South Indian Education Society's

Graduate School of Technology

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

Autonomous Institute Affiliated to University of Mumbai

Department of Electronics and Computer Science

Curriculum Structure for Undergraduate Academic Program in

Electronics and Computer Science

Third Year Syllabus

Board of Studies
Department of Electronics and Computer Science

Academic Council
SIES Graduate School of Technology

Effective from: AY 2026-27

PREAMBLE

Dear Students, Faculty, and Stakeholders,

Greetings and congratulations to all the stakeholders of SIES Graduate School of Technology for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2- 10/2023(AC-Policy) dated 10 July 2024 conferred the autonomous status affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. Autonomy will help design and implement curriculum which is more learner centric and robust to cater to the changing need of Society and Industry.

The Department of Computer Engineering SIES Graduate School of Technology, Nerul, Navi Mumbai, was established in 2002 and the current intake capacity is 180.One of the notable achievements is accreditation by the National Board of Accreditation (NBA) in 2011,2021,2024 which reflects our commitment in maintaining high standards of education and infrastructure.
We are delighted to announce the introduction of the newly designed curriculum for autonomy at SIES Graduate School of Technology, The newly designed curriculum for the Computer Engineering course at our autonomous institute is a reflection of our commitment to excellence, innovation, and inclusivity in higher education. Guided by the principles and objectives of the National Education Policy (NEP), this curriculum aims to create a robust framework that not only equips students with in-depth technical knowledge but also fosters holistic development, ethical values, and a lifelong passion for learning.

Curriculum emphases on flexibility, multidisciplinary education, and a learner-centric approach. It aims to develop well-rounded engineers with a strong foundation in core computer engineering skills, while integrating emerging technologies such as AI, machine learning, and cybersecurity. The curriculum also offers flexibility through electives, allowing students to tailor their education and foster interdisciplinary learning for a comprehensive skill set.

This curriculum is designed with strong industry collaboration to provide students with real-world experience through internships and projects, ensuring they are industry-ready upon graduation. We promote lifelong learning, ensuring that students remain curious, adaptable, and committed to growth throughout their careers. This curriculum empowers students to become innovative engineers, ethical leaders, and global citizens who will contribute to the advancement of technology and the betterment of society.

We would like to express our sincere gratitude to the faculty, alumni, students, industry experts, academicians, and stakeholders for their continuous support in strengthening our academics, making SIESGST one of the top engineering colleges in the nation and the premier choice for engineering aspirants.

Chairperson
Board of Studies
Computer Engineering
SIES Graduate School of Technology

Chairperson
Academic Council
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

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

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	10	04	--	53
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	02	02	01	06
Internship/On Job Training (OJT)		--	--	--	--	--	--	--	12	12
Co-curricular Courses (CC)	Liberal Learning Courses	04	--	--	--	--	--	--	--	04
Total Credits (Major)		**21**	**21**	**22**	**21**	**22**	**22**	**20**	**19**	**168**

CURRICULUM STRUCTURE

AND

THIRD YEAR SYLLABUS

(ELECTRONICS AND COMPUTER SCIENCE)

Academic Year 2026-27

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

Multidisciplinary Minor (MDM)

Track	Minor Track	Partner Institute if any	Year/ Sem	Module	Code	Eligible
1	Machine Learning	SIES GST	SE/IV	Artificial Intelligence	MDMC4011	IT/EXTC/ CSE IOT
			TE/V	Machine Learning	MDMC5012	
				Machine Learning Lab	MDML5011	
			TE/VI	Natural Language Processing	MDMC6013	
				Natural Language Processing Lab	MDML6012	
			BE/VII	Deep Learning	MDMC7014	
				Deep Learning lab	MDML7013	
2	Data Science	SIES GST	SE/IV	Statistical Foundation for Data Science	MDMC4021	ECS/CE/EXTC
			TE/V	Data Analytics and Visualization	MDMC5022	
				Data Analytics and Visualization Lab	MDML5021	
			TE/VI	Decision Making and Business Intelligence	MDMC6023	
				Decision Making and Business Intelligence Lab	MDML6022	
			BE/VII	Big Data Analytics	MDMC7024	
				Big Data Analytics Lab	MDML7023	
3	Embedded Systems	SIES GST	SE/IV	Microprocessor and Microcontrollers	MDMC4031	CE/AIDS/AIML
			TE/V	RTOs and Embedded systems	MDMC5032	
				RTOs and Embedded systems Lab	MDML5031	
			TE/VI	Sensor Technology	MDMC6033	
				Sensor Technology Lab	MDML6032	
			BE/VII	Industrial Internet of Things	MDMC7034	
				Industrial Internet of Things Lab	MDML7033	
4	Cyber Security	SIES GST	SE/IV	Computer Network	MDMC4041	AIDS/AIML
			TE/V	Cryptography and Network Security	MDMC5042	
				Cryptography and Network Security Lab	MDML5041	
			TE/VI	Cloud Computing and Security	MDMC6043	
				Cloud Computing and Security Lab	MDML6042	
			BE/VII	Digital Forensics	MDMC7044	
				Digital Forensics Lab	MDML7043	
5	System Programming	SIES GST	SE/IV	Advance Data Structure	MDMC4051	CSEIOT/ECS/ IT
			TE/V	Advance Algorithm	MDMC5052	
				Advance Algorithm Lab	MDML5051	
			TE/VI	System Programming and Compiler Construction	MDMC6053	
				System Programming and Compiler Construction Lab	MDML6052	
			BE/VII	Distributed Systems	MDMC7054	
				Distributed Systems Lab	MDML7053	

6	Management	SIES SBS	SE/IV	Cost Management	MDMC4061	EXTC/CE/IT/ ECS/AIDS/ AIML/CSE IOT
			TE/V	Supply Chain Management	MDMC5062	
			TE/VI	Organizational Behaviour and Human Resource Management	MDMC6063	
			BE/VII	Marketing Management	MDMC7064	

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 and Visualization	Decision Making and Business Intelligence	Big Data Analytics
		MDML5021	MDML6022	MDML7023
		Data Analytics and Visualization Lab	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
		MDML5051	MDML6052	MDML7053
		Advance Algorithm Lab	System Programming and Compiler Construction Lab	Distributed Systems Lab

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	Organizational Behaviour and Human Resource Management	Marketing Management

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

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
	Total		**12**	**18**	--	**12**	**9**	--	**21**

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).

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/ FEC2022	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).

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

Program Structure for Second Year

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	Electronics 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	Electronics 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				CIAP	ESEP	Total
		Internal Assessment		ESEs	Exam Duration (Hrs.)			
		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	Electronics 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	Electronics 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

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

Program Structure for Second Year
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 (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

Program Structure for Third Year
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	Interpersonal and Career Skills Lab	AEC	--	2*+ 2	--	--	2	--	2
MDML50X1	Multidisciplinary Minor (MDM- II) Lab/Tut	MDM	--	2 &	--	--	1 &	--	1
ECPEL501X	Program Elective I Lab	PEC	--	2	--	--	1	--	1
ECM501	Mini Project 2	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	50
ECL503	Interpersonal and Career Skills Lab	--	--	--	--	50	--	50
MDML50X1	Multidisciplinary Minor (MDM- II) Lab	--	--	--	--	25	--	25
ECPEL501X	Program Elective I Lab	--	--	--	--	25	--	25
ECM501	Mini Project 2	--	--	--	--	25	25	50
Total		**100**	**100**	**300**		**175**	**75**	**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 2. Faculty Load: ½ hour per week per four groups
& Indicates Tutorial only for MDML5062

Program Elective – I

Technology Bucket			
Embedded Systems	**AIML**	**Security**	**Networking**
ECPEC5011: Sensors & Applications	**ECPEC5012:** Image and Video Processing	**ECPEC5013:** Data Compression and Encryption	**ECPEC5014:** Information Theory & Coding

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

Program Structure for Third Year
Semester VI

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned		
			Theory	Pract.	Tut	Theory	Pract.	Total
ECC601	Software Engineering and Web Technology	PCC	3	--		3	--	3
ECC602	Basics of VLSI Design	PCC	3	--		3	--	3
ECC603	Cryptography and Network Security	PCC	2	--		2	--	2
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
MDML60X2	Multidisciplinary Minor (MDM-III) Lab/ Tut	MDM	--	2&		--	1&	1
ECPEL601X	Program Elective II Lab	PEC	--	2		--	1	1
ECM601	Major Project I	Project	--	4#		--	2	2
Total			**14**	**16**		**14**	**8**	**22**

& Indicates Tutorial only for MDML5062

Examination Scheme –ECS Semester-VI

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE[s]	Exam Duration (Hrs.)			
		ISE	MSE					
ECC601	Software Engineering and Web Technology	20	20	60	3	--	--	100
ECC602	Basics of VLSI Design	20	20	60	3	--	--	100
ECC603	Cryptography and Network Security	15	15	45	2	--	--	75
MDMC60X3	Multidisciplinary Minor (MDM- III)	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
ECL603	Skill Lab -Cloud Computing	--	--	--	--	25	25	50
MDML60X2	Multidisciplinary Minor (MDM- III) Lab/ Tut	--	--	--	--	25	--	25
ECPEL601X	Program Elective II Lab	--	--	--	--	25	--	25
ECM601	Major Project I	--	--	--	--	25	25	50
Total		**95**	**95**	**285**	**--**	**150**	**75**	**700**

# Indicates workload of a learner (Not faculty) for Major Project I. Faculty Load: ½ hour per week per four groups
& Indicates Tutorial only for MDML6063

Program Elective – II

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

Program Structure for Fourth Year

Semester VII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned		
			Theory	Pract.	Tut	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/Tut	MDM	--	2[&]		--	1[&]	1
ECPEL701X	Program Elective-III Lab	PEC	--	2		--	1	1
ECP701	Major Project II	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/Tut	--	--	--	--	25[&]	25[&]	50
ECPEL701X	Program Elective-III Lab	--	--	--	--	25	--	25
ECP701	Major Project II	--	--	--	--	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
& Indicates Tuts only for MDMC7064

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 Technology	**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

Program Structure for Fourth Year

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 III	Project	--	4#	--	2	2
ECINT801	Internship	Internship	--	--	--	12	12
Total			**06**	**4**	**06**	**14**	**19**

Examination Scheme – ECS Semester-VIII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE^{s}	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 III	--	--	--	--	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

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

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
ECC501	Microprocessor and Microcontroller	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC501	Microprocessor and Microcontroller	20	20	60	--	--	100

Course pre-requisite:

1. FEC 204: Digital system design
2. ECC 305: Computer Organization & Architecture

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 equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors and microcontroller.
2. To Understand the architecture and operation of microprocessors and microcontrollers.
3. To develop skills in programming microprocessors and microcontrollers.
4. To familiarize with development tools and software (e.g. assemblers, compilers, debuggers etc.)
5. To prepare students for higher processor / Controller architectures.
6. To Apply suitable advanced control strategies to real- world industrial and nonlinear systems

Course Outcomes:

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

1. Describe core concepts of 8086 microprocessor.
2. Develop programming skills for Microprocessors.
3. Analyze and compare the architectural features and performance enhancements of 8086 and Pentium processors.
4. Apply the instructions of 8051 and write assembly language programs.
5. To interface various devices with Microcontroller system.
6. Explain the architecture of advanced controllers.

Module No.	Unit No.	Topics	Hrs.	CO
1		**8086 Microprocessor**	**06**	**CO1**
	1.1	8086 Architecture		
	1.2	Memory Segmentation		
	1.3	8086 pin description		
	1.4	Interrupt and Interrupt service routines, Dedicated interrupts, Software interrupts		
		Self-Learning Topics: Minimum mode and Maximum mode of operation		
2		**8086 Programming**	**06**	**CO2**
	2.1	Addressing modes		
	2.2	Instruction Set and Assembler Directives		
	2.3	Assembly language programming		
		Self-Learning Topics: Interfacing with 8086,8255 PPI.		
3		**Pentium Processor**	**06**	**CO3**
	3.1	Comparison of 8086 and Pentium		
	3.2	Pentium Architecture		
	3.3	Superscalar Operation		
	3.4	Integer &Floating-Point Pipeline Stages		
	3.5	Branch Prediction Logic		
	3.6	Cache Organization, MESI Protocol		
		Self-learning Topics: 80386 Processor		
4		**8051 Microcontroller**	**08**	**CO4**
	4.1	Differences between Microprocessor and Microcontroller		
	4.2	Architecture of 8051		
	4.3	Memory Organization of the 8051		
	4.4	Addressing modes of 8051		
	4.5	Instruction set		
	4.6	Assembly language programming		
		Self-learning Topics: I/O ports, Interrupts and interrupt handling		
5		**8051 Interfacing**	**08**	**CO5**
	5.1	I/O port programming		
	5.2	Programming 8051 Timers		
	5.3	Serial Port Programming		

	5.4	Interrupts Programming		
	5.5	LCD & Keyboard Interfacing		
	5.6	ADC, DAC & Sensor Interfacing		
	5.7	Stepper Motor and DC motor Interfacing		
		Self-learning Topics: Serial communication UART, I2C Protocol		
6		**Introduction to ARM7**	**05**	**CO6**
	6.1	Introduction & Features of ARM 7		
	6.2	Concept of Cortex-A, Cortex- R and Cortex-M		
	6.3	Architectural inheritance, Pipelining		
	6.4	Programmer's model		
		Self-learning Topics: Exceptions and interrupts handling, Instruction set		
		Total	**39**	

Textbooks:

1. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hill, 3rd Edition.
2. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI, Eastern Economy Edition.
3. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, 2nd Edition2006
4. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010
5. Steve Furber, "ARM System on chip Architecture", Pearson, 2nd Edition

Reference books:

1. Douglas V Hall, SSSP Rao "Microprocessors & Interfacing", McGraw Hill, 2nd Edition
2. "MCS@51 Microcontroller, Family User's Manual" Intel, order no:272383-002, February 1994.
3. James Antonakons," The Pentium Microprocessor ", Pearson Education, 1st Edition
4. Barry B Brey, "Intel Microprocessors", PEI, 8th Edition
5. James A. Langbridge, "Professional Embedded Arm Development", Wrox, John Wiley Brand & Sons Inc., Edition 2014

Online References:

- NPTEL: https://swayam.gov.in/nd1_noc20_ee11/preview
- NPTEL: https://nptel.ac.in/courses/108/105/108105102/
- NPTEL:https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894

- MOOC Course: https://www.mooc-list.com/tags/microprocessors

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks=15 marks for activities +05 marks for 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. 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
ECC502	Computer Network	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC502	Computer Network	20	20	60	--	--	100

Course pre-requisite:

1. ECL404: Skill Lab -Linux

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO7: Ethics
5. PO11: Lifelong learning
6. PSO2: Develop innovative multidisciplinary projects

Course Objectives:

1. To introduce the fundamental concepts of computer networks, layered architecture, and protocol hierarchies.
2. To explain the functionalities of OSI and TCP/IP models and their role in network communication.
3. To describe physical transmission media, network devices, and switching techniques for data transfer.
4. To analyze data link layer protocols for error detection, flow control, and medium access.
5. To illustrate network layer addressing, routing algorithms, and IP protocol operations.
6. To discuss transport and application layer services, protocols, and client-server communication paradigms.

Course Outcomes:

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

1. Describe the architecture, services, and protocol hierarchies of computer networks.
2. Explain physical layer transmission media and demonstrate the role of network devices in communication.

3. Analyze data link layer design issues and apply error detection, flow control, and MAC protocols.
4. Compute IP addressing schemes and evaluate routing algorithms for efficient network design.
5. Differentiate between TCP and UDP services and implement flow and congestion control mechanisms.
6. Illustrate application layer protocols and develop client-server communication scenarios.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Data Communications and Networking**	**06**	**CO1**
	1.1	Introduction to computer networks, Network software, Layers and services, Network topologies, protocol hierarchies, design issues for the layers, connection oriented and connectionless services.		
	1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layers. Internet		
		Self-Learning Topics: Addressing: physical/logical/port addressing/socket addressing.		
2.0		**Physical Layer**	**05**	**CO2**
	2.1	Guided Transmission Media: Twisted pair, Coaxial, Fiber optics.		
	2.2	Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Infrared, Circuit and Packet Switching.		
	2.3	Network Devices: Repeaters, Hubs, Switches, Routers and Gateways		
		Self-Learning Topics: Broadband standards: Cable modem, DSL, and HFC.		
3.0		**Data Link Layer**	**08**	**CO3**
	3.1	DLL Design Issues - Services, Framing, Error Control, Flow Control, Error Detection and Correction, Elementary Data Link Protocols, Stop and Wait, Sliding Window - Go Back N, Selective Repeat.		
	3.2	Medium Access Control sublayer: Channel Allocation problem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD), Local Area Networks - Ethernet (802.3), Introduction to wireless LAN: 802.11x		
		Self-learning Topics: Ethernet Features, Ethernet Types and their comparison, Maximum Transmission Unit (MTU), and frame format for standard Ethernet.		
4.0		**Network layer**	**10**	**CO4**

	4.1	Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses, IPv4 Addressing (classfull and classless), Sub-netting and Super-netting design problems, IPv4 Protocol, IPv6 Packet Format, IPv6 Addressing, Transition from IPv4 to IPv6.		
	4.2	Routing algorithms: Intra-domain Routing -Shortest Path, Distance Vector Algorithms, Link State Routing, Inter-domain Routing Protocols.		
	4.3	Introduction to ICMP, ARP, RARP		
		Self-learning Topics: VLSM and NAT, Quality of service		
5.0		**Transport Layer**	**06**	**CO5**
	5.1	Connectionless and Connection–oriented services at transport layer, Transmission Control Protocol (TCP): TCP Services, TCP Segment, TCP three-way handshake.		
	5.2	User datagram Protocol (UDP), UDP Services, UDP Datagram		
	5.3	TCP Flow control, error control and congestion control		
		Self-learning Topics: TCP and UDP checksum calculation		
6.0		**Application layer**	**04**	**CO6**
	6.1	Application layer Paradigms, Client-Server Paradigm: Application Programming Interface		
	6.2	Introduction to Application layer Protocols: HTTP, FTP, DNS, SMTP, TELNET, SSH, DHCP.		
		Self-learning Topics: TFTP and SNMP Protocols		
		Total	**39**	

Textbooks:

1. Andrew S Tanenbaum, Computer Networks -, 5th Edition, Pearson Education , June 2021
2. Behrouz A. Forouzan, Forouzan Mosharrat, Computer Networks A Top down Approach, McGraw Hill education ,2023.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, Second Edition, 2016.

Reference books:

1. James F. Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education, 2022.
2. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson

Education, 1997.
3. W. A. Shay, Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
4. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India, 2007.

Online References:

- NPTEL: Computer Networks (Prof. Bhaskaran Raman / Prof. Rajesh Sundaresan) https://nptel.ac.in/courses/106/105/106105081
- Cisco Networking Academy – Introduction to Networks (Free Modules) https://www.netacad.com/courses/networking
- RFC Repository for Internet Standards https://www.rfc-editor.org
- IETF (Internet Engineering Task Force) – Protocol Standards and drafts https://www.ietf.org

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks=15 marks for activities +05 marks for 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. Question paper will comprise 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
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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC503	Discrete Structures and Automata Theory	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC503	Discrete Structures and Automata Theory	20	20	60	--	--	100

Course 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. PSO1: To acquire knowledge in cutting- edge technologies

Course Objectives:

1. To cultivate clear thinking for Creative Problem Solving
2. To train students to understand and construct Mathematical Proofs.
3. To introduce the notions of Sets, Relations, Functions, Graphs and their applications.
4. To build concepts of theoretical design of Basic machines, Deterministic and Non-Deterministic Finite state machines and Pushdown Machines.
5. To gain the conceptual understanding of fundamentals of Grammars.
6. To prepare students with the mathematical aspects in other courses such as Formal Specification, Verification, Artificial Intelligence etc.

Course Outcomes:

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

1. Apply the notion of mathematical thinking, mathematical proofs in problem solving
2. Analyze relations and functions, interpret their properties, and apply closures, partial orders, lattices, and the pigeonhole principle to solve problems.

3. Perform operations with Sets, Relations, Functions, Graphs and their applications.
4. Design Deterministic Finite Automata (DFA) and Non-deterministic Finite Automata (NFA) and Pushdown Automata with understanding of power and limitations
5. Design Context Free Grammar and perform the operations like simplification and normal forms.
6. Apply Discrete Structures and Automata Theory concepts into solving real world computing problems in the domain of Formal Specification, Verification, Artificial Intelligence etc.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Set Theory and Logic**	**06**	**CO1**
	1.1	Set Theory: Fundamentals - Sets and Subsets, Venn Diagrams, Operations on sets, Laws of Set Theory, Power Set,.		
	1.2	Principle of Inclusion and Exclusion, Mathematical Induction.		
	1.3	Propositions and Logical operations, Truth tables, Equivalence, Implications		
	1.4	Laws of Logic, Normal Forms, Inference		
	1.5	Predicates and Quantifiers		
		Self-learning Topics: Applications of Venn diagrams in everyday problem solving, Basic proof techniques: Direct proof and mathematical induction		
2.0		**Relations and Functions**	**07**	**CO2**
	2.1	Relations- Definition, Properties of Relations		
	2.2	Types of binary relations (Equivalence and partial ordered relations),		
	2.3	Closures, Poset, Hasse diagram and Lattice		
	2.4	Functions-Definition, Types of Functions (Injective, Surjective and Bijective)		
	2.5	Identity and Inverse Functions		
	2.6	Pigeonhole Principle, Extended Pigeonhole Principle		
		Self-learning Topics: Real-life examples of equivalence relations, Applications of the pigeonhole principle in simple counting problems.		
3.0		**Graph Theory**	**07**	**CO3**
	3.1	Graphs and their basic properties - degree, path, cycle, subgraphs, Types of graphs		
	3.2	Definitions, Paths and circuits: Eulerian and		

		Hamiltonian, Planner Graph.		
	3.3	Isomorphism of graphs, Dijkstra Shortest Path Algorithm		
	3.4	Trees, Types of Trees		
		Self-learning Topics: Real-life applications of graphs, Tree applications in computer science.		
4.0		**Finite Automata**	**07**	**CO4**
	4.1	Introduction of Automata and its applications.		
	4.2	Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA) Definitions, transition diagrams and Language recognizers, NFA to DFA Conversion.		
	4.3	Eliminating epsilon-transitions from NFA.		
	4.4	FSM with output: Moore and Mealy machines.		
		Self-learning Topics: Use of DFA in text search, Real-life examples of Mealy and Moore machines		
5.0		**Regular Expression (RE) and Regular Grammar (RG)**	**05**	**CO5**
	5.1	Regular Grammar and Regular Expression (RE): Definition, Equivalence and Conversion from RE to RG and RG to RE.		
	5.2	Equivalence of RE and FA, Converting RE to FA and FA to RE.		
		Self-learning Topics: Practical uses of regular expressions, Use of regular expressions in search tools		
6.0		**Context Free Grammar (CFG) and Push Down Automata (PDA)**	**07**	**CO6**
	6.1	Grammars: Chomsky hierarchy, CFG- Definition, Sentential forms, Leftmost and Rightmost derivations.		
	6.2	Context Free Languages (CFL): Parsing and Ambiguity. CFLs: Simplification and Applications.		
	6.3	Normal Forms: Chomsky Normal Form.		
	6.4	PDA- Definition, Transitions (Diagrams, Functions and Tables), Design of PDA with Graphical Notation and Instantaneous Descriptions		
		Self-learning Topics: Use of grammar rules in programming languages, PDA analogy: Stack behavior using balanced parentheses.		
	Total		**39**	

Textbooks:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.
2. C.L.Liu, "Elements of Discrete Mathematics", Second edition 1985, McGraw-HillBook Company, Reprinted 2000.
3. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation‖", Pearson Education.
4. Vivek Kulkarni, "Theory of Computation", Oxford University Press, India.

Reference books:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 5th ed. New Delhi, India: Tata McGraw-Hill, 2003.
2. Michael Sipser, Introduction to the Theory of Computation, 3rd ed. Boston, MA, USA: Cengage Learning, 2012
3. Zvi Kohavi and Niraj K. Jha, Switching and Finite Automata Theory, 3rd ed. Cambridge, U.K.: Cambridge University Press, 2009.
4. John C. Martin, Introduction to Languages and the Theory of Computation, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2003.
5. Kavi Mahesh, Theory of Computation: A Problem-Solving Approach. New Delhi, India: Wiley India, 2012.

Online References:

- NPTEL: https://onlinecourses.nptel.ac.in/noc22_cs49/preview
- NPTEL: https://nptel.ac.in/courses/106105196

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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. 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC5022	Data Analytics and Visualization	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC5022	Data Analytics and Visualization	20	20	60	--	--	100

Pre- requisite:

1. ECC301: Applied Mathematics III
2. ECC401: Applied Mathematics IV
3. ECL304: Skill Lab -Python Programming

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO5: Engineering Tool Usage
5. PO11: Lifelong Learning

Course Objectives:

1. To Introduce the concept of Data Analytics Lifecycle.
2. To Develop data modeling using Regression and Time series Techniques.
3. To define geospatial data and geospatial information.
4. To create awareness about Text analytics and its applications.
5. To provide overview of Data analytics and visualization with R/ Python.
6. To understand data visualization using power BI and tableau

Course Outcomes:

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

1. Apply the data analytics lifecycle to prepare data and build analytical models.
2. Apply Regression and Timeseries models on a given data set and perform prediction.
3. Illustrate various types of sources for raster and vector data.
4. Analyze Text data and gain insights.
5. Experiment with different analytics techniques and visualization using R / Python
6. Develop interactive Power BI dashboards integrating data transformation and visualization for professional reporting.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction to Data analytics and Life cycle**	**04**	
	1.1	**Data Analytics Lifecycle Overview:** Key roles, project background, business understanding, hypothesis creation, and identification of data sources.		**CO1**
	1.2	**Data Preparation & Modeling:** Data conditioning, Extract–Transform–Load (ETLT), exploration, visualization, variable selection, and model planning/building using common analytical tools.		
	1.3	**Results & Deployment:** Communicating insights effectively and operationalizing the analytics solution for real-world implementation.		
		Self-learning Topics: Case studies of end-to-end analytics projects, CRISP-DM vs Data Analytics Lifecycle		
2.0		**Regression Models and Time Series**	**08**	
	2.1	**Regression:** Regression equation, **assessing** model fit and assumptions, Cross-validation and model selection, Stepwise regression methods, Prediction using regression models.		**CO2**
	2.2	**Logistic Regression and Comparison:** Logistic Response function and logit, Logistic regression and Generalized Linear model, ROC, AUC, and confusion matrix for model evaluation Linear and logistic regression: similarities and differences.		
	2.3	Overview of Time Series Analysis Box-Jenkins Methodology, ARIMA Model Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models, ARMA and ARIMA Models, Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions		
		Self-learning Topics: Introduction to GLM families beyond logistic (Poisson, Gamma), GARCH models for volatility forecasting (finance)		
3.0		**Geospatial Data Analysis**	**08**	
	3.1	Introduction to Geospatial Data, Sources of Raster Data, Sources of Vector Data, Overview of Geospatial Data Analysis Tools, Overview of Geospatial Programming languages.		**CO3**
		Self-learning Topics: Case studies of applications where raster and vector data is used.		
4.0		**Text Analytics**	**06**	
	4.1	History of text mining, Roots of text mining overview of seven practices of text analytic, Application and use cases for Text mining: extracting meaning from unstructured text, Summarizing Text.		**CO4**
	4.2	Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency		

		(TFIDF), Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.		
		Self-learning Topics: Case studies on healthcare (clinical notes), Ecommerce (reviews, rating analysis)		
5.0		**Data Analytics and visualization with R / Python**	**06**	
	5.1	Introduction to R: Data Import and Export, Attribute and Data type, Descriptive statistics, Visualization and Analysis using R.		**CO5**
	5.2	Essential Data Libraries for data analytics and Visualization in Python, Visualization and Analysis using Python.		
		Self-learning Topics: Case studies on simple analytical reports using Python or R, Introduction to dataset import workflows in R/Python		
6.0		**Introduction to Data Visualization Tools**	**07**	
	6.1	Principles of data visualization, Power BI / Tableau interface & dashboards, DAX basics, calculated measures, Storytelling with data, Interactive reporting.		**CO6**
		Self-learning Topics: Introduction to connecting different data sources in dashboards		
		Total	**39**	

Textbooks:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education services Wiley Publication.
2. Data Analytics using Python: Bharati Motwani, Wiley Publications.
3. Data Analytics using R, Bharati Motwani, Wiley Publication.
4. Practical Statistics for Data Scientists 50+ Essential Concepts Using R and Python, O'Reilly Publications 2nd Edition.
5. Practical Text Mining and statistical Analysis for non-structured text data applications,1st edition, Grey Miner, Thomas Hill.

Reference books:

1. Data Mining, Concepts and Techniques: 3rd edition, Jiawei Han, Micheline Kamber and Jian Pei .
2. Python for Data Analysis: 3rd Edition, Wes McKinney , Publisher(s): O'Reilly Media, Inc.
3. Data Analytics using R, Bharati Motwani, Wiley Publications.

Online References:

- NPTEL: https://nptel.ac.in/courses/110106072
- NPTEL: https://microsoftlearning.github.io/DP-900T00A-Azure-Data- Fundamentals/Instructions/Labs/dp900-pbi-06-lab.html
- Coursera: Data Visualization with Python | Coursera

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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. 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.

SIES Graduate School of Technology

Department of Electronics & Computer Science

Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC5052	Advance Algorithm	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC5052	Advance Algorithm	20	20	60	--	--	100

Pre- requisite:

1. FEC104: C Programming
2. ECC302 : Data Structure

Program Outcomes Addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO11: Life-Long Learning

Course Objectives:

1. To learn mathematical background for analysis of algorithm.
2. To enable students to apply probabilistic and randomized techniques to evaluate the performance of algorithms in uncertain environments.
3. To learn and design dynamic programming solutions for optimization problems and analyze their correctness and efficiency.
4. To understand and apply graph flow techniques for network problems.
5. To apply linear programming and computational geometry methods to analyze geometric and optimization problems.
6. To learn advanced algorithms.

Course Outcomes:

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

1. Understand analysis techniques for algorithms.
2. Appreciate the role of probability and randomization in the analysis of algorithms.
3. Apply dynamic programming techniques to solve a given problem.
4. Appreciate the role of graph algorithms in solving a variety of problems.
5. Apply linear programming and geometric algorithms to model and solve real-world computational problems.
6. Understand the concepts of Optimization, Approximation and multithreaded algorithms.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction**	**07**	**CO1**
	1.1	Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis.		
	1.2	Recurrences: The substitution method, Recursive tree method, Masters method, proving technique (contradiction, mathematical induction).		
		Self-learning Topics: Amortized analysis- aggregate analysis, accounting analysis, potential analysis dynamic tables.		
2.0		**Probabilistic Analysis and Randomized Algorithm**	**08**	**CO2**
	2.1	Probabilistic and Randomized Algorithm: Probabilistic approach to algorithm and Randomized Analysis, Indicator Random Variable (IRV), Randomized Quick Sort, Analysis of Hiring Problem, Las Vegas and Monte Carlo algorithm		
		Self-learning Topics: Balls-in-bins problem, randomized algorithms for 2-SAT		
3.0		**Dynamic algorithms**	**07**	**CO3**
	3.1	Introduction to Dynamic Algorithms, all pair shortest path, 0/1 knapsack, travelling salesman problem, Matrix Chain Multiplication, Optimal binary search tree, Analysis of All algorithms and problem solving.		
		Self-learning Topics: OBST, Johnson' algorithm for Flow shop scheduling		
4.0		**Maximum Flow networks**	**06**	**CO4**
	4.1	Augmenting path algorithms: Flow networks, The Ford-Fulkerson method, Edmond-Karp, Max-Flow Min-Cut Theorem, Push Relabel algorithm.		
	4.2	Bipartite Matching: Maximum bipartite matching		
		Self-learning Topics: The relabel-to-front algorithm		
5.0		**Linear Programming and Computational Geometry**	**07**	**CO5**
	5.1	Linear Programming: Introduction to linear programming, geometric interpretation, LP duality, Simplex algorithm.		
	5.2	Computational Geometry: Line Segment Properties, Convex Hull Graham's scan algorithm, Conic Programming		
	5.3	Geometric Searching: Point Location in polygon using Ray Crossing		
		Self-learning Topics: Competitive Ratio, K-Server		

6.0		Advanced Algorithms and NP problems	04	CO6
	6.1	Optimization Algorithms: Genetic algorithm (GA)		
	6.2	Approximation Algorithms: Vertex-cover problem		
	6.3	Multithreaded algorithms: Merge sort.		
	6.4	Introduction to NP-Hard and NP-Complete Problems		
		Self-learning Topics: Implementation of Genetic algorithm and Vertex-cover problem		
		Total	**39**	

Textbooks:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 4th ed. Cambridge, MA, USA: MIT Press, 2022.
2. H. Bhasin, *Algorithms: Design and Analysis*. New Delhi, India: Oxford University Press, 2016.
3. E. Horowitz, S. Sahni, and S. Rajasekaran, *Fundamentals of Computer Algorithms*. Hyderabad, India: Universities Press, 2008.
4. A. A. Deshpande and O. G. Kakde, *C and Data Structures*. New Delhi, India: Dreamtech Press, 2004.

Reference books:

1. M. T. Goodrich, R. Tamassia, and D. M. Mount, *Data Structures and Algorithms in C++*, 2nd ed. Hoboken, NJ, USA: Wiley, 2011.
2. R. Thareja, *Data Structures Using C*, 3rd ed. New Delhi, India: Oxford University Press, 2023.
3. M. A. Weiss, *Data Structures and Algorithm Analysis in C*, 2nd ed. Upper Saddle River, NJ, USA: Pearson Education, 2002.
4. R. K. Arora, *Optimization: Algorithms and Applications*. Boca Raton, FL, USA: Chapman & Hall/CRC Press, 2015.

Online References:

- NPTEL: https://swayam.gov.in/nd1_noc19_cs47/preview
- NPTEL: https://www.mooc-list.com/tags/algorithms
- NPTEL: https://www.coursera.org/specializations/algorithms

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

1. 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC 5062	Supply Chain Management	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
MDMC 5062	Supply Chain Management	20	20	60	25	--	125

Pre- requisite:

1. Basic MS Excel.

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO7: Global and Ethical Practices
4. PO8: Collaborative Teamwork
5. PO9: Communication
6. PO11: Lifelong Learning

Course Objectives:

1. To introduce the fundamental concepts, components, and processes of supply chain management in manufacturing and service sectors.
2. To develop understanding of demand forecasting, inventory management, procurement, and logistics as core elements of SCM.
3. To equip students with the ability to analyze supply chain networks, evaluate performance, and identify improvement opportunities.
4. To familiarize students with supply chain technologies such as ERP systems, RFID, IoT, and analytics tools.
5. To build decision-making skills related to sourcing, production planning, transportation, and distribution strategies.
6. To promote awareness of sustainability, risk management, and global challenges in supply chain operations.

Course Outcomes:

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

1. Explain key supply chain, logistics, and international shipping concepts.
2. Apply analytical tools to solve basic warehousing, transportation, and network design problems.
3. Analyse supply chain flows and identify performance gaps, risks, and integration challenges.
4. To evaluate supply chain efficiency using cost, service, sustainability, and responsiveness metrics.
5. Design technology-enabled and resilient supply chain solutions for domestic and global environments.
6. Demonstrate understanding of sustainable, ethical, and technology-enabled supply chain practices and **assess** their impact on organizational performance.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0	**1**	**Module 1: Introduction to Supply Chain, Logistics and International Shipping**	**09**	**CO1, CO2**
		Introduction to Supply Chain, Decision Phases in a Supply Chain, Linkages and Decisions in SCM. Process and Cycle View of a Supply Chain. Supply Chain Models: Efficient Chain, Responsive Supply Chain and Agile Models. Importance of supply chain flows. Logistics and Shipping: functions. Objectives, Goals, Decisions. 1st Party, 2nd Party, 3rd Party, 4th Party Logistic service provider Introduction to International Shipping: Freight Forwarders, shipping documents, Ports and customs, Incoterms Reverse Logistics.		
		Self-learning Topics: Importance of supply chain flows. Logistics and Shipping: functions. Objectives, Goals, Decisions		
2.0	**2**	**Warehousing and Transportation**	**09**	**CO2, CO3**
		Warehouse: role, type, functions. Warehouse location modelling: methods such as COG, MCOG, and the LP approach. Layout design, Space calculation, Warehouse automation, Hub and Spoke Model, WMS Distribution, Role, Importance, Levels, Channels, Structure, Functions. Channel partners, functions. Infrastructure, road, rail, air, water, pipeline. Freight Management, Freight cost. Transportation Network Route Planning, Containerization, and Packing. Effective / Cost Optimising strategies. Cross-docking, Milk run, and transhipment.		
		Self-learning Topics: Role, Importance, Levels, Channels, Structure, Functions. Channel partners, functions.		
3.0		**Performance Measurement and Controls in Supply Chain Management**	**03**	**CO3,CO4**
		Supply Chain Cost Calculations Supply Chain Reliability & Responsiveness Supply Chain Asset Management: cash to cash cycle, return on working capital & working capital Analytics Framework Based on SCOR Model		
		Self-learning Topics: Concepts of Supply Chain Asset Management: cash to cash cycle & working capital		
4.0		**Designing a network in a supply chain**	**06**	**CO2, CO4**

				CO5
		Network design in the supply chain Alternate channels in distribution Location decisions in the supply chain using Excel Role and factors affecting network designing Network Optimisation Model Network design in an uncertain environment Flexibility in Supply Chain Practical problems using Excel		
		Self-learning Topics: Role and factors affecting network designing		
5.0		**Supply Chain Integration and Designing Global Supply Chain Networks**	**06**	**CO3, CO5**
		Bullwhip effect, Collaborative Planning Forecasting Replenishment (CPRF) concept. Inventory Management and Risk Pooling, Strategic Alliances, Retailer-Supplier Partnerships: Types, Requirements, and Inventory Ownership. Outsourcing and related decisions Global Market: Technological/ Cost/ Political, and Economic Forces. Risks and Advantages of the International Supply Chain. International versus Regional products. Local autonomy versus central control. Regional differences in Logistics- Cultural differences/ infrastructure/ performance expectation, and evaluation, Information systems availability, and human resources.		
		Self-learning Topics: Concepts related to Outsourcing and related decisions, Risks and Advantages of the International Supply Chain.		
6.0		**Ethical issues in Supply Chain and Technological Trends in Supply Chain**	**06**	**CO4, CO5**
		Supply chain vulnerability. Conformance to applicable laws such as Contract and commercial laws, Trade regulation, government procurement regulations, patents, Copyrights, trademark laws, transportation and logistics laws and regulations Environmental laws. International practices. Confidentiality and proprietary information. Functional application of technologies in Supply Chain: Blockchain, AI, IOT, RFID, AR, VR, ERP Goldratt Supply Chains, Sustainable Supply Chain, Resilient supply chains, Green Supply chain, Lean supply chain.		

		Self-learning Topics: Concepts of Blockchain, AI, IOT, RFID, AR, VR, ERP		
		Tutorial on application of supply chain management concepts in excel		
		Total	**39**	

Textbooks:

1.Supply Chain Management: Strategy, Planning, and Operation, 6th Edition, Sunil Chopra & Peter Meindl, Pearson Education

Reference books:

1. Supply Chain Analytics and Modelling: Quantitative Tools and Applications, 1st Edition, Kogan page
2. .Supply Chain Logistics Management, 2nd Edition, Bowersox, Donald J, 2014, McGraw Hills.
3. Supply Chain Management: The Basics & Beyond, Copacino, William C, 1997, ST. Lucie Press.
4. Logistics and Supply Chain Management, Martin Christopher

Online References:

- https://www.emerald.com/ijlm
- https://www.emeraldgrouppublishing.com/journal/scm

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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.

CIAP (25-Marks):

At least 06 Tutorials covering entire syllabus must be given during the “Class Wise Tutorial”.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEC5011	Sensors and Applications	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC5011	Sensors and Applications	20	20	60	--	--	100

Course pre-requisite:

1. FEC1021: Engineering Physics-I
2. FEC2021: Engineering Physics-II
3. ECC303: Electronic Devices and Circuits
4. ECC502: Controls and Instrumentation

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 various physical parameters and their sensing techniques.
2. To explain the working principle and applications of proximity, chemical, and optical sensor systems.
3. To comprehend basic concepts and mechanical properties of Micro-Electro-Mechanical Systems (MEMS) for miniaturized sensing and actuation.
4. To interpret the operation of MEMS sensors, actuators and passive structures.
5. To understand the concept of data acquisition systems and signal conditioning.
6. To provide insight into various sensor applications.

Course Outcomes:

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

1. Comprehend the transduction principle of various sensors and their selection criteria.
2. Explain the basic principle and application of proximity, chemical and optical sensors
3. Explain the basic principle and application of miscellaneous, smart, and wireless sensors.
4. Develop different concepts of MEMS sensors and actuators for real-world applications.

5. Explain various parameters of data acquisition systems and select an appropriate signal conditioning unit as per the requirement.
6. Comprehend the working principle of sensors for various applications.

Module No.	Unit No.	Topics	Hrs.	CO
1		**Introduction to Sensors**	**03**	**CO1**
	1.1	Classification of Sensors: Sensors classified with criteria like primary physical quantity to be sensed, transduction principle, material and technology used and application.		
	1.2	Criteria to choose Sensor: Accuracy, Environmental condition, Range, Calibration, Resolution, Cost and Repeatability.		
	1.3	Digital sensors: Principle and its advantage over analog sensors.		
		Self-learning Topics: Sensor limitations and measurement issues.		
2		**Types of sensors-I**	**09**	**CO2**
	2.1	Proximity Sensors: Inductive, Capacitive, Photoelectric and Ultrasonic sensors, applications.		
	2.2	Chemical Sensors: Gas, Smoke, Conductivity and pH sensors, applications.		
	2.3	Optical Sensors: Light Dependent Resistor, Optocoupler, Phototransistor, Photomultiplier tube, solar cell, applications.		
		Self-learning Topics: Bio sensors, nano sensors, and their applications.		
3		**Types of sensors-II**	**09**	**CO3**
	3.1	Miscellaneous Sensors: Sound, Motion, Pressure, Level, Moisture, Humidity, Laser, Image and GPS sensors, applications.		
	3.2	Smart sensors: Low-power, Self–diagnostic and Self-calibration.		
	3.3	Wireless sensors: sensor node, NB-IoT sensors, LoRa sensors.		
		Self-learning Topics: RF sensors and their applications.		
4		**MEMS Sensors and Actuators**	**06**	**CO4**
	4.1	MEMS Sensors: General design methodology, techniques for sensing, Pressure sensor, Mass Flow sensor, Acceleration sensor, Angular Rate sensor and Gyroscopes, Micro machined microphones, Chemical sensors, Taguchi Gas sensor, Combustible Gas sensors.		

	3.2	MEMS Actuators: Techniques for actuation, Digital Micro mirror Device, Micro Machined Valves.		
		Self-learning Topics: MEMS devices - RF MEMS Switches and their applications.		
5		**Data Acquisition and Signal Conditioning**	**06**	**CO5**
	5.1	Fundamentals of Data Acquisition: Analog and Digital data acquisition systems with different configurations, Data loggers, Noise and interference.		
	5.2	Signal Conditioning: Wheatstone Bridge, Flash ADC, R2R DAC.		
	5.3	Utilization of Signal conditioning circuits for Temperature, Pressure, Optical, Strain gauges, Displacement and Piezoelectric Transducers.		
		Self-learning Topics: Application specific examples of signal Conditioning circuits.		
6		**Sensor Applications**	**06**	**CO6**
	6.1	Onboard Automobile sensing system, home appliances sensors, Aerospace Sensors, Sensors for Environmental Monitoring, Biomedical Sensing Applications.		
	6.2	Radio sensors for industrial applications, Radio Astronomy, Remote Sensing, Ground Penetrating Radars, Underwater Sensing, LIDAR.		
		Self-learning Topics: Applications in the field of robotics and automation.		
		Total	**39**	

Textbooks:

1. D. V. S. Murty, "*Transducers and Instrumentation"*, 2nd edition. New Delhi, India: PHI Learning, 2013.
2. D. Patranabis, "Sensor and Transducers", 2nd Edition, Prentice Hall, New Delhi, 2003.
3. A. V. Raisanen, A. Lehto, "Radio Engineering for Wireless Communication and Sensor Applications", Artech House, USA, 2003.
4. Ramon Pallas Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd edition, John Wiley and Sons, 2000.
5. V. K. Garg, "Wireless Communication and Networking", New Delhi, India: Elsevier, 2011.

Reference books:

1. Nadim Maluf, Kirt Williams, "An Introduction to Microelectromechanical Systems Engineering", Artech House, 2004.

2. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co., 19th edition, 2011.
3. N Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", 2nd edition, IET, 2020.
4. C.S. Rangan, G.R. Sarma, V.S. Mani, "Instrumentation Devices and System", Tata McGraw Hill, 1997.
5. J. Fraden "Handbook of Modern Sensors: Physics, Designs, and Applications", 4th edition, Springer, 2016.

Online References:

- NPTEL: https://swayam.gov.in/nd1_noc20_ee90/preview
- NPTEL: https://nptel.ac.in/courses/108106193

Course Assessment:
ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination
$ ESE of duration 03 hours is 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEC5012	Image and Video Processing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC5012	Image and Video Processing	20	20	60	--	--	100

Pre-requisite:

1. ECC301-Applied Mathematics III
2. ECC401-Applied Mathematics IV

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design / Development of Solutions.
4. PO4: Conduct Investigations of Complex Problems
5. PO11: Life-Long Learning
6. PSO1: To acquire knowledge in cutting- edge technologies.

Course Objectives:

1. To understand fundamentals of digital image and video formation, representation, and standards.
2. To study various image enhancement techniques in spatial and frequency domains.
3. To learn techniques for image segmentation and morphological processing.
4. To understand and apply different image transform techniques.
5. To explore lossless and lossy image compression methods.
6. To study motion estimation techniques and their applications in video processing.

Course Outcomes:

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

1. Describe the fundamentals of digital images, videos, and their standard formats.
2. Apply spatial and frequency domain techniques for image enhancement.
3. Apply segmentation and morphological operations for feature extraction.
4. Apply various transforms for image analysis and representation.
5. Compare different image compression techniques for efficient storage and transmission.
6. Analyze motion estimation methods and their role in video coding applications.

Module No.	Unit No.	Topics	Hrs.	Course Outcome
1.0		**Digital Image and Video Fundamentals**	**05**	**CO1**
	1.1	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization, Representation of Digital Image, Connectivity, Image File Formats: BMP, TIFF and JPEG. Color Models (RGB, HSI, YUV)		
	1.2	Fundamentals of Digital Video, Chroma Sub-sampling, Video Standards, Composite and Component Video Systems, Digital Video Formats and Application.		
		Self-Learning: Applications of Digital Image and Video Processing in Real Life, Evolution of Image and Video Storage Formats		
2.0		**Image Enhancement**	**08**	**CO2**
	2.1	**Point Processing:** Digital Negative, contrast stretching, thresholding, gray level slicing, bit plane slicing, log transform and power law transform. **Spatial Domain:** Neighborhood Processing: Averaging filters, order statistics filters, high pass filters and high boost filters		
	2.2	**Frequency Domain:** DFT for filtering, Ideal, Gaussian and Butterworth filters for smoothening and sharpening		
	2.3	**Histogram Modeling:** Histogram equalization and histogram specification		
		Self-Learning: Real-Time Image Enhancement Techniques Used in Mobile Cameras, Effect of Different Filters on Image Sharpness and Noise Reduction		
3.0		**Image Segmentation & Morphological Operations**	**07**	**CO3**
	3.1	**Segmentation:** Discontinuities (point, Line, Edge) Image Edge detection using Robert, Sobel, Prewitt and Laplacian Mask.		
	3.2	Region Oriented Segmentation: Region growing by pixel Aggregation, Region Splitting and Merging		
	3.3	**Morphology:** Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation.		
		Self-Learning: Real-Time Applications of Image Segmentation in Medical Imaging and Object Detection, Role of Morphological Processing in Document Image Analysis		
4.0		**Image Transforms**	**08**	**CO4**
	4.1	Introduction to Unitary Transforms, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)		

	4.2	Discrete Hadamard Transform (DHT), Fast Hadamard Transform (FHT), Discrete Cosine Transform (DCT), Inverse DCT		
		Self-Learning: Applications of DCT in JPEG Image Compression, Comparison of DFT, DHT, and DCT in terms of energy compaction and computation time		
5.0		**Image Compression**	**07**	**CO5**
	5.1	Introduction, Redundancy, Fidelity Criteria		
	5.2	Lossless Compression Techniques: Run length Coding, Arithmetic Coding, Huffman Coding		
	5.3	Lossy Compression Techniques: Improved Gray Scale Quantization, Vector Quantization, MPEG		
		Self-Learning: Applications of Image Compression in Real-Time Systems, Role of Transform Coding (DCT/DWT) in Image Compression		
6.0		**2D Motion Estimation in Videos**	**04**	**CO6**
	6.1	Motion Estimation Techniques: Optical Flow, Pixel-based Motion Estimation, Region-based Motion Estimation, Multi-resolution Motion Estimation		
	6.2	Applications of Motion Estimation: Application of Motion Estimation in Video Coding		
		Self-Learning: Multi-Resolution / Pyramid-Based Motion Estimation, Region-Based Motion Estimation and Object-Level Tracking, Applications of Motion Estimation in Video Coding		
		Total	**39**	

Textbooks:

1. Gonzalez, Rafael C. & Woods, Richard E. “Digital Image Processing “. Pearson, 4th Edition (2018).
2. Wang, Yao; Ostermann, Jörn; Zhang, Ya-Qin, “Video Processing & Communications”, Prentice Hall, 1st Edition (2002).
3. Jayaraman, S.; Esakkirajan, S.; Veerakumar, T. “Digital Image Processing”, Tata McGraw-Hill Education, 3rd Edition, 2009. Central University of Punjab Catalog
4. Jain, Anil K., “Fundamentals of Digital Image Processing”, Prentice Hall (India), 1st Edition 1989
5. Sridhar, S. “Digital Image Processing”, Oxford University Press, 2nd Edition 2012

Reference books:

1. Tekalp, A. Murat, “Digital Video Processing”, Prentice Hall, 2nd Edition (2015).
2. PTG Media
3. Forsyth, David A.; Ponce, Jean, “Computer Vision: A Modern Approach”, Pearson, 2nd Edition (2011).

4. Chanda, Bhabatosh; Majumder, Dwijesh Dutta, "Digital Image Processing & Analysis", PHI Learning / Prentice Hall of India, 2nd Edition 2011.
5. Sayood, Khalid, "Introduction to Data Compression", Morgan Kaufmann, 5th Edition (2017).

Online References:

- NPTEL: https://onlinecourses.nptel.ac.in/noc22_ee116/preview
- NPTEL: https://onlinecourses.nptel.ac.in/noc21_ee20/preview
- Coursera: https://www.coursera.org/learn/introduction-image-processing

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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
ECPEC 5013	Data Compression and Encryption	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC 5013	Data Compression and Encryption	20	20	60	--	--	100

Course pre-requisite:

1. ECC305 – Computer Organization & Architecture

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. Gain a fundamental understanding of data compression methods for text, images, video and audio.
2. Understand the concepts of cryptography and different algorithms to provide system security.
3. Understand and analyze audio and video compression techniques and standards for efficient multimedia data representation and transmission.
4. Develop knowledge of classical and modern symmetric key cryptographic techniques and evaluate their role in securing data.
5. Apply number theory concepts such as modular arithmetic and theorems in the design and analysis of cryptographic algorithms.
6. Understand public key cryptography, authentication mechanisms, and system security techniques to safeguard digital systems against threats.

Course Outcomes:

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

1. Apply various compression techniques for text and understand image compression and its standards.

2. Use suitable compression techniques for specified lossless and lossy audio and video applications
3. Apply different symmetric cryptographic techniques and standards.
4. Apply number theory concepts to solve the cryptographic problems
5. Compare between symmetric and asymmetric cryptography, Analyze different public key cryptography algorithms.
6. Describe system security facilities designed to protect a computer system from security threats.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Data Compression**	**06**	**CO1**
	1.1	Data compression, modelling and coding, Need for compression from information theory point of view. Lossless and Lossy Compression, **Lossless Compression:** Arithmetic Coding, Dictionary Based Compression. JPEG lossless		
	1.2	**Lossy Compression**: Rate Distortion criteria, Quantization, Differential Encoding- Predictive coding, Differential pulse code modulation (DPCM), ADPCM. JPEG 2000, Image Compression DCT.		
		Self-learning Topics: Real-life applications of lossless vs lossy compression, Concept of redundancy removal in data compression		
2.0		**Video and Audio Compression**	**06**	**CO2**
	2.1	Sound, Digital Audio, μ-Law and A-Law Companding, MPEG- 4 Audio Layer, Advanced Audio Coding (AAC) standard.		
	2.2	Video compression: Motion compensation, temporal and spatial prediction, MPEG-1,2,4, H.264 encoder and decoder.		
		Self-learning Topics: Basics of frame types in video, H.266, and H.265		
3.0		**Data Security**	**10**	**CO3**
	3.1	Security Goals, Cryptographic Attacks and Techniques		
	3.2	Symmetric Key: Substitution Cipher, Transposition Cipher, Stream and Block Cipher		
	3.3	DES, double DES and triple DES, AES		
		Self-learning Topics: Difference between active and passive attacks, Real-world examples of symmetric-key usage		
4.0		**Number Theory**	**04**	**CO4**

	4.1	Prime Numbers, Fermat's and Euler's Theorem.		
	4.2	Chinese Remainder Theorem.		
		Self-learning Topics: Prime numbers in cryptography, Simple applications of modular arithmetic		
5.0		**Asymmetric Key Cryptography**	**09**	**CO5**
	5.1	Principles of Public Key Crypto System, RSA, Key Management, Diffie-Hellman Key Exchange.		
	5.2	Message Integrity, Message Authentication and Hash Functions, SHA, HMAC, Digital Signature Standards.		
		Self-learning Topics: Public key vs private key in everyday life, Hash functions in password storage.		
6.0		**System Security**	**04**	**CO6**
	6.1	Intrusion Detection System, Secure Electronic Transactions.		
	6.2	Firewall Design, Digital Immune systems, Biometric Authentication, Ethical Hacking.		
		Self-learning Topics: Basic working of firewalls, Common cybersecurity threats.		
	Total		**39**	

Textbooks:

1. K. Sayood, Introduction to Data Compression, 3rd ed. San Francisco, CA, USA: Morgan Kaufmann, 2006.
2. B. A. Forouzan, Cryptography and Network Security, 2nd ed. New Delhi, India: Tata McGraw-Hill, 2007.
3. M. Nelson and J.-L. Gailly, The Data Compression Book, 2nd ed. New Delhi, India: BPB Publications, 1996.
4. W. Stallings, Cryptography and Network Security: Principles and Practice, 5th ed. Boston, MA, USA: Pearson Education, 2010.

Reference books:

1. D. Salomon, Data Compression: The Complete Reference, 4th ed. New York, NY, USA: Springer, 2007.
2. M. Bishop, Computer Security: Art and Science. Boston, MA, USA: Addison-Wesley, 2003.
3. B. A. Menezes, Network Security and Cryptography, 2nd ed. New Delhi, India: Cengage Learning, 2010.

Online References:

- NPTEL: https://nptel.ac.in/courses/106105162
- NPTEL: https://nptel.ac.in/courses/106105031

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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. 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.

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
ECPEC5014	Information Theory and Coding	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
ECPEC5014	Information Theory and Coding	20	20	60	--	--	100

Pre-requisite:

1. ECC301: Applied Mathematics III
2. ECC401: Applied Mathematics IV

Program Outcomes addressed:

PO1: Engineering knowledge
PO2: Problem analysis
PO11: Lifelong Learning
PSO1: To acquire knowledge in cutting-edge technologies.

Course Objectives:

1. To introduce the fundamental concepts of probability theory.
2. To develop understanding of information theory and source coding principles for efficient and reliable communication.
3. To familiarize students with various error detection techniques and introduce the principles and structure of block codes.
4. To enable students to analyze and design linear block codes, cyclic codes and convolutional codes for reliable data transmission.

Course Outcomes:

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

1. Explain the fundamentals of probability theory.
2. Apply the concepts of information theory in source coding.
3. Apply various error detection techniques such as parity checks, checksums, and CRC to detect errors in digital data.
4. Construct and analyze linear block codes using generator and parity-check matrices for data reliability.
5. Design and implement cyclic codes using generating polynomials and perform encoding and decoding operations.
6. Analyze convolutional codes and apply encoding and decoding algorithms.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Probability Theory**	**04**	**CO1**
	1.1	Introduction to probability theory: Axiomatic definition of probability, marginal, joint and conditional probabilities, Bayes theorem.		
	1.2	Types of random variables, discrete & continuous, PMF, PDF and cumulative distribution function, independent event.		
		Self-Learning Topics: Binary symmetry channel		
2.0		**Information Theory and Source Coding**	**07**	**CO2**
	2.1	Information content of a source symbol, source entropy, average information rate, AWGN channel, Shannon-Hartley channel capacity theorem, Shannon's limit.		
	2.2	Fixed and variable length source codes, statistical and non-statistical source codes, Kraft's inequality, Shannon's source coding theorem, Huffman code, extended Huffman code, Shannon-Fano code, LZ code and arithmetic code.		
		Self-Learning Topics: Mutual information, demonstrate LZ compression using built-in libraries (zlib in Python).		
3.0		**Error detection code**	**04**	**CO3**
	3.1	Vertical Redundancy Check (VRC) code, Horizontal Redundancy Check (HRC) code, Two-dimensional code, Repetition code, Cyclic Redundancy Check (CRC) code, Checksum code, Burst error detection code.		
		Self-Learning Topics: Error detection in TCP/IP network and Ethernet network.		
4.0		**Linear Block code**	**08**	**CO4**
	4.1	Introduction: Code rate, code efficiency, code redundancy, systematic and non-systematic codes, Hamming weight and minimum Hamming weight, Hamming distance and minimum Hamming distance, detection capability and correction capability, Hamming bound, perfect block code, Linearity and cyclic properties, Singleton bound, maximum distance code, Hamming code.		
	4.2	Code Generation: Systematic linear block code generation, calculation of error detection and correction capabilities, implementation of encoder.		
	4.3	Code Detection: Syndrome test, decoding table, block diagram of a decoder, error detection and correction, implementation of decoder.		
		Self-Learning Topics: Design generator matrix for different linear block codes.		
5.0		**Cyclic codes**	**08**	**CO5**

	5.1	Generator polynomials, non-systematic cyclic code generation, systematic cyclic code generation, equivalent generator matrix for a generator polynomial, implementation of encoder using shift registers.		
	5.2	Code detection: Syndrome test, decoding table, block diagram of a decoder, error detection and correction, implementation of decoder.		
		Self-Learning Topics: BCH codes, dual codes., RS code and LDPC code.		
6.0		**Convolutional Codes**	**08**	**CO6**
	6.1	Code rate, code efficiency, code redundancy, constraint length, generator sequence, generator polynomial, impulse response, generator matrix,		
	6.2	Code generation using shift registers, using time-domain method, using transform-domain method and using generator matrix.		
	6.3	State of the encoder, state transition table, state diagram, tree diagram, trellis diagram, encoding and decoding using the above diagrams.		
	6.4	Recursive Systematic Convolutional (RSC) code and Turbo code.		
		Self-Learning Topics: Applications of convolutional code in mobile communication system.		
		Total	**39**	

Textbooks:

1. T L Singal, *Digital Communication*, Mc-Graw Hill, New Delhi, First Edition, 2015.
2. P Ramakrishna Rao, *Digital Communication*, Tata Mc-Graw Hill, New Delhi, First Edition,2011.
3. Sklar B, and Ray P. K., *Digital Communication: Fundamentals and applications*, Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.

Reference books:

1. Jorge Castiñeira Moreira & Patrick G. Farrell, *Error Control Coding*, Wiley student edition, 2014.
2. H. Taub, D. Schlling, and G. Saha, *Principles of Communication Systems*, Tata Mc-Graw Hill, New Delhi, Third Edition, 2012.
3. Lathi B P, and Ding Z, *Modern Digital and Analog Communication Systems*, Oxford University Press, Fourth Edition, 2017.
4. Haykin Simon, *Digital Communications*, John Wiley and Sons, New Delhi, Fourth Edition, 2014.
5. Shu Lin & Daniel J. Costello Jr, *Error Control Coding*, Pearson India, Second Edition, 2010.

Online References:

- NPTEL: https://onlinecourses.nptel.ac.in/noc20_ee94/preview
- Johns Hopkins University: https://ep.jhu.edu/courses/525707-error-control-coding/

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. The 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. 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL501	Microprocessor and Microcontroller Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL501	Microprocessor and Microcontroller Lab	--	--	--	25	25	50

Pre-requisite:
1.FEL 203: Digital System Design Lab

Program Outcomes addressed:
1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO5: Modern tool usage
4. PO11: Lifelong Learning
5. PSO2: Develop innovative multidisciplinary projects

Lab Objectives:
1. To use development tools for writing, assembling, and simulating assembly language programs.
2. To implement arithmetic, logical, data transfer, and control instructions on the 8086.
3. To develop assembly language programs using registers, ports, and internal memory of 8051.
4. To verify data transmission, reception, and timing behavior through experimentation.
5. To develop control programs for proper operation of interfaced peripherals.
6. To identify syntax, logical, and runtime errors in assembly language programs.

Lab Outcomes:
After successful completion of the course, students will be able to:
1. Demonstrate different development tools of microprocessor and micro-controller-based systems .
2. Implement and verify 8086 assembly language programs.
3. Develop programs in assembly language for 8051 processor.
4. Develop the program in assembly language for performing input/output operation, serial communication and delay generation.
5. Interface peripherals with 8051 microcontrollers.
6. Debug and troubleshoot microprocessor and microcontroller-based systems.

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Title: Assembly Program to Perform Arithmetic Operations (Using Immediate, Direct and Indirect addressing) using 8086 microprocessor AIM: To write and execute an assembly language program to perform arithmetic operations using immediate, direct, and indirect addressing modes on 8086 microprocessor. Objectives: • To study the architecture and instruction set of 8086 microprocessor. • To understand immediate, direct, and indirect addressing modes. • To implement arithmetic operations such as addition, subtraction, multiplication, and division. • To analyze the results and effect on processor flags.	**LO1, LO2**
2	Title: Assembly Program to Perform Logical Operations using 8086 microprocessor AIM:To implement logical operations using assembly languageprogramming on 8086 microprocessor. Objectives: • To understand logical instructions such as AND, OR XOR, NOT, and TEST. • To perform bitwise logical operations on data. • To study the effect of logical operations on flag registers. • To develop problem- solving skills using assembly language.	**LO1, LO2**
3	Title: Assembly program based on string instruction: Calculate length of string using 8086 microprocessor. AIM: To write an assembly language program using string instructions to calculate the length of a given string using 8086 microprocessor. Objectives: • To understand string handling instructions of the 8086. • To implement looping and pointer manipulation for string processing. • To calculate the length of a string stored in memory. • To observe the role of index registers in string processing.	**LO1, LO2**
4	Title: Assembly program based on BCD to ASCII conversion using 8086 microprocessor. AIM: To develop an assembly language program to convert BCD data into its ASCII equivalent using 8086 microprocessor. Objectives:	**LO1, LO2**

	• To understand BCD and ASCII data representations. • To perform data manipulation using arithmetic and logical instructions. • To convert numeric data into display- friendly ASCII format. • To enhance understanding of data conversion techniques in microprocessors.	
5	Title: Assembly program based on Hexadecimal to decimal conversion using 8086 microprocessor. AIM: To write an assembly language program to convert a hexadecimal number into its decimal equivalent using 8086 microprocessor. Objectives: • To study different number systems and their conversions. • To apply arithmetic operations for base conversion. • To convert hexadecimal data into decimal form. • To improve logical thinking and algorithm design using assembly language.	**LO1, LO2**
6	Title: Assembly program to arrange numbers in ascending and descending order using 8086 microprocessor. AIM: To develop an assembly language program to arrange a given set of numbers in ascending and descending order using 8086 microprocessor. Objectives: • To understand sorting techniques in assembly language. • To implement comparison and data exchange operations. • To use loops and conditional jumps efficiently. • To verify sorted output in both ascending and descending order.	**LO1, LO2**
7	Title: Assembly program to calculate factorial of a given number using 8086 microprocessor. AIM: To write an assembly language program to calculate the factorial of a given number using 8086 microprocessor. Objectives: • To understand iterative logic using loops in assembly language. • To implement factorial computation using multiplication instructions. • To study the use of registers for intermediate results. • To analyze program execution and output correctness.	**LO1, LO2**
8	Title: Implementation of MESI Protocol AIM: To implement the MESI cache coherence protocol and study its role in maintaining data consistency among multiple processor caches in a shared-memory multiprocessor system.	**LO1, LO3, LO4**

	Objectives: • To understand the concept of cache coherence and the need for coherence protocols in multiprocessor architectures. • To implement the MESI protocol states-Modified, Exclusive, Shared, and Invalid-for cache line management. • To analyze state transitions of the MESI protocol during read and write operations in a multi-core environment. • To evaluate the effectiveness of the MESI protocol in reducing memory inconsistencies and improving system performance.	
9	Title: Serial port programming of 8051microcontroller. AIM: To study and implement serial communication using the serial port of 8051 microcontroller. Objectives: • To understand serial communication concepts and protocols. • To study serial port control registers of the 8051. • To transmit and receive data serially. • To verify communication between the microcontroller and external devices.	**LO1, LO3, LO4**
10	Title: Experiment based on Timers Using 8051 microcontroller. AIM: To study and implement timer operations using the internal timers of 8051 microcontroller. Objectives: • To understand different timer modes of the 8051. • To generate precise time delays using timers. • To configure timer registers for required delay. • To verify timing accuracy through program execution.	**LO1, LO3, LO5**
11	Title: LCD Interfacing using 8051 microcontroller. AIM: To interface a character LCD with the 8051 microcontroller and display information. Objectives: • To understand LCD working principles and control signals. • To interface LCD with the 8051 microcontroller. • To display characters, numbers, and strings on the LCD. • To implement command and data mode LCD operations.	**LO1, LO3, LO5**
12	Title: Sensor interfacing using an ADC using 8051 microcontroller. AIM: To interface an analog sensor with an ADC and process theoutput using 8051 microcontroller. Objectives: • To understand analog- to- digital conversion principles. • To interface ADC with the 8051 microcontroller. • To read and process sensor data digitally.	**LO1,LO3, LO5**

	• To display or utilize sensor output for control applications.	
13	Title: Generation of different waveforms using DAC using 8051 microcontroller. AIM: To generate different analog waveforms using a DAC interfaced with 8051 microcontroller. Objectives: • To study digital- to- analog conversion techniques. • To interface DAC with the 8051 microcontroller. • To generate waveforms such as square, ramp, and sine waves. • To observe waveform output using CRO/DSO.	**LO1, LO3, LO5, LO6**
14	Title: Speed Control of DC Motor (using PWM) using 8051 microcontroller. AIM: To control the speed of a DC motor using PWM technique implemented with 8051 microcontroller. Objectives: • To understand PWM generation using microcontrollers. • To control duty cycle for motor speed variation. • To interface DC motor with driver circuitry. • To analyze the relationship between duty cycle and motor speed.	**LO1, LO3, LO5, LO6**
15	Title: Stepper Motor Interfacing using 8051 microcontroller. AIM: To interface and control a stepper motor using 8051 microcontroller. Objectives: • To understand the working principle of stepper motors. • To implement stepping sequences using 8051 programming. • To control the speed and direction of the stepper motor. • To study precise position control using stepper motors.	**LO1, LO3, LO5, LO6**

Online Resources:

- https://esd-coep.vlabs.ac.in/Objective.html
- https://iiitbh.ac.in/microproces
- http://ebootathon.com/labs/beta/ec/MicroprocessorAndMicrocontrollerLab/exp1/simulation.html

Software Tools:

Before starting the experiments there should be one session on study of development tools like Editor, Emulator, Linker, Keil etc. Computation/ Simulation based experiments are also encouraged.

Term Work:

- The term work should consist of at least 12 experiments.

- The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.

Practical Exam: (2 hours/ 25 Marks)

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL502	Computer Network Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL502	Computer Network Lab	--	--	--	25	25	50

Pre-requisite:

1. ECL404: Skill Lab -Linux

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO5: Modern tool usage
5. PO7: Ethics
6. PO9: Individual and teamwork
7. PO11: Lifelong learning
8. PSO2: Develop innovative multidisciplinary projects

Lab Objectives:

1. To analyze network protocols and packet structures using tools like Wireshark.
2. To practice basic networking commands and physical cable preparation for LAN connectivity.
3. To configure and compare network topologies and hardware components using simulation tools.
4. To implement static and dynamic routing protocols for efficient network communication.
5. To perform subnetting, IP addressing, and socket programming for data transmission.
6. To configure firewalls and routing tables for secure network operations.

Lab Outcomes:

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

1. Analyze TCP/IP stack and interpret protocol headers and encapsulation.
2. Execute networking commands and prepare/test UTP cables for LAN connectivity.
3. Configure and compare network topologies and hardware components using Cisco Packet Tracer.
4. Implement static and dynamic routing protocols (RIP, OSPF, BGP, EIGRP) and verify routing tables.
5. Perform subnetting, configure IP addressing schemes, and develop socket programs for TCP/UDP.
6. Configure firewalls and manage routing tables for secure network operations.

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Title: Analysis of TCP/IP Stack Using Packet Capturing Tool (Wireshark) AIM: To study and analyze the TCP/IP protocol stack by capturing and examining network packets using Wireshark. Objectives: • Capture live network packets using Wireshark • Identify protocols at each layer of the TCP/IP model • Analyze packet structure including headers and payload • Study encapsulation and decapsulation process across layers • Interpret source/destination addressing and protocol behavior	LO1
2	Title: Study and Execution of Basic Networking Commands in Linux/Netkit AIM: To understand and execute basic networking commands used for configuration, monitoring, and troubleshooting. Objectives: • Study commonly used networking commands in Linux/Netkit • Configure and display network interface parameters • Test network connectivity between hosts • Monitor network status and routing information • Perform basic network troubleshooting using command-line tools	LO2
3	Title: Preparation, Testing, and Implementation of Network Cables in LAN AIM: To prepare, test, and deploy Ethernet cables for Local Area Network communication. Objectives: • Understand UTP cable structure and TIA/EIA standards • Prepare straight-through, crossover, and rollover cables • Crimp RJ-45 connectors using crimping tools • Test cable continuity using a cable tester • Use prepared cables to establish LAN connections	LO2
4	Title: Configuration and Comparison of Network Topologies Using Cisco Packet Tracer AIM: To design, configure, and analyze different network topologies using simulation tools. Objectives: • Configure bus, star, ring, and mesh topologies • Simulate data transmission in different topologies • Compare performance, reliability, and scalability • Analyze fault tolerance of each topology	LO3

	• Understand practical applications of network topologies	
5	Title: Configuration and Comparison of Network Hardware Components Using Cisco Packet Tracer AIM: To study and configure various network hardware components and analyze their functionality. Objectives: • Configure routers, switches, hubs, and end devices • Understand the role of each network hardware component • Analyze data flow through network devices • Compare device performance and usage scenarios • Verify connectivity across network components	LO3
6	Title: Configuration of Static Routing in a Network Using Cisco Packet Tracer AIM: To implement static routing and understand routing table formation. Objectives: • Configure IP addressing on routers and end devices • Implement static routes between different networks • Analyze routing table entries • Verify packet forwarding between networks • Study the limitations of static routing	LO4
7	Title: Configuration of Distance Vector Routing Protocol (RIP) AIM: To study and configure RIP routing protocol and observe its routing behavior. Objectives: • Configure RIP protocol on multiple routers • Understand distance vector routing mechanism • Observe routing table updates and hop count metric • Analyze convergence behavior of RIP • Verify network connectivity using test packets	LO4
8	Title: Configuration of Path Vector Routing Protocol (BGP) AIM: To study and implement BGP for inter-domain routing. Objectives: • Configure BGP with different autonomous systems • Establish neighbor relationships • Study BGP path selection attributes • Analyze BGP routing table entries • Verify communication between different AS networks	LO4
9	Title: Configuration of Link State Routing Protocol (OSPF)	LO4

	AIM: To configure and analyze OSPF routing protocol using simulation tools. Objectives: • Configure OSPF areas and routers • Understand link state advertisements (LSAs) • Analyze shortest path first (SPF) algorithm • Observe routing convergence • Verify routing using simulation traffic	
10	Title: Configuration of Hybrid Routing Protocol (EIGRP) AIM: To study and implement EIGRP routing protocol and analyze its features. Objectives: • Configure EIGRP on multiple routers • Study composite metrics used by EIGRP • Analyze fast convergence behavior • Compare EIGRP with other routing protocols • Verify end-to-end connectivity	LO4
11	Title: Implementation of Subnetting and IP Addressing AIM: To design and implement subnetting for efficient utilization of IP addresses. Objectives: • Perform subnet calculations for given networks • Design multiple subnets from a single network • Configure IP addressing based on subnet design • Test connectivity within and across subnets • Analyze benefits of subnetting	LO5
12	Title: Implementation of Socket Programming Using TCP and UDP AIM: To implement client-server communication using TCP and UDP socket programming. Objectives: • Study socket architecture and APIs • Implement reliable communication using TCP • Implement connectionless communication using UDP • Compare TCP and UDP communication behavior • Analyze performance and reliability differences	LO6
13	Title: Configuration of Firewall Using IP Tables AIM: To configure and manage firewall rules for securing a network. Objectives: • Understand firewall and packet filtering concepts • Configure IP Tables for traffic control • Allow or deny traffic based on rules	LO6

	• Secure network services using firewall policies • Verify firewall operation through testing	
14	Title: Routing Configuration and IP Forwarding in Linux/Windows AIM: To configure routing tables and enable IP forwarding in operating systems. Objectives: • View existing routing table entries • Add and delete static routes • Configure default gateways • Enable and verify IP forwarding • Analyze packet routing and forwarding behavior	LO4, LO6
15	Title: Configuration and Analysis of Virtual LANs (VLANs) Using Cisco Packet Tracer AIM: To design, configure, and analyze Virtual Local Area Networks (VLANs) using Cisco Packet Tracer and study their role in logical network segmentation and efficient communication. Objectives: • Configure VLANs on network switches using Cisco Packet Tracer • Understand the role of VLANs in reducing broadcast traffic and improving network performance • Analyze data flow within and across VLANs • Compare communication behavior in same- VLAN and inter- VLAN scenarios • Verify connectivity between end devices using VLAN configuration and routing	LO1 LO2, LO3, LO4, LO5, LO6

Online Resources:

- https://www.netacad.com/
- 9tut.com – CCNA Tutorials & Labs

Term Work:

- Term work should consist of at least 12 experiments.
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Term work will be assessed as Continuous Internal Assessment Practical (CIAP)

Term work Marks:

- 25 Marks (Total Marks) = 20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL503	Interpersonal and Career Skills Lab	--	02*+02	--	--	02	--	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECL503	Interpersonal and Career Skills Lab	--	--	--	50	--	50

Pre-requisite:

1. FEL204: Professional Communication Techniques Course

Program Outcome mapped:

1. PO6: The Engineer and the World
2. PO7: Ethics
3. PO8: Individual and Collaborative Teamwork
4. PO9: Communication
5. PO10: Project Management & Finance
6. PO11: Lifelong Learning

Course Objectives

The course is designed:

1. To equip students with career development skills to align with the corporate and global requirements.
2. To develop students' ability to conduct and participate in professional business meetings.
3. To apply the knowledge of effective writing skills to produce technical/business documents.
4. To train students in creating effective, dynamic technical/business presentations.
5. To build strong interpersonal skills required for effective workplace communication.
6. To familiarise students with corporate ethics and Intellectual Property Rights.

Course Outcomes

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

1. Apply essential skills while appearing for recruitment processes or applying for higher education for a successful career.
2. Demonstrate professional behaviour; to plan, participate in, and document business meetings effectively.

3. Compose well-structured technical/business documents.
4. Design and deliver effective technical/business presentations using suitable strategies.
5. Employ strong interpersonal skills to overcome workplace challenges by understanding professional communication.
6. Practice principles of corporate ethics and understand Intellectual Property Rights.

Module No.	Unit No.	Topics	Hrs.	Mapped to CO
1.		**Career Skills**	**08**	**CO1**
	1.1	SWOT Analysis		
	1.2	Cover letter, Resume/CV: Resume Building, Types of Resumes (Chronological, Functional & Combination), Curriculum Vitae, Difference between Resume and CV		
	1.3	Group Discussion: Purpose, Types of GDs (Normal, Case-based & Role Plays)		
	1.4	GD Etiquettes, Parameters of Evaluating a GD		
	1.5	Interviews (Face to face and Virtual): Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based)		
	1.6	Modes of Interviews: Face-to-face, Telephonic		
	1.7	Virtual Interview planning and preparation, Online interview etiquettes		
	1.8	Statement of Purpose		
2.		**Business Meetings**	**03**	**CO2**
	2.1	Documentation: Notice, Agenda, Minutes of the Meeting		
	2.2	Conducting Business Meetings: Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members, Meeting Etiquettes		
	2.3	Writing Minutes of the Meeting		
3.		**Advanced Technical Writing**	**06**	**CO3**
	3.1	Purpose and Classification of Reports: Classification based on Subject Matter (Technology, Accounting, Finance, Marketing, etc.), Time Interval (Periodic, One-time, Special)		

	3.2	Function (Informational, Analytical, etc.), Physical Factors (Memorandum, Letter, Short & Long)		
	3.3	Language and Style: Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections and Figures/Tables, Proof-reading through Plagiarism Checkers		
	3.4	Project Report: Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter)		
	3.5	Proposals: Format and Style of Technical Proposals, Parts of a Proposal		
	3.6	Technical Paper Writing: Parts of a Technical Paper, Language, Style and Formatting, Referencing in IEEE Format		
4.		**Effective Presentation**	**02**	**CO4**
	4.1	Effective Presentation Strategies: Defining purpose, analysing audience & location, structuring a presentation, Types of presentation aids, Using body language and Voice modulation		
	4.2	Group Presentation: Sharing Responsibility in a Team, Building the contents and visuals together, Transition Phases		
5.		**Interpersonal Skills**	**05**	**CO5**
	5.1	Emotional Intelligence		
	5.2	Leadership		
	5.3	Time Management		
	5.4	Decision Making		
	5.5	Responsible Use of social media		
6.		**Corporate Ethics and Intellectual Property Rights**	**02**	**CO6**
	6.1	Introduction to Corporate Ethics		
	6.2	Intellectual Property Rights: Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications, Integrated Circuits, Trade Secrets (Undisclosed Information)		
		Total	**26**	

Reference books:

1. J. Butterfield, Professionalism: Soft Skills for a Digital Workplace. Boston, Massachusettes: Cengage Learning, © Course Technology, Cengage Learning, 2011.
2. R. V. Lesikar and J. D. Petit, Report Writing for Business, 10th ed. McGraw-Hill/Irwin, 1995.
3. L. A. Olsen and T. N. Huckin, Technical Writing and Professional Communication, 2nd ed. McGraw-Hill Humanities, Social Sciences & World Languages, 1991.
4. L Ann Masters and H. Wallace, Personal Development for Life and Work., 12th ed. Mason, Oh: South-Western Cengage Learning, 2011.
5. H. A. Murphy and Herbert William Hildebrandt, Effective Business Communications, 7th ed. McGraw-Hill Companies, 1988.
6. F. Luthans, Organization Behavior, 12th ed. New York: Mcgraw Hill, 2011.
7. R. C. Sharma and K. Mohan, Business Correspondence and Report Writing : A Practical Approach to Business & Technical Communication, 6th ed. New Delhi: Tata Mcgraw-Hill, 2017.
8. K. Alex, Soft skills : Know yourself & know the world, 3rd ed. New Delhi: S. Chand & Company Ltd, 2012.
9. R Subramanian, Professional ethics, 2nd ed. New Delhi: Oxford University Press, 2013.
10. S. Robbins and T. A. Judge, Organizational Behavior, 18th ed. Pearson Higher Education AU, 2024.

Online References:

1. **Directorate General of Training (DGT).**
Employability Skills Curriculum. Ministry of Skill Development & Entrepreneurship, Government of India, https://www.dgt.gov.in/sites/default/files/Employability_Skills_Curriculum.pdf.
2. **Punjab State Open University (PSOU).**
Technical Writing and IPR Syllabus. PSOU, https://psou.ac.in/asset/docs/course_syllabus/20221125183033165f0acdb4.pdf.
3. **National Institute of Technology Kurukshetra (NITKKR).**
Professional Ethics and Intellectual Property Rights (HSIR-13). NITKKR, https://nitkkr.ac.in/wp-content/uploads/2024/07/Professional-Ethics-and-IPR-HSIR-13.pdf.
4. **Commonwealth Corporation.**
Career Readiness Curriculum Guide. CommCorp, https://commcorp.org/wp-content/uploads/2016/07/resources_eyf-career-readiness-curriculum-guide.pdf.

Course Assessment:

Term Work (CIAP): **50 Marks**

Term Work (CIAP) shall consist of Oral & Written assessment for 25 marks each

Oral evaluation to be conducted for **25 Marks** through:

a) Report Presentation 10 marks
b) Group Discussion 10 marks
c) Mock Interviews 05 marks

Written evaluation to be conducted for **25 Marks** through:

a) Project Report (25 to 30 pages) 10 marks
b) Assignments based on all modules 10 marks
c) Attendance 05 marks

CIAP will be conducted based on the above scheme for **50 Marks.**

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDML5021	Data Analytics and Visualization Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
MDML5021	Data Analytics and Visualization Lab	--	--	--	25	--	25

Pre- requisite:

1. ECL304: Skill Lab -Python Programming

Program Outcomes Addressed

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. PO9: Communication
7. PO11: Lifelong Learning

Lab Objectives:

1. To demonstrate effective use of libraries in data analytics
2. To implement regression methods in real data analytics scenarios.
3. To use time series techniques to perform predictive analysis
4. To Implement text analytics techniques in practical scenarios
5. To use appropriate visualization methods in R and Python for data analysis.
6. To explore data visualization concepts using practical visualization tools.

Lab Outcomes:

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

1. Explore various data analytics Libraries in R and Python
2. Implement various Regression techniques for prediction.
3. Build various time series models on a given data set.
4. Design Text Analytics Application on a given data set.
5. Interpret various visualizations of given data sets using various tools
6. Develop interactive dashboards integrating data transformation, visualization for professional reporting

Suggested List of Experiments: Students are required to complete at least 12 experiments.		
Sr. No.	**Title of Experiments**	**LO**
1	**Data Analytics Libraries Exploration** A retail company has collected large volumes of sales and customer data but lacks meaningful insights. As a data analyst, you are required to explore and utilize data analytics libraries in Python and R to process and visualize the data. **Tasks:** • Use Python libraries (NumPy, Pandas, Matplotlib) and R libraries (dplyr, tidyr, ggplot2). • Perform data cleaning and transformation. • Generate summary statistics. • Create basic visualizations to identify trends and patterns. **Recommended Datasets:** • https://www.kaggle.com/datasets/rohitsahoo/sales-forecasting • https://archive.ics.uci.edu/ml/datasets/Online+Retail	LO1
2	**Simple Linear Regression** A real estate firm wants to predict house prices based on property size (area). You are required to build a predictive model to understand this relationship. **Tasks:** • Implement simple linear regression in Python/R. • Visualize the regression line. • Evaluate model performance using R^2. • Interpret the relationship between variables. **Recommended Datasets:** • https://www.kaggle.com/datasets/harishkumardatalab/housing-price-prediction • https://archive.ics.uci.edu/ml/datasets/Housing	LO1
3	**Multiple Linear Regression** A marketing company wants to analyze how different advertising channels (TV, radio, digital) impact product sales. **Tasks:** • Build a multiple regression model. • Analyze the influence of each independent variable. • Perform feature selection. • Interpret coefficients and statistical significance. **Recommended Datasets:** • https://www.kaggle.com/datasets/ashydv/advertising-dataset • https://www.kaggle.com/datasets/sazid28/advertising.csv	LO2
4	**Time Series Analysis** A supermarket chain wants to analyze monthly sales data to identify trends and	LO3

	seasonal demand patterns for better inventory management. **Tasks:** • Perform time series decomposition. • Identify trend and seasonality components. • Apply rolling statistics. • Visualize temporal patterns. **Recommended Datasets:** • https://www.kaggle.com/datasets/kyanyoga/sample-sales-data • https://www.kaggle.com/datasets/robikscube/time-series-dataset	
5	**ARIMA Forecasting Model** An energy company wants to forecast future electricity demand based on historical consumption data. **Tasks:** • Identify ARIMA parameters (p, d, q). • Build and train the ARIMA model. • Perform forecasting. • Compare predicted vs actual values and evaluate accuracy. **Recommended Datasets:** • https://www.kaggle.com/datasets/robikscube/hourly-energy-consumption • https://www.kaggle.com/datasets/sudalairajkumar/daily-temperature-of-major-cities	LO4
6	**Geospatial Data Visualization** A city planning authority needs to visualize infrastructure distribution such as roads, buildings, and land areas for urban planning. **Tasks:** • Load and preprocess geospatial data (vector and raster). • Use tools like QGIS / GeoPandas / Rasterio. • Create spatial visualizations (maps). • Interpret spatial patterns. **Recommended Datasets:** • https://www.naturalearthdata.com/downloads/ • https://earthdata.nasa.gov/	LO5
7	**Geospatial Data Analytics: Perform supervised classification on Sentinel images to identify Land Use / Land Cover (Google Earth Engine)** An environmental agency wants to monitor land use changes such as urban expansion, deforestation, and water bodies. **Tasks:** • Use Google Earth Engine. • Train supervised classification models. • Classify satellite images (Sentinel data). • Generate Land Use/Land Cover maps. **Recommended Datasets:** • https://developers.google.com/earth-engine/datasets	LO5

	• https://www.kaggle.com/datasets/apollo2506/satellite-imagery-datasets	
8	**Text analytics: Implementation of Spam filter/Sentiment analysis in python/R**. An e-commerce company wants to analyze customer reviews to understand satisfaction levels and detect spam messages. **Tasks:** • Preprocess text data (tokenization, stopword removal, etc.). • Build classification models. • Perform sentiment/spam detection. • Evaluate using confusion matrix, accuracy, precision, and recall. **Recommended Datasets:** • https://www.kaggle.com/datasets/lakshmi25npathi/imdb-dataset-of-50k-movie-reviews • https://archive.ics.uci.edu/ml/datasets/SMS+Spam+Collection	LO4
9	**Visualization experiments in R using different Libraries.** A financial analyst needs to present stock market trends and investment insights to stakeholders using effective visualizations. **Tasks:** • Use R libraries (ggplot2, plotly, lattice). • Create at least two types of visualizations. • Ensure clarity and storytelling. • Interpret key insights. **Recommended Datasets:** • https://www.kaggle.com/datasets/borismarjanovic/price-volume-data-for-all-us-stocks-etfs • https://finance.yahoo.com/	LO5
10	**Visualization experiments in R using different Libraries.** A telecom company is experiencing high customer churn and wants to understand the underlying patterns. As a data analyst, you are provided with customer data including usage patterns, billing information, service complaints, and demographics. Tasks: • Use R libraries (ggplot2, plotly, lattice). • Create at least two types of visualizations. • Ensure clarity and storytelling. • Interpret key insights. Recom**mended Datasets:** • https://www.kaggle.com/datasets/blastchar/telco-customer-churn	
11	**Visualization experiments in python using different Libraries.** A healthcare organization wants to analyze patient data to identify patterns in disease occurrence and improve treatment planning. **Tasks:** • Use Python libraries (Matplotlib, Seaborn, Plotly, Bokeh). • Create advanced visualizations (heatmaps, pair plots, interactive charts).	LO5

	• Identify trends and correlations. • Present actionable insights. **Recommended Datasets:** • https://www.kaggle.com/datasets/ronitf/heart-disease-uci • https://www.kaggle.com/datasets/imdevskp/corona-virus-report	
12	**Visualization experiments in python using different Libraries.** A manufacturing company wants to improve production efficiency by analyzing machine performance, downtime, defect rates, and output across different shifts and plants. **Tasks:** • Use Python libraries (Matplotlib, Seaborn, Plotly, Bokeh). • Create advanced visualizations such as time-series plots, heatmaps (machine vs downtime), and comparative bar charts. • Analyze patterns in machine breakdowns, defect rates, and production output. • Identify correlations between variables such as shift timing, machine usage, and defects. • Present actionable insights to reduce downtime and improve overall equipment effectiveness (OEE). **Recommended Datasets:** • https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification	
13	**Build one complete interactive dashboard (Power BI/Tableau)** A business manager requires a real-time dashboard to monitor KPIs such as sales, profit, and regional performance. **Tasks:** • Use Power BI or Tableau. • Integrate multiple datasets. • Apply filters, slicers, and calculated fields (DAX). • Design interactive and user-friendly dashboards **Recommended Datasets:** • https://www.kaggle.com/datasets/kyanyoga/sample-sales-data • https://www.kaggle.com/datasets/olistbr/brazilian-ecommerce	LO6
14	**Build one complete interactive dashboard (Power BI/Tableau)** A manufacturing company wants to monitor plant performance across multiple units, focusing on KPIs such as production output, downtime, equipment efficiency (OEE), and maintenance costs. The management needs a real-time dashboard to support operational and strategic decisions. **Tasks:** • Integrate multiple datasets (production logs, maintenance records, downtime reports). • Apply filters, slicers, and calculated fields (DAX) for KPIs like OEE, MTTR, and MTBF. • Design interactive dashboards with drill-down capabilities. • Identify bottlenecks, high downtime areas, and cost drivers.	

	• Present actionable insights to improve efficiency and reduce operational losses. **Recommended Datasets:** • https://www.kaggle.com/datasets/arnabbiswas1/microsoft-azure-predictive-maintenance	
15	**To explore advanced chart types (waterfall, treemap funnel, map) in Power BI** A logistics company wants to analyze supply chain efficiency and operational performance using advanced visual tools. **Tasks:** • Create charts like waterfall, treemap, funnel, and map visuals. • Integrate visuals into a dashboard. • Analyze hierarchical and flow-based data. • Provide insights for decision-making. **Recommended Datasets:** • https://www.kaggle.com/datasets/shashwatwork/dataco-smart-supply-chain-for-big-data-analysis • https://www.kaggle.com/datasets/ramakrishnanthiyagu/supply-chain-management	LO6

Textbooks:

1. EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Indianapolis, IN, USA: Wiley, 2015.
2. R. V. McCarthy, M. M. McCarthy, and W. Ceccucci, Applying Predictive Analytics: Finding Value in Data, 2nd ed., Cham, Switzerland: Springer, 2019.
3. N. D. Lewis, Introduction to Data Science: A Practical Approach with R and Python, Hoboken, NJ, USA: Wiley, 2017.
4. W. McKinney, Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, 3rd ed., Sebastopol, CA, USA: O'Reilly Media, 2022.

Reference books:

1. B. Motwani, Data Analytics Using R, New Delhi, India: Wiley, 2015.
2. W. McKinney, Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, 3rd ed., Sebastopol, CA, USA: O'Reilly Media, 2022.
3. J. Schwabish, Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks, New York, NY, USA: Columbia University Press, 2021.
4. A. A. Albright and W. L. Winston, Business Analytics: Data Analysis and Decision Making, 7th ed., Boston, MA, USA: Cengage Learning, 2023.

Online Resources:

- Coursera-Data Visualization with Python: Data Visualization with Python | Coursera
- Microsoft-Fundamentals of data visualization with Power BI: Explore fundamentals of data visualization with Power BI | DP-900T00A-Azure-Data-Fundamentals
- NPTEL course on R-Programming https://onlinecourses.nptel.ac.in/noc19_ma33/preview

Software Tools

1. Open-Source Data Visualization Tools

Term Work:

- Term work should consist of at least 12 experiments.
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDML5051	Advanced Algorithms Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
MDML5051	Advanced Algorithms Lab	--	--	--	25	-	25

Pre- requisite:

1. FEC104: C Programming
2. ECC302 Data Structure

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO11: Life-Long Learning

Lab Objective:

1. Introduce fundamental algorithm-analysis techniques
2. Develop the ability to apply probabilistic and randomized approaches
3. Equip students with the knowledge of dynamic programming principles.
4. Impart understanding of graph algorithms and flow-network techniques.
5. Provide competency in applying algorithmic strategies
6. Build an understanding of computational complexity classes

Lab Outcomes :

Upon completion of this course, Learners will be able to:

1. Analyze various types of algorithms by applying different mathematical analysis techniques.
2. Understand and apply probabilistic analysis and randomized algorithms.
3. Develop dynamic programming algorithms for various real-time applications.
4. Apply appropriate graph-based algorithm for the various flow networks
5. Apply appropriate algorithms to solve computational and linear programming problems
6. Understand complexity classes through implementation and case studies.

Suggested List of Experiments: Students are required to complete at least 12 experiments.

Sr. No.	Title of Experiments	LO
1	A software development team is optimizing algorithms for a performance-critical application and needs to compare different implementation approaches. Students are required to implement both recursive and non-recursive (iterative) versions of algorithms (such as factorial, Fibonacci, or searching) and analyze their performance in terms of time, space, and efficiency.	LO1
2	A software company is developing a system that performs frequent operations such as dynamic array insertions and stack operations, where occasional expensive operations may occur. Students are required to study and implement amortized analysis to evaluate the average cost per operation over a sequence of operations.	LO1
3	A software company handling large datasets needs an efficient sorting technique that performs well even with unpredictable input patterns. Students are required to implement a randomized algorithm using Randomized Quicksort, where the pivot is selected randomly to improve average performance and avoid worst-case scenarios.	LO2
4	A company conducting a recruitment drive wants to select the best candidates from a sequence of applicants interviewed one by one, where each candidate has a performance rating. Students are required to implement the Hiring Problem, selecting a candidate only if they are better than all previously interviewed candidates, and print the number of hires along with their ratings.	LO2
5	A logistics company managing multiple delivery routes needs to determine the shortest paths between all pairs of locations to optimize transportation time and cost. Students are required to implement an all-pairs shortest path algorithm using dynamic programming, specifically the Floyd-Warshall algorithm, to compute the minimum distances between every pair of nodes in a weighted graph.	LO3
6	A logistics company needs to maximize profit while transporting goods with limited vehicle capacity, where each item can either be fully included or excluded. Students are required to implement the 0/1 Knapsack problem using dynamic programming to determine the optimal selection of items.	LO3
7	A company performing large-scale data processing needs to multiply multiple matrices efficiently, where the order of multiplication significantly affects computation time. Students are required to implement the Matrix Chain Multiplication using dynamic programming to determine the optimal parenthesization that minimizes the number of scalar multiplications.	LO3
8	A transportation network system needs to determine the shortest paths from a source location to all other locations, even when some routes have negative costs (such as discounts or rebates). Students are required to implement the Bellman-Ford algorithm using dynamic programming to compute shortest distances and detect negative weight cycles.	LO3
9	A logistics or network service provider needs to determine the maximum possible flow of resources (such as data, traffic, or goods) from a source to a destination through a network with capacity constraints on each link. Students are required to implement the Ford-Fulkerson algorithm to compute the maximum flow in a given network.	LO4
10	A network service provider needs to determine the maximum data flow from a source to a destination while efficiently handling capacity constraints and ensuring optimal routing. Students are required to implement the Edmonds-Karp algorithm,	LO4

	an optimized version of the Ford-Fulkerson method that uses BFS to find shortest augmenting paths.	
11	A large-scale network system, such as data centers or transportation grids, needs to efficiently manage and maximize the flow of resources between source and destination under capacity constraints. Students are required to implement the Push-Relabel algorithm, which uses preflows and height functions to optimize flow distribution.	LO4
12	A geographic mapping company needs to determine the outer boundary of a set of location points to efficiently represent regions such as land plots or coverage areas. Students are required to implement the Graham Scan algorithm to compute the convex hull of given 2D points in counterclockwise order without duplicating the starting point.	LO5
13	A manufacturing company aims to maximize its profit by optimally allocating limited resources such as labor, materials, and time across different products. Students are required to implement the Simplex algorithm to solve a linear programming problem and determine the optimal solution.	LO5
14	A data analytics company handling large datasets needs to improve sorting performance by utilizing multi-core processors efficiently. Students are required to design and implement Parallel Merge Sort using multithreading, where the array is divided into subarrays and sorted concurrently in separate threads before merging.	LO6
15	Design the 2-approximation vertex-cover algorithm for an undirected graph G (V,E).	LO6

Textbooks:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 4th ed. Cambridge, MA, USA: MIT Press, 2022.Algorithms: Design and Analysis, Harsh Bhasin, OXFORD.
2. H. Bhasin, *Algorithms: Design and Analysis*. New Delhi, India: Oxford University Press, 2016.C and Data structures, Deshpande, Kakde, Dreamtech Press.
3. E. Horowitz, S. Sahni, and S. Rajasekaran, *Fundamentals of Computer Algorithms*. Hyderabad, India: Universities Press, 2008.
4. A. A. Deshpande and O. G. Kakde, *C and Data Structures*. New Delhi, India: Dreamtech Press, 2004.

Reference books:

5. M. T. Goodrich, R. Tamassia, and D. M. Mount, Data Structures and Algorithms in C++, 2nd ed. Hoboken, NJ, USA: Wiley, 2011.
6. R. Thareja, Data Structures Using C, 3rd ed. New Delhi, India: Oxford University Press, 2023.
7. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd ed. Upper Saddle River, NJ, USA: Pearson Education, 2002.
8. R. K. Arora, Optimization: Algorithms and Applications. Boca Raton, FL, USA: Chapman & Hall/CRC Press, 2015.

Online Resources:

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

Software Tools:

1. Dev C++
2. Google Collaboratory notebook

Term Work:

- Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiments) + 05 Marks (Attendance). The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL501l	Sensors and Applications Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL501l	Sensors and Applications Lab	--	--	--	25	--	25

Pre-requisite:

1. ECL303: Electronic Devices and Circuits Lab
2. ECL401: Controls and Instrumentation Lab

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 demonstrate the physical principles and internal mechanisms of sensors
2. To analyze sensor characteristics through hands-on experimentation and software simulation.
3. To develop and model MEMS-based components, specifically focusing on the material properties and structural design of piezoresistive and piezoelectric sensors/actuators.
4. To simulate and observe performance analysis of Micro-Electro-Mechanical Systems.
5. To realize the use of different signal conditioning circuits
6. To select the optimal sensing technology for a specific real-world application.

Lab Outcomes:

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

1. Illustrate the working of sensors used for the measurement of various physical variables.
2. Understand the characteristics of various sensors and measurement of parameters using simulation tools.
3. Apply the knowledge in the development of piezoresistive/piezoelectric sensors and actuators.
4. Design and simulate MEMS devices and systems using simulation tools.
5. Demonstrates the use of signal conditioning circuits for various sensor applications.

6. Identify and select the appropriate sensor and design a viable sensor-based solution for a given real-world problem.

Suggested List of Experiments:

Sr. No.	Title of Experiments	LO
1	Measuring Linear Displacement using Inductive Proximity Sensors. Aim: To determine the relationship between physical displacement and the output signal of an inductive sensor. Objectives: • To understand the working principle of inductive sensors based on Faraday's and Lenz's laws. • To calibrate the sensor and plot its sensitivity over a specific linear range	LO1
2	Implementation of a Distance Measurement System using Ultrasonic Sensors and Arduino. Aim: To design and test a non-contact system for measuring the distance of an object using acoustic reflection. Objectives: • To interface the HC-SR04 ultrasonic sensor with an Arduino and calculate distance based on the speed of sound. • To evaluate the accuracy of the sensor across a range of 2cm to 400cm and display results in real-time.	LO1
3	Real-time Humidity Sensing and Data Acquisition using Arduino. Aim: To monitor atmospheric relative humidity using a DHT series sensor and an Arduino microcontroller. Objectives: • To understand the resistive/capacitive humidity sensing mechanism of the DHT11/DHT22 sensor. • To develop a program to extract humidity data and display it on the Serial Monitor or an LCD.	LO1
4	Detection of Soil Moisture Content for Smart Irrigation Applications. Aim:	LO1

	To quantify the water content in soil by measuring electrical conductivity between sensor probes. Objectives: • To calibrate the soil moisture sensor by mapping its analog voltage output to moisture percentage. • To implement a threshold-based alert system that identifies dry, moist, and wet soil conditions.	
5	Study of LDR and Phototransistor Characteristics. Aim: To analyze and plot the electrical response of light-dependent resistors and phototransistors under varying light intensities. Objectives: • To measure the change in resistance/current relative to the intensity of incident light. • To determine the response time and sensitivity of both sensors for light-controlled switching applications.	LO2
6	Characterization of a Strain Gauge for Structural Health Monitoring. Aim: To study the piezoresistive effect in a strain gauge and establish its Gauge Factor. Objectives: • To observe the change in electrical resistance when the gauge is subjected to mechanical deformation. • To plot the characteristic curve of strain versus resistance for a given material.	LO2
7	Virtual Prototyping of an Anemometer using Proximity Sensors and Arduino. Aim: To simulate the measurement of wind speed by counting the rotations of a virtual anemometer using a proximity sensor. Objectives: • To design a simulation model that converts rotational frequency (RPM) into linear wind speed. • To implement logic in Arduino (Simulation) to process pulse signals from the proximity sensor.	LO2
8	Simulation of Liquid Level Measurement in a Tank using a Capacitive Probe.	LO2

	Aim: To model and simulate the change in capacitance of a probe as a function of the dielectric medium (liquid level). Objectives: • To analyze how the rising liquid level affects the dielectric constant between probe electrodes. • To simulate a signal conditioning circuit that converts capacitance changes into a measurable voltage.	
9	Design and Simulation of an Orifice Plate for Industrial Flow Applications. Aim: To design an orifice plate and simulate the pressure drop across it to determine fluid flow rates. Objectives: • To apply Bernoulli's principle to calculate flow based on differential pressure. • To optimize the orifice diameter (beta ratio) for a specific application in a virtual environment.	LO2
10	Modeling the Response of Chemical Sensors to Gas Concentrations. Aim: To study the working principles of gas/chemical sensors through computer-aided simulation. Objectives: • To simulate the change in sensor conductivity when exposed to varying concentrations of target chemicals. • To understand the selectivity and sensitivity parameters of common electrochemical sensors.	LO2
11	Simulation of a Piezoresistive Pressure Sensor Aim: To simulate the electrical response of a piezoresistive material under applied mechanical pressure. Objectives: • To model the stress distribution across the sensor diaphragm using simulation tools. • To verify the linearity of the voltage output relative to the input pressure.	LO3
12	Simulation of Micro-displacement in Piezoelectric Actuators.	LO3

	Aim: To study the converse piezoelectric effect and simulate the mechanical stroke of an actuator. Objectives: • To analyze the relationship between applied voltage and mechanical displacement (strain). • To evaluate the actuator's performance under different frequency and load conditions.	
13	Simulation of Electrostatic Actuation in MEMS Micromirror Devices. Aim: To analyze the tilting mechanism and optical switching capabilities of a micromirror. Objectives: • To simulate the pull-in voltage and angular displacement of the mirror. • To evaluate the switching speed and stability of the device for projection applications.	LO4
14	Accurate Measurement of Unknown Resistance using a Wheatstone Bridge. Aim: To apply the null-deflection principle to find the value of an unknown resistor. Objectives: • To understand the balancing condition of a bridge circuit • To determine the sensitivity of the bridge and the impact of component tolerances on accuracy.	LO5
15	Case Study on the Deployment of Sensors in Industrial/Medical Systems. Aim: To analyze the selection, integration, and performance of sensors in a real-world application. Objectives: • To identify the specific sensor requirements (range, resolution, environment) for a chosen case study. • To evaluate the socio-economic and technical benefits of implementing the sensor system.	LO6

Online Resources:

1. Virtual lab: https://sil-coep.vlabs.ac.in/List%20of%20experiments.html
2. NYBSYS: https://nybsys.com/types-of-sensors/

3. NanoHUB: https://nanohub.org/

Term Work:

- The term work should consist of atleast 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) = 20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL5012	Image and Video Processing Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL 5012	Image and Video Processing Lab	--	--	--	25	--	25

Pre-requisite:

1. ECC301-Applied Mathematics III
2. ECC401-Applied Mathematics IV

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 understand the fundamental concepts of digital images and videos, including sampling, quantization, colour models, video standards, and various image/video file formats.
2. To implement and analyze image enhancement techniques in both spatial and frequency domains for improving image quality.
3. To apply image segmentation for extracting meaningful information from images and to understand real-time applications.
4. To understand and apply morphological operations for analyzing, enhancing, and extracting structural information from digital images.
5. To explore image transforms, image compression techniques, and basic motion estimation methods used in video processing.
6. To understand basic video processing concepts, including motion estimation methods used for analyzing and compressing video sequences.

Lab Outcomes:

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

1. Explain digital image/video basics including sampling, quantization, colour models, and file formats.
2. Apply spatial and frequency-domain enhancement techniques to improve image quality.
3. Analyze the impact of various filters and camera techniques on image sharpness and noise.
4. Perform image segmentation and morphological operations for feature extraction.
5. Implement and compare image transforms such as DFT, DCT, DHT, and FFT.
6. Apply lossless/lossy compression and basic motion estimation techniques used in video processing.

Suggested List of Experiments: Student are required to complete at least 10 experiments.		
Sr. No.	**Title of Experiments**	**LO**
1	Title: Sampling and Quantization of Images Aim: To study the effects of sampling and quantization on digital images. Objectives: • Implement spatial sampling and intensity quantization. • Observe degradation in image quality at different sampling rates and quantization levels. • Understand trade-offs between image fidelity and storage requirements.	LO1
2	Title: Conversion Between RGB, HSI, and YUV Color Models Aim: To convert images between different color spaces. Objectives: • Implement algorithms for RGB ↔ HSI and RGB ↔ YUV conversions. • Analyze how color representation changes across models. • Study applications in compression, enhancement, and segmentation.	LO1
3	Title: Image Enhancement Techniques Aim: To implement basic intensity transformations. Objectives: • Apply digital negative, contrast stretching, intensity slicing, and bit-plane slicing. • Implement log and power-law transformations. • Evaluate enhancement results on different image types.	LO2,LO3
4	Title: Spatial Domain Filtering Aim: To study smoothing and sharpening filters. Objectives: • Implement average, median, and Gaussian filters for smoothing. • Apply high-pass and high-boost filters for sharpening. • Compare effects on image sharpness and noise reduction.	LO2,LO5
5	Title: Image Sharpening and Noise Analysis Aim: To apply sharpening filters for enhancing image details and edges and analyze their effect on noise amplification. Objectives:	

	• Implement spatial domain sharpening filters such as Laplacian and high-pass filters. • Enhance edges and fine details in digital images. • Analyze the impact of sharpening on noise amplification. • Compare results using different sharpening techniques.	
6	Title: Frequency Domain Filtering (DFT-based) Aim: To implement frequency domain filtering using DFT. Objectives: • Apply Ideal, Gaussian, and Butterworth filters for smoothing and sharpening. • Compare frequency responses and visual results. • Study trade-offs between sharpness and ringing artifacts.	LO2
7	Title: Histogram Processing Aim: To enhance images using histogram techniques. Objectives: • Implement histogram equalization for contrast improvement. • Perform histogram specification to match target distributions. • Analyze enhancement results quantitatively and visually.	LO3,LO4
8	Title: Edge Detection Aim: To detect edges using gradient and Laplacian operators. Objectives: • Implement Roberts, Prewitt, Sobel, and Laplacian operators. • Compare edge maps for accuracy and noise sensitivity. • Evaluate performance on different image types.	LO4
9	Title: Region-Based Segmentation Aim: To segment images using region growing, splitting, and merging. Objectives: • Implement region growing based on similarity criteria. • Apply region splitting and merging for hierarchical segmentation. • Compare efficiency and accuracy of methods.	LO4
10	Title: Morphological Operations Aim: To perform morphological feature extraction. Objectives: • Implement erosion, dilation, opening, and closing. • Apply Hit-or-Miss transform for shape detection. • Study applications in noise removal and object extraction.	LO5
11	Title: Transform Analysis Aim: To implement and compare different transforms. Objectives: • Implement DFT, FFT, DCT, DHT, and FHT. • Compare energy compaction properties.	LO6

	• Analyze computational complexity and efficiency.	
12	Title: Image Compression Techniques Aim: To study lossless and lossy compression methods. Objectives: • Implement Run Length Coding, Huffman Coding, and Arithmetic Coding for grayscale images. • Apply scalar/vector quantization and DCT-based JPEG-like compression. • Compare compression ratios and reconstruction quality.	LO5,LO6
13	Title: Motion Estimation Aim: To estimate motion in image sequences. Objectives: • Implement optical flow for pixel-based motion estimation. • Apply block matching techniques. • Perform region-based motion estimation. • Compare accuracy and computational cost.	LO6
14	Title: Image Compression using Quantization and DCT Aim: To implement scalar/vector quantization and DCT-based JPEG-like compression. Objectives: • Implement scalar quantization for image data. • Implement vector quantization techniques for image compression. • Apply DCT-based transformation for JPEG-like compression. • Evaluate compression performance in terms of quality and compression ratio.	LO5,LO6
15	Title: Motion Estimation Techniques in Video Processing Aim: To implement optical flow, block matching (pixel-based), and region-based motion estimation. Objectives: • Implement optical flow methods to estimate motion between consecutive frames. • Apply block matching (pixel-based) algorithms for motion estimation. • Implement region-based motion estimation techniques. • Evaluate and compare the performance of different motion estimation methods.	LO5,LO6

Online Resources:

- NPTEL: https://onlinecourses.nptel.ac.in/noc22_ee116/preview
- Coursera: https://www.coursera.org/learn/introduction-image-processing
- NPTEL: https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Term Work:

- The term work should consist of at least 12 experiments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =20 Marks (Experiment) + 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/Oral 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).

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL5013	Data Compression and Encryption Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL5013	Data Compression and Encryption Lab	--	--	--	25	25	50

Pre-requisite:

1. FEL103:C programming Lab
2. ECL304: Skill Lab -Python Programming

Program Outcome Addressed:

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 provide hands-on experience in implementing data compression techniques.
2. To reinforce understanding of cryptographic algorithms through programming practice.
3. To apply number-theory concepts to real cryptographic systems.
4. To develop skills for analyzing and evaluating compression and security methods.
5. To design and implement systems that integrate data compression and encryption techniques for efficient and secure data transmission.
6. To evaluate and compare different algorithms based on performance metrics such as compression ratio, execution time, and security strength.

Lab Outcomes:

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

1. Implement and evaluate lossless and lossy text and image compression techniques using standard

coding methods.
2. Apply audio compression and companding techniques and demonstrate their effect on signal quality and efficiency.
3. Apply symmetric cryptographic techniques for data confidentiality.
4. Implement public key cryptographic algorithms and key exchange protocols.
5. Use number theory algorithms in cryptography.
6. Analyze the performance, efficiency, and security of implemented methods.

Suggested Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Compression Ratio Analysis of Various File Formats. Aim: To determine and compare the compression ratio achieved after compressing different file formats. Objectives: • To calculate the compression ratio by comparing original and compressed file sizes. • To analyze the effectiveness of compression techniques on different file types	LO1
2	Implementation of Huffman Coding for Lossless Data Compression Aim: To implement Huffman coding for lossless data compression. Objectives: • To generate Huffman codes based on symbol frequency distribution. • To evaluate the reduction in data size achieved using Huffman coding.	LO1
3	Implementation of Arithmetic Coding Technique Aim: To implement Arithmetic coding for efficient lossless compression. Objectives: • To encode a sequence of symbols into a fractional value using probability intervals. • To compare the compression efficiency of Arithmetic coding with other coding techniques.	LO1
4	Audio Compression using μ-Law and A-Law Companding Aim: To implement μ-law and A-law companding techniques for audio signal compression. Objectives: • To understand the process of logarithmic compression and expansion of audio signals. • To compare the performance of μ-law and A-law companding methods.	LO2
5	Image Compression using Discrete Cosine Transform (DCT) Aim: To implement Discrete Cosine Transform (DCT) for image compression. Objectives:	LO1

	• To transform image data from spatial domain to frequency domain using DCT. • To analyze the role of DCT coefficients in reducing image size.	
6	Implementation of LZW Compression Algorithm. Aim: To implement the LZW (Lempel-Ziv-Welch) compression algorithm. Objectives: • To encode data using dictionary-based lossless compression. • To study the efficiency of dynamically generated dictionaries in data compression	LO1
7	Implementation of Substitution Cipher for Text and Image Encryption. Aim: To implement substitution cipher for encrypting text and image data. Objectives: • To replace original characters or pixel values with substituted values based on a key. • To study the basic principle of symmetric key encryption.	LO3
8	Implementation of Transposition Cipher for Text and Image Encryption. Aim: To implement transposition cipher for secure data encryption. Objectives: • To rearrange characters or pixel positions according to a predefined key pattern. • To understand the concept of positional encryption in cryptography.	LO3
9	Verification and Implementation of Fermat's Theorem Aim: To implement Fermat's theorem for mathematical and cryptographic applications. Objectives: • To verify Fermat's Little Theorem for given prime numbers. • To understand its significance in modular arithmetic and cryptography.	LO5
10	Implementation of RSA Cryptographic Algorithm Aim: To implement RSA algorithm for public key encryption and decryption. Objectives: • To generate public and private keys using prime numbers. • To perform secure encryption and decryption of messages using RSA	LO4
11	Diffie-Hellman Key Exchange Mechanism. Aim: To implement Diffie-Hellman key exchange for secure key sharing. Objectives: • To generate a shared secret key between two communicating parties. • To understand the concept of secure key exchange over an insecure channel	LO4
12	Implementation of SHA-1 / SHA-256 Hash Function. Aim: To implement SHA-1 / SHA-256 for secure hashing of data. Objectives: • To generate a fixed-length hash value for the given input data. • To study the role of cryptographic hash functions in data integrity and	LO6

	security.	
13	Implementation of Differential Pulse Code Modulation (DPCM) Aim: To implement DPCM for efficient signal compression. Objectives: • To encode signals using predictive coding techniques. • To analyze the reduction in redundancy using DPCM.	LO2
14	Basic Video Compression using Frame Differencing / Motion Estimation Aim: To implement basic video compression using temporal redundancy reduction. Objectives: • To perform frame differencing for motion detection. • To analyze compression efficiency using temporal prediction.	LO2
15	Implementation of AES / DES Encryption Algorithm Aim: To implement AES or DES algorithm for secure data encryption. Objectives: • To perform encryption and decryption using symmetric key algorithms. • To analyze the security strength and performance of AES/DES.	LO3

Online Resources:

- NPTEL: https://nptel.ac.in/courses/106105162
- NPTEL: https://nptel.ac.in/courses/106105031

Term Work:

- Term work should consist of at least 10 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 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 / Oral 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).

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
ECPEL5014	Information Theory and Coding Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL5014	Information Theory and Coding Lab	--	--	--	25	25	50

Pre-requisite:

1. ECL304: Skill Lab -(Python Programming
2. ECC301: Applied Mathematics III
3. ECC401: Applied Mathematics IV

Program Outcomes addressed:

4. PO1: Engineering knowledge
5. PO2: Problem analysis
6. PO5: Modern tool usage
7. PO7: Ethics
8. PO8: Individual and teamwork.
9. PO9: Communication
10. PSO1: To acquire knowledge in cutting- edge technologies.

Lab Objectives:

1. To understand and apply fundamental Probability Theory concepts such as random variables, probability distributions, expectation, and conditional probability for analysing communication system performance.
2. To study Information Theory principles including entropy, mutual information, and channel capacity, and implement Source Coding techniques such as Shannon–Fano and Huffman coding.
3. To implement and verify Error Detection Codes like parity check, checksums, and CRC, and evaluate their error-detection capability using simulated data.
4. To design, generate, and decode Linear Block Codes, Cyclic Codes, and Convolutional Codes, and analyze parameters such as code rate, minimum distance, error-correcting capability, and syndrome decoding.
5. To simulate communication channels under noisy conditions (BSC/AWGN) and evaluate system performance using metrics such as Bit Error Rate (BER) and Signal-to-Noise Ratio (SNR), with and without forward error correction techniques.
6. To implement and analyze advanced source coding techniques such as LZW and assess their

efficiency in terms of compression ratio and computational performance.

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

1. Apply principles of information theory to model and analyze communication channels.
2. Evaluate entropy, mutual information, and channel capacity for communication system analysis.
3. Compute and interpret information-theoretic measures and source-coding algorithms.
4. Develop and test error detection techniques.
5. Perform encoding and decoding of various coding schemes.
6. Simulate and evaluate communication system performance under noise.

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Title: Entropy & Mutual Information for a Noise-Free Channel Aim: To compute entropy and mutual information for a noise-free communication channel. Objectives: - Implement entropy calculation for source symbols. - Determine mutual information when channels introduce no errors. Validate theoretical results with program outputs.	LO1,LO2
2	Title: Entropy & Mutual Information for a Binary Symmetric Channel (BSC) Aim: To evaluate entropy and mutual information for a BSC. Objectives: - Implement entropy calculation for binary input. - Compute mutual information considering crossover probability. - Analyze effect of error probability on channel efficiency.	LO1,LO2
3	Title: Channel Capacity using Shannon–Hartley Theorem Aim: To compute channel capacity using Shannon–Hartley theorem. Objectives: - Evaluate capacity for varying bandwidth and SNR. - Study trade-offs between bandwidth and noise power.	LO1,LO2
4	Title: Shannon–Fano Coding & Decoding Aim: To generate and evaluate Shannon–Fano codes. Objectives: - Implement Shannon–Fano coding algorithm. - Perform encoding and decoding of source symbols. - Compare efficiency with theoretical entropy.	LO3
5	Title: Huffman Coding & Decoding Aim: To generate and evaluate Huffman codes. Objectives: - Construct Huffman tree based on symbol probabilities.	LO3,LO5

	- Implement encoding and decoding procedures. Compare compression efficiency with Shannon–Fano coding.	
6	Title: LZW Coding & Decoding Aim: To implement LZW compression and decompression. Objectives: - Generate dictionary-based codes for input data. - Implement decoding using dynamic dictionary reconstruction. Evaluate compression ratio and efficiency.	LO3,LO5
7	Title: Error Detection using Parity, Checksum, and CRC Aim: To implement error detection techniques. Objectives: - Apply parity bit method for single-bit error detection. - Implement checksum for block error detection. - Apply CRC for burst error detection. Compare detection capabilities of each method.	LO4
8	Title: Forward Error Correction using Linear Block Codes Aim: To implement FEC using linear block codes. Objectives: - Encode data using generator matrix. - Decode using syndrome calculation. Demonstrate error correction capability.	LO5
9	Title: Coding & Decoding of Linear Block Codes Aim: To implement linear block coding and decoding. Objectives: - Construct generator and parity-check matrices. - Encode source data into codewords. Decode received data and correct errors.	LO5
10	Title: Coding & Decoding of Cyclic Codes Aim: To implement cyclic codes for error detection and correction. Objectives: - Generate cyclic redundancy codes using polynomials. - Implement encoding and decoding algorithms. Demonstrate cyclic property in error correction.	LO5
11	Title: Coding & Decoding of Convolutional Codes Aim: To implement convolutional coding and decoding. Objectives: - Encode data using shift registers and generator polynomials. - Decode using Viterbi algorithm. Evaluate performance in noisy channels.	LO5
12	Title: BER vs SNR Simulation for BSC/AWGN with and without FEC Aim: To simulate Bit Error Rate (BER) vs Signal-to-Noise Ratio (SNR). Objectives: - Implement BER calculation for BSC and AWGN channels. - Compare BER performance with and without FEC.	LO6

	- Plot BER vs SNR curves to analyze coding gain.	
13	Title: Syndrome Decoding for Linear Block Codes Aim: To implement and analyze syndrome decoding. Objectives: - Compute syndrome using parity-check matrix. - Identify and correct errors using syndrome table. - Verify error correction capability under simulated conditions.	LO5
14	Title: Performance Analysis of Error Control Codes over Noisy Channels Aim: To analyze performance of different coding schemes in noisy environments. Objectives: - Simulate linear block, cyclic, and convolutional codes over BSC/AWGN channels. - Compare BER performance for different coding techniques. - Evaluate trade-offs between error performance and computational complexity.	LO5,LO6
15	Title: Channel Capacity of Binary Symmetric Channel (BSC) under Varying Noise Conditions Aim: To simulate and analyze the channel capacity of a BSC for different crossover probabilities. Objectives: - Implement BSC model with varying error (crossover) probability. - Compute channel capacity using theoretical and simulated methods. - Analyze the relationship between noise level and channel capacity.	LO1,LO6

Online References:

1. NPTEL: https://nptel.ac.in/courses/108102117
2. NPTEL: https://nptel.ac.in/courses/117108097

Term Work:
The term work should include 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

25 Marks (Total Marks) =20 Marks (Experiment) + 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/Oral 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).

Course Code	Course Name	Credits Assigned			
		Theory	Practical	Tutorial	Total
ECM501	Mini Project 2	--	1	--	1

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECM501	Mini Project 2	--	--	--	25	25	50

Program Outcomes addressed:

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 and The World.
7. PO7: Ethics.
8. PO8: Individual and Collaborative Team work.
9. PO9: Communication.
10. PO10: Project Management and Finance.
11. PO11: Life-Long Learning.

Objectives:

1. To identify user or societal needs and formulate clear problem statements.
2. To work collaboratively for effective problem-solving.
3. To apply engineering fundamentals to develop feasible solutions.
4. To promote self-learning and research-oriented thinking.

Outcomes: Upon completion of this course, learners will be able to:

1. Identify and define real-world or research problems through requirement gathering and stakeholder interaction.
2. Develop project objectives, scope, and feasibility using software engineering and SDLC principles.
3. Analyze requirements and develop system designs using standard modelling techniques.
4. Implement solutions using appropriate technologies, engineering practices, and version control.
5. Test and validate the system through structured test cases, datasets, and simulations.
6. Compose technical documentation, present project outcomes, and demonstrate teamwork, ethics, and self-learning.

1 Guidelines for Mini Project

1.1 General Guidelines

a) Students shall form groups of 3 to 4 members; groups with fewer than three or more than four students are not permitted.
b) Students should conduct surveys to identify needs and develop problem statements in consultation with faculty.
c) Each group shall submit an **implementation plan** using a Gantt Chart, PERT, or CPM chart, covering weekly activities and milestones.
d) Every group must maintain a **logbook** to record weekly progress, tasks completed, challenges faced, and supervisor's comments and signatures.
e) Faculty supervisors may provide necessary guidance; however, emphasis shall be on **self-learning, independent thinking, and initiative.**
f) Students should understand the problem thoroughly, **propose multiple solution approaches**, and select the most appropriate solution in consultation with the supervisor.
g) Students shall develop the selected solution into a working model using domain-specific tools, technologies, or components and demonstrate the same.
h) The solution must be validated using proper justification through test cases, benchmark data, experimentation, or simulations, and the final report must be compiled as per the guidelines for the project report.
i) Students must follow **ethical practices,** maintain academic integrity, avoid plagiarism, and appropriately acknowledge all references and sources used.
j) Students are encouraged to use **standard engineering tools** such as version control systems (e.g., Git), project management tools, and proper documentation tools during project execution.
k) Evaluation will consider problem identification, planning, implementation quality, testing and validation, documentation, presentation, teamwork, and overall contribution.
l) Students should be encouraged to explore opportunities for **innovation, entrepreneurship,** and potential **intellectual property** creation such as patent, copyright, or research publication.
m) Students must follow **lab safety norms** and responsibly use equipment, hardware, and computational resources during the execution of the project.

1.2 Guidelines for the Project Report:

a) Report should not exceed 30 pages. Simply staple it to discourage use of plastic.
b) Report must contain Gantt chart, architectural diagram, Data Flow Diagrams, applicable UML diagrams, screenshot of outputs (Include only required information pages).
c) The recommended report writing format is in LaTeX.

2 Guidelines for Assessment of Mini Project:

2.1 Evaluation of Term Work (CIAP):

A. A Review/Progress Monitoring Committee shall be constituted by the Head of Department. Mini Project progress shall be evaluated continuously, with a minimum of two reviews in the semester.

B. Continuous assessment should also emphasize individual performance, including each student's contribution, understanding of the project, and responses during review interactions.

C. The Review/Progress Monitoring Committee may consider the following points:
   a) students' group shall complete project in all aspects including,
      i. Identification of need/problem
      ii. Proposed final solution
      iii. Procurement of components/systems
      iv. Building prototype and testing
   b) Two reviews will be conducted for continuous assessment,
      i. **First Review:** Finalization of problem and proposed solution
      ii. **Second Review:** Implementation and testing of the solution

D. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

1.2 Distribution of Marks

The distribution of Term Work marks shall be as follows:

a) Marks by Guide/Supervisor based on Logbook: 10
b) Marks by Review Committee: 10
c) Quality of Project Report: 05

1.3 Evaluation Rubrics CIAP (Term work)

Mini Project shall be assessed based on the following criteria;

a) Quality of Survey and Need Identification
b) Clarity and Completeness of Problem Definition
c) Innovativeness and Creativity in Proposed Solutions
d) Feasibility of Solution and Justification of Selected Approach
e) Cost Effectiveness and Societal/Environmental Impact
f) Quality of System Design and Use of Engineering Norms
g) Implementation Quality and Functioning of Prototype as per Requirements
h) Effective Use of Technical Skill Sets and Tools
i) Teamwork, Leadership, and Individual Contribution
j) Clarity in Documentation, Presentation, and Communication

All criteria in generic may be considered for evaluation of performance of students in mini project.

2.4 ESEP (Practical / Oral) Examination:

a) The report should be prepared as per the guidelines issued by the University of Mumbai.
b) Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by the head of Institution.
c) Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
d) End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

2.5 Evaluation Rubrics ESEP (Practical / Oral)

Mini Project shall be assessed based on the following rubrics:

a) Quality of problem identification & clarity
b) Innovation & creativity in solution
c) Feasibility, cost effectiveness & societal impact
d) Functionality and correctness of the working model
e) Effective use of engineering tools and skill sets
f) Adherence to engineering standards and norms
g) Individual contribution and teamwork

Written and oral communication skills

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
ECC601	Software Engineering and Web Technology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC601	Software Engineering and Web Technology	20	20	60	--	--	100

Course Pre-requisite:

1. ECC 303: Database Management Systems
2. ECC 502: Computer Networks

Program Outcomes Addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO7: Ethics
5. PO11: Lifelong learning

Course Objectives:

1. To introduce fundamental concepts of software engineering and software development processes.
2. To develop the ability to design and model software systems using appropriate principles and architecture.
3. To enable students to apply testing strategies and maintenance practices for reliable software systems.
4. To provide knowledge of web technologies and front-end development for building interactive applications.
5. To impart skills in back-end development and database connectivity for dynamic web applications.
6. To impart hands-on experience in building secure and scalable server-side applications by integrating Java- based web technologies with database and session management techniques.

Course Outcomes:

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

1. Apply software engineering and Agile practices for effective requirement gathering, analysis, and quality software development.
2. Apply design principles and patterns to create scalable systems and document them using UML and use case models.

3. Design and execute software testing strategies using standard tools to ensure product quality.
4. Develop responsive web applications using HTML5, CSS3, Bootstrap, and web protocols.
5. Build dynamic front-end applications using JavaScript, DOM, JSON, event handling, and validation.
6. Develop server-side applications using Servlets, JSP, JDBC, with session and database management

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Software Engineering & Software Development**	**06**	**CO1**
	1.1	Nature of Software, Software process framework Models: Waterfall Model, Incremental, Prototyping and Spiral Model		
	1.2	Agile process, Agility Principles, Extreme Programming (XP), Scrum, Requirements gathering and analysis, Software Requirement Specification (SRS)		
		Self-learning Topics: SDLC, Agile methodologies, Software process improvement		
2.0		**Software Design & Architecture**	**07**	**CO2**
	2.1	Design Concepts, Design Principles, Architecture Design, Component Level Design, System Level Design, User Interface Design, Project management tools (Jira, You track)		
	2.2	Modeling & Documentation :UML diagrams (class, sequence, activity), Use case modeling Architectural Patterns : Layered architecture (MVC, MVVM), Microservices and service-oriented architecture		
		Self-learning Topics: SOLID principles, UML modelling tools		
3.0		**Testing & Maintenance**	**06**	**CO3**
	3.1	Software Testing Basics: Unit testing, integration testing, system testing, Test-driven development (TDD) Testing Tools: JUnit, NUnit, Selenium, Mocking frameworks Debugging & Code Reviews: Common debugging techniques, Peer review best practices Continuous Integration/Continuous Deployment (CI/CD): Jenkins, GitHub Actions, Automated builds and deployments.		
	3.2	Software Maintenance: Corrective, adaptive, perfective maintenance, Refactoring and technical debt		

		management		
		Self-learning Topics: Test automation, frameworks, Containerization		
4.0		**Introduction to Web Technology**	**06**	**CO4**
	4.1	Web Essentials: Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers HTML5 – fundamental syntax and semantics, Tables, Lists, Image, HTML5 control elements, Semantic elements, Drag and Drop, Audio – Video controls CSS3 – Inline, embedded and external style sheets – Rule cascading, Inheritance, Backgrounds, Border Images, Colors, Shadows, Text, Transformations, Transitions, Animation, Basics of Bootstrap.		
		Self-Learning Topics: ES6 Features (let/const, arrow functions), Using Fetch API for HTTP Requests		
5.0		**Front-End Development**	**07**	**CO5**
	5.1	Java Script: An introduction to JavaScript–JavaScript DOM Model, Date and Objects-Regular Expressions-Exception Handling, Validation-Built-in objects-Event Handling, DHTML with JavaScript, JSON introduction – Syntax – Function Files – Http Request –SQL		
		Self-Learning Topics: ES6 Features (let/const, arrow functions), React, Flutter		
6.0		**Back-End Development & Database Connectivity**	**07**	**CO6**
	6.1	Servlets: Java Servlet Architecture, Servlet Life Cycle, Form GET and POST actions, Session Handling, Understanding Cookies, Installing and Configuring Apache Tomcat Web Server		
	6.2	Database Connectivity: JDBC perspectives, JDBC program example JSP: Understanding Java Server Pages, JSP Standard Tag Library (JSTL), Creating HTML forms by embedding JSP code.		
		Self-Learning Topics: MVC Architecture Basics, SQL Injection Prevention		
		Total	**39**	

Textbooks:

1. Roger S. Pressman & Bruce R. Maxim – Software Engineering: A Practitioner's Approach, 8th Edition, McGraw Hill, 2014.
2. Ian Sommerville – Software Engineering,10th Edition, Pearson, 2015.
3. Paul Deitel & Harvey Deitel – Internet & World Wide Web: How to Program,5th Edition,
4. 2012, Pearson
5. Herbert Schildt – Java: The Complete Reference,11th Edition, McGraw Hill, 2018.

Reference books:

1. Robert C. Martin, A Handbook of Agile Software Craftsmanship, Edition: 1st edition PHI, 2009.
2. Efrem G. Mallach, Developing Web Sites with HTML, CSS and JavaScript,2025.
3. Saroj Pandey, Sunil Sharma Web Technology – HTML, CSS, JavaScript: Complete Reference, 2024.

Online References:

- NPTEL : Software Engineering (IIT Kharagpur) Complete video lectures + note https://nptel.ac.in/courses/106105182
- IEEE SWEBOK – Software Engineering Body of Knowledge: https://www.computer.org/education/bodies-of-knowledge/software-engineering
- MDN Web Docs: HTML, CSS, JavaScript https://developer.mozilla.org/
- Free Code Camp: Projects & Interactive Coding https://www.freecodecamp.org/
- Oracle Java Documentation (Official): https://docs.oracle.com/javase/

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 Marks.
- ISE 20 Marks=15 marks for activities+ 5 marks for attendance.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination

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

1. 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC602	Basics of VLSI Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
ECC602	Basics of VLSI Design	20	20	60	--	--	100

Course pre-requisite:

1. FEC204: Digital System Design
2. ECC303: Electronic Devices and Circuits

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 VLSI Design flow and technology trends.
2. To characterize MOSFET behaviour by simulating and plotting the V-I characteristics
3. To realize MOS based circuits using different design styles.
4. To design and implement complex Boolean functions and sequential circuits.
5. To study and analyze different memory circuits.
6. To understand and design high-performance arithmetic units.

Course Outcomes:

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

1. Explain VLSI design methodologies and semiconductor fabrication processes.
2. Analyze the static and dynamic behavior of NMOS and CMOS inverters.
3. Design CMOS logic gates using various design styles.
4. Realize combinational and sequential logic functions.
5. Demonstrate understanding of memory architectures and their working principles.
6. Design and evaluate high-speed arithmetic circuits.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**VLSI Design flow and Technology Trends**	**05**	**CO1**
	1.1	VLSI Design Flow: Full custom and Semicustom IC design flow.		
	1.2	Semiconductor Manufacturing: Semiconductor technology trend, clean rooms, Fabrication flowchart for steps in IC fabrication.		
	1.3	Scaling: Types of scaling, comparison of MOSFET Model levels.		
	1.4	Technology Comparison: Comparison of BJT and MOS technologies, long channel and short channel MOS devices.		
		Self-learning Topics: Novel MOSFET Architectures FinFET, GAA-FET, CNTFET		
2.0		**MOSFET Inverters**	**08**	**CO2**
	2.1	Introduction to MOS inverters: Active and passive load nMOS inverters, CMOS inverter and their comparison.		
	2.2	Circuit Analysis of MOS Inverters Static Analysis of Resistive nMOS and CMOS Inverters: Calculation of critical voltages and noise margins.		
	2.3	Design of symmetric CMOS inverter.		
	2.4	Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay.		
		Self-learning Topics: Various components of power dissipation in CMOS circuits		
3.0		**MOS Circuit Design Styles**	**07**	**CO3**
	3.1	Static CMOS.		
	3.2	Pseudo NMOS design styles		
	3.3	Pass transistor, Transmission gate.		
	3.4	Dynamic: C^2MOS.		
	3.5	Layout of CMOS Inverter, CMOS NAND, CMOS NOR.		
		Self-learning Topics: NORA, Zipper design styles		
4.0		**Combinational and Sequential Circuit Realization**	**07**	**CO4**
	4.1	Analysis and design of 2-I/P NAND, 2-I/P NOR and complex Boolean function realization using equivalent CMOS inverter for simultaneous switching, Complex Boolean function realization using various design styles and Basic gates and MUX realization using pass transistor and transmission gate logic.		

	4.2	SR Latch, JK FF, D FF using CMOS logic.		
		Self-learning Topics: 1 Bit Shift Register realization using CMOS logic.		
5.0		**Semiconductor Memories**	**06**	**CO5**
	5.1	SRAM: 6T SRAM operation, design strategy, read/write circuits, sense amplifier.		
	5.2	DRAM: 1T DRAM, operation modes, leakage currents, refresh operation, physical design.		
	5.3	ROM Array: NAND and NOR based ROM array.		
		Self-learning Topics: Flash memory: F-N tunnelling, FSM.		
6.0		**Data Path Design**	**06**	**CO6**
	6.1	Adder: CLA adder, MODL, Manchester carry chain, High-speed adders: carry skip, carry select and carry save.		
	6.2	Multipliers and shifter: Array multiplier and barrel shifter.		
		Self-learning Topics: On chip clock generation and distribution, Interconnect delay model, interconnect scaling and crosstalk.		
		Total	**39**	

Textbooks:

1. S. M. Kang and Y. Leblebici, “CMOS Digital Integrated Circuits Analysis and Design”, Revised 4th edition. New Delhi, India: McGraw Hill Education, 2019.
2. J. P. Uyemura, “Introduction to VLSI Circuits and Systems”, New Delhi, India: Wiley India, 2006.
3. S. K. Gandhi, “VLSI Fabrication Principles: Silicon and Gallium Arsenide”, 2nd edition. New Delhi, India: Wiley India, 1994.

Reference books:

1. J. M. Rabaey, A. Chandrakasan, and B. Nikolic, “Digital Integrated Circuits: A Design Perspective”, 2nd edition. Noida, India: Pearson Education, 2023.
2. D. A. Pucknell and K. Eshraghian, “Basic VLSI Design”, 3rd edition. New Delhi, India: PHI Learning, 2017.
3. I. Sutherland, B. Sproull, and D. Harris, “Logical Effort: Designing Fast CMOS Circuits”, San Francisco, CA, USA: Morgan Kaufmann, 1999.
4. N. H. E. Weste, D. Harris, and A. Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th edition. Chennai, India: Pearson Education, 2022.
5. A. K. Sharma, “Advanced Semiconductor Memories: Architectures, Designs, and Applications”, New Delhi, India: Wiley India, 2014.

Online Resources:
NPTEL: https://onlinecourses.nptel.ac.in/noc26_ee85/preview
NPTEL: https://nptel.ac.in/courses/117106092

Course Assessment:
ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination
$ ESE of duration 03 hours is 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC603	Cryptography and Network Security	02	--	--	02	--	--	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECC603	Cryptography and Network Security	15	15	45	--	--	75

Pre-requisite:

1. ECC502: Computer Network

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
7. PO8: Ethics

Course Objectives

1. To understand fundamental principles and algorithms of cryptography.
2. To analyze various network attacks, threats, and their countermeasures.
3. To implement and evaluate encryption, hashing, and digital signature mechanisms.
4. To explore secure communication protocols for confidentiality and integrity.
5. To study authentication, access control, and system-level protection techniques.
6. To evaluate risk management, policies, and emerging trends in cybersecurity.

Course Outcomes

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

1. Explain and apply classical and modern cryptographic techniques.
2. Implement and evaluate public key cryptography, digital signatures, and key management mechanisms.
3. Design secure network communication protocols.
4. Implement authentication and access control mechanisms.
5. Evaluate risk management strategies and design security policies.
6. Investigate and propose secure solutions using emerging technologies.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Cryptographic Foundations**	**05**	**CO1**
	1.1	Classical Encryption Techniques Substitution techniques-mono alphabetic, Poly alphabetic, Transposition.		
	1.2	Symmetric Key Cryptography – Stream and Block Ciphers.		
	1.3	Feistel Structures, DES, double and triple des, and AES Algorithms, Modes of Operation (ECB, CBC, CFB, OFB, CTR).		
		Self-Learning Topics: RC5, Blowfish, Cryptanalysis Basics.		
2.0		**Public Key Cryptography and Key Management**	**05**	**CO2**
	2.1	Principles of Public Key Cryptography.		
	2.2	RSA, Diffie–Hellman Key Exchange.		
	2.3	Digital Signatures, Certificates, and PKI.		
	2.4	Hash Functions (SHA-1 elaborative, other SHA Family comparative) and Message Authentication Codes (HMAC).		
		Self-Learning Topics: Elliptic Curve Cryptography, Quantum-Resistant Cryptography, Blockchain Hashing.		
3.0		**Network Security Protocols**	**04**	**CO3**
	3.1	Secure Sockets Layer (SSL/TLS): Architecture, Handshake, and Alerts.		
	3.2	IPSec: AH and ESP, Transport and Tunnel Modes.		
	3.3	VPNs, Email Security (PGP, S/MIME).		
		Self-Learning Topics: QUIC Protocol, HTTPS 2.0, Zero Trust Communication.		
4.0		**Malicious Software**	**04**	**CO4**
	4.1	SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents		
	4.2	Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie		
		Self-Learning Topics: Study the recent malicious software's and their effects.		
5.0		**IP Security, Transport level security**	**03**	**CO5**
	5.1	IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP),		
	5.2	Web Security considerations, HTTPS, Secure Shell (SSH) Protocol Stack.		
		Self-Learning Topics: VPN using IPSec, Digital Certificates		
6.0		**Network Management Security and Network Access Control**	**05**	**CO6**
	6.1	Network Management Security: SNMPv3, NAC: Principle elements of NAC, Principle NAC enforcement methods,		

		How to implement NAC Solutions, Use cases for network access control		
		Self-Learning Topics: Explore any open source network management security tool		
		Total	**26**	

Textbooks

1. W. Stallings, Cryptography and Network Security: Principles and Practice, 8th edition. Upper Saddle River, NJ, USA: Pearson, 2020
2. B. A. Forouzan, Cryptography and Network Security, 3rd edition. New York, NY, USA: McGraw-Hill, 2015.
3. A. Kahate, Cryptography and Network Security, 4th edition. New Delhi, India: McGraw-Hill Education, 2019.
4. B. Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, 20th Anniversary edition. Indianapolis, IN, USA: Wiley, 2015.

Reference Books

1. C. Kaufman, R. Perlman, and M. Speciner, Network Security: Private Communication in a Public World, 3rd edition. Boston, MA, USA: Pearson, 2022.
2. C. Kaufman, R. Perlman, and M. Speciner, Network Security: Private Communication in a Public World, 2nd edition. Upper Saddle River, NJ, USA: Pearson Education, 2002.
3. D. P. Nagpal, Information Security, New Delhi, India: S. Chand Publishing, 2014.

Online References

- NPTEL: https://nptel.ac.in/courses/106105162
- NPTEL: https://nptel.ac.in/courses/106105031
- Coursera: https://www.coursera.org/learn/crypto

Course Assessment:
ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks.
- ISE 15 marks = 05 marks for attendance + 10 marks for activities.

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

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
MDMC 6023	Decision Making and Business Intelligence	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC6023	Decision Making and Business Intelligence	20	20	60	--	--	100

Pre-requisite:

1. ECC303: Database Management Systems
2. MDMC5022: Data Analytics and Visualization

Program Outcome:

1. Engineering knowledge
2. Problem analysis
3. Design and Development of the solution
4. Complex problem
5. Engineering Tool usage

Course Objectives:

1. Understand the fundamentals of decision-making processes.
2. Analyze different types of decisions and decision environments.
3. Explain the architecture and components of Decision Support Systems (DSS).
4. Understand the principles, lifecycle, and architecture of Business Intelligence (BI).
5. Apply concepts of data preparation, integration, and quality management.
6. Explore BI reporting, dashboards, visualization, and emerging BI trends.

Course Outcomes:

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

1. Identify and classify decision types and environments.
2. Apply decision-making techniques such as what-if, sensitivity, and goal-seek analysis.
3. Explain BI architecture, lifecycle, and workflow.
4. Perform data preparation activities.
5. Design basic BI reports, dashboards, KPIs, and visualizations.
6. Evaluate modern BI trends, cloud BI tools, governance principles, and BI applications.

Module No.	Unit No.	Topics	Hrs.	CO
1		**Foundations of Decision Making**	**07**	**CO1**
	1.1	Introduction to Decision Making, Types of Decisions: Structured, Semi-structured, Unstructured, Decision-making environments (Certainty, Risk, Uncertainty), Rational & Bounded Rationality Models, Heuristics, Biases & Cognitive Limitations, Role of Information in Organizational Decision Making, Decision Support in Enterprises.		
		Self-Learning: Case studies of good vs. poor decisions, Decision frameworks used in industry		
2		**Decision Support Systems (DSS)**	**06**	**CO2**
	2.1	DSS Concept, Need & Applications, DSS Architecture (database, model base, UI), Types: Data-driven, Model-driven, Knowledge-driven DSS, What-if, Goal-seek, Sensitivity Analysis, Group Decision Support Systems (GDSS), Executive Information Systems (EIS)		
		Self-Learning: GDSS in corporate problem solving, DSS tools used in supply chain & healthcare		
3		**Introduction to Business Intelligence**	**06**	**CO3**
	3.1	What is BI, Evolution & Scope, BI in Strategic, Tactical & Operational Decisions, BI Lifecycle, BI Architecture, BI Workflow: Data → Insights → Action, Role of BI Analysts.		
		Self-Learning: Case studies of BI adoption		
4		**Data Preparation & Integration for BI**	**08**	**CO4**
	4.1	Importance of Data for BI, Data Sources: Enterprise systems, logs, files, cloud sources, ETL Concepts (high level): Extraction techniques, Data Cleaning & Transformation, Loading into BI-ready storage, Data Quality Dimensions (accuracy, completeness, consistency, timeliness), Data Profiling, Metadata Basics (technical vs. business metadata), Master Data & Reference Data Concepts.		
		Self-Learning: ETL tools overview (Talend, SSIS, Informatica)		
5		**BI Reporting, Dashboards & Visualization**	**07**	**CO5**
	5.1	Principles of Data Visualization, BI Reporting Types: Operational, Tactical, Strategic, KPIs, Metrics & Scorecards, Dashboard Design Principles, Real-time & Self-service Reporting Concepts, BI Reporting Tools		

		Overview.		
		Self-Learning: Best practices in dashboard layouts, Industry examples of KPI dashboards		
6		**BI Applications & Emerging Trends**	**05**	**CO6**
	6.1	Cloud BI(overview), BI Service, BI in Domains: Finance, Healthcare, Retail, Manufacturing, Data Governance & Data Stewardship, BI Ethics, Privacy, Responsible Data Use, Performance Management & Balanced Scorecard.		
		Self-Learning: Big data basic concepts, Digital transformation using BI		
		Total	**39**	

Textbooks:

1. E. Turban, R. Sharda, and D. Delen, Decision Support and Business Intelligence Systems, 10th ed. Pearson, 2014.
2. J. R. Evans, Business Analytics: Methods, Models, and Decisions, 2nd ed. Pearson, 2016.
3. N. Godbole, Business Intelligence, 1st ed. New Delhi, India: Wiley India, 2013.
4. L. T. Moss and S. Atre, Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications, 1st ed. Boston, MA, USA: Addison-Wesley, 2003.

Reference books:

1. T. H. Davenport and J. Harris, Competing on Analytics: The New Science of Winning, 1st ed. Harvard Business Review Press, 2007.
2. C. Vercellis, Business Intelligence: Data Mining and Optimization for Decision Making, 1st ed. Wiley, 2009. (BI sections only)
3. W. L. Winston, Microsoft Excel Data Analysis and Business Modeling, 4th ed. Microsoft Press, 2014.
4. P. Ponniah, Data Preparation for Analytics Using SAS, 1st ed. Wiley, 2017.

Online References:

- Microsoft Power BI Learning Path: https://learn.microsoft.com/power-bi/
- Tableau Official Learning Portal: https://www.tableau.com/learn
- AWS Cloud BI (QuickSight) Documentation: https://docs.aws.amazon.com/quicksight/

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 3 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of **6** questions, each carrying **20** 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.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC 6053	System Programming and compiler Construction	03	--	--	03	--	--	03

Corse Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
MDMC6053	System Programming and compiler Construction	20	20	60	--	--	100

Pre-requisite:

1. ECL402: Skill Lab-Linux
2. ECC305: Computer Organization and Architecture

Program Outcome mapped:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of solutions
4. PO7: Ethics
5. PO11: Life-Long Learning

Course Objectives:

1.To introduce role and functionality of various system programs over application programs
2.To explore basic concepts, structure and design of assemblers, macro processors, linkers and loaders
3.To explore the need to follow the syntax in writing an application program
4.To investigate the analysis phase of compiler designed to understand the programmer 's requirements without ambiguity
5.To synthesize the outcomes of analysis phase to produce the object code that is efficient in terms of space and execution time, by applying code optimization techniques.
6. To understand the working of parallel compilers

Course Outcomes:

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

1. Identify the relevance of different system programs and understand various data structures used for design of assembler.

2. Discuss microprocessor design and distinguish between different loaders and linkers and their contribution in developing efficient user applications
3. Analyse lexical analysis and Syntax and semantic analysis phases of compiler.
4. Generate Intermediate code as part of synthesis phase.
5. Illustrate Code optimizations, code generation and error detection.
6. Apply parallelization in compiler in sorting arrays.

Module No.	Unit No.	Topics	Hrs.	Mapped to CO
1		**Introduction to System Programming and Assembler design**	**07**	
	1.1	Concept of System Software, Goals of system software, system program and system programming,		**CO1**
	1.2	Introduction to various system programs		
	1.3	Elements of Assembly Language programming, Assembly scheme, pass structure of assembler,		
	1.4	Assembler Design: Two pass assembler X86 processor, data structures used		
		Self-Learning Topics: X86 Addressing Modes & Instruction Format, Relocation and Linking Concepts		
2		**Macros, Linker and Loader**	**06**	
	2.1	Introduction, Macro definition and call, Design of Two pass macro processor, data structures used		**CO2**
	2.2	Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes		
	2.3	Direct Linking Loader, Dynamic linking and loading		
		Self-Learning Topics: Advanced Macro Expansion Techniques, Loader implementation issues		
3		**Introduction to Compilers and Analysis Phase:**	**11**	
	3.1	Overview of compilers, difference between compilers and interpreters, structure of a compiler		**CO3**
	3.2	Role of lexical analyzer, Input buffering, specification and recognition of tokens		
	3.3	Context-free grammars, Parsing techniques : Top Down and Bottom-Up approach, Recursive Descent Parser , Predictive Parser, LL(1) Parser		
	3.4	LR Parsers - SLR Parser - Canonical LR Parser - LALR Parser. Operator Precedence Parser		
	3.5	Syntax-directed definitions, evaluation orders, and type checking		
		Self-Learning Topics: Ambiguity in grammars and ambiguity removal , Operator precedence table construction		

4		**Intermediate Code Generation:**	**05**	
	4.1	Intermediate Code, Intermediate code generation methods		**CO4**
	4.2	Three Address Code representation		
	4.3	**Self-Learning Topics:** Attribute Grammars (Synthesized & Inherited Attributes), 3AC generation for loops and conditionals		
5		**Code optimization and generation**	**06**	
	5.1	Code Optimization: Sources of optimization, Loop Optimization: Unrolling, Fusion, Invariant Code Motion, optimization of basic blocks, loops, dataflow analysis,Directed Acyclic Graph		**CO5**
	5.2	Design of a code generator, run-time storage management, target machine architecture.		
	5.3	Error Detection and Recovery: Lexical, syntactic, and semantic errors; error recovery strategies.		
		Self-Learning Topics: RISC vs CISC and impact on code generation		
6		**Parallel Compiler**	**04**	
	6.1	Parallel compilation, parallel parsing, semantic analysis, and optimization techniques		**CO6**
	6.2	Parallel Code Generation: Code generation for parallel architectures, synchronization, instruction scheduling.		
		Self-Learning Topics: Loop parallelization techniques, Dependence analysis for parallel compilation		
		Total	**39**	

Textbooks:

1. D. M Dhamdhere: Systems programming and Operating Systems, Tata McGraw Hill, 1999.

2. A. V. Aho, R. Shethi, Monica Lam, J.D. Ulman: Compilers Principles, Techniques and Tools, Pearson Education, Second Edition ,ISBN 978-81317-2101-8, 2008.

3. Modern Compiler Design, by Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs, Koen Langendoen, 2nd ed,, ISBN 978 1461 446989, Springer, 2012.

4. Allen. “Optimizing Compilers for Modern Architectures.” .2004.

Reference Books:

1.Manoj Chandak and Khushboo Khurana “Compiler Design”,2018.

2. Randy Allen & Ken Kennedy, “Optimizing Compilers for Modern Architectures”, ISBN 81-8147-366-3, Morgan Kaufmann, Elsevier, 2002.

Online References

- NPTEL: http://www.nptelvideos.in/2012/11/compiler-design.html
- Coursera: https://www.coursera.org/lecture/nand2tetris2/unit-4-1-syntax-analysis-5pC2Z

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE: To be conducted as a 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.

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
MDMC 6063	Organizational Behaviour and Human Resource Management	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC 6063	Organizational Behaviour and Human Resource Management	20	20	60	25	--	125

Course pre-requisite:

1. Basic understanding of communication and teamwork in project environments
2. Curiosity to learn about human behavior and roles in organizations

Program Outcomes addressed:

1. PO2: Problem Analysis
2. PO7: Global and Ethical Practices
3. PO8: Collaborative Teamwork
4. PO9: Communication
5. PO10: Project Management and Finance
6. PO11: Lifelong Learning

Course Objectives:

1. To explain fundamental concepts of organizational behaviour, including perception, motivation, leadership, teamwork, and communication, relevant to technical and professional environments.
2. To help students understand individual and group behaviour and develop the ability to apply behavioural principles for effective collaboration in engineering teams.
3. To enable students to apply HRM concepts such as recruitment, training, performance appraisal, and employee engagement in engineering and project-based organizations.
4. To develop skills in conflict resolution, negotiation, and decision-making, preparing students to handle workplace challenges in technical settings.
5. To build the ability **to** analyze organizational culture and structure, and understand how these factors influence innovation, productivity, and technology-driven work environments.
6. To prepare students to become effective engineering professionals by cultivating leadership, ethical behaviour, interpersonal skills, and a people-oriented mindset essential for managing diverse teams

Course Outcomes:

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

1. Relate the key concepts of organizational behaviour and human resource management relevant to engineering workplaces.
2. Understand motivation, communication, and leadership theories to improve individual and team performance in technical environments.

3. Apply workplace situations, identify behavioural issues, and evaluate their impact on engineering teams and project outcomes.
4. Analyse HR practices such as recruitment, performance appraisal, and training, and justify their relevance in engineering industries.
5. Evaluate solutions or strategies for conflict resolution, teamwork enhancement, and employee engagement in engineering projects.
6. Create and demonstrate ethical behaviour, interpersonal skills, and professional conduct, and evaluate their role in shaping an effective organizational culture.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0	**1**	**Introduction to Organizational Behaviour and Interpersonal skills**	**5**	
		Meaning and significance of OB, functions, roles and skills related to management; contributing disciplines to the field of OB; challenges and opportunities for OB. Importance of interpersonal skills for engineers; verbal and non-verbal communication; active listening; giving and receiving feedback; building trust and rapport; handling difficult conversations		**CO1, CO2**
		Self-learning Topics: Contributing disciplines to OB, Challenges and opportunities in OB, Importance of interpersonal skills for engineers		
2.0	**2**	**Personality, Perception and Decision Making**	**6**	
		Meaning and determinants of personality; major personality traits and attributes; Big Five Model; Job Fit Theory; measuring personality; managing emotions at the workplace. Meaning of perception; factors influencing perception and attitude; Attribution Theory; errors in attribution; link between perception and individual decision making.		**CO2**
		Self-learning Topics: Meaning of perception; factors influencing perception and attitude		
3.0	**3**	**Values, Attitudes, Job Satisfaction, Learning and Motivation**	**6**	
		Definition and types of values; definition and types of attitudes; definition and measurement of job satisfaction; meaning of learning; methods of learning at work. Definition of motivation; theories of motivation (Theory X & Theory Y, Maslow's Need Hierarchy, Two-factor theory, ERG theory, Goal-setting theory, Reinforcement theory, Equity theory, Expectancy theory); motivation from theory to application; link between skill-based plans and motivation theories.		**CO2**
		Self-learning Topics: Definition and types of attitudes; definition and measurement of job satisfaction; meaning of learning; methods of learning at work.		
4.0	**4**	**Leadership Theories, Styles & Team Influence, Applied Leadership Skills for Engineering Teams**	**6**	
		Concept of leadership; leader vs manager; leadership traits and competencies; overview of major leadership theories (trait, behavioural, contingency/situational); leadership styles and their relevance in		**CO2, CO3**

		technical teams. Leading teams; delegation and empowerment; decision-making and problem-solving as a leader; power and influence; ethical leadership; developing one's own leadership plan.		
		Self-learning Topics: Differences between a leader and a manager.		
5.0	**5**	**Understanding Group Behavior and Teams, Conflicts in the Organization- Organizational Culture and Stress and Organizational Change**	**10**	
		Definition of groups and teams; Stages of group and team development; Group structure: roles, norms, status; Group tasks and decision making; Types of teams - problem-solving, self-managed, cross-functional, virtual etc.; Features of effective teams; Creating and managing effective teams in engineering projects. Definition of conflict; transitions in conflict thought; functional and dysfunctional conflict; the conflict process; negotiation process; bargaining strategies (distributive & integrative). **Organizational Culture and Stress** – Definition of organizational culture; types of culture; functions of culture; culture as an asset and liability; creating and sustaining culture; learning organizational culture; Hofstede's model of culture; **Organizational Stress** – definition of stress; understanding stress and its consequences; sources of stress; managing stress. Meaning of change; forces of change; levels of change; resistance to change; process of change; role of managers in facilitating change.		**CO4, CO5**
		Self-learning Topics: Group structure: roles, norms, status; Group tasks and decision making.		
6.0	**6**	**Introduction to Human Resource Management & Talent Acquisition Performance Management, Development & Employee Engagement**	**6**	
		Meaning, scope and objectives of HRM; role of HR in organizations and specifically in engineering / project-based firms; HR planning; job analysis and job descriptions; recruitment and selection basics. Training and development; performance management and feedback; basics of compensation and rewards; employee engagement and welfare; HR's role in supporting career development of engineers.		**CO4, CO6**
		Self-learning Topics: Meaning, scope and objectives of HRM, ; HR's role in supporting career development of engineers.		
		Tutorial: Case studies, role play and quiz on organizational behavior and HRM		
		Total	**39**	

Textbooks:

1. Robbins, S. P., & Judge, T. A. (2022). Organizational behavior (19th ed.). Pearson.
2. Aswathappa, K. (2018). Organizational behaviour (12th ed.). McGraw Hill Education.
3. Dessler, G. (2020). Human resource management (16th ed.). Pearson.

4. Armstrong, M. (2021). Armstrong's handbook of human resource management practice (16th ed.). Kogan Page.

Reference books:

1. Luthans, F. (2021). Organizational behavior: An evidence-based approach (14th ed.). McGraw Hill.
2. Schermerhorn, J. R., Hunt, J. G., & Osborn, R. N. (2020). Organizational behavior (14th ed.). Wiley.
3. Mondy, R. W., & Martocchio, J. J. (2016). Human resource management (14th ed.). Pearson.
4. Mathis, R. L., Jackson, J. H., & Valentine, S. R. (2019). Human resource management (15th ed.). Cengage Learning.

Course Assessment:
ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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.

CIAP (25-Marks):
At least 06 Tutorials covering entire syllabus must be given during the "Class Wise Tutorial".

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEC6011	Robotics and Applications	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC6011	Robotics and Applications	20	20	60	--	--	100

Course Pre- requisites:

1. FEC 201: Applied Mathematics-II
2. FEC104: C-Programming
3. FEL 104: Applied Mechanics and Robot dynamics
4. ECC 301: Applied Mathematics-III
5. ECL 304: Skill lab-Python Programming

Program Outcomes Addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Engineering tool Usage
5. PO9: Communication
6. PO11: Life-long Learning.

Course Objectives:

1. To introduce the fundamental concepts of robotics.
2. To develop understanding of robot kinematics.
3. To provide knowledge of robot dynamics and actuation systems.
4. To familiarize learners with robotic sensors and perception.
5. To build competence in robot control, motion planning, and mobile robotics.
6. To develop hands-on understanding of robot programming.

Course Outcomes:

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

1. Explain the fundamentals of robotics, robot classification, anatomy, and diverse application areas across industries.
2. Apply kinematic modeling techniques including transformation matrices, forward and inverse kinematics, and DH parameters for robotic manipulators.
3. Analyze robot dynamics and actuation mechanisms using principles of force, torque, Newton–Euler, and Lagrangian methods and evaluate different actuator technologies.

4. Evaluate and integrate various robotic sensors and perception systems, including vision processing and basic sensor fusion concepts.
5. Design and analyze robot control strategies and motion planning algorithms and interpret mobile robot kinematics and navigation concepts.
6. Develop and implement basic robot programming using ROS, simulation tools, and AI/ML techniques for robotic applications.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Robotics**	**06**	**CO1**
	1.1	Definition, scope, importance of robotics, History and evolution of robotic systems		
	1.2	Classification of robots: industrial, service, mobile, humanoid, Anatomy of a robot: links, joints, end-effectors, DOF, workspace		
	1.3	Industrial applications: manufacturing, healthcare, agriculture, defense, logistics, Overview of automation & Industry 4.0		
		Self-learning Topics: Soft robotics: materials, applications, emerging trends		
2.0		**Robot Kinematics**	**07**	**CO2**
	2.1	Coordinate frames and transformation matrices		
	2.2	Forward kinematics, Inverse kinematics (analytical concepts)		
	2.3	Denavit–Hartenberg (D–H) parameters, Homogeneous transformations, Kinematic redundancy, singularities		
		Self-learning Topics: Jacobian matrix: derivation, geometric vs analytical Jacobian, Velocity kinematics & differential kinematics		
3.0		**Robot Dynamics & Actuation**	**06**	**CO3**
	3.1	Concepts of force, torque, inertia, Dynamic modeling of manipulators		
	3.2	Newton–Euler and Lagrangian formulations (conceptual)		
	3.3	Actuation systems: **Electric**- DC motors, servo motors, stepper motors **Pneumatic & Hydrolic Systems.**		
	3.4	Power transmission: gears, belts, harmonic drives.		
		Self-learning Topics: Dynamic simulation using MATLAB / Gazebo		
4.0		**Sensors, Perception & Vision Systems**	**07**	**CO4**
	4.1	Sensors:Proximity, IR, ultrasonic, tactile, force/torque sensors		
	4.2	Encoders, IMU, gyroscope, LIDAR and Radar basics.		
	4.3	Perception & Vision: Image acquisition and preprocessing, Feature extraction, segmentation.		
	4.4	Object detection and recognition, Basics of sensors, Sensor types and working.		
		Self-learning Topics: 3D perception: depth cameras (Intel RealSense), stereo vision		

5.0		**Control system & Mobile Robotics**	**07**	**CO5**
	5.1	Introduction to control systems, Mathematical modelling basics, Standard test signals, Time domain response characteristics, frequency domain basics.		
	5.2	Robot Control: Open-loop and closed-loop control, PID controller: concept and tuning, Joint space vs task space control.		
	5.3	Mobile Robotics: Wheeled robot models – differential drive, skid steer, Kinematics of mobile robots, Basics of SLAM (mapping & localization), Autonomous navigation architecture.		
		Self-learning Topics: Motion Planning: Trajectory generation, Path planning algorithms: BFS, DFS, A*, Dijkstra, RRT (conceptual).		
6.0		**Robot Programming, AI in Robotics & Applications**	**06**	**CO6**
	6.1	Robot Programming: Basics of Robot Operating System (ROS), ROS nodes, topics, publishers/subscribers.		
	6.2	Simulation tools: Gazebo, Webots, CoppeliaSim, Programming robots using Python/C++.		
	6.3	AI & Applications: Role of AI & ML in robotics, Reinforcement learning for robot decision-making.		
	6.4	Collaborative robots (CoBots), Use cases: smart factories, autonomous vehicles, agriculture, logistics, defense.		
		Self-learning Topics: Ethics in robotics & AI, I-based motion planning (Neural Motion Planner basics)		
		Total	**39**	

Textbooks:

1. S. K. Saha, “Introduction to Robotics”, 3rd edition, McGraw Hill Education, 2025.
2. Spong, Hutchinson & Vidyasagar, “Robot Modeling and Control”, 2nd edition, Wiley 2020.
3. Robert Shilling, “Fundamentals of Robotics - Analysis and control, Prentice Hall of India, 2009.
4. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., 2nd edition, 2011.

Reference books:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India,2009.
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006.
3. Mikell P. Groover, “Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008.
4. S. R. Deb and Sankha Deb, “Robotics Technology and Flexible Automation” , 2nd edition, Tata McGraw Hill, 2009.

Online References:

- ROS Tutorials – Official Documentation: https://wiki.ros.org/ROS/Tutorials
- NPTEL: Robotics by IIT Kanpur, Robot Kinematics and Dynamics by IIT Kharagpur
- Coursera / edX (Free audit mode): Robotics Specialization (University of Pennsylvania), Modern Robotics (Northwestern University)
- MATLAB Robotics Toolbox (Peter Corke): https://petercorke.com/toolboxes/robotics-toolbox/
- Gazebo & Webots Official Documentation: https://gazebosim.org, https://cyberbotics.com

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

1. 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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEC6012	Artificial Intelligence	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC6012	Artificial Intelligence	20	20	60	--	--	100

Course Pre- requisite:

1. ECC301: Applied Mathematics III
2. ECC401: Applied Mathematics IV
3. ECC302: Data Structures

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design / Development of Solutions.
4. PO5: Engineering tool usage
5. PO8: Individual and Collaborative Teamwork.
6. PO11: Life-Long Learning
7. PSO1: To acquire knowledge in cutting-edge technologies.

Course Objectives:

1. To gain a perspective of AI and its foundations.
2. To study different agent architectures and properties of the environment.
3. To understand the basic principles of AI towards problem solving, inference, perception, knowledge representation, and learning.
4. To investigate probabilistic reasoning under uncertain and incomplete information
5. To explore the current scope, potential, limitations, and implications of intelligent systems.
6. To gain a perspective of AI and its foundations.

Course Outcomes:

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

1. Identify the characteristics of the environment and differentiate between various agent architectures.
2. Apply the most suitable search strategy to design problem-solving agents.
3. Represent a natural language description of statements in logic and apply the inference rules to

design Knowledge-Based agents.

4. Apply a probabilistic model for reasoning under uncertainty.
5. Apply evolutionary optimization techniques to solve complex problems.
6. Describe the various building blocks of an expert system for a given real-world problem.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction to Artificial Intelligence Agents**	**05**	**CO1**
	1.1	Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally , History of AI, The present state of AI, Ethics in AI.		
	1.2	Applications of AI in FinTech, Healthcare and Autonomous Systems		
	1.3	**Introduction to agents**: Structure of Intelligent Agent, Characteristics of Intelligent Agents, Types of Agents: Simple Reflex, Model Based, Goal Based, Utility Based Agents.		
	1.4	**Environment Types:** Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent		
		Self-learning Topics: Turing Test and Modern Alternatives, Introduction to Multi-Agent Systems		
2.0		**Problem Solving and Search Techniques**	**10**	**CO2**
	2.1	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems.		
	2.2	Solving Problems by Searching, Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality		
	2.3	Informed Search, Heuristic Function, Admissible Heuristic, Informed Search Technique, Greedy Best First Search, A* Search, Local Search, Hill Climbing Search.		
	2.4	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning		
		Self-learning Topics: Memory Bound Algorithm: SMA, SMA*		
3.0		**Knowledge Representation and Reasoning**	**10**	**CO3**
	3.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems		

	3.2	Propositional Logic (PL), Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula,		
	3.3	Predicate Logic, FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL, Introduction to logic programming (PROLOG)		
	3.4	Forward Chaining, Backward Chaining and Resolution in FOPL		
		Self-learning Topics: Rule-based systems and production systems, Ontologies, semantic web basics, KR design patterns.		
4.0		**Reasoning Under Uncertainty**	**04**	**CO4**
	4.1	Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution		
	4.2	Bayes' Rule and its use, Bayesian Belief Networks, Reasoning in Belief Networks		
		Self-learning Topics: Markov Models: Markov Chains and Hidden Markov Models (HMMs), Probabilistic Programming (e.g., Pyro, Stan)		
5.0		**Evolutionary Algorithms**	**05**	**CO5**
	5.1	Introduction: Need of Evolutionary algorithms, Difference of Classical Optimization and Evolutionary Algorithms		
	5.2	Genetic algorithm: Selection Operators, Cross Over Operators, Elitism, Exploration and Exploitation Tradeoff		
	5.3	Simulated Annealing Search, Particle Swarm Optimization		
		Self-learning Topics: Hybrid Evolutionary Algorithms (GA + Local Search), Applications of Evolutionary Algorithms in Engineering Optimization		
6.0		**Planning and Learning**	**05**	**CO6**
	6.1	The planning problem, Partial order planning, total order planning.		
	6.2	Learning in AI, Learning Agent, Concepts of Supervised, Unsupervised, Semi -Supervised Learning, Reinforcement Learning, Ensemble Learning.		
	6.3	Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory.		
		Self-learning Topics: Development of Expert Systems, Classical planning: STRIPS representation, Recent advances in Deep Learning and Generative AI (LLMs, Explainable AI).		
		Total	**39**	

Textbooks:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021.
2. Elaine Rich and Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2009.
3. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition, Pearson Education, 2008.

Reference books:

1. Ivan Bratko, PROLOG Programming for Artificial Intelligence, 4th Edition, Pearson Education, 2011.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, 1st Edition, Prentice Hall, 1990. Saroj Kaushik, Artificial Intelligence, 2nd Edition, Cengage Learning, 2011.
3. David E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, 1st Edition, Addison-Wesley, New York, 1989.
4. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, Addison-Wesley, 1992.
5. N. P. Padhy, Artificial Intelligence and Intelligent Systems, 6th Edition, Oxford University Press, 2005.

Online References:

- Massachusetts Institute of Technology, 6.034: Artificial Intelligence Course Materials (Lectures & Assignments), MIT OpenCourseWare
- Stanford University, CS221: Artificial Intelligence – Course Materials, Stanford University.
- NPTEL: Artificial Intelligence Courses (Video Lectures & Notes), IITs (via NPTEL)
- OpenAI Academy: OpenAI Educational Resources and Learning Materials, OpenAI.
- Google for Education: Google AI Education – Learn AI Skills, Google.

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

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.

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.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical		Theory	Practical	Tutorial	Total
ECPEC6013	Cyber Security	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC6013	Cyber Security	20	20	60	--	--	100

Pre-requisite:
1. ECC502: Computer Network

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 need for Cyber Security Awareness.
2. To understand the flow and methodology of an attack
3. To learn and explore various static and web vulnerability analysis tools.
4. To understand the various IPR, privacy and security compliances.
5. To implement basic security mechanisms and defensive strategies in networks and applications.
6. To analyze cybersecurity incidents and design mitigation strategies using modern tools.

Course Outcomes:
After successful completion of the course, students will be able to:
1. Understand the need of Cyber Security and its aspects.
2. Illustrate the various tools and techniques used by attackers to launch their attacks.
3. Identify cyber-attacks and its countermeasures.
4. Identify various web application and Network vulnerability scanning techniques and defense methodologies.
5. Describe the various Privacy and standard compliances with the help of real-world applications.
6. Analyze real-world cybersecurity initiatives and evaluate the role of emerging technologies.

Module No.	Unit No.	Topics	Hrs.	CO

1.0		**Introduction to Cyber space**	**08**	**CO1**
	1.1	**Cyber Crime:** Cybercrime definition, Types of Cybercrime. Classifications of cybercrime, Cyber Hygiene, Types of Hackers – Hacker sand Crackers - Cyber-Attacks and Vulnerabilities - Malware threats -Sniffing - Gaining Access - Escalating Privileges - Executing Applications - Hiding Files - Covering Tracks - Worms - Trojans - Viruses - Backdoors		
	1.2	Cyber Attacks: Cyber-attack Lifecycle, Cyber stalking, Cyber-café and Cybercrimes, Botnets, Attack vector, Attacks on Wireless and mobile Networks.		
		Self-Learning Topics: Major cyber-attacks in India (case studies), Study of famous malware: WannaCry / Stuxnet.		
2.0		**Cyber-crime Attacks and Techniques**	**08**	**CO2**
	2.1	**Attacks Techniques**: Password Cracking, Key loggers and Spywares Steganography, Identity Theft (ID Theft), Banner Grabbing Techniques, ransom wares, Crypto wares		
	2.2	Network information gathering, vulnerability scanning, Virtual Private Networks (VPN), Open Port Identification, Social engineering, Types of social engineering, how cybercriminal works? Prevention from being victim of social engineering.		
		Self-Learning Topics: map scanning on a test network, steganography tool (OpenStego).		
3.0		**Cyber Attacks and Preventions**	**06**	**CO3**
	3.1	Cyber-attacks, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC, MAC, RBAC, ABAC, BIBA, attacks on WIFI and prevention, traditional techniques, theft of internet hours, Wi-Fi measures		
	3.2	Attacks on Mobile phone and prevention, mobile phone theft, mobile virus, Mishing, vishing, smishing, hacking Bluetooth		
		Self-Learning Topics: WPA2 vs WPA3 Wi-Fi security standards, Research secure mobile practices (permissions, 2FA)		
4.0		**Web and Network Security**	**08**	**CO4**
	4.1	Web Security: OWASP, Web Security Considerations, Management, Cookies, Privacy on Web, Web Browser Attacks, Web Bugs, Clickjacking, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security		
	4.2	Network security: Syn-DOS: DDOS, defenses against Denial-of-Service Attacks. Virtual Private Networks (VPN)		
		Self-Learning Topics: OWASP vulnerabilities, DVWA		

		(Damn Vulnerable Web App) basics		
5.0		**Cyber Laws**	**05**	**CO5**
	5.1	Information Security Privacy and Standard Compliances (WR) HIPPA, FISMA, PCI DSS, GDPR, Intellectual Property Aspect of Cyber Law, Creative Commons Library, Data Protection Laws in India.		
		Self-Learning Topics: GDPR and India's Data Protection Act, Creative Commons license types.		
6.0		**Cyber Security Initiatives (case studies)**	**04**	**CO6**
	6.1	Online Banking, Mobile Banking Security, Security of Debit and Credit Card, UPI Security		
	6.2	Role of AI/ML in Cyber Security		
		Self-Learning Topics: ML-based anomaly detection in cybersecurity.		
		Total	**39**	

Textbooks:

1. Nina Godbole, Sunit Belapure, "Cyber Security-Understanding Cyber Crimes, Computer Forensics and Legal Perspective", Wiley-India,2011.
2. The Complete Cyber Security Course -Volume 1- Nathan House, 2017.
3. Network Security Bible, Eric Cole, Second Edition, Wiley, 2009

Reference books:

1. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi, 2024.
2. James Graham, Richard Howard, Ryan Olson. "Cyber Security Essentials, CRC Press, 2018.
3. Build your own Security Lab, Michael Gregg, Wiley India, 2008.
4. Computer Security, Dieter Gollman, 3rd edition, Wiley, 2011.

Online References:

- Virtual Penetration Testing Labs: https://pentesterlab.com
- OWASP: https://owasp.org/
- DVWA: https://dvwa.co.uk
- FISMA: https://csrc.nist.gov/projects/risk-management/fisma-background
- PCI DSS: https://www.itgovernance.eu/blog/en/a-guide-to-the-4-pci-dss-compliance-levels
- GDPR: https://gdpr.eu/what-is-gdpr/

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 Marks.
- ISE 20 Marks=15 marks for activities+ 5 marks for attendance.

MSE:

- To be conducted as written examination for 20 marks (on 40%-50% syllabus)

End Semester Examination

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

1. 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.

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
ECPEC6014	Advanced Networking Technologies	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ECPEC6014	Advanced Networking Technologies	20	20	60	--	--	100

Course pre-requisite:

1. ECC 502: Computer Network

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO7: Ethics
5. PO11: Lifelong learning
6. PSO2: Develop innovative multidisciplinary projects

Course Objectives:

1. To introduce advanced wireless LAN and WAN technologies and their architectures.
2. To explain optical networking concepts including SONET, WDM, and DWDM.
3. To describe emerging wireless technologies such as WPAN, WMAN, VANET, and sensor networks.
4. To analyze network security principles, threats, and safeguards for secure communication.
5. To illustrate multimedia networking protocols and compression techniques for efficient data transmission.
6. To discuss network design principles including hierarchical and ubiquitous computing models.

Course Outcomes:

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

1. Describe wireless LAN/WAN technologies and IEEE 802.11 architecture.
2. Explain SONET, WDM, and DWDM concepts in optical networking.
3. Analyze advanced wireless technologies and their applications in modern networks.

4. Apply security mechanisms and firewall configurations for network protection.
5. Illustrate multimedia communication protocols and techniques for real-time data transfer.
6. Design network architectures using hierarchical and backbone design principles.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Wireless LAN and WAN Technologies**	**08**	**CO1**
	1.1	Introduction to Wireless networks : Infrastructure networks, Ad-hoc networks.		
	1.2	IEEE 802.11 architecture and services		
	1.3	Medium Access Control sub-layers		
	1.4	CSMA/CA, Physical Layer, 802.11 Security considerations		
	1.5	Asynchronous Transfer Mode (ATM): Architecture, ATM logical connections, ATM cells, ATM Functional Layers.		
		Self-learning Topics: Classification of wireless networks: WLAN, WPAN, WMAN, WWAN.		
2.0		**Optical Networking**	**06**	**CO2**
	2.1	SONET: SONET/SDH, Architecture, Signal, SONET devices, connections, SONET layers, SONET frames, STS Multiplexing, SONET Networks.		
	2.2	WDM, DWDM: Frame format, DWDM architecture, Optical Amplifier, Optical cross connect, Performance and design considerations.		
		Self-learning Topics: Classification of optical wireless communication technologies: OCC, FSO, Li-Fi, VLC.		
3.0		**Advanced Technologies of wireless Networks**	**10**	**CO3**
	3.1	WPAN: 6LoWPAN-features, architecture, protocol stack and applications.		
	3.2	Wireless adhoc networks: features, advantages and applications. Mobile adhoc networks: features and architecture.		
	3.3	WMAN(IEEE802.16): Introduction, features, WMAN Network Architecture, and Applications		
	3.4	Vehicular Adhoc Networks (VANETS): Characteristics, Protocols & Applications.		
	3.5	Wireless Sensor Networks: Network Architecture, Design Considerations, Network Protocol Stack, and Applications		
		Self-learning Topics: WPAN protocols: Bluetooth, zigbee, comparison between MANET and VANET.		

4.0		**Network Security**	**05**	**CO4**
	4.1	Security goal, Security threats, security safeguards, firewall types and design, IPTABLES		
	4.2	Internet Security: Network Layer Security, Transport Layer Security, Application Layer Security		
		Self-learning Topics: Intrusion Detection and Prevention Systems (IDS/IPS)		
5.0		**Multimedia Information and Networking**	**06**	**CO5**
	5.1	Compression Fundamentals, Digital Representation, Compression techniques.		
	5.2	Multimedia Communication across networks, RTP, RTSP, SIP, H.323.		
		Self-learning Topics: Content Delivery Networks (CDN) and adaptive streaming.		
6.0		**Network Design**	**04**	**CO6**
	6.1	Three tier Network design layers: Application layer, Access layer.		
	6.2	Backbone layers, Ubiquitous computing and Hierarchical computing.		
		Self-learning Topics: Campus network design principles		
		Total	**39**	

Textbooks:

1. Forouzan, Behrouz A. Data Communications and Networking. 5th edition, McGraw-Hill Education, 2012.
2. Kurose, J. F., & Ross, K. W. Computer Networking: A Top-Down Approach. 8th edition, Pearson, 2021.
3. Stallings, William. Data and Computer Communications. 10th edition, Pearson, 2013

Reference books:

1. Forouzan, Behrouz A. TCP/IP Protocol Suite. 4th edition, Tata McGraw Hill Education, 2010.
2. Shah, Deven, and Ambavade. Advanced Communication Networking. 2nd ed., Technical Publications, 2019

Online References:

- Computer Networks And Internet Protocol
  https://onlinecourses.nptel.ac.in/noc24_cs19/preview
- IEEE 802.11 Wireless LAN Standards (official)
  https://standards.ieee.org/standard/802_11-2020.html

- Introduction to Optical Fiber Communications – IEEE
  https://spectrum.ieee.org/tag/optical-communications
- Cybersecurity Fundamentals – NIST
  https://www.nist.gov/cyberframework
- Cisco Enterprise Network Design Guide
  https://www.cisco.com/c/en/us/solutions/enterprise/design-zone.html

Course Assessment:
ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
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MSE:

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End Semester Examination
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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
ECL601	Software Engineering and Web Technology Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL601	Software Engineering and Web Technology Lab	--	--	--	25	25	50

Pre-requisite:
1. ECC 303: Database Management Systems
2. ECC 502: Computer Networks

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 understand and apply software engineering principles in real-world projects.
2. To gain practical experience in web technologies including HTML5, CSS3, JavaScript, JSP, Servlets, and database connectivity.
3. To develop skills in requirement analysis, UML modeling, and documentation using IEEE standards.
4. To practice testing techniques (black box and white box) and use modern tools for debugging and CI/CD.
5. To design and develop responsive and interactive web applications using modern frameworks and tools.
6. To integrate front-end and back-end technologies for building dynamic web solutions.

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

1. Identify requirements and apply process model to selected case study.
2. Analyse and design models for the selected case study using UML modelling
3. Use various Software Engineering and Project Management Tools
4. Design responsive web pages using HTML5, CSS3, and Bootstrap.
5. Implement client-side validation using JavaScript and ES6 features.
6. Develop dynamic web applications using Java Servlets, JSP, and JDBC.

Suggested List of Experiments

Sr. No.	Title of Experiments	LO
1.	Title: Problem Identification and Feasibility Study Aim: To prepare a detailed problem statement, conduct feasibility study, and identify a suitable software process model for the selected project. Objectives: • To identify and define a real-world software problem • To analyze technical, economic, operational, and schedule feasibility • To study various software process models • To select a suitable process model for the project • To justify the selected process model	LO1
2	Title: Software Requirement Specification (SRS) Development Aim: To develop a Software Requirement Specification (SRS) document as per IEEE standards for the selected project. Objectives: • To understand IEEE SRS documentation standards • To gather functional and non-functional requirements • To document system requirements systematically • To define system constraints and assumptions • To prepare a complete SRS document	LO1

3	Title: Project Scheduling Using Project Management Tools Aim: To prepare a project schedule using a suitable project management tool. Objectives: • To understand project planning concepts • To identify project tasks and milestones • To allocate timelines and dependencies • To represent the schedule using Gantt chart or PERT chart • To monitor project progress effectively	LO3
4	Title: UML Use Case and Class Diagram Development Aim: To identify system scenarios and develop UML Use Case and Class diagrams for the project. Objectives: • To identify actors and system use cases • To model functional behavior using Use Case diagrams • To identify classes, attributes, and relationships • To design Class diagrams • To understand object-oriented design concepts	LO2
5	Title: UML Activity, State Transition, and Sequence Diagrams Aim: To develop Activity, State Transition, and Sequence diagrams for the selected project. Objectives: • To represent workflow using Activity diagrams • To model object states using State Transition diagrams • To illustrate object interactions using Sequence diagrams • To understand dynamic behavior of the system • To improve system clarity and design	LO2
6	Title: Black Box Testing Aim: To design and write black box test cases for the developed system. Objectives: • To understand black box testing techniques • To identify test conditions and inputs	LO3

	• To write test cases based on functional requirements • To verify expected outputs • To ensure system functionality	
7	Title: White Box Testing Aim: To design and write white box test cases for the developed system. Objectives: • To understand white box testing methods • To analyze control flow and logic • To design test cases for code coverage • To verify internal logic of the system • To improve software reliability	LO3
8	Title: Installation and Configuration of LAMP / WAMP / XAMPP Server Aim: To install and configure LAMP, WAMP, or XAMPP server for web application development. Objectives: • To understand server-side architecture • To install Apache web server • To configure MySQL database • To install PHP • To test server functionality	LO4
9	Title: Design of a Responsive Portfolio Website Aim: To design and develop a responsive portfolio website using HTML5, CSS3, and Bootstrap. Objectives: • To create structured web pages using HTML5 • To style web pages using CSS3 • To make the website responsive using Bootstrap • To design user-friendly layouts • To understand responsive web design principles .	LO4

10	Title: Registration Form with Client-Side Validation Aim: To design a registration form with client-side validation using JavaScript DOM and ES6 features. Objectives: • To design an HTML registration form • To validate input fields using JavaScript • To use DOM manipulation techniques • To apply ES6 features • To enhance user input accuracy	LO5
11	Title: Implementation of Login System Using Java Servlets and JSP Aim: To implement a login system using Java Servlets and JSP with session handling and cookies. Objectives: • To understand Servlet and JSP architecture • To implement user authentication • To manage sessions using HttpSession • To use cookies for user tracking • To secure user login functionality	LO5,LO6
12	Title: Interactive Web Application with Database Connectivity Aim: To design interactive web pages using a framework with MySQL database connectivity. Objectives: • To connect web applications to MySQL database • To perform CRUD operations • To design interactive user interfaces • To handle form submissions • To ensure data persistence	LO5,LO6
13	Title: Version Control Using Git and GitHub Aim: To learn and apply version control techniques using Git and GitHub for project management. Objectives: • To understand the concept of version control systems • To install and configure Git	LO3

	• To create and manage local repositories • To perform operations like commit, push, pull, and merge • To collaborate using GitHub repositories	
14	Title: Continuous Integration using GitHub Actions / CI Tool Aim: To implement Continuous Integration (CI) for automating build and testing processes using modern CI tools. Objectives: • To understand the concept of Continuous Integration and DevOps • To configure a CI pipeline using GitHub Actions (or Jenkins) • To automate build and test execution • To detect integration issues early • To improve software quality through automation	LO3,LO4
15*	Title: Mini-Project Based on Software Engineering and Web Technology Aim: To design and develop a mini-project applying Software Engineering and Web Technology concepts. Objectives: • To apply software engineering principles • To implement frontend and backend technologies • To integrate database connectivity • To perform testing and validation • To demonstrate complete software development lifecycle	LO1, LO2, LO3, LO4, LO5, LO6

Online resources:

- http://vlabs.iitkgp.ac.in/sevl/
- https://cs.gmu.edu/~rpettit/files/project/SRS-template.doc
- https://www.w3schools.com/
- https://www.javaguides.net/2019/03/login-form-using-jsp-servlet-jdbc-mysql-example.html

Term Work:
Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 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/Oral Exam: (2 hours/ 25 Marks)

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL602	Basics of VLSI Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL602	Basics of VLSI Design Lab	--	--	--	25	--	25

Pre-requisite:

1. FEL203: Digital System Design Lab
2. ECL303: Electronic Devices and Circuits Lab

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 understand and analyze the transfer and output characteristics.
2. To design and simulate CMOS inverter and logic gates.
3. To perform transient analysis and determine parameters of complex logic functions
4. To design and simulate arithmetic building blocks using various logic styles.
5. To design and comprehend stability analysis of memory cells,
6. To develop and simulate CMOS layouts.

Lab Outcomes:

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

1. Plot and interpret the V-I characteristics of NMOS and PMOS devices
2. Design and simulate CMOS inverter and evaluate parameters.
3. Implement and analyze complex logic functions.
4. Model and simulate arithmetic circuits.
5. Design, analyze and evaluate CMOS memory circuits such as ROM, DRAM, and SRAM..
6. Create, simulate, and extract CMOS layouts.

Suggested List of Experiments:

Sr. No.	Title of Experiments	LO
1	Analysis of V-I Characteristics for NMOS and PMOS Transistors. Aim: To study and plot the drain and transfer characteristics of MOS transistors to understand their operating regions. Objectives: • To plot output characteristics for varying • To determine device parameters	LO1
2	Static and Transient Analysis of CMOS Inverters with Varying Aspect Ratios. Aim: To design and analyze CMOS inverter Objectives: • To perform DC analysis • To observe the impact of transistor sizing on propagation delay and output transitions.	LO2
3	VTC Analysis and Noise Margin Calculation for Universal Gates (NAND/NOR). Aim: To evaluate the robustness of NAND and NOR gates by analyzing their Voltage Transfer Characteristics. Objectives: • To calculate High and Low Noise Margins • To validate the gate performance by comparing its VTC against an equivalent CMOS inverter	LO2
4	Transient Performance Analysis of NAND and NOR Gates. Aim: To measure and analyze the time-domain response of CMOS logic gates. Objectives: • To calculate Rise Time, Fall Time, and average Propagation Delay • To investigate how different input combinations affect the output response speed.	LO2
5	Modeling Equivalent CMOS Inverters for Complex Logic Gates. Aim:	LO2

	To simplify NAND/NOR gate structures into a single equivalent inverter for delay estimation. Objectives: • To calculate the equivalent W/L for series and parallel transistor configurations. • To verify through simulation that the equivalent inverter matches the switching characteristics of the target gate.	
6	Implementing Boolean Equations using Multiple CMOS Design Styles. Aim: To compare the area and power efficiency of logic implemented via Static CMOS, Pseudo-NMOS, and Pass Transistor Logic. Objectives: • To design a specific logic function • To analyze the trade-offs in terms of transistor count and output voltage swing.	LO3
7	Implementation of Flip-Flops using Diverse Design Methodologies. Aim: To design and simulate a D-Flip-Flop or JK-Flip-Flop using various logic styles Objectives: • To verify the functional timing • To compare the clock-to-Q delay across different implementation styles.	LO3
8	Design and Simulation of a 4:1 Multiplexer using NMOS Pass Transistors. Aim: To implement a multiplexing function using the Pass Transistor Logic (PTL) style to reduce transistor count. Objectives: • To observe the "threshold voltage drop" effect at the output of NMOS pass gates. • To verify the truth table and select-line functionality of the 4:1 MUX.	LO4
9	Design and Simulation of a 1-bit Adder/Subtractor Circuit. Aim: To implement a full adder/subtractor unit and verify its logical correctness. Objectives: • To design the Sum/Difference and Carry/Borrow logic using Static CMOS. • To analyze the critical path delay from input to the final carry/borrow output.	LO4
10	Design and Simulation of a 4-bit Binary Multiplier.	LO4

	Aim: To construct a 4-bit multiplier using an array of adders and AND gates. Objectives: • To implement the partial product generation logic and summation tree. • To evaluate the total power consumption and latency of the 4-bit multiplication operation.	
11	Study of NAND-based and NOR-based ROM Arrays. Aim: To design and simulate Read-Only Memory structures to understand data storage and retrieval. Objectives: • To analyze the difference in access time between NAND and NOR architectures. • To verify the row decoding and column sensing logic within the memory array.	LO5
12	Performance Analysis of a 1T DRAM Cell. Aim: To simulate the charge storage and sensing mechanism of a single-transistor DRAM cell. Objectives: • To study the "Read" and "Write" operations and the importance of the refresh cycle. • To analyze the effect of bit-line capacitance on the sensed output voltage.	LO5
13	To design a 6-transistor SRAM cell and evaluate its data retention capabilities. Aim: To design a 6-transistor SRAM cell and evaluate its data retention capabilities. Objectives: • To analyze the Static Noise Margin (SNM) during Read and Write operations. • To verify the sizing requirements for the access and pull-down transistors to ensure cell stability.	LO5
14	Layout Design and Post-Layout Simulation of a CMOS Inverter Aim: To create a physical mask layout and perform Parasitic Extraction (PEX).	LO6

	Objectives: • To follow Lambda based design rules for creating p-diffusion, n-diffusion, and metal layers. • To compare the pre-layout (ideal) and post-layout (with parasitics) transient responses.	
15	Layout Design and Verification of CMOS NAND and NOR Gates. Aim: To design the physical layout for 2-input universal gates and ensure DRC/LVS compliance. Objectives: • To perform Design Rule Check (DRC) and Layout Vs Schematic (LVS) verification. • To analyze the area occupied by the NAND vs. NOR layouts and optimize for compactness.	LO6

Online Resources:

- Virtual labs: https://www.vlab.co.in/
- NPTEL: http://www.digimat.in/nptel/courses/video/108107380/L01.html

Term Work:
The term work should consist of atleast 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL603	Skill Lab-Cloud Computing	--	02*+ 02	--	--	02	--	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECL603	Skill Lab-Cloud Computing	--	--	--	25	25	50

Pre-requisite:

1. ECC502: Computer Network
2. ECL404: Skill lab-Linux

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

Lab Objectives:

1. To conceptualize cloud computing fundamentals.
2. To make students familiar with key concepts of virtualization.
3. To familiarize students with different cloud service models, including IaaS, PaaS, and SaaS,
4. To provide students with an understanding of Security as a Service (SECaaS
5. To acquaint students with open cloud platforms, containerization technologies, and orchestration.
6. To design, deploy, and optimize scalable cloud-based architectures by applying cost management, performance monitoring, and best practices for reliability and availability.

Lab Outcomes:

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

1. Implement different types of virtualization techniques.
2. Analyze various cloud computing service models and implement them to solve the given problems.
3. Identify major security issues in the cloud and provide appropriate security solutions.
4. Explore various open cloud platforms and recommend the appropriate one for the given application.
5. Implement the concept of containerization and orchestration.
6. Implement Serverless architecture and configure workflows.

Module No.	Unit No.	Topics	Hrs.	LO
1.0		**Introduction to Cloud Computing**	**03**	**LO1**
	1.1	Definition of Cloud Computing, Need for Cloud computing, Characteristics, NIST model		
	1.2	Cloud deployment models (Public, Private, Hybrid, Community) and Service Models: IaaS, PaaS, SaaS.		
	1.3	Advantages and Disadvantages of Cloud computing.		
		Self-Learning Topics: Compare cloud vs traditional computing		
2.0		**Virtualization and Hypervisors**	**04**	**LO2**
	2.1	Introduction and benefits of virtualization, Virtualization Structures and Implementation Levels, Virtual Machine Monitor (VMM).		
	2.2	Hypervisors- Type I, II (Xen, KVM, VMware ESXi, Hyper-V), Virtualization Mechanisms and Tools, Hosted vs Bare Metal Hypervisors		
		Self-Learning Topics: Virtualization vs Containerization (Docker/Kubernetes).		
3.0		**Cloud Core Services**	**08**	**LO3**
	3.1	Introduction to the AWS Cloud. **Compute service:** Introduction to EC2, Instance Types, instance lifecycle, Auto Scaling, Load Balancing.		
	3.2	**Storage service:** Introduction to S3, working with Buckets, setting bucket security, bucket properties, working with Elastic Block Store (EBS) Volumes, and Object Storage Vs Block Storage.		
	3.3	**Network as a Service:** Introduction to virtual private cloud (VPC), Subnets, Elastic Network Interfaces, Internet Gateways, Route Tables, Security Groups, and Network ACLs.		
	3.4	**Database as a Service:** Introduction to Amazon Relational Database Service (RDS), Database Engines, Non-relational (No-SQL) Databases, Types of Non-relational Databases, and their features.		
	3.5	**Deployment & Management Services:** Amazon Elastic Beanstalk		
		Self- Learning Topics: Comparison of AWS services with other cloud service platforms like Azure and GCP. Selection criteria for cloud vendors.		
4.0		**Cloud Security and Identity Management**	**04**	**LO4**
	4.1	**Security service:** AWS Identity and Access Management (IAM). **Amazon Cognito:** Provides user authentication, authorization, and user management for web and mobile applications through user pools. **AWS Key Management Service (KMS):** A managed		

		service for creating, storing, and controlling encryption keys.		
	4.2	AAA Administration for Clouds - AAA model, SSO for Clouds – Authentication management and Authorization management in clouds		
		Self-Learning Topics: Cloud Security in AWS		
5.0		**Containerization and Orchestration**	**03**	**LO5**
	5.1	**Containerization using Docker** – Docker containerization concepts, image building, running containers, Docker architecture		
	5.2	**Kubernetes** – Kubernetes orchestration, Kubernetes architecture, steps to deploy a Kubernetes Cluster on local systems, deploy applications on Kubernetes, and create a Service in Kubernetes		
		Self- Learning Topics: Basics of CI/CD pipeline		
6.0		**Serverless and ML on Cloud**	**04**	**LO6**
	6.1	**Serverless Computing:** Introduction, Working with Serverless environment, Basics of serverless events and functions, AWS Lambda. **Application services:** AWS Simple Notification Service (SNS), Simple Queue Service (SQS), and Simple Email Service (SES).		
	6.2	Machine Learning with SageMaker: Introduction to SageMaker Studio, preparing datasets, and training ML models using built-in algorithms.		
		Self-Learning Topics: Explore real-world use cases, case study on sustainability and green cloud practices.		
		Total	**26**	

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	**Title: Introduction to Virtualization** AIM: To study and implement Hosted Virtualization using VirtualBox& KVM. Objective: • To know the concept of Virtualization along with their types, structures and mechanisms. • To create and run Virtual machines inside hosted hypervisors like VirtualBox and KVM with their comparison based on various virtualization parameters.	LO1
2	**Title: To study and implement Bare Metal Hypervisor using Xen Server** AIM: To study and implement Bare Metal Hypervisor using Xen Server. Objectives: • Understand Xen architecture and components • Install Xen Hypervisor and related packages • Configure GRUB to boot Xen • Launch Xen Manager and create/manage VMs	LO1
3	**Title: Introduction to Identity and Access Management** AIM: To understand and manage Identity and Access Management (IAM) by exploring users, groups, and policies. Objectives: • Explore IAM Users and Groups • Inspect IAM policies applied to groups • Add users to groups • Locate IAM sign-in URL • Experiment with policy effects	LO3
4	**Title: Introduction to Cloud Compute Service** AIM: To understand and manage compute instances. Objectives: • Launch compute instance • Configure security groups • Monitor and resize the compute instance	**LO2**
5	**Title: Working with block storage services** AIM: To manage Block Storage volumes. Objectives: • Create and attach Block Storage volume • Format and mount volume • Create a snapshot and restore volume	**LO2**
6	**Title: Scale and Load Balance Your Architecture** AIM: To implement Load Balancing and Auto Scaling. Objectives: • Create a load balancer	**LO2**

	• Configure Auto Scaling group • Monitor performance using CloudWatch	
7	**Title: Build Your Virtual Private Cloud and Launch a Web Server** AIM: To design and deploy a custom VPC and launch a compute instance. Objectives: • Create VPC and subnets • Configure security group • Launch compute instance in VPC	**LO2**
8	**Title: Introduction to Cloud Object Storage Service** AIM: To learn basic features of Object Storage Service. Objectives: • Create storage bucket • Upload objects • Manage permissions and bucket policies	**LO2**
9	**Title: Build Your DB Server and Interact With Your DB Using an App** AIM: To deploy and configure Relational Database Service (RDS). Objectives: • Launch RDS instance • Configure DB connectivity • Interact with DB using web app	**LO2**
10	**Title: Securing Applications by Using Amazon Cognito** AIM: To secure applications using Amazon Cognito. Objectives: • Create user pool • Configure identity pool • Integrate authentication in app	**LO3**
11	**Title: Encrypting Data at Rest by Using AWS Encryption Options** AIM: To implement encryption using AWS KMS. Objectives: • Review default encryption • Create KMS key • Encrypt EBS and S3 data	**LO3**
12	**Title: Automating Infrastructure Deployment with CloudFormation** AIM: To automate deployment using CloudFormation. Objectives: • Deploy VPC and app layers • Explore templates in Designer • Delete stack with retention policy	**LO2**
13	**Title: Building Decoupled Applications by Using SQS** AIM: To build decoupled architecture using SQS and SNS. Objectives: • Configure S3 events to SNS • Subscribe SQS to SNS	**LO6**

	• Implement message polling	
14	**Title: Implementing a Serverless Architecture on Cloud** AIM: **To design and implement serverless architecture using function as a service.** **Objectives:** • **Invoke FaaS from object storage/DB** • **Configure notifications using the notification service** • **Build serverless workflow**	**LO6**
15	**Title: Installation and Configuration of OpenStack** AIM: To install and configure OpenStack using DevStack. Objectives: • Understand OpenStack architecture • Install OpenStack using DevStack • Access Horizon dashboard and launch instances	**LO4**
16	**Title: To study and Implement Containerization using Docker** AIM: To know the basic differences between Virtual machine and Container. Objectives: • Demonstrate creating, finding, building, installing, and running containers • Work with Linux/Windows application containers on local or cloud platform	**LO5**
17	**Title: To study and implement container orchestration using Kubernetes** AIM: To understand steps to deploy Kubernetes Cluster and manage applications. Objectives: • Deploy Kubernetes Cluster on local systems • Deploy applications on Kubernetes • Create a Service in Kubernetes • Develop Kubernetes configuration files in YAML • Create a deployment in Kubernetes using YAML	**LO5**
18	**Title: To Train a Machine Learning Model using Cloud ML Services** AIM: To train a machine learning model using Cloud ML Services by applying the XGBoost algorithm on a biomechanical vertebral column dataset. Objectives • Split data into training, validation, and test datasets • Train an XGBoost model in Amazon SageMaker	**LO6**
19	**Title: To develop Machine Learning Pipeline with Cloud ML Services** AIM: To deploy a trained machine learning model using Cloud ML Services , perform predictions, and execute batch transformations on the test dataset. Objectives: • Deploy a machine learning model • Use the test dataset to perform a batch transformation with the model	**LO6**

Text books

[1] R. Buyya, C. Vecchiola, and S. T. Selvi, Mastering Cloud Computing, 1st ed. New Delhi, India: McGraw Hill Education, Jul. 1, 2017.

[2] A. Srinivasan and J. Suresh, Cloud Computing: A Practical Approach for Learning and Implementation, 1st ed. New Delhi, India: Pearson Education, Jan. 1, 2014.

[3] R. L. Krutz and R. D. Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 1st ed. Hoboken, NJ, USA: John Wiley & Sons.

[4] B. Sosinsky, Cloud Computing Bible, 1st ed. Hoboken, NJ, USA: Wiley Publishing, Jan. 11, 2011.

Reference books

[1] K. Jayaswal, J. Kallakurchi, D. J. Houde, and D. Shah, Cloud Computing Black Book, 2nd ed. New Delhi, India: Dreamtech Press, Jan. 1, 2014.

[2] M. Wittig and A. Wittig, Amazon Web Services in Action, 2nd ed. Shelter Island, NY, USA: Manning Publications.

[3] P. Arora, R. Biyani, and S. Dave, To the Cloud: Cloud Powering an Enterprise, 1st ed. New Delhi, India: Tata McGraw-Hill Education, Jan. 20, 2012.

[4] K. Hwang, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 1st ed. Burlington, MA, USA: Morgan Kaufmann Publishers, Nov. 22, 2011.

Term Work:

Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) = 20 Marks (Experiment) + 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/Oral Exam: (2 hours/ 25 Marks)

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

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
MDML6022	Decision Making and BI Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
MDML6022	Decision Making and BI Lab	--	--	--	25	--	25

Pre-requisite:

1.ECL304: Skill Lab-Python Programming

Lab Objectives:

1. To build a strong practical foundation in decision-making concepts.
2. To enable learners to use decision analysis tools.
3. To develop hands-on skills in data collection, profiling, cleaning, and transformation.
4. To introduce learners to the fundamentals of BI tools.
5. To guide learners in designing business-oriented KPIs and metrics.
6. To provide experience in developing end-to-end BI solutions.

Lab Outcomes:

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

1. Identify decision types and apply decision-support techniques.
2. Use analytical tools like what-if, goal seek, and sensitivity analysis.
3. Perform data preparation activities.
4. Develop BI reports and create interactive dashboards.
5. Design KPIs, metrics, and visualizations.
6. Construct interactive dashboards and small-scale BI solutions.

Suggested List of Experiments:

Sr. No.	Title of Experiments	LO
1	**Study of Decision Types & Decision Environments** • Identify real-world examples of structured, semi-structured, and unstructured decisions. • Analyse scenarios under certainty, risk, and uncertainty	LO1
2	**Implement What-If Analysis using Spreadsheet Tools** • Vary input parameters and observe impact on output (e.g., sales forecasting, profit estimation).	LO1
3	**Goal Seek Technique for Decision Making** • Use spreadsheet tools to determine required input to achieve a desired goal (e.g., break-even point).	LO2
4	**Design a Simple Decision Support System (DSS) Model** • Build a small DSS model using formulas, functions, and macros for a given business scenario.	LO2
5	**Scenario Analysis & Multi-Criteria Decision Making (MCDM) using Spreadsheets** • Define a decision problem with 3–5 alternatives and multiple criteria (e.g. cost, time, quality, risk). • Assign weights to criteria. • Use spreadsheet to compute a score for each alternative (weighted sum or simple normalized scoring).	LO2
6	**Data Collection and Data Profiling** • Collect a dataset (CSV/Excel). • Perform profiling: check data types, missing values, ranges, outliers	LO3
7	**Data Cleaning & Transformation** • Perform data cleaning (handling missing values, duplicates, formatting). • Apply transformations (normalizing, merging, splitting columns	LO3
8	**Design a dashboard** that helps a business manager monitor sales performance. Explain which KPIs you would include, how you would structure the layout, and what interactive elements (filters, drill-downs, slicers) you would add to support decision-making.	LO4
9	**Creating KPIs and Metrics for BI Reporting** • Identify KPIs for a problem statement (e.g., sales, HR, finance). • Design metric calculations in spreadsheet or BI tool.	LO4
10	**Designing BI Reports using visualization tools** • Import cleaned data. • Create basic reports (tables, cards, simple charts)	LO5
11	**Data Integration from Multiple Sources** • Combine datasets from different sources (CSV + Excel, or two Excel sheets).	LO5

	• Resolve schema mismatches and perform basic joins using spreadsheet or Power Query	
12	**Interactive Dashboard Creation** • Create dashboards with slicers/filters. Add interactive visuals like bar charts, line charts, KPI cards.	LO6
13	**Introduction to Visualization – Data Import & Basic Charts** • Import data in Tool. • Create bar, line, pie charts, tables. • Work with dimensions & measures.	LO6
14	**Cloud-Based BI using Cloud BI** • Upload cleaned dataset to cloud storage or connect via web source • Build BI reports/dashboards on cloud BI platform (simulate remote team access)	LO6
15	**BI Case Study** • Students prepare a BI solution for any domain: o Retail o HR o Healthcare o Banking o Manufacturing • Includes data preparation, visualization, dashboards, insights, and recommendations.	LO6

Textbooks:

1. E. Turban, R. Sharda, and D. Delen, Decision Support and Business Intelligence Systems, 10th ed. Pearson, 2014.
2. J. R. Evans, Business Analytics: Methods, Models, and Decisions, 2nd ed. Pearson, 2016.
3. N. Godbole, Business Intelligence, 1st ed. Wiley India, 2013.
4. L. T. Moss and S. Atre, Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications, 1st ed. Addison-Wesley, 2003.

Reference books:

1. T. H. Davenport and J. Harris, Competing on Analytics: The New Science of Winning, 1st ed. Harvard Business Review Press, 2007.
2. C. Vercellis, Business Intelligence: Data Mining and Optimization for Decision Making, 1st ed. Wiley, 2009. (BI sections only)
3. W. L. Winston, Microsoft Excel Data Analysis and Business Modeling, 4th ed. Microsoft Press, 2014.
4. P. Ponniah, Data Preparation for Analytics Using SAS, 1st ed. Wiley, 2017.

Online Resources:

- Microsoft Power BI Learning Path: https://learn.microsoft.com/power-bi/
- Tableau Learning Resources: https://www.tableau.com/learn
- Google Data Studio (Looker Studio) Tutorials: https://support.google.com/looker-studio

Term Work:

- Term work shall consist of at least 12 experiments (Ensure that all the LOs are covered). Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDML6053	System Programming and compiler Construction Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
MDML6053	System Programming and compiler Construction Lab	--	--	--	25	--	25

Pre- requisite:

1. ECC503: Discrete Structure and Automata Theory
2. ECL404: Skill Lab-Linux
3. ECC305: Computer Organization and Architecture

Program Outcomes Addressed

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of solutions
4. PO6: The Engineer and The World
5. PO7: Ethics
6. PO11: Life-Long Learning

Lab Objectives:

1. To generate machine code by implementing two pass assemblers.
2. To implement Two pass macro processor.
3. To construct Top- down/Bottom-up parser.
4. To identify and Validate tokens for given high level language
5. To implement synthesis phase of compiler.
6. To explore LEX & YACC tools

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

1. Identify data structures for implementation of two pass assemblers.
2. Design Two pass macro processor.
3. Use Lex and YACC tool for Compiler design
4. Construct various types of Parsers
5. Appreciate role of Intermediate Code Generation in connection with language designing
6. Apply optimization principles on given code

Suggested List of Experiments: Students are required to complete at least 12 experiments.

Sr. No.	Title of Experiments	LO
1	A startup building an embedded system needs to convert human-readable assembly instructions into machine code for a custom processor. Design a **two-pass assembler** that first builds symbol tables and then generates final machine code.	LO1
2	A compiler toolchain company wants to support reusable code blocks in assembly using macros. Develop a two-pass macro processor that expands macros efficiently before actual assembly translation	LO2
3	A software company is developing a compiler for a new programming language. Implement a Lex-based lexical analyzer to scan source code and identify tokens such as keywords, operators, and identifiers.	LO3
4	A code analysis tool needs to break down C programs into meaningful components for further processing. Build a tokenizer in C that extracts tokens like keywords, literals, and symbols from source code.	LO4
5	An IDE wants to provide syntax highlighting by distinguishing reserved words from user-defined names. Write a Lex program that classifies tokens as keywords or identifiers in C programs.	LO3
6	A compiler designer needs to validate grammar rules before parser construction. Develop a C program to compute FIRST and FOLLOW sets for a given grammar to assist in syntax analysis.	LO4
7	A language processing system requires efficient syntax validation of code. Design and implement an SLR(1) bottom-up parser to parse input strings based on grammar rules using C program.	LO4
8	A compiler development team is automating syntax checking of programs. Implement a YACC-based syntax analyzer that verifies whether input code follows defined grammar rules.	LO3
9	An educational compiler tool needs fast parsing for simple grammars. Write a predictive parser in C that uses LL(1) parsing techniques for syntax validation	LO4
10	A static code analysis tool must identify operators used in programs for	LO3

	optimization. Create a LEX program to detect and classify different operators in C code.	
11	A parser generator fails when given left-recursive grammars. Develop a C program to automatically eliminate left recursion from grammar rules to make them suitable for top-down parsing.	LO4
12	A compiler backend needs an intermediate representation for optimization. Write a C program that converts expressions into three-address code **(TAC)**.	LO5
13	A software system aims to improve execution efficiency of compiled programs. Implement optimization techniques like constant folding, dead code elimination, and common subexpression elimination.	LO6
14	A compiler must translate optimized intermediate code into machine-level instructions. Develop a target code generator that converts intermediate representation into assembly/machine code.	LO5
15	A data analytics company needs faster processing of large datasets. Implement a parallel sorting algorithm using OpenMP to improve performance on multi-core processors.	LO6

Textbooks:

1. J. P. Bennett Introduction to Compiling Techniques A first course using ANSI C, Lex and Yacc, ISBN 0-07-053073-4, TMH .
2. Charles N. Fischer, Richard J. LeBlanc Crafting a compiler with C, Pearson Education 2007

Reference books:

1. John R levine ,"flex & bison", ISBN 81-8404-816-5, SPD- O'Reilly
2.Anthony AabyCompiler "Construction using Flex and Bison" http://cs.wwc.edu/~aabyan/464/Book.
3.Andrew W. Appel Princeton University. Jens Palsberg Modern Compiler. Implementation in Java, Second Edition. Purdue University. CAMBRIDGE University press@2002.

Online Resources:

- IITK Tutorial: https://cse.iitkgp.ac.in/~bivasm/notes/LexAndYaccTutorial.pdf
- IBM Tutorial: https://www.ibm.com/docs/en/zos/2.1.0?topic=tools-tutorial-using-lex-yacc

Software Tools

1.Lex and YACC tool

Term Work:

- Term work should consist of at least 12 experiments.(Ensure that all LO's are covered). Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 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
ECPEL6011	Robotics and Applications Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL6011	Robotics and Applications Lab	--	--	--	25	--	25

Pre- requisites:

1. FEC 201: Applied Mathematics-II
2. FEC104: C-Programming
3. FEL 104: Applied Mechanics and Robot dynamics
4. ECC 301: Applied Mathematics-III
5. ECL 304: Skill lab(Python)

Program Outcomes Addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Engineering tool Usage
5. PO6: The Engineer and the World
6. PO8: Ethics

Lab Objectives:

1. To understand fundamentals of robotics including kinematics, dynamics, and control.
2. To gain hands-on experience with sensors, actuators, and robotic mechanisms.
3. To perform robot simulation using ROS, Gazebo, Webots or MATLAB.
4. To implement motion planning, path planning, and mobile robot navigation.
5. To develop robot programming skills using ROS, Python and microcontrollers.
6. To integrate hardware and software systems in a robotic platform.

Lab Outcomes:

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

1. Apply fundamental and advanced concepts of robot kinematics and dynamics to analyze and solve robotics problems.
2. Design and implement embedded control systems by interfacing sensors and actuators with microcontrollers.

3. Develop and test perception algorithms using vision and sensor data for environment interaction and obstacle avoidance.
4. Formulate and implement path planning and control algorithms for mobile and manipulator robots.
5. Integrate AI techniques and ROS-based software tools for developing and deploying advanced robotic applications.
6. Develop interdisciplinary problem-solving skills by integrating mechanical design, electronics, programming, and data analysis in robotics projects.

Suggested List of Experiments:

Sr. No.	Title of Experiments	LO
1	Title: Installation and Setup of ROS, Gazebo, CoppeliaSim, and Python Libraries Aim: To install and configure essential robotics software tools required for simulation and programming of robotic systems. Objectives • To install Robot Operating System (ROS) on a Linux system • To set up Gazebo and CoppeliaSim simulation environments • To install necessary Python libraries for robotics applications • To verify proper installation through sample simulations	LO1
2	Title: Implementation of Rotation and Translation Matrices in Python/MATLAB Aim: To understand and implement basic spatial transformations used in robotics. Objectives • To study coordinate transformations in 2D and 3D space • To implement rotation matrices about different axes • To implement translation matrices using homogeneous coordinates • To visualize the effect of transformations programmatically	LO1
3	Title: Forward Kinematics of a 2-DOF/3-DOF Robotic Manipulator Aim: To design and validate the forward kinematic model of a robotic manipulator using physical hardware. Objectives • To derive forward kinematic equations using DH parameters • To implement forward kinematics in software	LO1, LO2

	• To measure actual end-effector position on hardware • To validate theoretical results using real-time visualization	
4	Title: Inverse Kinematics of a 2-DOF/3-DOF Robotic Manipulator Aim: To compute joint variables required to achieve desired end-effector positions. Objectives • To formulate inverse kinematics equations • To implement analytical or numerical IK methods • To control hardware joints using computed values • To validate accuracy through real-time end-effector tracking	LO1. LO2
5	Title: Dynamic Modeling and Torque Calculation of a 2-DOF Planar Arm Aim:To analyze the dynamics of a robotic manipulator and calculate required joint torques. Objectives • To derive equations of motion using Euler–Lagrange method • To compute torque requirements during motion • To simulate arm dynamics • To understand effects of mass, inertia, and gravity	LO2, LO3
6	Title:Design of a Simple Servo-Based Robotic Arm for Pick-and-Place Operation Aim:To design and implement a basic robotic arm capable of pick-and-place tasks. Objectives • To assemble a servo-driven robotic arm • To interface servos with a microcontroller • To program coordinated joint movements • To demonstrate pick-and-place functionality	LO2, LO3
7	Title: Basic Mobile Robot Programming using Arduino/ESP32 Aim:To program a basic mobile robot using an embedded controller. Objectives • To interface motors with Arduino/ESP32 • To develop motion control programs • To test different movement patterns	LO4

	• To understand embedded control concepts	
8	Title: Simple Robot Vision using OpenCV: Color-Based Object Detection Aim: To implement basic machine vision techniques for object detection. Objectives • To capture images using a camera • To process images using OpenCV • To detect objects based on color thresholding • To display and analyze detection results	LO4
9	Title: Obstacle Avoidance Robot using Ultrasonic/IR Sensors Aim: To design a robot capable of avoiding obstacles autonomously. Objectives • To interface ultrasonic/IR sensors • To measure distance to obstacles • To implement obstacle avoidance logic • To test robot behavior in real environments	LO3
10	Title: Implementation of A* Path Planning in a 2D Grid World Aim: To implement optimal path planning for a mobile robot. Objectives • To understand graph-based path planning • To implement A* algorithm in Python • To visualize the planned path in a grid world • To analyze performance of the algorithm	LO4
11	Title: Design of a Line Following Robot using IR Sensors with P and PD Control Aim: To implement feedback control techniques for a line-following robot. Objectives • To interface IR sensors for line detection • To implement proportional (P) control • To implement proportional-derivative (PD) control • To compare tracking performance	LO5

12	Title: Basic ROS Programming using Preconfigured TurtleBot World Aim: To introduce ROS-based robot programming and simulation. Objectives • To understand ROS architecture and nodes • To work with TurtleBot simulation • To publish and subscribe ROS topics • To control robot motion using ROS	LO5
13	Title: Mobile Robot Control Using Smartphone via Bluetooth/Wi-Fi Aim: To control a mobile robot wirelessly using a smartphone. Objectives • To establish Bluetooth/Wi-Fi communication • To develop a mobile control interface • To send control commands to the robot • To demonstrate real-time wireless control	LO4, LO5
14	Title: Deep Learning-Based Real-Time Object Recognition for Robotic Applications Aim: To apply deep learning techniques for object recognition in robotics. Objectives • To study CNN-based object recognition models • To integrate pre-trained deep learning models • To perform real-time object detection • To analyze recognition accuracy and speed	LO6
15	Title: Autonomous Robot Navigation using SLAM and ROS Aim: To implement autonomous navigation using SLAM techniques. Objectives • To understand SLAM principles • To generate maps using sensors • To localize robot within a map • To navigate autonomously using ROS	LO5, LO6

16	Title: Mini Project on Robotic Application Aim: To design and implement a complete robotic system integrating learned concepts. Objectives • To identify a real-world robotic problem • To design hardware and software solution • To implement control, sensing, and intelligence • To present and demonstrate the working prototype	LO5, LO6

Textbooks:

1. Fundamentals of Robotics: Applied Case Studies with MATLAB® & Python by Hamid D. Taghirad (CRC Press, 2025).
2. Python Programming Handbook for Robotics Development.

Reference books:

1. Modern Robotics: Mechanics, Planning, and Control by Kevin Lynch and Frank Park (2018).
2. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy by Lentin Joseph

Online Resources:

- https://www.mathworks.com/products/robotics.
- ROS Tutorials and Documentation: https://docs.ros.org
- OpenCV Documentation: https://opencv.org
- https://github.com/aras-labs/Fundamentals_of_Robotics.
- https://www.mathworks.com/academia/books/matlab-with-python-debray.html.

Software Tools:

1. MATLAB with Robotics System Toolbox and Simulink (including ROS Toolbox)
2. Python with robotics libraries (Robotics Toolbox for Python, OpenCV)
3. Robot Operating System (ROS / ROS 2)
4. Gazebo or CoppeliaSim for robot simulation
5. Arduino IDE and ESP32 development environment

Hardware Tools:

1. Microcontroller boards: Arduino Uno, ESP32, Raspberry Pi
2. Servo motors (for robotic arm actuation)
3. Ultrasonic and IR sensors (for obstacle detection and line following)
4. Camera or webcam (for vision-based tasks)
5. Mobile robot chassis/platform or TurtleBot (for ROS experiments)
6. Communication modules: Bluetooth/Wi-Fi modules

Term Work:
Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL6012	Artificial Intelligence Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL6012	Artificial Intelligence Lab	--	--	--	25	--	25

Pre- requisite:

1. FEL103: C-Programming Lab
2. ECL304: Skill Lab-Python Programming

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design / Development of Solutions.
4. PO5: Engineering tool usage
5. PO8: Individual and Collaborative Teamwork.
6. PSO1: To acquire knowledge in cutting-edge technologies.

Lab Objectives:

1. To design and analyze AI agents using PEAS (Performance measure, Environment, Actuators, Sensors) for real-world scenarios.
2. To implement uninformed and informed search algorithms (such as BFS, DFS, A*) to solve practical problem statements.
3. To evaluate and compare the performance of AI search algorithms like A* and Greedy Best-First Search based on efficiency and optimality.
4. To develop logic-based programs using Prolog for solving simple AI problems.
5. To represent knowledge using logical statements and apply inference techniques for reasoning in natural language problems.
6. To construct basic planning models and Bayesian Belief Networks for decision-making under uncertainty.

Lab Outcomes:

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

1. Articulate the design of AI agents in terms of PEAS properties
2. Apply informed and uninformed search techniques to solve real-life problem statements

3. Analyze the performance of alternative AI algorithms such as A*, Greedy Best-First Search etc.
4. Implement simple programs using Prolog.
5. Represent natural language description as statements in Logic and apply inference rules to it.
6. Construct simple planning and Bayesian Belief Network for a given problem.

Suggested List of Experiments:

Sr. No.	Title of Experiments	LO
1	Provide the PEAS description and TASK Environment for a given AI problem. **AIM:** To design and represent intelligent agents using the PEAS framework. **Objectives:** • Define Performance Measure, Environment, Actuators, Sensors • Model real-world AI problems using PEAS • Analyze agent behavior in different environments • Design rational agents	LO1
2	Implement various uninformed search techniques. (BFS, DFS) **AIM:** To implement uninformed search algorithms for problem solving. **Objectives:** • Implement Breadth First Search (BFS) • Implement Depth First Search (DFS) • Compare time and space complexity • Analyze completeness and optimality	LO2
3	Implement informed search techniques: A* algorithm. **AIM:** To implement A* algorithm for informed search. **Objectives:** • Understand heuristic functions • Implement A* using g(n), h(n), f(n) • Compare with uninformed search methods • Analyze efficiency and optimality	LO2
4	Implement Greedy Best First Search. **AIM:** To implement Greedy Best First Search and compare with A*. **Objectives:** • Implement Greedy Best First Search • Compare with A* algorithm • Analyze optimality and performance • Study limitations of greedy approach	LO3
5	Write a program to implement game playing algorithm TIC-TAC-TOE using python. **AIM:** To implement game playing using AI techniques. **Objectives:** • Implement Minimax algorithm	LO3

	• Understand adversarial search • Enable optimal decision making • Implement Alpha-Beta pruning	
6	Write a program to implement the Genetic Algorithm. (Captcha Generation, password Suggestion, numeric function computation) **AIM:** To implement Genetic Algorithm for optimization problems. **Objectives:** • Understand selection, crossover, mutation • Solve optimization problems • Implement password generation or numeric optimization • Analyze convergence behavior	LO3
7	Write simple programs using PROLOG as an AI programming Language. **AIM:** To implement basic AI programs using PROLOG. **Objectives:** • Write facts and rules in PROLOG • Perform logical queries • Understand declarative programming • Build simple expert systems	LO4
8	Apply forward, backward and resolution inference algorithms to prove the goal sentence from the following set of statements in FOPL. **AIM:** To apply inference techniques in FOPL. **Objectives:** • Implement forward chaining • Implement backward chaining • Apply resolution method • Prove goal statements logically	LO5
	Create a Bayesian Network for the given Problem Statement and draw inferences from it. **AIM:** To model uncertainty using Bayesian Networks. **Objectives:** • Define random variables • Construct Bayesian Network • Assign conditional probabilities • Perform probabilistic inference	LO6
10	Create a FOL knowledge base and implement unification and inference algorithms. **AIM:** To create a knowledge base and apply unification in FOL. **Objectives:** • Represent knowledge in FOL • Implement unification algorithm • Apply inference rules	LO5

	• Solve logical queries	
11	Implement planning in AI using Block World problem. AIM: To implement planning in AI using Block World problem. Objectives: • Define initial and goal states • Apply planning algorithms • Generate sequence of actions • Understand STRIPS representation	LO6
12	Implement Supervised Learning using Simple Dataset AIM: To implement a basic supervised learning technique for prediction. Objectives: • Understand concept of supervised learning • Train model using labeled dataset • Perform prediction on test data • Evaluate accuracy of the model	
13	**Implement Unsupervised Learning (Clustering)** AIM: To implement unsupervised learning using clustering technique. Objectives: • Understand concept of unsupervised learning • Implement simple clustering algorithm (e.g., K-means) • Group data based on similarity • Analyze clustering results	]
14	**Study and Implement Learning Agent Model** **AIM:** To understand and implement components of a learning agent. **Objectives:** • Study components: performance element, learning element, critic, problem generator • Design simple learning agent model • Simulate learning behavior • Analyze agent improvement over time	
15	Case study: AI application from IEEE/ACM/Springer and prepare a structured technical analysis.	LO1

Textbooks:

1. S. J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Upper Saddle River, NJ, USA: Pearson Education, 2021.
2. I. Bratko, Prolog Programming for Artificial Intelligence, 4th ed. Harlow, U.K.: Addison-Wesley, 2012.

Reference books:

1. S. Marsland, Machine Learning: An Algorithmic Perspective, 2nd ed. Boca Raton, FL, USA: CRC Press, 2015.
2. A. K. Pandey, Artificial Intelligence with Python, 2nd ed. Birmingham, U.K.: Packt Publishing, 2018.

Online Resources:

- GitHub: https://github.com/aimacode/aima-python?utm_source=chatgpt.com
- AIMA: https://aima.cs.berkeley.edu/2nd-ed/code.html

Software Tools

1. Python

Term Work:

Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL6013	Cyber Security Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL6013	Cyber Security Lab	--	--	--	25	--	25

Pre-requisite:

1. ECC502: Computer Network

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 understand the fundamentals of network and system security and their practical implementation.
2. To explore and analyze security threats and vulnerabilities in networks and applications.
3. To gain hands-on experience in cryptographic algorithms and secure authentication mechanisms.
4. To learn and apply firewall configuration, browser security settings, and packet analysis using modern tools.
5. To develop skills in implementing encryption, hashing, and secure communication techniques.
6. To encourage problem-solving and teamwork through simulation-based security experiments

Lab Outcomes:

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

1. Demonstrate understanding of network sniffing, traffic capture, and basic attack concepts.
2. Apply cryptographic algorithms (Caesar, AES, DES) and hashing (MD5, SHA-256)
3. Develop scripts for port scanning, vulnerability assessment, and packet analysis.
4. Analyze the behavior and impact of cyber-attacks such as DDOS, IP spoofing, and DNS attacks.
5. Evaluate Python-based tools for spam filtering, malware analysis, and security web

scraping.
6. Design and implement a simple IDS that processes distributed logs to detect intrusion attempts.

Suggested List of Experiments

Sr. No.	Title of Experiments	LO
1.	Title: Installation and Exploration of Wireshark for Network Traffic Analysis Aim: To install and explore the basic functionalities of Wireshark version 2.0.5 for understanding packet sniffing and network traffic analysis. Objectives: • To install and configure Wireshark on the system • To capture live network traffic from different interfaces • To analyze packets based on protocols such as TCP, UDP, ICMP, and HTTP • To understand packet structure including headers and payload • To apply filters for effective packet analysis	LO1
2	Title: Implementation of Classical Encryption and Decryption Using Caesar Cipher Aim: To implement fundamental encryption and decryption mechanisms using classical substitution ciphers such as the Caesar cipher. Objectives: • To understand the concept of classical cryptography • To study the working of substitution ciphers • To implement Caesar cipher encryption technique • To perform decryption using the same key • To analyze limitations of classical encryption methods	LO2
3	Title: Implementation of Symmetric Key Encryption Using AES and DES Aim: To implement symmetric key encryption and decryption techniques using standard algorithms such as AES and DES. Objectives: • To understand symmetric key cryptography • To implement AES encryption and decryption • To implement DES encryption and decryption • To compare security levels of AES and DES	LO2

	• To study the importance of key size in encryption	
4	Title: Generation and Verification of Digital Hashes Using MD5 and SHA-256 Aim: To generate and verify digital hashes for files and messages using cryptographic hashing techniques. Objectives: • To understand cryptographic hash functions • To generate MD5 hashes for files and messages • To generate SHA-256 hashes for files and messages • To verify data integrity using hash comparison • To analyze hash collision resistance concepts	LO2
5	Title: Packet Capture and Analysis Using Python Libraries Aim: To write a script to capture and analyze network packets using libraries such as Scapy or PySpark. Objectives: • To understand packet sniffing concepts • To capture real-time network packets programmatically • To analyze protocol headers and payload data • To filter packets based on protocol or port • To interpret captured packets for network analysis	LO3
6	Title: Basic Penetration Testing Using Nmap Aim: To perform basic penetration testing tasks such as port scanning and vulnerability scanning using Nmap. Objectives: • To understand penetration testing fundamentals • To perform port scanning on target systems • To identify open ports and running services • To detect basic vulnerabilities using Nmap scripts • To analyze scan reports for security assessment	LO3
7	Title: Simulation and Analysis of Cyber Attacks Aim: To simulate cyber-attacks and analyze their impact on network systems. Objectives: • To simulate Distributed Denial of Service (DDoS) attacks • To perform IP spoofing attacks	LO4

	• To execute DNS-based attacks • To analyze network traffic during attacks • To understand attack impact and mitigation methods	
8	Title: Spam Detection Using Filtering and Classification Techniques Aim: To implement a script capable of detecting spam messages using filtering and classification techniques. Objectives: • To understand spam detection concepts • To preprocess message data • To apply filtering techniques for spam identification • To classify messages as spam or non-spam • To evaluate detection effectiveness	LO5
9	Title: Web Scraping for Automated Data Collection Aim: To create a web-scraping system that automatically collects and extracts data from websites. Objectives: • To understand principles of web scraping • To extract information from web pages using parsing techniques • To automate the data collection process • To store extracted data for further analysis • To understand legal and ethical considerations of web scraping	LO5
10	Title: Static Malware Analysis for Threat Identification Aim: To perform basic static malware analysis by extracting file signatures, strings, and metadata. Objectives: • To understand static malware analysis techniques • To extract file signatures and hash values • To analyze readable strings from executables • To examine file metadata • To identify indicators of malicious behavior	LO5

11	Title: Threat Intelligence Gathering Using Security APIs Aim: To interact with external security-focused services and APIs such as VirusTotal or Shodan for threat analysis. Objectives: • To understand threat intelligence concepts • To analyze files and URLs using VirusTotal • To gather network intelligence using Shodan • To interpret security threat reports • To understand practical applications of threat intelligence	LO6
12	Title: Development of a Simple Intrusion Detection System (IDS) Aim: To develop a simple Intrusion Detection System for monitoring and detecting suspicious activities. Objectives: • To understand IDS concepts and architecture • To monitor network or system activities • To detect unusual or suspicious behavior • To generate alerts for intrusion attempts • To analyze IDS effectiveness	LO6
13	Title: Implementation of a Distributed Intrusion Detection System (DIDS) Aim: To develop a Distributed Intrusion Detection System that gathers attack information from multiple network nodes and prepares intrusion reports. Objectives: To • To understand the concept of Distributed IDS • To collect log files from users across the network • analyze logs for intrusion attempts • To correlate attack information from multiple sources • To generate comprehensive intrusion detection reports	LO6
14	Title: Configuration and Testing of Firewall Rules Aim: To configure and test firewall rules for controlling incoming and outgoing network traffic. Objectives: • To understand the concept of firewalls and network security policies • To configure firewall rules using tools like Windows Firewall / UFW (Linux) • To allow or block specific ports and IP addresses	LO4

	• To monitor traffic based on configured rules • To analyze the effectiveness of firewall configurations	
15	Title: Secure Communication Using SSL/TLS Protocol Aim: To implement and analyze secure communication using SSL/TLS protocols. Objectives: • To understand the working of SSL/TLS protocols • To establish a secure client-server communication • To generate and use digital certificates • To analyze encrypted traffic using tools like Wireshark • To compare secure (HTTPS) and non-secure (HTTP) communication	LO2, L04

Online Resources:

- Virtual Penetration Testing Labs- https://pentesterlab.com
- OWASP- https://owasp.org/
- DVWA- https://dvwa.co.uk
- FISMA - https://csrc.nist.gov/projects/risk-management/fisma-background
- PCI DSS ttps://www.itgovernance.eu/blog/en/a-guide-to-the-4-pci-dss-compliance-levels

- **Term Work**:
  Term work should consist of at least 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

- **Term work Marks (CIAP):**
  25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
  The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECPEL6014	Advanced Networking Technologies Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECPEL6014	Advanced Networking Technologies Lab	--	--	--	25	--	25

Pre-requisite:

1. ECC502: Computer Network

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and development of solutions
4. PO5: Modern tool usage
5. PO7: Ethics
6. PO9: Individual and teamwork
7. PO11: Lifelong learning
8. PSO2: Develop innovative multidisciplinary projects

Lab Objectives:

1. To introduce advanced wireless LAN and WAN technologies and their architectures.
2. To explain optical networking concepts including SONET, WDM, and DWDM.
3. To describe emerging wireless technologies such as WPAN, WMAN, VANET, and sensor networks.
4. To analyze network security principles, threats, and safeguards for secure communication.
5. To illustrate multimedia networking protocols and compression techniques for efficient data transmission.
6. To discuss network design principles including hierarchical and ubiquitous computing models.

Lab Outcomes:

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

1. Implement and analyze wireless LAN/WAN.

2. Analyze SONET, WDM, and DWDM concepts in optical networking.
3. Analyze advanced wireless technologies and their applications in modern networks.
4. Apply security mechanisms and firewall configurations for network protection.
5. Illustrate multimedia communication protocols and techniques for real-time data transfer.
6. Design network architectures using hierarchical and backbone design principles.

	Suggested List of Experiments	
Sr. No.	**Title of Experiments**	**LO Mapping**
1	Title: Configure a Basic WLAN AIM: To set up a wireless LAN using an Access Point and wireless clients in Cisco Packet Tracer. Objectives: - Configure SSID and wireless security (WPA2). - Assign IP addresses to wireless devices. - Verify connectivity between wireless clients and wired network.	LO1
2	Title: Infrastructure vs Ad-hoc Wireless Network AIM: To compare infrastructure and ad-hoc wireless network configurations. Objectives: - Create an infrastructure network using an Access Point. - Configure an ad-hoc network between wireless clients. - Test connectivity and analyse differences in topology.	LO1
3	Title: Implement CSMA/CA in WLAN AIM: To observe collision avoidance in a wireless medium using CSMA/CA. Objectives: - Configure multiple wireless clients accessing the same AP. - Generate traffic and monitor packet transmission behavior. - Understand how CSMA/CA reduces collisions.	LO1
4	Title: Design a SONET-like Backbone AIM: To represent SONET ring topology using serial links in Packet Tracer. Objectives: - Create a redundant ring topology with routers. - Configure IP addressing and routing. - Test failover by disabling links.	LO2
5	Title: Configure WPAN-like Wireless Network AIM: To simulate short-range wireless connectivity using Packet Tracer. Objectives: - Connect IoT devices to a wireless router. - Configure basic wireless settings. - Verify device communication.	LO3
6	Title: Configure Firewall using ACLs	LO4

	AIM: To implement packet filtering using Access Control Lists. Objectives: - Configure standard and extended ACLs on routers. - Block/allow traffic based on IP and protocol. - Test security by generating traffic from different hosts.	
7	Title: Implement IPTABLES Equivalent AIM: To simulate IPTABLES functionality using ACLs. Objectives: - Create rules to allow HTTP and block FTP traffic. - Apply ACLs to router interfaces. - Verify filtering using simulation mode.	LO4
8	Title: Configure VPN Tunnel AIM: To establish a secure VPN tunnel between two routers. Objectives: - Configure GRE tunnel interfaces. - Assign IP addresses and routing. - Verify encrypted communication through the tunnel.	LO4
9	Title: Enable Secure Remote Access AIM: To configure SSH and HTTPS for secure device management. Objectives: - Enable SSH on routers and switches. - Configure HTTPS on a web server. - Test secure login and access.	LO4
10	Title: Configure VoIP in Packet Tracer AIM: To set up VoIP communication using IP phones and call manager. Objectives: - Configure IP phones and assign extensions. - Set up a call manager on a router. - Test voice calls between phones.	LO5
11	Title: Multimedia Streaming Simulation AIM: To simulate video streaming using HTTP server and clients. Objectives: - Configure an HTTP server with multimedia content. - Connect clients and request streaming. - Monitor bandwidth utilization.	LO5
12	Title: Design a 3-Tier Enterprise Network AIM: To create a hierarchical network with core, distribution, and access layers. Objectives: - Configure VLANs and inter-VLAN routing. - Implement STP for redundancy. - Verify connectivity across all layers.	LO6
13	Title: Implement Quality of Service (QoS) for Multimedia Traffic AIM: To configure and analyze Quality of Service (QoS) mechanisms to prioritize multimedia traffic in a network.	LO5

	Objectives: - Classify traffic based on application type (voice, video, data). - Configure priority queuing or CBWFQ on routers. - Analyze delay, jitter, and packet loss for multimedia traffic.	
14	Title: Simulate VANET Communication Using Mobile Nodes AIM: To study Vehicular Ad-Hoc Network (VANET) concepts by simulating mobile wireless nodes. Objectives: - Configure wireless nodes to represent vehicles. - Analyze dynamic topology changes due to node mobility. - Observe packet delivery and latency under changing network conditions.	LO3
15	Title: Wireless Network Security Analysis AIM: To analyze common wireless network security threats and implement basic protection mechanisms. Objectives: - Simulate wireless attacks such as unauthorized access. - Implement WPA2 security and MAC filtering. - Analyze the impact of security mechanisms on network performance.	LO4

Online Resources:

- https://www.netacad.com/
- 9tut.com – CCNA Tutorials & Labs

Term Work:
The term work should consist of atleast 12 experiments. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =20 Marks (Experiment) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Course Code	Course Name	Credits Assigned			
		Theory	Practical	Tutorial	Total
ECP601	Major Project I	--	2	--	2

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ECP601	Major Project I	--	--	--	25	25	50

Program Outcomes addressed:

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 and The World.
7. PO7: Ethics.
8. PO8: Individual and Collaborative Team work.
9. PO9: Communication.
10. PO10: Project Management and Finance.
11. PO11: Life-Long Learning.

Objectives:

1. Investigate and evaluate prominent literature to come with application-oriented project topics in connection with the curriculum.
2. Study and develop an outline for thinking and practice that illuminates and brings insight to the design and implementation aspects with respect to the project topic.
3. Design and create practical resources and solution aspect for the design and implementation.
4. Present an organised exploratory framework, while understanding the documentary deliverables within established academic practices and/ or ideas.
5. Offer inquiry-based argumentation / presentation along with project implementation
6. To promote self-learning and research-oriented thinking.

Outcomes: Upon completion of this course, learners will be able to:

1. Perform extensive Review of Literature from diverse knowledge banks or through interactions with Industry experts.
2. Developing or Creating ideas capable of addressing industrial or social solutions to identified problem domains.
3. Acquire knowledge of tools & technologies and application of their expertise in creating project implementation and deliverables.

4. Implement solutions using appropriate technologies, engineering practices, and version control.
5. Test and validate the system through structured test cases, datasets, and simulations.
6. Compose technical documentation, present project outcomes, and demonstrate teamwork, ethics, and self-learning.

1. Guidelines for Project topic selection Process to be defined and followed:

1.1 General Guidelines

a. Project orientation can be given at the end of fifth semester.
b. Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
c. Students can select the problem statement from the Industry and provide technology solution as capstone project. Capstone projects in engineering study are considered important as it allow students to integrate and apply the knowledge and skills acquired throughout their academic program and effectively demonstrating their learning of programme by tackling a real-world problem, ultimately keeping them well prepared for the job market
d. Student‘s should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
e. Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.

1.2 Topics can be finalized with respect to following criterion:

a. Topic Selection: The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
b. Technology Used: Use of latest technology or modern tools can be encouraged.
c. Students should not repeat work done previously (work done in the last three years).
d. Project work must be carried out by the group of at least 2 students and maximum 4.
e. The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
f. The Capstone Project- problems must be related to the programme or may be interdisciplinary, based on the industry expected outcomes.The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
g. Project shall address National Thrust area such as Environment, Digitization, Automation, sustainability and predefined Sustainable development goals(SDGs).
h. The project proposal presentations can be scheduled according to the domains

and should be judged by faculty who are expert in the domain.

i. Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
j. Guide allocation should be done and students have to submit weekly progress report to the internal guide.
k. Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
l. In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels.

1.3 Deployment Requirement

a. Each project must include a deployment phase, ensuring the solution is usable in a real-world or simulated environment.

Examples of deployment include:

- Web application hosted on cloud/server
- Mobile application (APK/Test version/Play Store)
- Industrial automation system implemented or simulated
- AI/ML model deployed via API or dashboard
- IoT system with real-time monitoring and control

2. Guidelines for Assessment of Major Project I:

1.1 Term Work Evaluation (CIAP)

a. A Review/Progress Monitoring Committee shall be constituted by the Head of Department. **Major Project I** shall be evaluated continuously, with a minimum of two reviews per semester.
b. Continuous assessment should also emphasize individual performance, including each student's contribution, understanding of the project, and responses during review interactions.
c. Project report to be submitted as per the guidelines issued by the department.
d. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

2.2 Distribution of marks

The distribution of Term Work marks for the semester shall be as follows:

a. Marks by Guide/Supervisor based on Logbook: 10
b. Marks by Review Committee: 10
c. Quality of Project Report: 05

1.3 Evaluation Rubrics CIAP (Term work);

a. Quality of literature survey and need identification
b. Clarity of problem definition
c. Innovation and creativity
d. Feasibility and justification of approach
e. Cost effectiveness and societal/environmental impact (SDGs)
f. Quality of system design and use of engineering norms
g. Implementation quality and functioning of prototype
h. Effective use of technical skill sets and tools
i. Teamwork, leadership, and individual contribution
j. Clarity in documentation, presentation, and communication
k. Deployment readiness and implementation feasibility
l. Usability, scalability, and real-world applicability of the deployed solution

1.4 ESEP (Practical/Oral) Examination:

a. **Major Project I** shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by the head of Institution.
b. Students shall be motivated to publish a paper based on the work in Conferences/students competitions.
c. End-semester Practical / oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

1.5 Evaluation Rubrics ESEP (Practical / Oral):

a. Problem identification and clarity
b. Innovation in solution
c. Feasibility and societal impact
d. Working model functionality
e. Effective use of engineering tools
f. Adherence to standards and norms
g. Teamwork and individual contribution
h. Communication skills
i. Deployment quality (hosting, execution, usability, and performance)

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 is to be conducted based on a 50% syllabus with a 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 is to be conducted based on a 50% syllabus with a duration of one hour.

In Semester Examination (ISE)

ISE 20 marks = 05 marks of attendance +15 marks for Activities.
ISE 15 marks = 05 marks of attendance +10 marks for Activities.
The Rubrics for activities are as follows. The activities will be decided by the 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	Winning 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 4weeks 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 to complete the certification, the grading must be done accordingly.