- Hardwired and Micro-programmed Control: Verticaland Horizontal Micro-Instructions, Nano-programming		
	2.3	Comparison between CISC and RISC architectures		
		Self-learning Topics: ALU and Shifters, VLIW architecture		
3		**Memory and I/O Organization**	08	
	3.1	Classification of Memories-Primary and Secondary Memories, ROM and RAM, Memory Inter- leaving		
	3.2	Memory Hierarchy, Cache Memory Concepts, Mapping Techniques, Write Policies, Cache Coherency		
	3.3	Virtual Memory Management-Concept, Segmentation, Paging, Page Replacement policies		
	3.4	Types of I/O devices and Access methods, Types of Buses, Bus Arbitration		
		Self-learning Topics: Virtual memory in modern operating systems		
4		**Operating System concepts**	14	
	4.1	Concept of a Process, Process States, Process Description, Process Control Block		
	4.2	Process scheduling -Pre-emptive and Non-pre-emptive scheduling algorithms (FCFS, Priority, SJF), Concept of Multi-Threading		
	4.3	Inter-Process Communication, Process Synchronization, Deadlock and Prevention		
	4.4	File Management -File Organization and Access		
	4.5	I/O Management and Disk Scheduling: FCFS, SSTF		
		Self-learning Topics: PPIs(8255)		
5		**Parallelism**	04	CO5

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	5.1	Introduction to Parallel Processing Concepts, Flynn's classification,Amdahl's law		
	5.2	Pipelining - Concept, Speedup, Efficiency, Throughput, Types of Pipeline hazards and solutions		
		Self-learning Topics: Parallel Processing in Python		
6		**Architectural Enhancements**	**04**	**CO6**
	6.1	Superscalar Architectures, Out-of-Order Execution, Multi-core processors, Clusters, GPU		
		Self-learning Topics: Edge Devices		
		Total		**39**

Text Books:

1. William Stallings, "*Computer Organization and Architecture: Designing for Performance*",Eighth Edition, Pearson.
2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill,2002.
3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts,John Wiley &Sons, Inc., 9th Edition,

Reference Books:

1. P. Hayes, "Computer Architecture and Organization", McGraw-Hill,1998.
2. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles andApplications*", Second Edition, Tata McGraw-Hill.
3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - TheHardware/Software Interface", MorganKaufmann,1998.
4. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
5. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_cs61/preview
2. https://www.udemy.com/course/computer-organization-and-architecture-j/?couponCode=ST4MT240225A
3. https://www.coursera.org/learn/comparch
4. https://onlinecourses.nptel.ac.in/noc21_cs44/preview

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Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination
$ ESE of duration 03 hours are of 80 marks and scaled to 60.

Question paper will comprise of 03 questions.
Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC306	Engineering Economics	**02**	-	-	**02**	-	-	**02**

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
CEC306	Engineering Economics	**50**	--	--	--	--	**50**

Pre-requisite :
Principles of Basic Mathematics

Program Outcomes addressed:
1. PO1: Engineering knowledge.
2. PO2: Problem analysis.
3. PO11: Project Management and Finance.

Course Objectives:
1. To introduce students to the basic principles of economics and their application to engineering decision-making.
2. To Explore the Role of Trade in a Modern Economy
3. To develop student's analytical skills in assessing consumer behavior and the determinants of demand and supply across different market structures, including price elasticity.
4. To enable students to understand cost analysis, pricing, project evaluation.
5. To develop the ability to make informed decisions regarding engineering projects based on economic criteria.
6. To Understand the Concept of Interest Rates and Their Role in the Economy

Course Outcomes: Upon completion of this course, learners will be able to…
1. Define the basic concept of micro and macroeconomics, engineering economics and their application in engineering economy.
2. Define and Explain the Concept of Market in the Modern Economy.
3. Evaluate the effects of changes in demand and supply on price determination of products and services.
4. Analyze the costs and benefits of various engineering solutions.
5. Develop the ability to account for time value of money using engineering economy factors and formulas.
6. Understand market dynamics and pricing strategies in different industrial sectors.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Economics**	**03**	
	1.1	**Economics** - Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics, The three problems of Economics Organization. Introduction to Engineering Economics.		**CO1**
		Self-Learning: Basic Economic Concepts: Cost, Benefit, Profit.		
2.0		**Market and Government in Modern Economy**	**03**	
	2.1	**Modern Economy** - Market Definition, How market solve three economics problems, Trade, Money & Capital, The economic role of Government.		**CO2**
		Self-Learning: Market Economy vs. Planned Economy, The Role of Private vs. Public Sectors		
3.0		**Supply, Demand and Product market**	**06**	
	3.1	**Basic Elements of Supply and Demand** - The determination of Demand and Supply, The Demand Schedule, The Supply Schedule, Equilibrium of supply and demand. Application of Supply and Demand.		**CO3**
	3.2	**Elasticity of Demand and Supply** - Price elasticity of Demand, Elasticity and Revenue, Price elasticity of Supply.		
	3.3	**Demand and Consumer behavior** - Choice and utility theory, Equimarginal principle, An alternative approach: substitution effect and income effect, From Individual to market demand.		
		Self-Learning: Case Study on demand and supply.		
4.0		**Production and Cost Theory**	**05**	
	4.1	**Production** - Production function, Laws of returns: Law of variable proportion, Law of returns to scale.		**CO4**
	4.2	**Cost and Revenue Concepts** - Total Costs, Fixed cost, Variable cost, Average cost and Marginal cost, The Link between production and costs, Analysis of cost minimization.		
		Self-Learning: Read case studies about businesses optimizing their production costs and making strategic production decisions.		
5.0		**Time value and Project evaluation with money**	**04**	
	5.1	**Time Value of Money** - Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.		**CO5**
	5.2	**Evaluation of Engineering Projects** -Present worth method, Future worth method, Annual worth method, Internal rate of return method.		

		Self-Learning: Learn to use financial calculators or Excel functions for quick calculations of TVM.		
6.0		**Money, Banking and Financial Markets**	**05**	
	6.1	**Money and Interest Rates** - The Evolution of Money, Functions of Money, Interest rates, Price of Money, Demand for money.		**CO6**
	6.2	**Banking and the supply of money** - Banking definition, Types of Banks, Banking as as a business, The process of Deposits creations.		
	6.3	**Financial Economics** - Financial assets, Risk and return on different assets, The stock market, Personal financial strategies.		
		Self learning: The evolution of financial market.		
		Total	**26**	

Textbooks:

1. Paul A. Samuelson and William D. Nordhaus, "Economics", Tata McGraw Hill, 20th edition, 2019.
2. L. Blank and A. Tarquin, *Engineering Economy*, 9th ed., McGraw-Hill, 2024.

Reference books:

1 J. V. O'Connor, *Introduction to Engineering Economics*, 5th ed., Pearson, 2013.

2 W S Jawadekar, "Management Information Systems", Tata McGraw Hill, 6th edition, 2020.

3 C. S. Park, *Fundamentals of Engineering Economics*, 4th ed., Pearson, 2018.

Online References:

1. https://www.mheducation.com/highered/product/Engineering-Economy-Blank.html.
2. https://archive.org/details/engineeringecono0000blan_t5b6.
3. https://online.stanford.edu/courses/cee146s-engineering-economics-and-sustainability.
4. https://www.liberty.edu/online/courses/ENGI220.

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 50 marks .
ISE 50 marks = 10 marks for attendance + 40 marks for activities.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL301	Data Structure Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL301	Data Structure Lab	--	--	--	25	25	50

Pre-requisite: C programming Lab (FEL103)

Program Objectives:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development
4. PO4: Complex problem
5. PO8: Ethics
6. PO11: Life-long learning

Lab Objectives:

1. To implement basic data structures such as arrays, linked lists, stacks and queues
2. To solve problems involving graphs and trees
3. To select an appropriate data structure for the given problem.
4. To develop an application using data structure algorithms.

Lab Outcomes:

After successful completion of the course, students will be able to:

1. Apply various linear data structures to perform operations like insertion, deletion, searching and traversing on them.
2. Apply various 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.

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Suggested Experiments: Students are required to complete at least 10 experiments.		
Star (*) marked experiments are compulsory.		
Sr. No.	**Title of Experiments**	**LO**
1*	Implement Stack ADT using array.	LO1
2*	Convert an Infix expression to Postfix expression using stack ADT.	LO1
3*	Evaluate Postfix Expression using Stack ADT.	LO1
4	Applications of Stack ADT.	LO1
5*	Implement Linear Queue ADT using array.	LO1
6*	Implement Circular Queue ADT using array.	LO1
7	Implement Priority Queue ADT using array.	LO1
8*	Implement Singly Linked List ADT.	LO2
9*	Implement Circular Linked List ADT.	LO2
10	Implement Doubly Linked List ADT.	LO2
11*	Implement Stack / Linear Queue ADT using Linked List.	LO1,2
12*	Implement Binary Search Tree ADT using Linked List.	LO3
13*	Implement Graph Traversal techniques:) Depth First Search b) Breadth First Search	LO3
14	Applications of Binary Search Technique.	LO4

Online Resources:

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

Term Work:
Term work should consist of at least 10 experiments.
Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)

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

Practical Exam: (2 hours/ 25 Marks)
End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL 302	Database Management Systems Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL 302	Database Management Systems Lab	--	--	--	25	25	50

Pre-requisite:

1. FEC104 C- Programming

Program Outcomes addressed:

1. PO2: Problem analysis
2. PO3: Design / Development of Solutions.
3. PO5: Modern Tool Usage
4. PO8: Ethics
5. PO9: Individual and Team Work
6. PO10: Communication
7. PO12: Lifelong learning

Lab Objectives:

1. To explore design and develop of relational model
2. To introduce basics of SQL and formulate queries
3. To introduce the concepts of transactions and transaction processing

Lab Outcomes:

After successful completion of the course, students will be able to:

1. Design ER /EER diagram and convert to relational model for the real-world application.
2. Apply DDL, DML, DCL and TCL commands.
3. Execute simple and complex queries.
4. Apply trigger and procedure.
5. Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity.

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

Textbooks:

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

Reference books:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 9th 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

Online References:

1. https://www.w3schools.com/sql/
2. https://www.tutorialspoint.com/sql/index.htm
3. https://learn.microsoft.com/en-us/sql/?view=sql-server-ver16

Term Work:

The term work should include 10 experiments: At least 02 assignments covering the entire syllabus must be given on the content of theory and practical of “Database Management Systems”.

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The assignments should be student-centric, and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)

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

Practical Exam: (2 hours/ 25 Marks)

End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL303	Electronic Devices & Circuits Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL303	Electronic Devices & Circuits Lab	--	--	--	25	--	25

Pre-requisite:

1. FEL102: Knowledge of Basic Electrical & Electronics Engineering Lab.

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
2. PO3: Design and Development of Solution
3. PO4: Conduct investigation of complex problem
4. PO5: Modern tool usage
5. PO9: Individual and Team work
6. PO12: Lifelong Learning
7. PSO2: Develop innovative multidisciplinary projects

Lab Objectives:

1. To introduce various lab equipments and measuring instruments used to perform Electronics Devices and Circuits laboratory work.
2. To comprehend the basic principles of semiconductor physics and how they influence the behavior of devices.
3. To assess the impact of biasing on the transistor's performance.
4. To investigate the design principles of various amplifiers.

Lab Outcomes:

After successful completion of the course, students will be able to:

1. Understand the use of various equipments, electronics devices and components, and measuring instruments used to perform laboratory work and simulation.
2. Analyze and understand the electrical characteristics and behavior of semiconductor devices.
3. Analyze DC biasing circuits of BJT/MOSFET.
4. Analyze the performance of single stage amplifiers and large signal amplifiers.
5. Analyze working of rectifier and filter circuits.

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Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	To study of PN junction diode characteristics.	**LO1,2**
2	To study Zener as a voltage regulator.	**LO1,2**
3	To study BJT characteristics.	**LO1,2**
4	To study JFET characteristics.	**LO1,2**
5	To study MOSFET characteristics.	**LO1,2**
6	To study BJT biasing circuits.	**LO1,3**
7	To study MOSFET biasing circuits.	**LO1,3**
8	To study BJT as CE amplifier.	**LO1,4**
9	To study frequency response of CE amplifier.	**LO1,4**
10	To study of CS amplifier	**LO1,4**
11	To study frequency response of CS amplifier.	**LO1,4**
12	To study Class A Power amplifier.	**LO1,4**
13	To study Class B Power amplifier.	**LO1,4**
14	To study full wave/bridge rectifier with filter	**LO1,5**

Term Work:
The term work should include 8 experiments: 5 hardware experiments, and 3 using simulators or virtual labs. At least 02 assignments covering the entire syllabus must be given on the content of theory and practical of "Electronics Devices & Circuits". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:
25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL304	Skill Lab (Python Programming)	-	02*+02	-	-	02	-	02

* Two hours of practical class to be conducted for full class as demo/ discussion.

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL304	Skill Lab (Python Programming)	-	-	-	25	25	50

Pre-requisite:
1. FEC104: C Programming
2. FEL103: C Programming Lab

Program Outcomes addressed:
1. PO 1: Engineering knowledge
2. PO 2: Problem analysis
3. PO 3: Design/Development of Solutions
4. PO 5: Modern tool usage
5. PO 9: Individual and teamwork
6. PO 10: Communication
7. PO 11: Life-long learning
8. PSO2: Develop innovative multidisciplinary projects.

Lab Objectives:
1. To introduce the fundamental concepts of Python programming and Python libraries.
2. To explain the concept of data visualization and statistical analysis.
3. To introduce GUI development and basic image processing techniques.
4. To explain the use of Python in embedded systems.

Lab Outcomes:
Students will be able to
1. Write Python programs using basic programming constructs, control structures, and functions to perform data manipulation and file operations.
2. Use NumPy for numerical computations and Pandas for data handling, including reading, writing, and processing structured data.
3. Visualize data using Matplotlib and Seaborn and apply statistical analysis techniques, including regression models, for data-driven insights.
4. Design simple graphical user interfaces and apply basic image processing techniques using OpenCV.
5. Implement IoT-based monitoring systems.
6. Demonstrate a python-based project.

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Module No.	Unit No.	Topics	Hrs.	LO
1.0		**Basics of Python programming**	**4**	**LO1**
	1.1	Introduction, Features, Python building blocks – Identifiers, Keywords, Indention, Variables and Comments, Data types (List, tuple, string, dictionary and Arrays) Operators: Arithmetic, comparison, assignment, logical, bitwise, identity operators.		
	1.2	Control flow statements: Conditional statements (if, if…else, nested if) Looping in Python (while loop, for loop), Exceptional Handling.		
		Self learning: Object-Oriented Programming (OOP) in Python		
2.0		**Functions and File I/O Handling**	**4**	**LO2**
	2.1	Functions: Built-in functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions.		
	2.2	File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, with keywords, Moving within a file, Manipulating files and directories, OS and SYS modules.		
		Self learning: Recursive function		
3.0		**Libraries in Python**	**5**	**LO3**
	3.1	Use of NumPy for arithmetic operations, Use of Pandas to access and analyze csv files, Use of SciPy for scientific computing and data analysis.		
	3.2	Use of Matplotlib and Seaborn library for data visualization, Use of Scikit-Learn (sklearn) for Linear and Logistic Regression.		
		Self learning: Implementing of other Machine Learning algorithms		
4.0		**Graphical User Interface and Image processing**	**5**	**LO4**
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.		
	4.2	Basic Image Processing using OpenCV library, simple image manipulation using image module.		
		Self learning: Implementation of Image Processing Techniques		
5.0		**Python for embedded systems**	**4**	**LO5**
	5.1	Capturing sensor signals using Raspberry Pi, Uploading acquired data to cloud platforms, Processing and analyzing data in cloud.		
	5.2	Implementation of IoT-Based Monitoring systems including sensor and actuators.		
		Self learning: Introduction of data processing in Raspberry pi, Architecture and Pinout diagram of Raspberry pi.		
6.0		**Course project**	**4**	**LO6**
		A python-based project.		
	Total		**26**	

Suggested List of Experiments:	
Sr. No.	**Title of Experiments**
1	**Module 1: Basics of Python Programming** Write Python programs to: a) Understand basic data types, operators, expressions, and input-output statements. b) Implement control flow statements: Conditional statements (if, if…else, nested if). c) Perform looping operations using while loop and for loop. d) Perform list and tuple operations using built-in functions. e) Implement built-in set and string functions. f) Perform basic array operations on 1-D and multidimensional arrays.
2	**Module 2: Functions and File I/O Handling** Write Python programs to: a) Implement user-defined functions and lambda functions. b) Demonstrate function arguments (positional, keyword, default, variable-length). c) Work with built-in functions and modules. d) Perform file handling operations: reading, writing, and appending text and CSV files. e) Handle exceptions using try-except-else-finally blocks.
3	**Module 3: Libraries in Python** Write Python programs to: a) Create and manipulate NumPy arrays (Ndarray) and perform basic operations. b) Implement mathematical functions using NumPy. c) Create and manipulate Pandas DataFrames. d) Perform data selection, handling missing values, and data operations using Pandas. e) Perform file read and write operations using Pandas.
4	**Module 4: Graphical User Interface (GUI) & Image Processing** Write Python programs to: a) Create a simple GUI using Tkinter (Buttons, Labels, Entry Fields, and Widget Attributes). b) Implement basic image processing operations using OpenCV. c) Perform image morphological operations and analyze them using OpenCV.
5	**Module 5: Python for Embedded Systems** Write Python programs to: a) Capture sensor signals using Raspberry Pi. b) Upload acquired data to cloud platforms. c) Process and analyze data in the cloud. d) Implement IoT-based monitoring applications.
6	**Module 6: Course Project** Develop a Python-based project integrating concepts from all modules.

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Software Tools:

1. Python IDE: https://www.python.org/downloads/
2. Anaconda Environment: https://www.anaconda.com/distribution/

Online References:

1. Github
2. Python
3. Documentation: https://docs.python.org/3/
4. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
5. http://spoken-tutorial.org
6. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
7. Numpy Documentation: https://numpy.org/doc/
8. Pandas Documentation: https://pandas.pydata.org/docs/
9. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
10. Scipy Documentation : https://www.scipy.org/docs.html
11. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
12. https://nptel.ac.in/courses/106/106/106106182/

Term Work:
The term work should include 12 experiments and one group-wise project. An attempt should be made to make skill lab – python more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

25 Marks (Total Marks) =10 Marks (Experiment) + 10 Marks (Project) + 05 Marks (Attendance)

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

Practical Exam: (2 hours/ 25 Marks)
End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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SIES Graduate School of Technology

Department of Electronics and Computer Science

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A	--	02#	--	--	1	--	1

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECM301	Mini Project 1A	--	--	--	25	25	50

# Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1/2 hour per week per group.

ProgramOutcomes:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer & the World
7. PO7: Ethics
8. PO8: Individual & CollaborativeTeamwork
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-Long learning

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.
5. To enhance written and oral communication skills.
6. To Foster ethical leadership and responsible decision-making

Outcome: At the end of the course, learners will be able to…

1. Identify problems based on societal /research needs.
2. Develop interpersonal skills to work as member of a group or a leader.
3. Apply Knowledge and skills to solve societal problems in a group.
4. Analyse the available results through theoretical/ experimental/simulations.
5. Excel in written and oral communication skills.
6. Apply standard norms of engineering practices and demonstrate project management principles during project work.

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Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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. Similarly, Mini Project 2 in semesters V and VI.
- 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.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, minimum of two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on the individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
  - Marks awarded by guide/supervisor based on log book : 10
  - Marks awarded by review committee: 10
  - Quality of Project report: 05
-

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

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SIES Graduate School of Technology
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One-year project:

- In the first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on a presentation given by the student group.
- First shall be for the finalization of the problem
- The second shall be on the finalization of the proposed solution of the problem.
- In the second semester, expected work shall be procurement of components/systems, building of working prototypes, testing, and validation of results based on work completed in an earlier semester.
- The first review is based on the readiness of building a working prototype to be conducted.
- Second review shall be based on a poster presentation cum demonstration of the working model in the last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete the project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototypes and testing
- Two reviews will be conducted for continuous assessment,
- First shall be for finalization of problem and proposed solution
- Second shall be for implementation and testing of the solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on the following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost-effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on the first six criteria, and remaining may be used for second-semester evaluation of the performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

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Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of the 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 the head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/student competitions.

Mini Project shall be assessed based on the 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 as member or leader
8. Clarity in written and oral communication

Internal Assessment:
For 03 credit - 80 marks subject Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.
For 02 credit - 60 marks subject Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.
In Semester Examination (ISE)

ISE 20 marks = 05 marks attendance +15 marks for Activities.

ISE 15 marks = 05 marks attendance +10 marks for Activities.

The Rubrics for activities are as follows. The activities will be decided by course in charge and approved by HoD.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	05 Marks
2	Literature review of papers/journals	05 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	05 Marks
4	Extra Experiments/ Virtual Lab	05 marks
5	Content beyond syllabus presentation	05 marks
6	Wins in the event/competition/hackathon pertaining to the course	10 Marks
7	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
8	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project /	10 Marks
11	GATE Based Assignment test/Tutorials etc.	10 Marks

*For sr.no.8, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC401	Applied Mathematics-IV	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC401	Applied Mathematics-IV	20	20	60	--	--	100

Pre-requisite:

1. **FEC101: Applied Mathematics -I**
2. **FEC201: Applied Mathematics -II**
3. **ETC301: Applied Mathematics -III**

Program Outcomes addressed:

1. **PO1: Engineering knowledge**
2. **PO2: Problem analysis**
3. **PO3: Design/development of solutions**
4. **PO4: Conduct Investigation of complex problems**

Course Objectives:

1. Evaluate eigenvalues and eigenvectors and apply them to solve systems of linear equations and matrix diagonalization.
2. To develop the ability to analyze and classify quadratic forms using matrix transformations.
3. Evaluate line and contour integrals, and construct the power series expansion of a complex-valued function.
4. To develop the ability to formulate and solve optimization problems using the principles of Calculus of Variations and Euler-Lagrange equations.
5. To equip students with the knowledge of vector differentiation and its applications in engineering.
6. To impart knowledge of vector integration and its applications in solving engineering.

Course Outcomes:

After successful completion of the course student will be able to

1. Compute eigenvalues and eigenvectors, analyze their properties, and apply them in engineering problem-solving.
2. Evaluate quadratic forms, classify them using eigenvalues and principal axes transformation, and apply them to solve engineering problems.
3. Apply the concepts of Complex Integration to evaluate integrals, analyze and compute residues, and solve various contour integrals.
4. Evaluate functionals, derive Euler-Lagrange equations, and apply Calculus of Variations to solve mathematical optimization problems in engineering.
5. Evaluate directional derivatives, gradient, divergence, and curl of vector functions, and apply vector differentiation techniques to solve engineering problems.
6. Evaluate line, surface, and volume integrals using Green's, Stokes', and Gauss' theorems, and apply them to solve engineering.

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Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Linear Algebra (Theory of Matrices)**	**07**	
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof). Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials.		**CO1**
	1.2	Similarity of matrices, diagonalizable and non-diagonalizable matrices.		
	1.3	Functions of Square Matrix, Derogatory and non-derogatory matrices.		
		Self-Learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms.		
2.0		**Quadratic Forms and Matrix Transformations**	**04**	
	2.1	Definition of Quadratic Forms, Matrix Representation, Classification of Quadratic Forms based on eigenvalues and Sylvester's Criterion.		**CO2**
	2.2	Rank, Index and Signature of a Quadratic Form. Reduction of Quadratic form to canonical forms by Orthogonal Transformation. Singular Value Decomposition.		
		Self-Learning Topics: Applications of Quadratic forms and applications of SVD in Engineering		
3.0		**Complex Integration**	**08**	
	3.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).		**CO3**
	3.2	Taylor's and Laurent's series (without proof).		
	3.3	Definition of Singularity, Zeroes, poles off(z), Residues, Cauchy's Residue Theorem (without proof).		
		Self-Learning Topics: Application of Residue Theorem to evaluate real integrations.		
4.0		**Calculus of Variations and Its Applications**	**07**	
	4.1	Definition of a Functional, Introduction to Calculus of Variations, Euler-Lagrange Equation-Special case when F does not contain y, when F does not contain x, when F contains x, y, and y'.		**CO4**
	4.2	Isoperimetric problems- Lagrange Method. Several dependent variables.		
	4.3	Functions involving higher order derivatives: Rayleigh-Ritz Method.		
		Self-Learning Topics: Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action, Several dependent variables.		
5.0		**Vector Differentiation**	**06**	
	5.1	Definition of a Vector, Scalar and Vector Triple Product, Gradient, Divergence, and Curl, Directional Derivatives, Angle between surfaces and related problems. Solenoidal and Irrotational (Conservative) Vector Fields.		**CO5**
	5.2	Finding scalar potential function ∅.		
		Self-Learning Topics: Identities connecting Gradient, Divergence and Curl, Angle between surfaces.		
6.0		**Vector Integration**	**07**	
	6.1	Line integrals – definition, work done of a conservative field and problems.		**CO6**
	6.2	Green's theorem (without proof) in a plane, Stokes' theorem (without Proof), Gauss' Divergence theorem (without proof) and problems (only evaluation).		

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		Self-Learning Topics: Applications of Green's theorem, Stoke's theorem & Gauss Divergence theorem in Engineering.		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition.

Reference books:

1. Matrices – Shanti Narayan, S. Chand Publications
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications.
3. Introductory Methods of Numerical Analysis – S. S. Sastry, Eastern Economy Edition.
4. Calculus of Variations with Applications – A. S. Gupta, PHI Learning.
5. Vector Calculus – Jerrold E. Marsden, Anthony J. Tromba, W. H. Freeman.
6. Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications.

Online References:
Course on Advanced Engineering Mathematics

- https://nptel.ac.in/courses
- https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

Course Assessment:
ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 05 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE is of duration 03 hours and 80 marks and will be scaled down to 60.

The question paper will comprise of 03 questions.
Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology

Department of Electronics and Computer Science Engineering

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC402	Controls and Instrumentation	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC402	Controls and Instrumentation	20	20	60	--	--	100

Course pre-requisite:

1. FEC1021: Engineering Physics-I
2. FEC2021: Engineering Physics-II
3. FEC103: Basic Electrical Engineering
4. FEC201: Applied Mathematics-II

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO11: Lifelong learning
5. PSO2: Develop innovative multidisciplinary projects

Course Objectives:

1. To calculate the mathematical models of a given system using block diagram reduction rules and Mason's gain formula.
2. To provide fundamental concepts of control system such as Time response and Frequency response.
3. To develop concepts of stability and its assessment criteria.
4. To provide basic knowledge about the various sensors and transducers.
5. To understand the concept of data acquisition systems and communication protocols.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Determine the mathematical models of a given system using block diagram reduction rules and Mason's gain formula.
2. Analyze first order and second order control systems for step input.
3. Analyze a given system in Time domain with respect to stability.
4. Analyze a given system in Frequency domain with respect to stability.
5. Understand and explain the working principle of sensors and transducers.
6. Explain various parameters of data acquisition systems and describe instrument communication standards.

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Module No.	Unit No.	Topics	Hrs.	CO
1		**Basics of Control systems and System Modelling**	**07**	**CO1**
	1.1	Introduction: Open and closed loop systems, example of control systems.		
	1.2	Block diagram reduction techniques and Signal Flow Graphs using Mason's Gain formula.		
		Self Learning: Analogies between electrical and mechanical systems.		
2		**Response of control system**	**06**	**CO2**
	2.1	Dynamic Response: Standard test signals and types of errors.		
	2.2	Analysis of First and Second Order Control System: First Order System: Analysis for inputs of Unit Step, Unit Ramp and Unit Parabolic, Concept of Time Constant, Steady State Error and types of error constants.		
	2.3	Second Order System: Analysis for input of Unit Step, Effect of Damping, Time Response Specifications: Delay time, Rise time, Peak Time, Peak Overshoot, settling time, Numerical Problems.		
		Self Learning: Concept of lead and lag compensators.		
3		**Stability Analysis in Time Domain**	**08**	**CO3**
	3.1	Stability in time domain: The concept of stability, necessary conditions for stability, Hurwitz stability criterion, Routh stability criterion, relative stability analysis.		
	3.2	Root locus Analysis: Root locus concept, general rules for constructing root-locus, root locus analysis of control system.		
		Self learning: Time domain analysis of P, PI, PD and PID controllers.		
4		**Stability Analysis in Frequency Domain**	**08**	**CO4**
	4.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins.		
	4.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot.		
	4.3	Nyquist Criterion: Concept of Nyquist stability criteria, stability analysis using Nyquist plot.		
		Self learning: Frequency response analysis of RC, RL, RLC circuits.		
5		**Sensors and Transducers**	**06**	**CO5**
	5.1	Basics of sensors and Transducers-Active and passive transducers, characteristics and selection criteria of transducers.		
	5.2	Displacement and pressure- Potentiometers, pressure gauges,		

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		linear Variable differential transformers (LVDT) for measurement of pressure and displacement strain gauges.		
	5.3	Temperature Transducers- Resistance temperature detectors (RTD). Thermistors and thermocouples, their ranges and applications.		
		Self learning: Real time applications using different sensors and transducers.		
6		**Data Acquisition Systems and Instrument Communication Standards**	**04**	**CO6**
	6.1	Introduction to instrumentation systems: Data acquisition system (DAS), SCADA communication architecture, types, applications.		
	6.2	Instrument interfacing, Field bus, Modbus, GPIB, USB Protocol, and HART communication Protocol.		
		Self learning: Explore Telemetry and types of telemetry systems.		
		Total	**39**	

Textbooks:

1. Ogata K, Yang Y., "Modern Control Engineering," 3rd Edition, 2002 Prentice Hall.
2. Nagrath, M. Gopal, "Control System Engineering," 7th Edition, 2021, New Age International Private Limited.
3. Gopal M, "Control Systems Principles and Design,"4th Edition, 2012, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. A.K. Sawhney, "Electrical & Electronic Measurement & Instrumentation" – DRS. India
5. H.S. Kalsi, "Electronic Instrumentation"-TMH, 2nd Edition.

Reference books:

1. Norman, "Control System Engineering," 3rd edition, 2004, John Wiley & sons.
2. Benjamin C. Kuo, "Automatic Control Systems," 7th edition, 1995, Pearson education.
3. C. S. Rangan, G. R. Sharma and V. S. Mani, "Instrumentation Devices and Systems," Tata McGraw-Hill Publishing Company Ltd.
4. Helfrick& Cooper, "Modern Electronic Instrumentation & Measuring Techniques" – PHI.
5. Stuart A. Boyer, "Supervisory Control and Data Acquisition (SCADA) Systems," 4th edition, 2016, International Society of Automation.

Online References:

1. Course: Control Systems by Prof. C. S. Shankar Ram (IIT Madras); Web Link: https://swayam.gov.in/nd1_noc20_ee90/preview
2. NPTEL Course: Control Systems by Prof. C.S. Shankar Ram, Department of Design Engineering, IIT Madras: - Web link- https://nptel.ac.in/courses/107/106/107106081/

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Course Assessment:
ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination
$ ESE of duration 03 hours is of 80 marks and scaled to 60.
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SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC403	Linear Integrated Circuits	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC403	Linear Integrated Circuits	20	20	60	--	--	100

Pre-requisite:

1. FEC103- Basic Electrical &Electronics Engineering
2. ECC304 -Electronic Devices and Circuits

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PSO1: To acquire knowledge in cutting- edge technologies

Course Objectives:

1. To study basic concepts of operational amplifiers.
2. To analyze and design various linear and non-linear applications of operational amplifiers.
3. To analyze and design astable and monostable multivibrators.
4. To understand the operation of the most commonly used ADC and DAC converter types.
5. To understand the fundamentals of various voltage regulator ICs and PLL and VCO and its applications.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Explain the basic building blocks and fundamentals of operational amplifiers.
2. Design linear applications of op-amp.
3. Design nonlinear applications of op-amp.
4. Design multivibrators using timer IC 555.
5. Analyze various ADC and DAC techniques.
6. Explain the functions of various voltage regulator ICs and gain knowledge about PLL IC 565 and VCO IC 566 and its applications.

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Module No.	Unit No.	Topics	Hrs	CO
1.0		**Introduction to Operational Amplifier**	**05**	**CO1**
	1.1	Basics of Differential Amplifier, Block diagram of Op-Amp, Ideal and practical characteristics of op-amp.		
	1.2	Configurations of Op Amp: Operational amplifier open loop and closed loop configurations, Inverting and Non-inverting configuration of Op-amp and voltage follower.		
		Self learning: Configurations of differential amplifier.		
2.0		**Linear Applications of Operational Amplifier**	**09**	**CO2**
	2.1	Summing and difference amplifier, Integrator & differentiator (ideal & practical), Instrumentation amplifier.		
	2.2	Active Filters: First and Second order active low pass, high pass, band pass.		
	2.3	Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.		
		Self learning: Voltage to current converter and current to voltage converter		
3.0		**Non-Linear Applications of Operational Amplifier**	**07**	**CO3**
	3.1	Comparators: Inverting comparator and non-inverting comparator, zero crossing detectors, window detector.		
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.		
	3.3	Waveform Generators: square wave generator and triangular wave generator.		
		Self learning: Basics of Precision Rectifiers peak detector, sample and hold circuit		
4.0		**Timer IC 555 and it's applications**	**07**	**CO4**
	4.1	Functional block diagram and working of IC 555.		
	4.2	Design of Astable and Monostable multivibrator using IC 555.		
	4.3	Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator.		
		Self learning: Bistable multivibrator and its applications		
5.0		**Analog to Digital and Digital to Analog Convertors**	**05**	**CO5**
	5.1	Specifications of DAC converter, DAC techniques: weighted resistor DAC and R-2R ladder DAC.		
	5.2	Specifications of ADC converter, ADC techniques: flash ADC, dual slope ADC, successive approximation ADC.		
		Self learning: Applications of DAC and ADC converter		
6.0		**Special Purpose Integrated Circuits**	**06**	**CO6**
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM317) voltage regulators.		

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	6.2	Functional block diagram and working of VCO IC 566 and application as frequency modulator.		
	6.3	Functional block diagram and working of PLL IC 565 and application as FSK Demodulator.		
		Self learning: Application of IC 566 as frequency modulator and application of PLL IC 565 as FSK Demodulator.		
	Total		**39**	

Textbooks:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th Edition.
2. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th Edition.

Reference books:

1. K. R. Botkar, "Integrated Circuits", Khanna Publishers (2004)
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw Hill, 3rd Edition.
3. David A. Bell, "Operation Amplifiers and Linear Integrated Circuits", Oxford University Press, Indian Edition.
3. R. F. Coughlin and F. F. Driscoll, "Operation Amplifiers and Linear Integrated Circuits", Prentice Hall, 6th Edition.
4. J. Millman, Christos CHalkias, and Satyabratatajit, Millman's,"Electronic Devices and Circuits," McGrawHill, 3rdEdition.

Online References:

1. NPTEL Course: Integrated Circuits and Applications by Prof. Prof. Shaik Rafi Ahamed, Department of Electrical Engineering IIT Guwahati: -
   Web link- https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. NPTEL Course: Analog Circuits, By Prof. Dr. Pramod Agarwal, IIT Roorkee:
   Web link- https://nptel.ac.in/courses/117107094

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.

MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE of duration 03 hours is of 80 marks and scaled to 60.

1. The question paper will comprise of 03 questions.
2. Question 1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question 3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology
Department of Electronics and Computer Science
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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC404	Critical Thinking & Design	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC404	Critical Thinking and Design	15	15	45	--	--	75

Pre- requisite: None

Program Outcomes Addressed

PO2: Problem analysis
PO3: Design/development of solutions
PO5: Modern Tool Usage
PO6: The Engineer and Society
PO7: Environment and Sustainability
PO9: Individual and Team Work
PO10: Communication
PO11: Project Management and Finance
PO12: Life Long Learning

Course Objectives:

1. To describe the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. To differentiate personal thinking stages and implement structured strategies for continuous cognitive growth.
3. To analyze key elements of thought and intellectual standards to enhance logical reasoning.
4. To examine the principles of design thinking and apply them to solve real-world problems through an iterative, user-centered approach.
5. To demonstrate hands-on experience with idea generation, customer insights, and problem framing to drive innovation.
6. To employ creative problem-solving techniques such as brainstorming, prototyping, and hypothesis validation to design user-centric solutions.

Course Outcomes: Learners will be able to

1. Interpret the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. Identify their cognitive development stage and implement structured strategies to progress as a critical thinker.
3. Apply intellectual standards like clarity, accuracy, and logic to improve reasoning and problem-solving skills.
4. Integrate design thinking principles to create innovative, balanced, and user-centered solutions.
5. Develop a broad perspective in understanding customer needs and effectively define problem statements using diverse methodologies.
6. Implement creative solutions and enhance ideas through iterative prototyping and user feedback using brainstorming techniques.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction to Critical Thinking**	**4**	
	1.1	**Introduction:** Start-up definition of Critical Thinking, How skilled are you as a Thinker? Hard Work, Concept of Critical Thinking, Establish new habits of thoughts, Develop confidence		**CO1**
	1.2	**Fairminded Thinker:** Weak Vs Strong Critical Thinking Requirement of Fairmindedness Intellectual: Humility, Courage, Empathy, Integrity, Perseverance, Autonomy Interdependence of Intellectual Virtues		
	1.3	**Self-Learning Topics:** Role of Intellectual Humility in Decision-Making, How to Overcome Cognitive Biases for Stronger Reasoning, Practical Techniques to Develop Fair-Minded Thinking. Case Study: The Challenger Disaster: How Ignoring Critical Thinking Led to Catastrophe		
2.0		**Four Stages of Development, Game Plan**	**3**	
	2.1	**Four Stages of Development:** Stage 1: Unreflective thinker, Stage 2: Challenged thinker, Stage 3: Beginning thinker, Stage 4: Practicing thinker		**CO2**
	2.2	**Game Plan:** Purpose & Key Components of Game Plan, Integrating of Game Plan Strategies		
	2.3	**Self-Learning Topics:** Characteristics and challenges at each stage, Common obstacles and how to address them, Practical ways to enhance critical thinking in work and academics. Case Study: Explores how a student progresses through four stages using self-reflection& discipline.		
3.0		**Self-Understanding, Parts & Universal Standards**	**3**	
	3.1	**Three Distinctive Functions:** Recognize the Mind's Three Distinctive Functions; Special Relationship		**CO3**
	3.2	**Thoughts & Intellectual Standards:** Fundamental structures of thought, The elements of thought, Universal Intellectual Standards: Clarity, Accuracy, Precision, Relevance, Depth, Breadth, Logic, Significance, Fairness		
	3.3	**Self-Learning:** Recognizing biases and promoting		

		ethical decision-making, Case Study: Analyzes how a company applied intellectual standards to refine its business strategies.		
4.0		**Design Thinking & its Key Tenets**	**5**	
	4.1	**Design Thinking Basics:** Traditional Model vs. Design Thinking, Five Stages: Inspire, Empathize, Define, Ideate, Prototype & Test Scale Thinking: Lean Thinking, Critical Thinking, Lateral Thinking, Design Thinking		**CO4**
	4.2	**Key Tenets:** Customer-Centric Approach, Thinking Beyond Products, Balancing Desirability, Feasibility & Viability, Broad & Compartmentalized Thinking, Visual Thinking & Hands-on Approach		
	4.3	**Self-Learning:** Understanding the shift from conventional problem-solving to iterative design processes, Designing solutions with user needs at the core while balancing business feasibility. Case Study: How a global brand used design thinking to enhance customer experience and increase engagement.		
5.0		**Inspire, Empathize and Define**	**5**	
	5.1	**Generating & Broadening Ideas:** Creating Stretch Goals, Power of Metaphors & Widening Perspectives, Importance of Diversity in Ideation		**CO5**
	5.2	**Empathize & Define:** New Channels for Customer Insights, Deep Customer Empathy & Stakeholder Analysis, Leveraging Technology for Insights, Mind Mapping: Stakeholders, Journey Mapping, Problem Framing		
	5.3	**Self-Learning:** Using metaphors and ideation techniques to expand creative possibilities, How diverse teams enhance innovation and problem-solving,Visualizing stakeholder journeys and structuring problem statements for better solutions. Case Study: How Airbnb used empathy mapping and customer insights to redefine its business model.		
6.0		**Ideate, Prototype and Test**	**6**	
	6.1	Ideate: Brainstorming & Hybrid Ideation Techniques, Challenging Assumptions & Breaking Patterns, Cross-Industry Inspiration (Analogous Design), Designing for Extreme Users & Ideation Triggers		**CO6**
	6.2	Prototype & Test: Rapid Prototyping & Hypothesis Validation, Storyboarding & Scenario Visualization, Collecting Feedback & Managing Failed Prototypes		
	6.3	**Self-Learning:** Exploring structured and unstructured brainstorming approaches, Testing ideas quickly		

		through prototypes and data-driven validation, Using visual storytelling to map user experiences and refine concepts. Case Study: Explore Apple's iterative prototyping process in designing user-friendly products.		
		Total	**26**	

Textbooks:

1. Richard Paul, Linda Elder, "Critical Thinking: Tools for Taking Charge of Your Learning and Your Life",Authors: Richard Paul, Linda Elder,2013,Pearson Education
2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving",2020, Penguin Random House India Private Limited

Reference books:

1. Roger L. Martin,"The Design of Business: Why Design Thinking is the Next Competitive Advantage",2009,Harvard Business Press
2. Richard Paul, Robert Niewoehner, Linda Elde,"The Thinker's Guide to Engineering Reasoning, 2013, Foundation for Critical Thinking Design
3. Tilmann Lindberg, Christoph Meinel, Ralf Wagner, Christo, "Design Thinking: Creating a Culture of Innovation",Springer
4. Brooke Noel Moore & Richard Parker,"Critical Thinking"13th Edition,2020,McGraw-Hill Education

Online References:

1. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
2. https://onlinecourses.nptel.ac.in/noc20_de03/preview
3. https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks.

MSE: To be conducted as written examination for 15 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 2 hours are of 60 marks and scaled to 45.

1. Question paper will comprise of **6** questions, each carrying **15** marks.
2. The students need to solve a total of **4** questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions **(Q.2 to Q.6)** will be selected from all the modules.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC4021	Statistical Foundations for Data Science	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC4021	Statistical Foundations for Data Science	20	20	60	--	--	100

Pre-requisite: Knowledge of
1 ECC301- Applied Mathematics-III

Program Outcomes addressed:
1 PO1: Engineering knowledge
2 PO2: Problem analysis
3 PO3: Design/ development of solution
4 PO4: Conduct investigation of complex problems
5 PO11: Lifelong Learning

Course Objectives:
1 To build an intuitive understanding of Mathematics and relate it to Artificial Intelligence, Machine Learning and Data Science.
2 To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3 To focus on exploring the data with the help of graphical representation and drawing conclusions.
4 To explore optimization and dimensionality reduction techniques.

Course Outcomes:
After successful completion of the course student will be able to
1 Use linear algebra concepts to model, solve, and analyze real-world problems.
2 Apply probability distributions and sampling distributions to various business problems.
3 Select an appropriate graph representation for the given data.
4 Apply exploratory data analysis to some real data sets and provide interpretations via relevant visualization
5 Analyze various optimization techniques.
6 Describe Dimension Reduction Algorithms

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Linear Algebra**	**05**	
	1.1	Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigenvalues and Eigen Vectors, The Singular Value Decomposition (SVD).		**CO1**
		Self-Learning: Applications of Eigenvalues and Eigenvectors in Machine Learning		
2.0		**Probability and Statistics**	**07**	

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	2.1	Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.		**CO2**
		Self-Learning: Bayesian Statistics and its Applications		
3.0		**Introduction to Graphs**	**05**	
	3.1	Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, plotting data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.		**CO3**
		Self-Learning: Graph-Based Data Structures in Python		
4.0		**Exploratory Data Analysis**	**08**	
	4.1	Need of exploratory data analysis, cleaning and preparing data, Feature engineering, Missing values, understanding dataset through various plots and graphs, draw conclusions, deciding appropriate machine learning models.		**CO4**
		Self-Learning: Handling Imbalanced Datasets in Machine Learning		
5.0		**Optimization Techniques**	**07**	
	5.1	Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method.		**CO5**
		Self-Learning: Hyperparameter Tuning in Machine Learning Models		
6.0		**Dimension Reduction Algorithm**	**07**	
	6.1	Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis.		**CO6**
	6.2	Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial		
		Self-Learning: Principal Component Analysis (PCA) vs. Linear Discriminant Analysis (LDA)		
		Total	**39**	

Textbooks:

1 Linear Algebra for Everyone, Gilbert Strang, Wellesley-Cambridge Press, 2020.
2 An Introduction to Probability and Statistics, Vijay K. Rohatgi & A. K. Md. Ehsanes Saleh, Wiley, 3rd Edition, 2015.
3 An Introduction to Optimization, Edwin K. P. Chong & Stanislaw H. Zak, Wiley, 2nd Edition, 2004.
4 Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
5 Exploratory Data Analysis Using R, Pearson, Ronald K, CRC Press, 1st Edition, 2018.

Reference books:

1 Introduction to Linear Algebra – Gilbert Strang, Wellesley-Cambridge Press, 5th Edition, 2016.
2 Advanced Engineering Mathematics – Erwin Kreyszig, Wiley, 10th Edition, 2011.
3 Foundations of Machine Learning – Mehryar Mohri, Afshin Rostamizadeh, and Ameet

Talwalkar, MIT Press, 2nd Edition, 2018.
4 Understanding Machine Learning: From Theory to Algorithms – Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014.
5 Mathematics and Programming for Machine Learning with R – William B. Claster, CRC Press, 1st Edition, 2020.

Online References:

1 https://math.mit.edu/_gs/linearalgebra/
2 https://www.coursera.org/learn/probability-theory-statistics
3 https://nptel.ac.in/courses/111/105/111105090/
4 https://onlinecourses.nptel.ac.in/noc21_ma01/preview
5 https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.

MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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SIES Graduate School of Technology
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Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC4051	Advance Data Structure	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC4051	Advance Data Structure	20	20	60	--	--	100

Pre-requisite:

1. FEL103, FEL205: Knowledge of Basic Programming

Program Outcome mapped:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/ development of solutions:
4. PO4: Conduct investigations of complex problems:
5. PO5: Modern tool usage:
6. PO6: The engineer and society

Course Objectives

1. To understand the fundamental concepts of data structures such as stacks, queues, linked lists, trees, and graphs, and their applications in problem-solving.
2. To analyze and implement various tree structures, including binary trees, binary search trees, AVL trees, and B-trees, and understand their use in efficient data organization and retrieval.
3. To explore graph representations, traversal techniques, and algorithms for solving real-world problems such as shortest path and minimum spanning tree.
4. To develop a deep understanding of recursion, storage management techniques, and their applications in dynamic memory allocation and garbage collection.
5. To master searching and sorting algorithms, hashing techniques, and their performance analysis for efficient data processing.
6. To apply data structures and algorithms to solve real-world problems such as polynomial operations, expression evaluation, scheduling, and Huffman coding.

Course Outcomes

After successful completion of the course, student will be able to…

1. Explain and implement linear data structures such as stacks, queues, and linked lists, and analyse their time and space complexity.
2. Construct and manipulate tree structures, including binary search trees, AVL trees, and B-trees, and apply them to solve problems like searching, insertion, and deletion.

3. Represent graphs using adjacency matrices and lists, and apply traversal algorithms (BFS, DFS) and shortest path algorithms (Dijkstra's) to solve problems.
4. Write recursive functions, analyse their performance, and implement storage management techniques such as memory allocation and garbage collection.
5. Implement and analyse searching algorithms (binary search, hashing) and sorting algorithms (quick sort, merge sort) for efficient data processing.
6. Apply data structures and algorithms to solve real-world problems such as polynomial operations, expression evaluation, and Huffman coding.

Theory Syllabus

Module No.	Unit No.	Topics	Hrs.	Mapped to CO
0		**Prerequisite**	**1**	**CO1**
	0.1	Defining, Declaring, and Initialization of Structure Variables.		
	0.2	Accessing Members of a Structure, Array of Structures, Nested Structures, Pointers to Structures.		
	0.3	Passing Structure, Structure Members, Structure Arrays, and Pointer to Structure as Function Parameters, Self-Referential Structures.		
		Self-Learning Topics: Memory Layout of Structures in C/C++, Union vs Structure, Introduction to Object-Oriented Programming (Classes and Objects).		
1.		**Stacks, Queues, and Linked Lists**	**8**	**CO1**
	1.1	Introduction to Data Structures: Linear and Non-Linear, Static and Dynamic.		
	1.2	Types of Asymptotic Notations in Complexity Analysis of Algorithms.		
	1.3	Concept of Stack and Queue, Array Implementation of Stack and Queue, Circular Queue, Double-Ended Queue, Priority Queue.		
	1.4	Concept of Linked Lists: Singly, Doubly, and Circular Linked Lists.		
	1.5	Insertion, Deletion, Update, and Copying Operations with Linked Lists, Reversing a Singly Linked List.		
	1.6	Linked List Implementation of Stack and Queue.		
		Self-Learning Topics: Skip Lists, XOR Linked Lists, Comparison of Linked Lists in Python vs C/C++, Applications in Real-Time Systems.	-	
2.		**Trees**	**8**	**CO2**
	2.1	Introduction to Trees: Terminology, Types of Binary Trees.		
	2.2	Non-Recursive Preorder, Inorder, and Postorder Traversal.		
	2.3	Creation of Binary Trees from Traversal.		

	2.4	Binary Search Tree (BST): Traversal, Searching, Insertion, and Deletion.		
	2.5	Threaded Binary Tree: Inorder Successor and Predecessor, Insertion, and Deletion.		
	2.6	AVL Tree: Searching, Traversing, Rotations (Right, Left), Insertion, and Deletion.		
	2.7	B-Tree and B+ Tree: Searching, Insertion, Deletion.		
		Self-Learning Topics: Trie, Segment Trees, Tree Implementations in Python, Red-Black Trees, Applications in Databases and File Systems.	-	
3.		**Graphs**	**5**	**CO3**
	3.1	Introduction to Graphs: Undirected Graph, Directed Graph, Terminology.		
	3.2	Connectivity in Undirected and Directed Graphs, Spanning Tree.		
	3.3	Representation of Graphs: Adjacency Matrix, Adjacency List, Transitive Closure, and Path Matrix.		
	3.4	Traversals: Breadth-First Search (BFS), Depth-First Search (DFS).		
		Self-Learning Topics: Graph Applications in Social Networks, GPS, Topological Sorting, Graph Coloring, Graph Databases (Neo4j).	-	
4.		**Recursion and Storage Management**	**5**	**CO4**
	4.1	Recursion: Writing Recursive Functions, Flow of Control, Winding and Unwinding Phases.		
	4.2	Recursive Data Structures, Tail Recursion, Direct and Indirect Recursion.		
	4.3	Storage Management: Sequential Fit Methods (First Fit, Best Fit, Worst Fit).		
	4.4	Fragmentation, Freeing Memory, Boundary Tag Method.		
	4.5	Buddy Systems: Binary Buddy System, Fibonacci Buddy System.		
	4.6	Compaction, Garbage Collection.		
		Self-Learning Topics: Tail Call Optimization, Memory Pools, Garbage Collection Algorithms, Memory Management in Python and Java, Recursion in Dynamic Programming.	-	
5.		**Searching and Sorting**	**6**	**CO5**
	5.1	Searching: Sequential Search, Binary Search.		
	5.2	Hashing: Hash Functions (Truncation, Mid-Square, Folding, Division).		
	5.3	Collision Resolution: Open Addressing (Linear Probing, Quadratic Probing, Double Hashing), Separate Chaining.		
	5.4	Sorting: Insertion Sort, Selection Sort, Merge Sort, Quick Sort, Radix Sort.		
		Self-Learning Topics: External Sorting, Consistent Hashing, Sorting in Python, Timsort, Introsort, Hashing in Cryptography and Blockchain, Complexity Analysis.	-	

6.		**Applications of Data Structures**	**6**	**CO6**
	6.1	Applications of Linked Lists: Polynomial Addition and Multiplication.		
	6.2	Applications of Stacks: Reversal of a String, Expression Evaluation, Polish Notation (Infix, Prefix, Postfix).		
	6.3	Applications of Queues: Scheduling, Round Robin Scheduling.		
	6.4	Applications of Trees: Huffman Coding, Heap Sort.		
	6.5	Applications of Graphs: Shortest Path Algorithms (Dijkstra's, Bellman-Ford, Floyd-Warshall).		
	6.6	Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm.		
		Self-Learning Topics: Bloom Filters, Disjoint Set Union (DSU), Data Structures in Blockchain, Real-World Applications of Stacks, Queues, Graphs in ML.	-	
		Total	39	

Textbooks:

1. Adam Drozdek, *Data Structures and Algorithms in C/C++*, Cengage Learning.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C*, Pearson.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, MIT Press.
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, *Data Structures and Algorithms in Python*, Wiley.
5. Reema Thareja, *Data Structures Using C*, Oxford University Press.

Reference Books:

1. Donald E. Knuth, *The Art of Computer Programming, Volume 1: Fundamental Algorithms*, Addison-Wesley.
2. Robert Sedgewick, Kevin Wayne, *Algorithms*, Addison-Wesley.
3. Narasimha Karumanchi, *Data Structures and Algorithms Made Easy*, CareerMonk Publications.
4. Robert Lafore, *Data Structures and Algorithms in Java*, Sams Publishing.
5. Bradley N. Miller, David L. Ranum, *Problem Solving with Algorithms and Data Structures Using Python*, Franklin, Beedle & Associates.

Online References:

1. https://www.geeksforgeeks.org/
2. https://www.tutorialspoint.com/
3. https://www.hackerrank.com/domains/tutorials/10-days-of-algorithms

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class test/ Case study etc. of 15 marks and 5 marks attendance.

MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

Question paper will comprise of 03 questions.
Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
Question3(20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
All COs should be mapped as per the weightage in the syllabus.

SIES Graduate School of Technology
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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDM C4061	Cost Management	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDM C4061	Cost Management	20	20	60	--	--	100

Pre-requisite: Basic Accounting principles, Quantitative skills etc.

Program Outcomes addressed: PO1, PO2, PO11

Course Objectives: To acquire knowledge and understanding of the concepts, techniques, and practices of cost and management accounting and to develop skills for decision making.

Course Outcomes: Upon completion of this course, learners will be able to…
CO1: To understand and analyze different cost concept and methods.
CO2: To understand the Elements of Cost & Cost classification.
CO3: To apply various material concepts & classifications for preparation of cost sheet.
CO4: To analyze various techniques of costing and its application in Finance, budgets and budgetary control.
CO5: To develop requisite data for cost control and cost reduction.
CO6: To evaluate marginal costing techniques for decision making.

Module No.	Unit No.	Topics	Hrs.	CO
1.0	**1**	**Module 1: Introduction to Cost Accounting**	**04**	
		Meaning of Cost, Cost Accounting & its Objectives, Comparison between Cost accounting and Financial Accounting, Comparison between Cost Accounting and Management Accounting, Types of cost, Methods of costing & Techniques of costing.		**CO1**
		Self-Learning: Basic cost accounting concepts		
2.0	**2**	Classification of Costs and Cost Sheet	**05**	

		Elements of Cost, Classification of Costs, Cost center and cost unit, Preparation of Cost Sheet & Estimated Cost Sheet.		**CO2**
		Self-Learning: Purpose and importance of cost sheet.		
3.0		**Material Management and Accounting for materials**	**06**	
		Managing Purchase Functions, Cost of Material, Storing of materials – Inventory control methods, Costs associated with storing and ordering material, Economic Order Quantity, Fixation of levels and calculation of the same, Issue control-Pricing issues (LIFO, FIFO, Weighted Average), Material control - Objectives in Material Control, Stock Turnover, Material losses wastage, scrap, spoilage, defectives.		**CO3**
		Self-Learning: Basic flowchart for material flow in a company.		
4.0		**Accounting for labour and Overheads**	**08**	
		Accounting for labour: Types of Labour Cost, Methods of Remuneration, Treatment of overtime, fringe benefits, idle time etc. Accounting for overheads: Production overheads – Collection, Distribution to Production and service departments, Computation of Overheads Rate based on Machine Hour Rate method, Allocations and Apportionment, Absorption of overheads.		**CO4**
		Self-Learning: Types of labour, classification of overheads.		
5.0		**Cost Control and Cost Reduction**	**10**	
		Introduction, Comparison between cost control & cost reduction, Budgets and Budgetary Control, Meaning and Purpose of Budget, Objectives of Budgetary Control, Dangers of budget, Types of Budgets- Flexible Budget Standard Costing, Concept and development of standard costing, Variance analysis for cost, Direct Material variance- Cost, Price, usage, mix and yield variance Direct Labour Variance- Cost, Efficiency, usage, mix, yield and idle-time variance, Overhead Variance – Variable & Fixed Overhead variance, Sales variances – Value, rate, volume and mix variance.		**CO5**
		Self-Learning: Differences and Interplay Between Cost Control and Cost Reduction.		
6.0		Marginal Costing & CVP Analysis	**06**	
		Nature and scope of Marginal Costing, Marginal Cost equation, Cost Profit volume analysis, Break Even point and Break-Even Analysis, Relevant cost analysis for decision making.		**CO6**
		Self-learning: Applications of Marginal Costing in Decision Making.		
		Total	**39**	

Textbooks:

1. B. Banerjee, *Cost Accounting: Theory and Practice*, 14th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2021.
2. M. Y. Khan and P. K. Jain, *Management Accounting*, 8th ed. New Delhi, India: McGraw-Hill Education, 2021.

Reference books:

1. P. Shah, *Management Accounting*, 6th ed. New Delhi, India: Oxford University Press, 2015.
2. C. Drury, *Management and Cost Accounting*, 12th ed. Andover, U.K.: Cengage Learning, 2024.

Online References:

1. https://dynamicstudyhub.com/cost-management.
2. https://www.wallstreetmojo.com/cost-management

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination:
$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL401	Controls and Instrumentation Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL401	Controls and Instrumentation Lab	--	--	--	25	--	25

Pre-requisite:
1. Knowledge of Basic Electrical & Electronics Engineering Lab (FEL102).
2. Electronic Devices and Circuits Lab (ECL303)

Program Outcomes addressed:
1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO5: Modern tool usage
5. PO9: Individual and teamwork
6. PO11: Lifelong learning
7. PSO2: Develop innovative multidisciplinary projects

Lab Objectives:
1. To determine the performance of control systems
2. To determine the stability of control systems
3. To understand working principle of different sensors and transducers
4. To understand the applications of instrumentation systems.

Lab Outcomes:
After successful completion of the course, students will be able to:
1. Simulate the performance of control systems
2. Analyse the stability of control systems via simulations
3. Demonstrate the characteristics of various sensors and transducers.
4. Develop the applications of Instrumentation systems.

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Obtain the transient response and time domain parameters for first and second order control systems. (using trainer kits or simulation)	**LO1**
2	Determine step and impulse response for Type '0', Type '1', and Type '2' systems. (Using trainer kits or simulation)	**LO1**
3	Determine stability of different types of control systems	**LO2**
4	Determine root locus plot for second order system using simulation (MATLAB/ Scilab) and obtain controller domain specification parameters. (verify results theoretically)	**LO2**
5	Determine Bode plot using MATLAB/Scilab for second order control system and obtain frequency domain specification parameters. (verify results theoretically)	**LO2**
6	Displacement measurement using LVDT	**LO3**
7	Temperature measurement using thermistor, thermocouple and RTD	**LO3**
8	Displacement measurement using capacitive transducer	**LO3**
9	Pressure Measurement using Strain Gauge	**LO3**
10	Study of elements of Data Acquisition System	**LO4**
11	Demonstration of the SCADA system using open source software	**LO4**
12	Use of any Industrial interface/BUS for effective communication	**LO4**
13	Study the effect of PI and PD controller on system performance (using trainer kits/MATLAB/Scilab)	**LO4**

Term Work:
The term work should include 8 experiments including hardware and simulation. At least 02 assignments covering the entire syllabus must be given on the content of theory and practical of "Controls and Instrumentation". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:
25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

SIES Graduate School of Technology
Department of Electronics and Computer Science
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL402	Linear Integrated Circuit Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL402	Linear Integrated Circuit Lab	--	--	--	25	25	50

Pre-requisite:
1. FEL102- Basic Electrical &Electronics Engineering Lab
2. ECL303 -Electronic Devices and Circuits Lab

Program Outcomes addressed:
1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design of Solutions
4. PO5: Modern tool usage
5. PO9: Individual and team work.
6. PSO1: To acquire knowledge in cutting- edge technologies.

Lab Objectives:
1. To design various linear and nonlinear applications of operational amplifiers.
2. To design ADC and DAC converters.
3. To design multivibrators, PLL and VCO
4. To understand various voltage regulator integrated circuits

Lab Outcomes:
After successful completion of the course, students will be able to:
1. Explain the basic building blocks and fundamentals of operational amplifiers.
2. Design linear applications of op-amp.
3. Design nonlinear applications of op-amp.
4. Design various ADC and DAC techniques.
5. Design multivibrators using timer IC 555, PLL IC 565 and VCO IC 566
6. Demonstrate various voltage regulator integrated circuits.

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Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Design inverting, non-inverting amplifier, summing and difference amplifier using IC 741	LO1
2	Design RC phase shift Oscillator/ Wein bridge Oscillator using op-amp IC 741	LO2
3	Design and analyze Integrator/ Differentiator using op-amp IC 741	LO2
4	Design and analyze second order active filters using op-amp IC 741	LO2
5	Implementation of comparator, zero crossing detector.	LO3
6	Design Schmitt trigger using op-amp IC 741	LO3
7	Design and implement DAC/ADC	LO4
8	Design Astable multivibrator using IC 555 for fixed frequency and variable duty cycle	LO5
9	Implementation of voltage regulator using LM317	LO6

Simulation Experiments

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	SPICE simulation on op amp parameters	LO1
2	SPICE simulation on design of linear application using op amp	LO2
3	SPICE simulation of non-linear applications of Op amp	LO3
4	SPICE simulation of Active filters	LO2
5	SPICE simulation of oscillators	LO2

Term Work:
The term work should include 10 experiments: 6 hardware experiments, and 4 using simulators or virtual labs. At least 02 assignments covering the entire syllabus must be given on the content of theory and practicals of "Linear Integrated Circuits". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)

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

Practical Exam: (2 hours/ 25 Marks)
End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL403	Value Education (UHV)	--	04	--	--	02	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL403	Value Education (UHV)	--	--	--	50	--	50

Program Outcome mapped:

- **Engineering Knowledge** – Apply mathematics, science, and engineering fundamentals to solve complex problems.
- **Problem Analysis** – Identify, formulate, and analyse engineering problems using foundational principles.
- **Design/Development of Solutions** – Design solutions and systems that meet specified needs with safety and sustainability considerations.
- **Investigation of Complex Problems** – Conduct research and use scientific methods to analyse and solve engineering challenges.
- **Modern Tool Usage** – Utilize appropriate techniques, resources, and modern engineering tools for problem-solving.
- **Engineer and Society** – Assess societal, health, safety, and legal aspects relevant to professional engineering.
- **Environment and Sustainability** – Understand and apply sustainable development principles in engineering solutions.
- **Ethics** – Uphold ethical principles and professional responsibilities in engineering practice.
- **Individual and Team Work** – Function effectively as an individual and as a member or leader in diverse teams.
- **Communication** – Communicate complex engineering activities effectively through reports, presentations, and instructions.
- **Project Management and Finance** – Apply engineering and management principles to project execution and financial decision-making.
- **Lifelong Learning** – Recognize the need for and engage in continuous learning to keep pace with technological advancements.

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Course Objectives:

1. **To introduce the fundamental concepts of human values**, including intrinsic and extrinsic values, and their relevance to personal and professional development in the context of IT engineering.
2. **To explore the principles of Universal Human Values (UHV)**, emphasizing self-awareness, self-exploration, and the application of tools like the JOHARI window and SWOT analysis in the IT profession.
3. **To study the different levels of harmony**—within oneself, in the family, society, and nature—and apply these concepts to achieve a balanced and fulfilling life, especially in the fast-paced IT industry.
4. **To comprehend the key aspects of professional ethics in IT**, including ethical standards, work ethics, and moral issues such as data privacy, cybersecurity, and AI ethics.
5. **To develop foundational values** such as integrity, impartiality, non-partisanship, and objectivity, and cultivate empathy, tolerance, and compassion in both personal and professional contexts, particularly in IT-related decision-making.
6. **To integrate human values into IT practices**, focusing on ethical decision-making, sustainable technology development, and responsible innovation.

Course Outcomes:

After successful completion of the course, students will be able to:

- **Understand and Explain** (*Understand*) the basic concepts of human values and their significance in personal and professional contexts, particularly in the IT industry.
- **Explore and Internalize** (*Apply*) human values to guide personal behavior and professional conduct in IT roles such as software development, data analysis, and cybersecurity.
- **Analyze and Apply** (*Analyze & Apply*) the concept of harmony at various levels of existence to achieve a balanced life, even in high-pressure IT environments.
- **Identify and Evaluate** (*Analyze & Evaluate*) ethical issues in the IT profession, including data privacy, cybersecurity, AI ethics, and intellectual property rights, using appropriate ethical theories and standards.
- **Demonstrate and Uphold** (*Apply & Evaluate*) integrity and ethical principles in professional and public service contexts, fostering empathy and compassion in IT projects that impact society.
- **Integrate and Implement** (*Create & Apply*) human values into IT practices, ensuring that technology development aligns with ethical, social, and environmental considerations.

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Course Modules and Topics:

Module No.	Unit No.	Topics	Mapped Learning Outcome (LO)
1.0		Introduction to Human Values and Their Relevance in IT	LO1
	1.1	Definition, Intrinsic & Extrinsic values, Shalom Schwartz's Theory of Basic Human Values, Value education: Need, Basic Guidelines and Scope, Self-exploration, Happiness and Prosperity, Harmony, Self-awareness: JOHARI window and SWOT analysis	LO1
	1.2	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	LO4
2.0		Understanding Human Beings and Harmony at Various Levels of Existence	LO3
	2.1	Human beings as a combination of the conscious 'I' and material body, Abraham Maslow's Hierarchy of Needs, Classification between I & Body, Co-existence, Harmony in Self: Swasthya and Sanyama	LO3
	2.2	Harmony in the Family -- Understanding Values in Human Relationships, Differentiation in relationships, Values in relationships	LO3
	2.3	Harmony in the Society -- From Family order to World Family Order, Comprehensive Human Goal, Harmony in Nature -- Understanding the Interconnectedness and Mutual Fulfilment, Understanding the Four Orders of Nature	LO3, LO6
3.0		Professional Ethics in IT	LO4
	3.1	Definition, Characteristics, Profession, Professionalism, Morality, Moral issues in the IT profession, Understanding Ethics, Ethical Standards, Work Ethics, Engineering Ethics	LO4
	3.2	Types of Inquiries, Kohlberg's Theory, Heinz Dilemma, Gilligan's Theory, and Ethical Theories	LO4
	3.3	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	LO4
4.0		Ethics, Integrity, and Aptitude in IT	LO5
	4.1	Essence, determinants, and consequences of ethics in human actions, Dimensions of ethics, Ethics in private and public relationships	LO5
	4.2	Key contributions from Indian and global moral thinkers and philosophers, emphasizing integrity, impartiality, and non-partisanship in professional settings	LO5
	4.3	Upholding objectivity and dedication to public service, Cultivating empathy, tolerance, and compassion, with a focus on their application in IT and public	LO5

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Module No.	Unit No.	Topics	Mapped Learning Outcome (LO)
		welfare	
5.0		Understanding Harmony in Nature and Sustainable IT Practices	LO6
	5.1	Concept of harmony in Nature: Meaning of harmony in nature, Disharmony with Nature -- causes, Implications of disharmony with nature	LO6
	5.2	Maintaining harmony with nature: Harmony through mutual fulfilment of the four orders in nature, Harmony through symbiotic relationship with nature, Achieving competence in maintaining harmony with nature in professional life	LO6
	5.3	Sustainable IT Practices: Green computing, energy-efficient algorithms, and eco-friendly technology development	LO6
6.0		Practicum Project -- Community Engagement and IT for Social Good	LO2, LO5, LO6
	6.1	Students carry out a community engagement project to benefit the local community through IT-based initiatives (e.g., developing apps for social causes, organizing digital literacy camps, or creating awareness about cybersecurity).	LO2, LO5, LO6
	6.2	Students write a reflective report on how the understanding of universal human values has been integrated into their IT project.	LO5, LO6

Textbooks:

1. **Naagarazan, R. S.** *A Textbook on Professional Ethics and Human Values*. 4th Edition. New Age International Publishers, 2021.
2. **Gaur, R.R., Sangal, R., & Bagaria, G.P.** *A Foundation Course in Human Values and Professional Ethics*. 3rd Edition. Excel Books, 2019.
3. **Khosla, Vaishali R., & Bhagat, Kavita.** *Human Values and Professional Ethics*. 2nd Edition. Macmillan Education, 2020.
4. **Harris, C.E., Pritchard, M.S., & Rabins, M.J.** *Engineering Ethics: Concepts and Cases*. 6th Edition. CENGAGE Learning, 2019.
5. **Murthy, PSR.** *Indian Culture, Values and Professional Ethics*. 4th Edition. BS Publications, 2022.

Reference Books:

1. **Kumar, Niraj.** *Lexicon for Ethics, Integrity & Aptitude for IAS General Studies Paper IV*. 2nd Edition. McGraw Hill Education, 2023.
2. **Subba Rao, G., & Roy Chowdhury, P. N.** *Ethics, Integrity & Aptitude*. 3rd Edition. McGraw Hill Education, 2020.

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Online References:

1. https://fdp-si.aicte-india.org/index.php
2. https://example.com/

Course Assessment:

Internal Assessment Method (With Rubrics)
The internal assessment will consist of **Continuous Internal Assessment (CIAP) = 50 marks** based on **Assignments, Case Studies, Presentations, and Practicum Projects**.

Assessment Component	Weightage (%)	Evaluation Criteria (Rubrics)
Assignment on Human Values	20%	- Excellent (5): Demonstrates deep understanding with real-life examples - Good (4): Good understanding with relevant examples - Satisfactory (3): Basic understanding with minimal examples - Needs Improvement (2): Partial understanding with errors - Poor (1): Little to no understanding
Case Study on Ethical Issues in IT	20%	- Excellent (5): In-depth analysis with ethical theories and solutions - Good (4): Covers major ethical aspects with examples - Satisfactory (3): Identifies ethical concerns with some analysis - Needs Improvement (2): Limited understanding with minor errors - Poor (1): Lacks analysis and ethical reasoning
Presentation on Sustainability in IT	20%	- Excellent (5): Well-structured, engaging, innovative ideas - Good (4): Clear and logical presentation with good insights - Satisfactory (3): Covers major points but lacks depth - Needs Improvement (2): Some points missing, lacks clarity - Poor (1): Unstructured, lacks coherence
Reflection Report on Practicum Project	20%	- Excellent (5): Thoughtful reflection, well-articulated impact - Good (4): Covers personal learning and impact clearly - Satisfactory (3): General reflection with limited depth

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		- Needs Improvement (2): Superficial understanding - Poor (1): Minimal effort, lacks insight
Participation in Discussion & Engagement	20%	- Excellent (5): Actively participates, provides insightful contributions - Good (4): Engaged, contributes relevant thoughts - Satisfactory (3): Participates but with limited contribution - Needs Improvement (2): Rarely participates, minimal effort - Poor (1): No participation

Examples of Practicum Projects for Community Engagement and IT for Social Good

The practicum project aims to encourage students to apply **Universal Human Values (UHV)** and **Ethics in IT** to solve real-world societal challenges. Below are some project ideas along with explanations of how they integrate **human values and ethics**:

Digital Literacy Program for Underprivileged Communities

Objective: Create and conduct workshops to educate marginalized communities about basic computer skills, cybersecurity awareness, and digital payments.

Implementation:

- Design an easy-to-understand curriculum on digital literacy.
- Conduct workshops/webinars in rural schools or community centers.
- Develop a simple mobile/web application for learning digital skills.
- Educate participants about data privacy, cyber threats, and ethical internet use.

Human Values & Ethics Integration:

- **Empathy & Compassion** – Address digital divide and empower underprivileged individuals.
- **Integrity & Responsibility** – Teach ethical use of technology and responsible online behavior.
- **Public Welfare** – Ensure safe digital access for vulnerable communities.

AI-Based Cyberbullying Detection for Schools & Colleges

Objective: Develop an AI model to identify cyberbullying in chat messages and social media posts, ensuring a safer digital environment.

Implementation:

- Collect and train data on cyberbullying-related words & phrases.
- Implement a Natural Language Processing (NLP)-based chatbot to detect abusive content.
- Educate students on ethical social media behavior and reporting mechanisms.
- Partner with schools/colleges to deploy the model in their IT systems.

Human Values & Ethics Integration:

- **Respect & Non-Partisanship** – Encourage online respectful interactions.

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- **Fairness & Objectivity** – Ensure non-biased AI in content moderation.
- **Safety & Privacy** – Protect users' personal data and identity.

Green Computing Awareness & E-Waste Management App

Objective: Develop an app to educate users on sustainable IT practices and provide an e-waste collection service.

Implementation:

- Create an app that guides users on green computing practices.
- Provide nearby e-waste collection centers and reward users for recycling.
- Conduct IT industry awareness campaigns on energy-efficient computing.
- Promote the use of renewable energy in data centers.

Human Values & Ethics Integration:

- **Environmental Sustainability** – Encourage eco-friendly IT solutions.
- **Social Responsibility** – Spread awareness about ethical e-waste disposal.
- **Harmony in Nature** – Minimize IT sector's negative impact on nature.

Cybersecurity Awareness Chatbot for Senior Citizens

Objective: Build a WhatsApp or Telegram chatbot that assists senior citizens in identifying and avoiding online scams, phishing, and frauds.

Implementation:

- Develop an AI chatbot that explains common online scams.
- Create step-by-step tutorials on safe internet banking and social media usage.
- Partner with local community centers and NGOs to spread awareness.
- Ensure chatbot provides real-time support and automated alerts.

Human Values & Ethics Integration:

- **Compassion & Empathy** – Assist vulnerable groups in safe internet use.
- **Integrity & Awareness** – Promote honest and secure online transactions.
- **Public Welfare** – Reduce cyber frauds targeting elderly people.

AI Ethics Awareness in IT Companies & Colleges

Objective: Develop an interactive website or mobile app to educate IT professionals and students on ethical AI usage and biases in AI systems.

Implementation:

- Provide interactive case studies on AI bias, privacy, and ethical dilemmas.
- Conduct quiz-based learning to test AI ethical understanding.
- Collaborate with IT professionals and faculty to design real-world scenarios.
- Ensure alignment with global AI ethics standards (e.g., IEEE, EU AI Act).

Human Values & Ethics Integration:

- **Integrity & Fairness** – Ensure unbiased AI algorithms.
- **Public Interest** – Educate developers on responsible AI implementation.
- **Transparency** – Promote explainable and fair AI decision-making.

Mobile App for Volunteer & Donation Matching

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Objective: Develop a volunteer-matching platform that connects IT professionals and students with social organizations in need of technical assistance.

Implementation:

- Allow users to register their skills (app development, cybersecurity, etc.).
- Connect them with NGOs or community projects that require IT support.
- Enable secure crowdfunding and donation tracking for transparency.
- Promote projects focused on digital inclusion and education.

Human Values & Ethics Integration:

- **Social Responsibility** – Encourage IT professionals to give back to society.
- **Transparency & Trust** – Maintain fair donation tracking.
- **Empathy & Compassion** – Align IT skills with community development.

Ethical Hacking & Cybersecurity Training for Students

Objective: Conduct a hands-on ethical hacking workshop to educate students on ethical penetration testing and cybersecurity best practices.

Implementation:

- Develop training modules on ethical hacking, cryptography, and network security.
- Conduct capture-the-flag (CTF) cybersecurity challenges for hands-on learning.
- Educate students on responsible disclosure of vulnerabilities.
- Partner with cybersecurity firms for internships and projects.

Human Values & Ethics Integration:

- **Ethical Responsibility** – Train IT students to prevent cyber crimes.
- **Accountability** – Promote responsible ethical hacking practices.
- **Public Safety** – Improve cybersecurity awareness in college networks.

AI-Powered Sign Language Recognition System

Objective: Develop an AI-based sign language recognition system to help hearing-impaired individuals communicate using real-time gesture recognition.

Implementation:

- Train a machine learning model on Indian Sign Language (ISL).
- Develop a mobile/web app that converts sign language gestures into text/speech.
- Partner with special education institutes and NGOs for deployment.
- Ensure open-source availability for future development.

Human Values & Ethics Integration:

- **Inclusion & Accessibility** – Bridge communication gaps for disabled individuals.
- **Fairness & Transparency** – Ensure AI is unbiased across different sign languages.
- **Social Welfare** – Enhance digital accessibility for differently-abled people.

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• Project Submission & Reflection Report

After completing the practicum project, students will submit a reflective report covering:

1. **Project Objective & Problem Statement**
2. **Implementation Details & Challenges Faced**

3. **Human Values & Ethics Integrated**
4. **Impact Assessment & Learning Outcomes**
5. **Future Improvements & Scalability**

Evaluation Rubric:

- **Excellent (5):** Clear objectives, strong ethical integration, significant social impact.
- **Good (4):** Good ethical integration, minor improvement areas.
- **Satisfactory (3):** Basic implementation, lacks depth in ethical application.
- **Needs Improvement (2):** Minimal social impact, weak ethical connection.
- **Poor (1):** Unclear project execution, little relevance to human values.

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SIES Graduate School of Technology

Department of Electronics and Computer Science

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL404	Skill Lab (Linux)	-	2*+2	-	-	02	-	02

***** Theory class to be conducted for full class

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECL404	Skill Lab (Linux)	-	-	-	25	25	50

Course pre-requisite:

1. FEL103: C-Programming

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution
4. PO4: Conduct investigations of complex problems
5. PO5: Modern tool Usage
6. PO9: Individual and Team work
7. PO12: Lifelong Learning
8. PSO2: Work in a multi-disciplinary environment

Lab Objectives:

1. To introduce the concept of open-source software
2. To Install Linux and implement standard commands (file, process, memory, user, group and device management)
3. To provide comprehensive exposure to server configurations and Linux networking: configuration, troubleshooting, and management commands.
4. To impart a comprehensive introduction to SHELL programming, services and utilities.
5. To introduce Linux security and virtualization technologies like Hypervisor, emulation and application.
6. To implement Case-study on Linux based operating systems for IoT and Cloud.

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Lab Outcomes:

After successful completion of the course, students will be able to:

1. Describe open-source operating systems.
2. Perform file, process, memory, user group and device management on Linux system Configure, troubleshoot, and manage network and servers.
3. Perform shell scripting and illustrate the use of services and utilities.
4. Demonstrate the use of hypervisors, virtual machines and implement security measures in Linux.
5. Explain the applications of operating systems meant for IoT and Cloud.

		Detailed Content	Hours	LO
1		**Open-Source Software**	**03**	**LO1**
		Need of Open Sources, Advantages and applications of Open sources, Free open-source software usage, Free Software Movement, Open-Source Software Development Model, comparison with close source / Proprietary software, widely used open-source software licenses.		
2		**Installation of Linux, Architecture and Functions**	**05**	**LO2**
	2.1	Installing Software on Debian Based Linux: Debian, Ubuntu, Kali Linux, Red Hat Linux.		
	2.2	Overview of Unix and Linux architectures, Linux files system, Linux standard directories, and Linux Directory Structure.		
	2.3	Basic Linux Commands, Linux Networking commands, Viewing Files and the Nano Editor, Editing Files in Vi, Graphical Editors, Deleting, Copying, Moving, and Renaming Files. Process management, Memory management, User- group and device management.		
3		**Linux Network and Server Configurations**	**06**	**LO3**
	3.1	Basics of Network Management, Setting up Dynamic and Static Addressing, Monitoring network services, Talking with DNS Servers, Remote System, Administration with Open SSH-Server & Putty.		
	3.2	TCP/IP Networking for Linux System Administrators, DNS and hostnames, DHCP, Network Troubleshooting, server configurations: LAMP Stack, NFS, FTP, TFTP, Squid, Apache, Mail, Samba and TELNET.		
4		**Bash Shell Scripting**	**04**	**LO4**
	4.1	Basics of shell programming, various types of shell available in Linux, Shell programming in bash, Conditional statements, Looping statements, Case statements, Parameter passing and arguments.		
	4.2	Temporary disabling of user's accounts, Creating and mounting file system, becoming super user using su, Getting system information with usename, host name. Disk partitions & sizes, users, kernel, installing and removing packages, rpm command		
	4.3	System shell variables, Shell variables, shell keywords, Creating Shell programs for automating system tasks, scheduling repetitive jobs using cron.		
5		**Security and Virtualization**	**03**	**LO5**

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	5.1	SE Linux and Firewalld: SE Linux Overview, SE Linux Tools, SE Linux Contexts, SE Linux Booleans, Use SE Linux port labeling to allow services to use non-standard ports, Diagnose and address SE Linux policy violations, Configure Firewalld, Understand Firewalld Components, Setting Default Firewalld Zone, Creating Own Services in Firewalld, Assigning Services to Firewalld Zones, Adding Rich Rules for Network Range		
	5.2	Virtualization: Introduction to virtualization and its types, need of virtualization, Benefits of Virtualization, Virtualization Implementation, Kernel based Virtual Machines (KVM) and XE		
6		**Advanced Operating Systems**	**05**	**LO6**
		Case Study: • IoT OS Requirements: Resource Constraints, Real-time Capabilities, Low Power Consumption • Contiki OS: Features, RPL Protocol, Simulation with Cooja • RIOT OS: Architecture, Multi-threading, Energy Efficiency • FreeRTOS: Task Scheduling, Inter-process Communication, Memory Management • TinyOS: NesC Language, Event-driven Programming		
		Case Study: • Characteristics of Cloud OS: Scalability, Virtualization, Multi-tenancy • Virtualization Technologies: Hypervisors (Type 1 & 2), Docker, Kubernetes • AWS, Azure, and Google Cloud OS Architectures • OpenStack: Components and Use Cases • Serverless Computing and OS Implications		
		Total	26	

Textbooks:

1. W. Stevens, Stephen Rago, “Advanced Programming in the UNIX Environment”, Addison Wesley Professional Computing Series
2. Yeswant Kanetkar – “UNIX Shell Programming”, First edition, BPB.
3. Cristopher Negus – “Red Hat Linux Bible”, Wiley Dreamtech India 2005 edition.
4. Jason Cannon,” Linux for Beginners: An Introduction to the Linux Operating System and Command line”
5. Linux: The Complete Reference, Sixth Edition by Richard Petersen, McGraw Hill Education.
6. Linux Command Line and Shell Scripting Bible by Richard Blum Wiley
7. Red hat Linux Networking and System Administration, by Terry Collings and Kurt Wall, Wiley.Wiley3rd edition 2005

Reference Books:

1. Linux Administration: A Beginner’s Guide by Wale Soyinka, McGraw-Hill Education
2. Red Hat Enterprise Linux 6 Administration, Real World Skills for Red Hat Administrators by Sander van Vugt, John Wiley and Sons
3. Official Red Hat Linux Users guide by Redhat, Wiley Dreamtech India
4. Graham Glass & King Ables – UNIX for programmers and users, Third Edition, Pearson Education.
5. Neil Mathew & Richard Stones – Beginning Linux Programming, Fourth edition, Wiley Dreamtech India.
6. Richard Petersen, Linux: The Complete Reference, Sixth Edition

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Software Tools:

1. https://www.virtualbox.org/wiki/Downloads
2. https://getfedora.org/
3. https://www.centos.org/download/
4. https://ubuntu.com/download/desktop
5. https://developers.redhat.com/products/rhel/download
6. https://ubuntu.com/tutorials/install-ubuntu-desktop#1-overview
7. https://docs.redhat.com/en/documentation/red_hat_enterprise_linux/7/html/installation_guide/chap-simple-install#sect-simple-install
8. https://www.kali.org/docs/installation/

Online Repository (browser-based terminals)

1. https://distrotest.net/
2. https://bellard.org/jslinux/
3. http://www.webminal.org/terminal/
4. https://www.tutorialspoint.com/unix_terminal_online.php
5. https://www.tecmint.com/install-dhcp-server-in-ubuntu-debian/
6. https://www.digitalocean.com/community/tutorials/how-to-install-and-configure-postfix-as-a-send-only-smtp-server-on-ubuntu-16-04
7. https://ubuntu.com/server/docs/about-dynamic-host-configuration-protocol-dhcp
8. https://images.app.goo.gl/mypTBT2fhv9iaZyZA ----------Kubernetes
9. https://images.app.goo.gl/ByTvR4hc1fuenhtA6---------- Docker

Online Resources: (Study Resources)

1. https://training.linuxfoundation.org/training/introduction-to-linux/
2. https://www.netacad.com/courses/os-it/ndg-linux-unhatched
3. https://www.netacad.com/courses/os-it/ndg-linux-essentials
4. https://www.edx.org/course/fundamentals-of-red-hat-enterprise-linux
5. https://linuxhandbook.com/tag/bash-beginner/
6. https://www.learnshell.org/
7. https://itsfoss.com/shell-scripting-resources/

Suggested List of Programming Assignments/laboratory Work:	
Sr. No.	**Title of Experiments**
1	Installation of Red HAT/Centos/Fedora Linux operating system using following method CD-ROM, Network Installation or Kickstart Installation. a. Partitioning drives b. Configuring boot loader (GRUB/LILO) c. Updating and upgrading the system d. Shutting down and reboot
2	Learning and executing Linux commands for a. Interacting with BASH shell and built-in shell variables b. Navigation c. File and directory management d. Working with links e. Searching files f. creates users, groups, change permission, software selection and installation and make changes in Grub file. Creating, modifying and deleting users Creating, modifying and deleting groups g. Managing file permissions, attributes and ownerships h. Setting Default Permissions with umask

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	i. Setting up access control list for files and directories
3	Learning and executing Linux commands for Process management tasks like a. Executing a process b. Getting process info c. Killing a process d. Changing process attributes e. Managing foreground and background processes f. Scheduling automated jobs using CRON jobs
4	Learning and executing Linux commands for managing Storage drives in Linux environment a. Create partitions b. Install file system c. Mount and unmount partitions manually from CLI d. Automated mounting using fstab e. Encrypt volumes f. SWAP, LVM, RAID, Primary Partition, Extended Partition and Linux files system
5	Learning and executing Linux commands for managing networking in Linux environment a. Enable networking services from command line b. Configure IP and other network settings from command line. c. Configure IP and other network settings from configuration files. d. Configure SSH based services for CLI and GUI access on remote machines.
6	Install and configure an NFS server and mount NFS shares on Linux Environment. Install and configure files sharing services using FTP server. Install and configure Samba file server and share files across local network.
7	Install and configure DHCP server, DNS server
8	Install and configure TELNET server, SSH server
9	Install and configure a LAMP stack and deploy a full stack web application on it with SSL/TLS security.
10	Shell Scripting: a. Write a shell script program to display list of user currently logged in. b. Write a shell script to add user and password on Linux system c. Write a shell script that deletes all lines containing a specified word d. Write a shell Script program to check whether the given number is even or odd. e. Write a shell script program to check variable attributes of file and processes. f. Write a shell script program to check and list attributes of processes. g. Write an awk script to find the number of characters, words and lines in a file h. Write an awk script to develop a Fibonacci series. i. Write an awk script to display the pattern of given string or number.
11	Configuring security for the Linux Server environment using SELinux and FirewallD.
12	Case Study on Docker, Kubernetes.
13	Case Study on AWS, Azure, and Google Cloud OS Architectures .

Suggested List of Course project:	
Sr. No.	**Title of Experiments**
1	Develop a scientific calculator using shell script.
2	Installation of Contiki /RIOT Operating System.
3	Install and set up KVM to run isolated instances of other operating systems inside a Linux host system
4	Creation of a network bridge.

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5	Configuration of Linux box as a router or a packet forwarder.
6	Case Study on Docker, Kubernetes
7	Case Study on AWS, Azure, and Google Cloud OS Architectures
8	Network Attached Storage(NAS)
9	Network monitoring service.
10	Automation using Bash.

This is suggested list and changes can be done as per content of syllabus.

Term Work:

1. Term work should consist of 10 experiments and Journal must include at least 2 assignments
2. Mini Project based on the content of the syllabus (Group of 2-3 students)
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25-Marks (Experiments: 15-marks, Attendance: 05-marks, Course Project: -5-marks)
   Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Oral & Practical exam

Based on the entire syllabus of ECL404: Skill Laboratory: Linux Networking & Server Configuration and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM401	Mini Project 1B	--	02#	--	--	1	--	1

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECM401	Mini Project 1B	--	--	--	25	25	50

# Indicates workload of a learner (Not Faculty) for Mini Project 1B. Faculty Load: 1/2 hour per week per four groups.

Program Outcomes:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer & the World
7. PO7: Ethics
8. PO8: Individual & CollaborativeTeamwork
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-Long learning

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.
5. To enhance written and oral communication skills.
6. Foster ethical leadership and responsible decision-making

Outcomes:

At the end of the course learners will be able to…

1. Identify problems based on societal /research needs.
2. Develop interpersonal skills to work as a member of a group or leader.
3. Apply Knowledge and skill to solve societal problems in a group.
4. Analyse the available resultsthrough theoretical/ experimental/simulations.
5. Excel in written and oral communication skills.
6. Apply standard norms of engineering practices and demonstrate project management principles during project work.

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Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- 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.
- 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.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by the head of departments of each institute. The progress of mini project to be evaluated on a continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee 10
    - Quality of Project report 05

The review/progress monitoring committee may consider the following points for assessment based on either one year or half year project as mentioned in general guidelines.

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One-year project:

- In the first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on a presentation given by the student group.
    - First shall be for finalization of the problem
    - The second shall be on finalization of the proposed solution of the problem.
- In the second semester expected work shall be procurement of components/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - The first review is based on the readiness of building a working prototype to be conducted.
    - Second review shall be based on a poster presentation cum demonstration of the working model in the last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalization of problem and proposed solution
    - 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/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

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Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of the 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 the head of the Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/student competitions.

Mini Project shall be assessed based on the 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

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Internal Assessment:
For 03 credit - 80 marks subject Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.
For 02 credit - 60 marks subject Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.
In Semester Examination (ISE)

ISE 20 marks = 05 marks attendance +15 marks for Activities.

ISE 15 marks = 05 marks attendance +10 marks for Activities.

The Rubrics for activities are as follows. The activities will be decided by course in charge and approved by HoD.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	05 Marks
2	Literature review of papers/journals	05 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	05 Marks
4	Extra Experiments/ Virtual Lab	05 marks
5	Content beyond syllabus presentation	05 marks
6	Wins in the event/competition/hackathon pertaining to the course	10 Marks
7	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
8	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project /	10 Marks
11	GATE Based Assignment test/Tutorials etc.	10 Marks

*For sr.no.8, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.

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