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 & Telecommunication Engineering

Curriculum Structure FE to B.E

and

Second Year Syllabi

Board of Studies
Department of Electronics & Telecommunication Engineering

Academic Council
SIES Graduate School of Technology

Effective from: AY 2025-26

PREAMBLE

Dear Students and Stakeholders,

We are excited to present the newly created autonomous curriculum at the SIES Graduate School of Technology's Department of Electronics and Telecommunication (EXTC) engineering. This innovative program seeks to improve creativity, develop excellence, and adjust to the ever-changing requirements of society—all of which will increase the country's technological prowess and competitiveness abroad.

The Department has designed its curricula using a top-down methodology. A clear and measurable set of learning objectives, the design of content that is aligned with the learning objectives, the integration of experiential learning through projects, skill laboratories, internships, and industry collaboration, the mapping of the program outcomes to courses, and the setting of the stage for ongoing evaluation and improvement are among the steps. After identifying the industry requirements, four honors/minor tracks—Cyber Security, AIML, Data Science, Blockchain—are introduced.

The content of program electives, laboratory courses, core courses, and honors/minor courses has all been designed with the current industry trends in mind. We have added courses that will undoubtedly prepare our graduates for different industries in India.

Our program is meant to give students a thorough grasp of fundamental subjects including electronics, communication, and signal processing, in line with the transformative vision outlined in the National Education Policy (NEP) 2020. Students get the abilities necessary to handle challenging problems through interdisciplinary courses, skill labs, and specially created laboratory courses. The curriculum offers program electives in a variety of subjects, to accommodate students with a wide range of interests.

Teachers have a plethora of chances within the independent curriculum to innovate and improve the learning experience for students. Instructors can take part in research and development projects, actively contribute to curriculum creation, and provide internships for students to experience new things. Instructors might establish collaborations with business associations to enhance the curriculum through projects, internships, and guest lectures that are pertinent to the business. In general, curriculum autonomy seeks to give instructors the ability to be heavily involved in determining how students learn in the subject of Electronics and Telecommunication engineering.

We therefore hope to enable our graduates to become leaders, innovators, and worldwide ambassadors of excellence in the field of Electronics and Telecommunication engineering by fostering creativity, resilience, and an inquisitive attitude. We extend an invitation to all interested parties to join us in reshaping engineering education as we set out on this revolutionary adventure. Let us work together to achieve greatness, innovation, and societal impact.

Chairperson
Board of Studies
Electronics & Telecommunication Engineering
SIES Graduate School of Technology

HEAD
Department of Electronics & Telecommunications
S.I.E.S. Graduate School of Technology
Sri Chandrasekarendra Saraswathy Vidyapuram
Plot 1-C & E, Sector-V, Nerul, Navi Mumbai-400 706

Chairperson
Academic Council
SIES Graduate School of Technology

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

Semester-wise Credit Distribution Structure for Four Year UG Engineering

Program – Electronics and Telecommunication Engineering: One Major,One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course(BSC)	BSC/ESC	7	6		--	--	--	--	--	13
Engineering Science Course (ESC)		9	10		--	--	--	--	--	19
Programme Core Course (PCC)	Program Courses	--	--	17	11	12	12	04		56
Programme Elective Course (PEC)		--	--	--	--	03	03	07		13
Multidisciplinary Minor (MDM)	Multidisciplinary Courses		-		03	04	04	04		15
Open Elective(OE) Other than a particular program		--	--	--	--	--	--	03	03	06
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	01	01	02	02	--	02	--	--	08
Ability Enhancement Course (AEC - 01, AEC-02)	Humanities Social Science and Management (HSSM)		02	--	--	02	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	--	02	--	--	--	--	02
Research Methodology(RM)	Experiential Learning Courses	--	--	--	--	--	--	--	03	03
Community Engagement Project (CEP) / Field Project (FP)		--	--	01	01	--	--	-	-	02
Project		--	--	--	--	01	01	02	02	06
Internship/On Job Training (OJT)		--	---						09	09
Co-curricular Courses(CC)	Liberal Learning Courses	04			--	--	--	--	-	04
Total Credits (Major)		**21**	**21**	**22**	**21**	**22**	**22**	**20**	**17**	**166**

CURRICULUMSTRUCTURE

SECOND YEAR ENGINEERING
(Electronics and Telecommunication Engineering)
Academic Year 2025-26

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
VEC	Value Education Courses
VSEC	Vocational and Skill Enhancement Courses
AEC	Ability Enhancement Courses
RM	Research Methodology
CEP/FP	Community Engagement Project/Field Project
OJT	On Job Training/Internship
CC	Co-curricular 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

Program Structure for First Year Engineering
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	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**	**17**	--	**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.
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 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
ESEP: End Semester Examination Practical

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

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

Semester II

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
FEC201	Applied Mathematics -II	BSC	3	--	--	3	--	--	3
FEC2021/ FEC1022	Applied Physics/Applied Chemistry[@]	BSC	3	--	--	3	--	--	3
FEC203	Engineering Graphics	ESC	2	--	--	2	--	--	2
FEC204	Digital System Design	ESC	3	--	--	3	--	--	3
FEC205	Professional Communication Techniques	AEC	2	--	--	2	--	--	2
FEL2011/ FEL1012	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
	Total		**13**	**14**	--	**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	02	--	--	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 of2 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 of 20/15 marks.
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SIES Graduate School of Technology
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Bachelor of Engineering

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

Semester III

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETC301	Applied Mathematics III	PCC	3	--	--	3	--	--	3
ETC302	Electronic Devices and circuits	PCC	3	--	--	3	--	--	3
ETC303	Microprocessor and Microcontroller	PCC	3	--	--	3	--	--	3
ETC304	Network Theory	PCC	3	--	--	3	--	--	3
ETC305	Signals & Systems	PCC	3	--	--	3	--	--	3
ETC306	Engineering Economics	HSSM	2	--	--	2	--	--	2
ETL301	Electronic Devices and circuits Lab	PCC	--	2	--	--	1	--	1
ETL302	Microprocessor and Microcontroller Lab	PCC	--	2	--	--	1	--	1
ETL303	Skill Lab (Python Programming)	VSEC	--	2*+2	--	--	2	--	2
ETM301	Mini Project 1A	CEP	--	2$	--	--	1	--	1
Total			**17**	**10**	**--**	**17**	**5**	**--**	**22**

Examination Scheme - EXTC Semester-III

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC301	Applied Mathematics III	20	20	60	3	--	--	100
ETC302	Electronic Devices and circuits	20	20	60	3	--	--	100
ETC303	Microprocessor and Microcontroller	20	20	60	3	--	--	100
ETC304	Network Theory	20	20	60	3	--	--	100
ETC305	Signals & Systems	20	20	60	3	--	--	100
ETC306	Engineering Economics	50	--	--	--	--	--	50
ETL301	Electronic Devices and circuits Lab	--	--	--	--	25	25	50
ETL302	Microprocessor and Microcontroller Lab	--	--	--	--	25	25	50
ETL303	Skill Lab (Python Programming)	--	--	--	--	25	25	50
ETM301	Mini Project 1A	--	--	--	--	25	25	50
Total	--	**125**	**125**	**300**	**--**	**100**	**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

Program Structure for Second Year

W.E.F.A.Y.2025-26

Semester IV

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETC401	Applied Mathematics-IV	PCC	3	--	--	3	--	--	3
ETC402	Principles of Communication Engineering	PCC	3		--	3	--	--	3
ETC403	Linear Integrated Circuits	PCC	3		--	3	--	--	3
ETC404	Critical Thinking and Design	HSSM	2	--	--	2	--	--	2
MDMC40X1	Multidisciplinary Minor (MDM-I)	MDM	3	--	--	3	--	--	3
ETL401	Principles of Communication Engineering Lab	PCC	--	2	--	--	1	--	1
ETL402	Linear Integrated Circuits Lab	PCC	--	2	--	--	1	--	1
ETL403	Skill Lab (Linux)	VSEC	--	2*+2	--	--	2	--	2
ETL404	Value Education (UHV)	HSSM (VEC)	--	4	--	--	2	--	2
ETM401	Mini Project 1B	CEP	--	2$	--	--	1	--	1
Total			**14**	**14**	**--**	**14**	**7**	--	**21**

Examination Scheme - EXTC Semester-IV

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC401	Applied Mathematics-IV	20	20	60	3	--	--	100
ETC402	Principles of Communication Engineering	20	20	60	3	--	--	100
ETC403	Linear Integrated Circuits	20	20	60	3	--	--	100
ETC404	Critical Thinking and Design	15	15	45	2	--	--	75
MDMC40X1	Multidisciplinary Minor (MDM-I)	20	20	60	3	--	--	100
ETL401	Principles of Communication Engineering Lab	--	--	--	--	25	25	50
ETL402	Linear Integrated Circuits Lab	--	--	--	--	25	25	50
ETL403	Skill Lab (Linux)	--	--	--	--	25	25	50
ETL404	Value Education (UHV)	--	--	--	--	50	--	50
ETM401	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.
UHV: Universal Human Values
$ Indicates workload of a learner (Not faculty) for Mini Project 1B. Faculty Load: ½ hour per week per four groups.

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

Program Structure for Third Year
W.E.F.A.Y.2026-27

Semester V

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETC501	Digital Communication	PCC	3	--	--	3	--	--	3
ETC502	Discrete Time Signal Processing	PCC	3	--	--	3	--	--	3
ETC503	Electromagnetics Engineering and Antenna	PCC	3	--	--	3	--	--	3
MDMC50X2	Multidisciplinary Minor (MDM-II)	MDM	3	--	--	3	--	--	3
ETPEC501X	Program Elective-I	PEC	3	--	--	3	--	--	3
ETL501	Digital Communication Lab	PCC	--	2	--	--	1	--	1
ETL502	Discrete Time Signal Processing Lab	PCC	--	2	--	--	1	--	1
ETL503	Electromagnetics Engineering and Antenna Lab	PCC	--	2	--	--	1	--	1
ETL504	Professional Communication & Ethics Lab	AEC	--	2*+2	--	--	2	--	2
MDML50X1	MDM-Lab I	MDM	--	2	--	--	1	--	1
ETM501	Mini Project 2A	Project	--	2$	--	--	1	--	1
Total			**15**	**14**	**--**	**15**	**7**	**--**	**22**

Examination Scheme - EXTC Semester-V

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC501	Digital Communication	20	20	60	3	--	--	100
ETC502	Discrete Time Signal Processing	20	20	60	3	--	--	100
ETC503	Electromagnetics Engineering and Antenna	20	20	60	3	--	--	100
MDMC50X2	Multidisciplinary Minor (MDM-II)	20	20	60	3	--	--	100
ETPEC501X	Program Elective-I	20	20	60	3	--	--	100
ETL501	Digital Communication Lab	--	--	--	--	25	25	50
ETL502	Discrete Time Signal Processing Lab	--	--	--	--	25	25	50
ETL503	Electromagnetics Engineering and Antenna Lab	--	--	--	--	25	25	50
ETL504	Professional Communication & Ethics Lab	--	--	--	--	50	--	50
MDML50X1	MDM-Lab I					25	--	25
ETM501	Mini Project 2A	--	--	--	--	25	25	50
Total		**100**	**100**	**300**		**175**	**100**	**775**

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

$ Indicates workload of a learner (Not faculty) for Mini Project 2A. Faculty Load: ½ hour per week per four groups

Program Elective – I

Technology Bucket			
Electronics	**Communication and Networking**	**Security/ Block chain**	**Data Science and Analytics**
ETPEC5011: Controls and Sensor Technology	**ETPEC5012:** Error Control Systems	**ETPEC5013:** IT Infra and Security	**ETPEC5014:** Data Structures and Algorithms

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

Program Structure for Third Year

W.E.F.A.Y.2026-27

Semester VI

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ETC601	Computer Communication Networks	PCC	3	--	3	--	3
ETC602	Mobile Communication Systems	PCC	3	--	3	--	3
ETC603	Digital VLSI	PCC	3	--	3	--	3
MDMC60X3	Multidisciplinary Minor (MDM-III)	MDM	3	--	3	--	3
ETPEC601X	Program Elective-II	PEC	3	--	3	--	3
ETL601	Computer Communication Networks Lab	PCC	--	2	--	1	1
ETL602	Mobile Communication Systems Lab	PCC	--	2	--	1	1
ETL603	Digital VLSI Lab	PCC	--	2	--	1	1
ETL604	Skill Lab – Cloud Computing	VSEC	--	2*+2	--	2	2
MDML60X2	MDM Lab-II	MDM	--	2	--	1	1
ETM601	Mini Project 2B	Project	--	2$	--	1	1
Total			**15**	**14**	**15**	**7**	**22**

Examination Scheme - EXTC Semester-VI

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC601	Computer Communication Networks	20	20	60	3	--	--	100
ETC602	Mobile Communication Systems	20	20	60	3	--	--	100
ETC603	Digital VLSI	20	20	60	3	--	--	100
MDMC60X3	Multidisciplinary Minor (MDM-III)	20	20	60	3	--	--	100
ETPEC601X	Program Elective-II	20	20	60	3	--	--	100
ETL601	Computer Communication Networks Lab	--	--	--	--	25	25	50
ETL602	Mobile Communication Systems Lab	--	--	--	--	25	25	50
ETL603	Digital VLSI Lab	--	--	--	--	25	25	50
ETL604	Skill Lab – Cloud Computing	--	--	--	--	25	25	50
MDML60X2	MDM Lab-II	--	--	--	--	25	--	25
ETM601	Mini Project 2B	--	--	--	--	25	25	50
Total	--	**100**	**100**	**300**	**--**	**150**	**125**	**775**

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

$ Indicates workload of a learner (Not faculty) for Mini Project 2B. Faculty Load: ½ hour per week per four groups

Program Elective – II

Technology Bucket			
Electronics	**Communication and Networking**	**Security/ Block chain**	**Data Science and Analytics**
ETPEC6011: Embedded Systems	**ETPEC6012:** Internet of Things	**ETPEC6013:** Data Compression and Cryptography	**ETPEC6014:** Database Management Systems

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

Program Structure for Fourth Year
W.E.F.A.Y.2027-28

SemesterVII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ETC701	Microwave and Radar Engineering	PCC	3	--	3	--	3
MDMC70X4	Multidisciplinary Minor (MDM-IV)	MDM	3	--	3	--	3
ETPEC701X	Program Elective-III	PEC	3	--	3	--	3
ETPEC702X	Program Elective-IV	PEC	3	--	3	--	3
OEC701X	Open Elective-I	OE	3	--	3	--	3
ETL701	Microwave and Radar Engineering Lab	PCC	--	2	--	1	1
MDML70X3	MDM-Lab III	MDM	--	2	--	1	1
ETPEL701X	Program Elective-III Lab	MDM	--	2	--	1	1
ETP701	Major Project Stage-I	MJP	--	4#	--	2	2
Total			**15**	**8**	**15**	**5**	**20**

Examination Scheme - EXTC Semester-VII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC701	Microwave and Radar Engineering	20	20	60	3	--	--	100
MDMCX4	Multidisciplinary Minor (MDM-IV)	20	20	60	3	--	--	100
ETPEC701X	Program Elective-III	20	20	60	3	--	--	100
ETPEC702X	Program Elective-IV	20	20	60	3	--	--	100
OEC701X	Open Elective-I	20	20	60	3	--	--	100
ETL701	Microwave and Radar Engineering Lab					25	25	50
MDMLX3	MDM-Lab III					25	25	50
ETPEL701X	Program Elective-III Lab	--	--	--	--	25		25
ETP701	Major Project Stage-I	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	--	**100**	**75**	**675**

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

Program Elective-III

Technology Bucket			
Electronics	**Communication and Networking**	**Security/ Blockchain**	**Data Science and Analytics**
ETPEC7011: Mixed VLSI	**ETPEC7012:** Wireless Sensor Networks	**ETPEC7013:** Cyber Security and Ethical Hacking	**ETPEC7014:** Big Data Analytics

Program Elective-IV

Technology Bucket			
Electronics	**Communication and Networking**	**Security/ Blockchain**	**Data Science and Analytics**
ETPEC7021: Robotics	**ETPEC7022:** Satellite and Nano SatelliteCommunication	**ETPEC7023:** Intelligent Forensics	**ETPEC7024:** Natural Language Processing

Open Elective-I

CourseCode	CourseName
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

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

Program Structure for Fourth Year
W.E.F.A.Y.2027-28

Semester VIII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
ETC801	Research Methodology	RM	3	-	3	-	3
OEC801X	Open Elective-II	OE	3	--	3	--	3
ETP801	Major Project Stage-II	MJP	--	4#	--	2	2
ETINT801	Internship/Project/Research	Internship	--	--	--	9	9
Total			**6**	**4**	**6**	**11**	**17**

Examination Scheme - EXTC Semester-VIII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
ETC801	Research Methodology	20	20	60	3	--	--	100
OEC801X	Open Elective-II	20	20	60	3	--	--	100
ETP801	Major Project Stage-II	--	--	--	--	100	50	150
ETINT801	Internship/Project/Research	--	--	--	--	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

CourseCode	CourseName
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

Multidisciplinary Minor (MDM)

Track	Minor Track	Partner Institute if any	Module	Code	Eligible
1	ML	SIES GST	Artificial Intelligence	MDMC4011	IT/EXTC/CSE IOT
			Machine Learning	MDMC5012	
			Natural Language Processing	MDMC6013	
			Deep Learning	MDMC7014	
2	DS	SIES GST	Statistical Foundation for Data Science	MDMC4021	ECS/CE/EXTC
			Data Analytics & Visualization	MDMC5022	
			Decision Making & Business Intelligence	MDMC6023	
			Big Data Analytics	MDMC7024	
3	Embedded Systems	SIES GST	Microprocessor and Microcontrollers	MDMC4031	CE/AIDS/AIML
			RTOs and Embedded systems	MDMC5032	
			Sensor Technology	MDMC6033	
			Industrial Internet of Things	MDMC7034	
4	Cyber Security	SIES GST	Computer Network	MDMC4041	AIDS/AIML
			Cryptography & System Security	MDMC5042	
			Cloud Computing and Security	MDMC6043	
			Digital Forensics	MDMC7044	
5	System Programming	SIES GST	Advance Data Structure	MDMC4051	CSEIOT/ECS/IT
			Advance Algorithm	MDMC5052	
			System Programming and Compiler Construction	MDMC6053	
			Distributed Systems	MDMC7054	
6	Management	SIESSBS	Cost Management	MDMC4061	EXTC/CE/IT/ECS/AIDS/AIML/CSE IOT
			Supply Chain Management	MDMC5062	
			HR & Organization	MDMC6063	
			Marketing Management	MDMC7064	

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC301	Applied Mathematics-III	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETC301	Applied Mathematics-III	20	20	60	--	--	100

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct Investigation of complex problems
5. PO11: Life-long Learning

Course Objectives:

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

Course Outcomes:

After successful completion of the course student will be able to

1. Apply the properties of Laplace&Inverse Laplace transform to the functions.
2. Construct the Fourier series of periodic functions for real life problems and complex engineering problems.
3. Apply the concept of complex numbers, complex functions, and their significance in data science and engineering.
4. Evaluate the strength and direction of relationships between variables using correlation and Regression techniques.
5. Apply the concepts of probability and expectation for getting the spread of the data and distribution of the data.
6. Apply the concept of probability distribution to engineering problems.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Laplace and Inverse Laplace Transforms**	**10**	
	1.1	Definition of Laplace transform, Laplace Transform(L) of Standard Functions.		**CO1**
	1.2	Properties of Laplace Transform: First shifting theorem, Change of Scale property, Multiplication by t, Division by t, Laplace Transform of derivatives (with proof) and integrals (without proof).		
	1.3	Evaluation of integrals using Laplace Transformation.		
	1.4	Inverse Laplace Transform: Introduction. Methods of finding Inverse Laplace Transform, using standard results, use of differentiation of f(s), Partial fraction method and convolution.		
		Self-learning Topics: Applications to solve ordinary differential equations.		
2.0		**Fourier Series**	**07**	
	2.1	Dirichlet's conditions, Definition of Fourier series.		**CO2**
	2.2	Fourier series of periodic functions with period 2π *and* $2l$.		
	2.3	Fourier series of even and odd functions. (No examples on Parseval Identity)		
	2.4	Half range Sine and Cosine Series.		
		Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.		
3.0		**Complex Variables**	**06**	
	3.1	Function f(z) of complex variable, limit, continuity and differentiability of f(z) Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof).		**CO3**
	3.2	Cauchy-Riemann equations in cartesian coordinates (without proof).		
	3.3	Milne-Thomson method to determine analytic function f(z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.		
	3.4	Harmonic function, Harmonic conjugate, and orthogonal trajectories		
		Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points, and standard transformations.		
4.0		**Statistical Techniques**	**05**	
	4.1	Karl Pearson's Coefficient of correlation (r) and related concepts with problems.		**CO4**
	4.2	Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems).		
	4.3	Lines of regression.		
		Self-learning Topics: Covariance.		
5.0		**Probability Theory**	**06**	
	5.1	Total Probability theorem and Bayes' theorem.		**CO5**
	5.2	Discrete and continuous random variable with probability distribution and probability density function.		
	5.3	Expectation, Variance, Laws of expectation.		
	5.4	Moment generating function, Raw and central moments up to 4th order.		

		Self- learning Topics: Skewness and Kurtosis of distribution (data).		
6.0		**Probability Distributions**	**05**	
	6.1	Revision of Binomial Distribution.		**CO6**
	6.2	Poisson Distribution.		
	6.3	Normal Distribution.		
		Self- learning Topics: Central Limit theorem and its application.		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 5th edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.

Reference books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication, 5th edition.
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education, 9th edition.
3. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
4. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.
5. Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications, 2007.

Online References:

Course on Advanced Engineering Mathematics

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

Course Assessment:

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

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

End Semester Examination

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC302	Electronic Devices and circuits	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETC 302	Electronic Devices and circuits	20	20	60	-	-	100

Course pre-requisite:

1. FEC1021:Applied Physics
2. FEC103: Basic Electrical Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution
4. PO12: Lifelong Learning
5. PSO1: Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF &microwave

Course Objectives:

1. To understand physical operation of semiconductor devices.
2. To perform DC and AC analysis of BJT and MOSFET amplifier circuits.
3. To analyze frequency response of single stage and multistage amplifiers.
4. To compare small signal and large signal amplifiers.

Course Outcomes:

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

1. Explain working of various electronics devices with the help of V-I characteristics.
2. Design DC biasing circuits and evaluate the performance parameters of BJT amplifier.
3. Design DC biasing circuits and evaluate the performance parameters of MOSFET amplifier.
4. Evaluate frequency response of BJT and MOSFET amplifier.
5. Analyze multistage BJT, MOSFET amplifiers and derive their performance parameters.
6. Analyze various power amplifier circuits.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Semiconductor Devices**	**06**	**CO1**
	1.1	PN junction diode characteristics, diode current equation, working of Zener diode, Application of Zener diode as voltage regulator		
	1.2	Construction, working, characteristics of BJT, JFET, MOSFET		
		Self learning: Application of Diode: Clipper, Clamper, Rectifier		
2.0		**DC and small signal analysis of BJT amplifier circuits**	**05**	**CO2**
	2.1	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias)		
	2.2	AC load line, Introduction to hybrid-pi model		
	2.3	Small signal analysis of CE amplifier using hybrid pi model. (Zi, Zo, Av and Ai)		
		Self-learning: BJT collector to base bias, emitter follower bias, re-model, hybrid model.		
3.0		**DC and small signal analysis of MOSFETamplifier circuits**	**10**	**CO3**
	3.1	DC load line and region of operation for MOSFETs. Analysis and designof biasing circuits for E-MOSFET (Drain-to-Gate bias & voltage divider bias).		
	3.2	Small signal analysis of CS amplifiers using hybrid pi model (Zi, Zo, Av)		
		Self learning: PMOS/NMOS circuits and logic-gates, Basic commercial audio amplifier (Eg: TI INA1620)		
4.0		**Frequency Response of small signal amplifiers**	**10**	**CO4**
	4.1	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance		
	4.2	low frequency analysis of CE & CS (EMOSFET)amplifier		
	4,3	High frequency analysis of CE & CS (EMOSFET)amplifier		
		Self learning: Frequency analysis of CB, CC, CG, CD amplifier		
5.0		**Multistage amplifiers**	**04**	**CO5**
	5.1	Introduction to multistage amplifier, Gain bandwidth product		
	5.2	Mid frequency analysis of multistage amplifier CE-CE		
	5.3	Mid frequency analysis of multistage amplifier CS-CS		
		Self learning: Cascode amplifier (CE-CB), (CS-CG), Darlington pair		
6.0		**Large Signal Amplifiers**	**04**	**CO6**
	6.1	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier		
	6.2	Analysis of Class A power amplifier (Series fed and transformer coupled).		
	6.3	Transformer less Amplifier: Class B power amplifier. Class AB output stage with diode biasing		
	6.4	Thermal considerations and heat sinks.		
		Self learning: Class C amplifier, Basic commercial power amplifier (Eg: TI OPA549)		
		Total	**39**	

Text books:

1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2nd Edition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications" International Version, OXFORD International Students, 6th Edition.
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

References:

1. Boylestad and Nashelesky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition.
2. A. K. Maini, "Electronic Devices and Circuits," Wiley.
3. T. L. Floyd, "Electronic Devices,"Prentice Hall, 9th Edition, 2012.
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition.
5. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

NPTEL/ Swayam Course:

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

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks 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. 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
ETC303	Microprocessor and Microcontroller	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
ETC 303	Microprocessor and Microcontroller	20	20	60	-	-	100

Pre-requisites

1. FEC 204: Digital system design

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO12: Lifelong Learning
4. PSO1: Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave

Course Objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors and microcontroller.
2. To understand architecture of 8086 and 8051.
3. To emphasize on instruction set and logic to build assembly language programs.
4. To prepare students for higher processor / Controller architectures.

Course Outcomes:

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

1. Describe core concepts of 8086 microprocessor.
2. Apply the instructions of 8086 and write assembly language programs.
3. Explain the architecture of advanced processors.
4. Describe core concepts of 8051 microcontroller.
5. Apply the instructions of 8051 and write assembly language programs.
6. Explain the architecture of advanced controller.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**The Intel Microprocessors 8086 architecture**	**08**	**CO1**
	1.1	8086 CPU Architecture, Functional Pin Diagram		
	1.2	Programmer's Model		
	1.3	Memory Segmentation, Banking in 8086		
	1.4	De-multiplexing of Address/Data bus		
	1.5	Functioning of 8086 in Minimum mode and Maximum mode		
	1.6	Interrupt structure and its servicing		
		Self learning: Timing diagram of minimum and maximum mode		
2.0		**Instruction set and programming of 8086**	**05**	**CO2**
	2.1	Addressing Modes, Instruction set		
	2.2	Program related -Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions		
		Selflearning:8255,8259 ,8257		
3.0		**Pentium processor**	**6**	**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		
	3.7	MESI Protocol		
		Self learning:80386 Processor		
4.0		**8051 Microcontroller**	**8**	**CO4**
	4.1	Comparison between Microprocessor and Microcontroller		
	4.2	Features, architecture and pin configuration of 8051		
	4.3	CPU timing and machine cycle		
	4.4	Memory organization		
	4.5	Counters and timers		
	4.6	Interrupts		
	4.7	Serial data input and output		
		Self learning: Input output ports		
5.0		**8051 Assembly Language Programming and Interfacing**	**06**	**CO5**
	5.1	Addressing modes, Instruction set , Assembler Directives		
	5.2	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts ,Interfacing with LEDs		
		Self learning: Serial communication UART, I2C Protocol		

6.0		**ARM7**	**06**	**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		
	6.5	Brief introduction to exceptions and interrupts handling		
		Self learning: 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:

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

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. 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
ETC304	Network Theory	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETC304	Network Theory	20	20	60	-	-	100

Pre-requisite :

1. FEC103: Basic Electrical and Electronics Engineering

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO5:Modern tool Usage
4. PSO1: Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave

Course Objectives:

1. To evaluate the Circuits using network theorems.
2. To analyze the Circuits in time and frequency domain.
2. To analyze Electrical Network using Graph Theory.
3. To synthesize passive network by various methods.

Course Outcomes:

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

1. Analyze Circuits by using network theorems.
2. Apply network topology for analyzing the circuit
3. Apply the time and frequency method of analysis.
4. Analyze Electrical Networks using network functions
5. Find the various network parameters for representation of two port network.
6. Synthesize the network using passive elements.

Module No.	Topics	Hrs.	CO
1.0	**Electrical circuit analysis**	**08**	**CO1**
	Circuit Analysis: Analysis of Circuits with and without dependent sources using generalized loop and node analysis, super mesh and super node analysis technique Circuit Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems (Use only DC source).		
	Self learning: Simulation of circuits using SPICE/P SPICE or any open source simulation tools		
2.0	**Graph Theory**	**06**	**CO2**
	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix. Relationship between sub matrices A, B & Q.		
	Self learning: Application of graph theory in electrical networks.		
3.0	**Time and frequency domain analysis**	**07**	**CO3**
	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equation with step signals. Frequency domain analysis of R-L-C Circuits using Laplace T: Forced and natural response, effect of damping factor. Solution using second order equation for step signal		
	Self learning: Transient behavior of an air conditioner,Mechanical equivalents of circuit elements		
4.0	**Network functions**	**06**	**CO4**
	Network functions for the one port and two port networks, driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions,testing for Hurwitz polynomial.		
	Self learning: Network function for stability analysis		
5.0	**Two port Networks**	**05**	**CO5**
	Parameters: Open Circuits(Z), short Circuit(Y), Transmission(ABCD) and Hybrid parameters(h), relationship among parameters, conditions for reciprocity and symmetry. Interconnections of Two-Port networks T & π representation		
	Self learning: Analysis of common emitter amplifier using two-port parameters.		
6.0	**Synthesis of RLC circuits**	**07**	**CO6**
	Positive Real Functions: Test for Positive real Functions. LC, RC & RL network Synthesis in Cauer-I &Cauer-II , Foster-I & Foster-II forms		
	Self learning: Signal Processing Filters, Impedance Matching Networks.		
	Total	**39**	

Textbooks:

1. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.
2. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd Edition.
3. Network Analysis and Synthesis, K. M. Soni, S. K. Kataria and Sons, 10th Edition.
4. Ravish R Singh." Network Analysis and Synthesis", McGraw Hill, 2nd Edition.

Reference books:

1. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co., Delhi, 6th Edition.
2. A. Sudhakar, Shyammohan S. Palli "Circuits and Networks", Tata McGraw-Hill Education, 5th Edition.
3. Smarajit Ghosh "Network Theory Analysis & Synthesis", PHI learning, 1st Edition.
4. K.S. Suresh Kumar, "Electric Circuit Analysis" Pearson, 2013.
5. D. Roy Choudhury, "Networks and Systems", New Age International, 1998.

Online References:

1. NPTEL/Swayam Course: Basic Electrical Circuits by Prof. Nagendra Krishnapura (IIT Madras): https://swayam.gov.in/nd1_noc20_ee64/preview
2. NPTEL/Swayam Course: Network Analysis by Prof. Prof. Tapas Kumar Bhattacharya (IIT Kharagpur): https://onlinecourses.nptel.ac.in/noc20_ee46/preview

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. 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
ETC 305	Signals and Systems	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
ETC 305	Signals and Systems	20	20	60	-	-	100

Prerequisite:

1. ETC301: Engineering Mathematics III

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO12: Lifelong Learning
4. PSO1: Achieve Eminence in domains like signal processing, VLSI, embedded IoT, RF & Microwave.

Course Objectives:

1. To introduce students to the idea of signal and system analysis and characterization in time and frequency domains.
2. To provide foundation of signal and system concepts to areas like communication systems, control systems, digital signal processing and image processing.

Course Outcomes:

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

1. Classify and analyze different types of signals.
2. Classify and analyze different types of systems.
3. Analyze continuous time and discrete time systems in the time domain.
4. Analyze continuous time and discrete time signals and systems in frequency domain using Fourier transform.
5. Analyze continuous time signals and systems in s- domain using Laplace transform.
6. Analyze discrete time signals and systems in the z- domain using z- transform.

Module No.	Unit No.	Topics	Hrs.	COs
1.0		**Introduction to signals**	**05**	**CO1**
	1.1	Introduction to Signals: Definition, Basic elementary signals: exponential, sine, step, impulse, ramp, rectangular, triangular, signum, sinc and $sinc^2$.		
	1.2	Classification of Signals: continuous and discrete time signals, analog and digital signals, even and odd signals, periodic and non-periodic signals, deterministic and non-deterministic signals, energy and power signals.		
	1.3	Mathematical operation on continuous and discrete time signals.		
		Self learning: Investigate the real-world applications of signals in communication systems:		
2.0		**Introduction to systems**	**06**	**CO2**
	2.1	Classification of systems: System representation, continuous time and discrete systems, systems with and without memory, causal and non-causal systems, linear and nonlinear systems, time invariant and time variant systems, stable and unstable systems, feedback and non-feedback systems.		
		Self learning: Applications of systems in communication, control and signal processing.		
3.0		**Time domain analysis of Continuous Time and Discrete Time systems**	**08**	**CO3**
	3.1	Linear Time Invariant (LTI) systems: Representation of systems using differential /difference equation, Impulse, step and exponential response, System stability and causality.		
	3.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems.		
	3.3	Sums on linear and circular convolutions.		
		Self learning: Applications of time domain analysis in communication, control and signal processing.		
4.0		**Analysis of Continuous and Discrete Time Signals and Systems using Fourier Transform**	**06**	**CO4**
	4.1	Fourier transform of periodic and non-periodic functions, Properties of Fourier transform, Inverse Fourier transform, Frequency response: computation of magnitude and phase response, Limitations of Fourier transform.		
	4.2	Applications of Fourier transform in communication systems		
		Self learning: Proof of Fourier transform properties.		
5.0		**Analysis of Continuous time LTI systems using Laplace Transform**	**06**	**CO5**
	5.1	Need of Laplace transform, Concept of Region of Convergence, Properties of Laplace transform, Relation between continuous time Fourier transform and Laplace transform, unilateral Laplace transform, inverse Laplace transform.		
	5.2	Analysis of continuous time LTI systems using Laplace transform: Causality and stability of systems in s-domain, Total response of a system.		
		Self learning: Proof of Laplace transform properties.		

6.0		**Analysis of Discrete time LTI systems using z-Transform**	**08**	**CO6**
	6.1	Need of z-transform, z-transform of finite and infinite duration sequences, Concept of Region of Convergence, z-transform properties, Standard z-transform pairs, relation between z-transform and discrete time Fourier transform, one sided z-transform, and inverse z-transform: Partial fraction method only.		
	6.2	Analysis of discrete time LTI systems using z-transform: Systems characterized by linear constant coefficient difference equation, transfer function, plotting poles and zeros of a transfer function, causality and stability of systems, total response of a system.		
		Self learning: Proof of z-transform Properties.		
		Total	**39**	

Textbooks:

1. Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition.
2. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition.
3. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, Second Edition.
4. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition.

Reference books:

1. Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third Edition.
2. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition.
3. V. Krishnaveni and A. Rajeshwari, Signals and Systems, Wiley-India, First Edition.
4. Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, Indian Edition.

Online References:

1. Signals and Systems Laboratory: Virtual Laboratory http://ssl-iitg.vlabs.ac.in/
2. Principles of Signals & Systems By Prof. Aditya K. Jagannatham (IIT Kanpur); https://swayam.gov.in/nd1_noc20_ee15/preview

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. 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
ETC306	Engineering Economics	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETC306	Engineering Economics	50		-	-	-	50

Pre-requisite :
Principles of Basic Mathematics

Program Outcomes addressed:

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

Course Objectives:

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

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

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

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Economics**	**03**	**CO1**
	1.1	**Economics** - Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics, The three problems of Economics Organization. Introduction to Engineering Economics.		
		Self-Learning: Basic Economic Concepts: Cost, Benefit, Profit.		
2.0		**Market and Government in Modern Economy**	**03**	**CO2**
	2.1	**Modern Economy** - Market Definition, How market solve three economics problems, Trade, Money & Capital, The economic role of Government.		
	2.2	**Self-Learning**: Market Economy vs. Planned Economy, The Role of Private vs. Public Sectors		
3.0		**Supply, Demand and Product market**	**06**	**CO3**
	3.1	**Basic Elements of Supply and Demand -** The determination of Demand and Supply, The Demand Schedule, The Supply Schedule, Equilibrium of supply and demand. Application of Supply and Demand.		
	3.2	**Elasticity of Demand and Supply -** Price elasticity of Demand, Elasticity and Revenue, Price elasticity of Supply.		
	3.3	**Demand and Consumer behavior** - Choice and utility theory, Equimarginal principle, An alternative approach: substitution effect and income effect, From Individual to market demand.		
		Self-Learning: Case Study on demand and supply.		
4.0		**Production and Cost Theory**	**05**	**CO4**
	4.1	**Production** - Production function, Laws of returns: Law of variable proportion, Law of returns to scale.		
	4.2	**Cost and Revenue Concepts** - Total Costs, Fixed cost, Variable cost, Average cost and Marginal cost, The Link between production and costs, Analysis of cost minimization.		
		Self-Learning: Read case studies about businesses optimizing their production costs and making strategic production decisions.		
5.0		**Time value and Project evaluation with money**	**04**	**CO5**
	5.1	**Time Value of Money -** Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.		
	5.2	**Evaluation of Engineering Projects** -Present worth method, Future worth method, Annual worth method, Internal rate of return method.		
		Self-Learning: Learn to use financial calculators or Excel functions for quick calculations of TVM.		
6.0		**Money, Banking and Financial Markets**	**05**	**CO6**
	6.1	**Money and Interest Rates -** The Evolution of Money, Functions of Money, Interest rates, Price of Money, Demand for money.		
	6.2	**Banking and the supply of money** - Banking definition, Types of Banks, Banking as as a business, The process of Deposits creations.		
	6.3	**Financial Economics** - Financial assets, Risk and return on different assets, The stock market, Personal financial strategies.		
		Self learning: The evolution of financial market.		
		Total	**26**	

Textbooks:

1. Paul A. Samuelson and William D. Nordhaus, “Economics”,Tata McGraw Hill, 20th edition, 2019.
2. "Engineering Economy" by Leland Blank and Anthony Tarquin, 9th edition, 2024.

Reference books:

1 "Introduction to Engineering Economics" by John V. O'Connor, 5th edition, 2013.
2 W S Jawadekar, “Management Information Systems”, Tata McGraw Hill, 6th edition, 2020.
3 "Fundamentals of Engineering Economics" by Chan S. Park,4th edition, 2018.

Online References:

1 https://www.mheducation.com/highered/product/Engineering-Economy-Blank.html
2 https://archive.org/details/engineeringecono0000blan_t5b6

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 25 marks.
ISE 50 marks = 10 marks for attendance + 40 marks for activities.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL301	Electronic Devices & Circuits Lab	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL301	Electronic Devices & Circuits Lab	-	-	-	25	25	50

Pre-requisite:

1. FEL102: Basic Electrical & Electronics Engineering Lab

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution
4. PO5: Modern tool usage
5. PO9:Indiviual and Team work
6. PO12: Lifelong Learning
7. PSO1:Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave.

Lab Objectives:

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

Lab Outcomes:

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

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

Suggested List of Experiments:		
Sr.No.	**Title of Experiments**	**LO**
1	Obtain characteristics and measure internal parameters of PN junction diode.	LO1,2
2	Investigate the Use of a Zener Diode as a Voltage Regulator for Stabilizing Output Voltage	LO1,2
3	Practical Analysis of BJT Characteristics and Evaluation of internal parameters	LO1,2
4	Practical Analysis of JFET Characteristics and Evaluation of internal parameters	LO1,2
5	Practical Analysis of MOSFET Characteristics and Evaluation of internal parameters.	LO1,2
6	Design and Analyse BJT Biasing Circuit and measure its operating point	LO1,3
7	Design and Analyse MOSFET Biasing Circuit and measure its operating point	LO1,3
8	Performance Analysis of BJT in Common Emitter Configuration for Amplification Applications	LO1,4
9	Frequency response analysis of BJT common emitter amplifier for performance evaluation across different frequencies	LO1,4
10	Performance Analysis of MOSFET in Common source Configuration for Amplification Applications	LO1,4
11	Frequency response analysis of MOSFET common source amplifier for performance evaluation across different frequencies	LO1,4
12	Performance Analysis of CE-CE BJT two stage amplifier.	LO1,4
13	Performance Analysis of CS-CS MOSFET two stage amplifier.	LO1,4
14	Performance Analysis of Cascode amplifier.	LO1,4
15	Comprehensive Study and Performance Analysis of Class A Power Amplifier.	LO1,5
16	Comprehensive Study and Performance Analysis of Class B Power amplifier.	LO1,5

Software Tools:
Before starting the experiments there should be one session on study of development tools like Tina Pro, LT Spice, Virtual Lab, Multi SIM etc. Computation/ Simulation based experiments are also encouraged**.**

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

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL302	Microprocessor and Microcontroller Lab	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL302	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. PO12: Lifelong Learning
5. PSO1:Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave.

Lab Objectives:

1. To emphasize the use of Assembly language program.
2. To equip students with the skills to program microprocessors and microcontrollers.

Lab Outcomes:

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

1. Demonstrate different development tools of microprocessor and microcontroller based systems
2. Develop the program in assembly language for 8086 processor.
3. Develop the program in assembly language for 8051 processor.
4. Develop the program in assembly language for performing input/output operation, serial communication and delay generation

Suggested List of Experiments:		
Sr. No.	**Title of Experiments**	**LO**
1	Assembly Program to Perform Arithmetic Operations(Using Immediate, Direct and Indirect addressing)	LO1,2,3
2	Assembly Program to perform Logical Operations	LO1,2,3
3	Assembly program based on string instruction: Calculate length of string	LO1,2,3
4	Assembly program based to perform BCD to ASCII conversion	LO1,2,3
5	Assembly program based to perform Hexadecimal to decimal conversion	LO1,2,3
6	Assembly program to calculate factorial of number	LO1,2,3
7	Assembly program to transfer of data bytes between Internal and External Memory	LO1,2,3
8	Assembly program to transfer of data bytes between External and External Memory	LO1,2,3
9	Experiment based on Timers	LO1,4
10.	Experiment based on Input /Output ports	LO1,4
11.	Experiment based on Serial Communication	LO1,4
12.	Assembly program to arrange numbers in ascending and descending order	LO1,2,3
13	Assembly program to find minimum and maximum number from given array	LO1,2,3
14	Assembly program to transfer block of data using String or without using string.	LO1,2,3

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 include 8 experiments: 4 microprocessor based and 4 microcontroller based experiments. At least 02 assignments covering the entire syllabus must be given on the content of theory and practical of "**Microprocessor and Microcontroller**". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL303	Skill Lab (Python Programming)	-	02*+02	-	-	02	-	02

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

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL303	Skill Lab (Python Programming)	-	-	-	25	25	50

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO5: Modern tool usage
5. PO9: Individual and teamwork
6. PO10: Communication
7. PO12: Life-long learning
8. PSO2: Become technocrats capable of working in multi-disciplinary fields

Lab Objectives:

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

Lab Outcomes:

Students will be able to

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

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

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

Software Tools:

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

Online References:

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

Term Work:
The term work should include 8 experiments and one group-wise project. An attempt should be made to make skill lab – python more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

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

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

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

Subject Code	Subject Name	TeachingScheme (Hrs.)			CreditsAssigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETM301	Mini-Project 1A:	-	02$	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETM301	Mini-Project 1A:	-	-	-	25	25	50

$indicates workload of Learner (Not Faculty),for Mini Project 1A.Faculty Load:1hour per week per four groups.

Pre-requisite:

1. FEL102: Basic Electrical & Electronics Engineering Lab
2. FEL 203: Digital System Design Lab

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: Modern tool usage
6. PO6: The Engineer and society
7. PO7: Environment and Sustainability
8. PO8: Ethics
9. PO9: Individual and teamwork
10. PO10: Communication
11. PO11: Project Management and Finance
12. PO12: Life-long learning
13. PSO1:Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave.

Course Objectives:

1. To make students familiar with the basics of Electronics, Microcontroller, Arduino board, Raspberry Pi, Arduino IDE (Integrated Development Environment) and Python programming.
2. To familiarize the students with the programming and interfacing of different devices with Arduino and Raspberry Pi Board.
3. To increase students critical thinking ability and provide solutions to some real time problems.

Course Outcomes:

After successful completion of the course student will be able to

1. Write basic codes for the Arduino board using the IDE for utilizing the onboard resources.
2. Apply the knowledge of interfacing different devices to the Arduino board to accomplish a given task.
3. Design Arduino based projects for a given problem.
4. Write code using python language using IDE for utilizing the onboard resources.
5. Apply the knowledge of interfacing different devices to raspberry Pi board to accomplish a given task.
6. Design Raspberry Pi based projects for a given problem.

Module No.	Section A: Arduino Board	Hrs.	CO
1.0	**Introduction to Arduino Board**	**1**	**CO1,2,3**
	Introduction to Arduino Uno board and integrated development environment (IDE)		
	Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.		
2.0	**GPIO(along with Analog pin) Programming**	**2**	**CO1,2,3**
	Introduction to programming GPIO, Analog and PWM PINS.		
	Interface any Digital Sensors to the Arduino board and display sensor values on serial Monitor		
	Interface any Analog sensor to the Arduino board and display sensor values on serial Monitor.		
	Generate varying duty cycle PWM using Arduino.		
3.0	**Controlling output devices/Displaying**	**2**	**CO1,2,3**
	Introduction to different sensor (Analog and Digital), Relays, Motors and display.		
	Interface an Analog Sensors to the Arduino board and display sensor values on LCD/TFT/Seven segment Display.		
	Interface a temperature sensor to Arduino and switch on a relay to operate a fan if temperature exceeds given threshold. Also display the temperature on any of the display device		
4.0	**Interfacing Communication Devices and Cloud Networking**	**2**	**CO1,2,3**
	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.		
	Interface Wi-Fi /Bluetooth/GSM/Zigbee/RF module to Arduino and program it to transfer sensor data wirelessly between two devices. Any two techniques from the above-mentioned modules needs to be interfaced.		
5.0	**Sample Projects**	**5**	**CO1,2,3**
	1. Waste Management System 2. Smart City Solutions 3. Energy Monitoring Systems 4. Smart Classrooms and learning Solutions 5. Home security systems 6. Smart Agriculture solutions 7. Healthcare solutions. 8. Industrial Applications 9. IoT Applications 10. Robotics		
	Total	**12**	

Module No.	Section B: Raspberry PI Board	Hrs.	CO
1.0	**Introduction to Raspberry PI**	**1**	**CO4,5,6**
	What is Raspberry PI? Downloading and Installation of NOOBS, First Power- Up & Having a Look around, Introduction to the Shell and Staying updated.		
	Familiarization with Raspberry PI and perform necessary software installation.		
2.0	**Interfacing with Input / Output Devices using Python**	**2**	**CO4,5,6**
	Introduction to Python, Connecting to the outside World with GPIO.		
	To Interface LED/Buzzer with Raspberry PI and write a program to turn ON LED for 1 sec after every 2 sec.		
	Apparatus Requirement: Raspberry PI with inbuilt Python Package, LED, Buzzer.		
	To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI and write a program to turn ON LED when Push button is pressed or at sensor detection.		
3.0	**Interfacing Temperature Sensor, Motors, Display Devices.**	**2**	**CO4,5,6**
	Introduction to Temperature sensor (Analog and Digital), Relays, Motors, (DC, Stepper) and Driver circuits.		
	To interface DHT11 sensor with Raspberry PI and write a program to print temperature and humidity readings.		
	Apparatus Requirement: Raspberry PI with inbuilt Python Package, DTH11 Sensor.		
4.0	**Interfacing Communication Devices and Cloud Networking**	**2**	**CO4,5,6**
	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.		
	To interface Bluetooth/Zigbee/RFID/WiFI with Raspberry PI and write a program to send sensor data to smart phone using Bluetooth/Zigbee/RFID/WIFI. (Any one can be used for performing)		
	Apparatus Requirement: Raspberry PI with inbuilt Python Package, Bluetooth/Zigbee/RFID/WIFI.		
5.0	**Understanding of Communication Protocols**	**2**	**CO4,5,6**
	Introduction to MQTT, IFTTT protocols and configuration steps.		
	Write a program on Raspberry PI to publish temperature data to MQTT broker		
	Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it.		
6.0	**Sample Projects**	**5**	**CO4,5,6**
	1. MQTT Based Raspberry Pi Home Automation: Controlling Raspberry Pi GPIO using MQTT Cloud 2. License Plate Recognition using Raspberry Pi and OpenCV 3. Real Time Face Recognition with Raspberry Pi and OpenCV 4. Smart Garage Door Opener using Raspberry Pi 5. Remote Controlled Car Using Raspberry Pi and Bluetooth 6. Fingerprint Sensor based door locking system using Raspberry Pi 7. Raspberry Pi Ball Tracking Robot using Processing 8. Web Controlled Home Automation using Raspberry Pi		

	9. Line Follower Robot using Raspberry Pi 10. Raspberry Pi based Smart Phone Controlled Home Automation 11. Web Controlled Raspberry Pi Surveillance Robotic Car 12. Raspberry Pi Based Weight Sensing Automatic Gate 13. Raspberry Pi Emergency Light with Darkness and AC Power Line Off 14. Detector 15. Detecting Colors using Raspberry Pi and Color Sensor TCS3200 16. Measure Distance using Raspberry Pi and HCSR04 Ultrasonic Sensor 17. Call and Text using Raspberry Pi and GSM Module 18. Raspberry Pi Home Security System with Email Alert 19. Raspberry Pi Based Obstacle Avoiding Robot using Ultrasonic Sensor 20. Web Controlled Notice Board using Raspberry Pi 21. RF Remote Controlled LEDs Using Raspberry Pi 22. RFID and Raspberry Pi Based Attendance System 23. Raspberry Pi Interactive Led-Mirror 24. Garage Door monitor using Raspberry Pi 25. Raspberry Pi Digital Code Lock on Breadboard 26. Electronic Voting Machine using Raspberry Pi		
	A case study on **SPI protocol** is encouraged.		
	Section 'B' Total Hrs.	**14**	
	Total Hrs A + B	**26**	

ReferenceBooks:

1. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education.
2. Simon Monk, "Raspberry PI Cookbook Software and Hardware Problems and Solutions" O'Reilly.
3. Simon Monk, Programming the Raspberry Pi, 2nd Edition: Getting Started with Python" The McGraw Hill.
4. "DK Workbooks: Raspberry Pi Project Workbook", DK Children; Workbook
5. Donald Norris, "Raspberry Pi Electronic Projects for Evil Genius", McGraw-Hill Education TAB.

Software Tools:

1. Raspbian OS: https://www.raspberrypi.org/downloads/
2. Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
3. SD Card Formatter: https://www.sdcard.org/downloads/formatter/
4. Arduino IDE: https://www.arduino.cc/en/main/software

Online Repository:

1. Git Hub
2. NPTEL Videos on Raspberry Pi and Arduino Programming
3. https://www.electronicsforu.com/raspberry-pi-projects
4. https://circuitdigest.com/simple-raspberry-pi-projects-for-beginners
5. https://www.electronicshub.org/raspberry-pi-projects/

Guidelines for Mini Project

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

Guidelines for Assessment of Mini Project:

Term Work (CIAP)

- The review /progress monitoring committee shall be constituted by head of department of each institute, The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Review/progress monitoring committee may consider following points for assessment based on general guidelines.

Assessment:

Students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalization of problem and proposed solution
- Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness

8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the standard format..
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

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

Term Work:

The term work should include 1 project: **Arduino**based and **Raspberry PI** based. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Distribution of Term work (25 Marks)shall be as below:

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee :10
- Quality of Project report :05

The final certification and acceptance of term work ensures satisfactory performance of project 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 demonstration of the projectand 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
ETC401	Applied Mathematics-IV	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETC401	Applied Mathematics-IV	20	20	60	--	--	100

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct Investigation of complex problems
5. PO11: Life-long Learning

Course Objectives:

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

Course Outcomes:

Upon completion of this course, learners will be able to…

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

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Linear Algebra (Theory of Matrices)**	**07**	
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof). Cayley-Hamilton Theorem (without proof).		**CO1**
	1.2	Similarity of matrices, diagonalizable and non-diagonalizable matrices.		
	1.3	Functions of Square Matrix, Derogatory and non-derogatory matrices.		
		Self-Learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms.		
2.0		**Quadratic Forms and Matrix Transformations**	**04**	
	2.1	Definition of Quadratic Forms, Matrix Representation, Classification of Quadratic Forms based on eigenvalues and Sylvester's Criterion.		**CO2**
	2.2	Rank, Index and Signature of a Quadratic Form. Reduction of Quadratic form to canonical forms by Orthogonal Transformation. Singular Value Decomposition.		
		Self-Learning Topics: Applications of Quadratic forms and applications of SVD in Engineering.		
3.0		**Complex Integration**	**08**	
	3.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).		**CO3**
	3.2	Taylor's and Laurent's series (without proof).		
	3.3	Definition of Singularity, Zeroes, poles off(z), Residues, Cauchy's Residue Theorem (without proof).		
		Self-Learning Topics: Application of Residue Theorem to evaluate real integrations.		
4.0		**Calculus of Variations and Its Applications**	**07**	
	4.1	Definition of a Functional, Introduction to Calculus of Variations, Euler-Lagrange Equation.		**CO4**
	4.2	Isoperimetric problems- Lagrange Method. Several dependent variables.		
	4.3	Functions involving higher order derivatives: Rayleigh-Ritz Method.		
		Self-Learning Topics: Hamilton Principle, Principle of Least action, Several dependent variables.		
5.0		**Vector Differentiation**	**06**	
	5.1	Definition of a Vector, Scalar and Vector Triple Product, Gradient, Divergence, and Curl, Directional Derivatives, Angle between surfaces and related problems. Solenoidal and Irrotational (Conservative) Vector Fields.		**CO5**
	5.2	Finding scalar potential function ∅		
		Self-Learning Topics: Identities connecting Gradient, Divergence and Curl.		

6.0		**Vector Integration**	**07**	
	6.1	Line integrals – Definition, work done of a conservative field and problems.		**CO6**
	6.2	Green's theorem (without proof) in a plane, Stokes' theorem (without Proof), Gauss' Divergence theorem (without proof) and problems (only evaluation).		
		Self-Learning Topics: Applications of Green's theorem, Stoke's theorem & Gauss Divergence theorem in Engineering.		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition.

Reference books:

1. **Matrices** – Shanti Narayan, S. Chand Publications,10th Edition.
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications, 2nd Edition.
3. **Introductory Methods of Numerical Analysis** – S. S. Sastry, 2nd Edition.
4. **Calculus of Variations with Applications** – A. S. Gupta, PHI Learning, 1st Edition.
5. **Vector Calculus** – Jerrold E. Marsden, Anthony J. Tromba, W. H. Freeman, 6th Edition.
6. **Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications, 2007.**

Online References:
Course on Advanced Engineering Mathematics

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

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

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 402	Principles of Communication Engineering	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
ETC 402	Principles of Communication Engineering	20	20	60	-	-	100

Prerequisite:

1. ETC 301: Applied Mathematics III
2. ETC 302: Electronic Devices and Circuits

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PSO1: Achieve Eminence in domains like signal processing, VLSI, embedded IoT, RF & Microwave.

Course Objectives:

1. To understand the fundamentals of basic communication systems.
2. To understand various analog modulation and demodulation techniques.
3. To focus on applications of analog modulation and demodulation techniques.

Course Outcomes:

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

1. Explain the basic components and types of noises in communication systems.
2. Explain about modulation and demodulation.
3. Analyze the concepts of amplitude modulation and demodulation.
4. Analyze the concepts of angle modulation and demodulation.
5. Analyze the techniques of a radio receiver.
6. Describe analog pulse modulation and multiplexing.

Module No.	Unit No.	Topics	Hrs.	COs
1.0		**Basics of communication systems**	**04**	**CO1**
	1.1	Block diagram of a communication system, types of communication channels. Explore various types of communication channels, including wired channels and wireless channels and study the channel bandwidth and channel capacity and their impact on data transmission rates.		
	1.2	Noise: Types of noises, SNR, Noise Factor, Noise Figure, Noise temperature and Friis transmission equation.		
		Self learning: Applications of different types of transmission media.		
2.0		**Basics of modulation and frequency domain analysis**	**06**	**CO2**
	2.1	Average power, Energy, PSD, ESD, Amplitude spectrum, Power spectrum, energy spectrum, power spectrum of a sinusoidal signal and periodic train of pulses, AWGN channel.		
	2.2	Modulation, needs, types, proof of modulation and demodulation using Fourier transform.		
		Self learning: Investigate different modulation techniques and its applications.		
3.0		**Amplitude Modulation**	**10**	**CO3**
	3.1	Basic concepts, mathematical analysis, time domain waveforms, modulation index, percentage modulation, bandwidth, amplitude spectrum, power spectrum of AMDSBFC, AMDSBSC, AMSSBSC (SSB), VSB and ISB modulations.		
	3.2	Generation of AMDSBFC (Low level transistor modulator), AMDSBSC (Balanced Modulator) and SSB (Filter and phase shift methods), envelope detection of AMDSBFC and synchronous detection of suppressed carrier signals, application of amplitude modulations.		
		Self learning: Learn about the various applications of AM in modern communication.		
4.0		**Angle Modulation**	**09**	**CO4**
	4.1	Basic concepts of FM and PM, mathematical analysis, time domain representation, modulation index, bandwidth calculation using Bessel function and Carson's rule.		
	4.2	FM modulator (Varactor diode modulator), Generation of FM using PM modulator and generation of PM using FM modulator, FM detector (Slope detector), Noise triangle, pre-emphasis and de-emphasis, application of angle modulation.		
		Self learning: Learn about the applications of FM in FM radio broadcasting, television sound transmission, and mobile communication.		
5.0		**AM and FM Receivers**	**04**	**CO5**
	5.1	Characteristics of a radio receiver, TRF and super heterodyne AM receivers, FM receiver, Comparison between AM and FM receivers.		
		Self learning: Investigate the concept of digital radio and how modern DAB (Digital Audio Broadcasting) or HD Radio systems use FM technology to provide enhanced audio and data services.		

6.0		**Pulse Modulation and multiplexing**	**06**	**CO6**
	6.1	Sampling theorem for low pass signal and band pass signal, proof, aliasing error.		
	6.2	PAM, PWM and PPM generation, detection and applications.		
	6.2	Multiplexing: FDM, TDM and applications.		
		Self learning: Explore the application of FDM in radio broadcasting and satellite communication.		
		Total	**39**	

Textbooks:

1. Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth Edition.
2. B.P. Lathi, Zhi Ding "Modern Digital and Analog Communication system", Oxford University Press.Fourth Edition.
3. Wayne Tomasi, "Electronics Communication Systems", Pearson education, Fifth Edition.

Reference books:

1. Taub, Schilling and Saha, “Principles of Communication systems”, Tata McGraw Hill, Third Edition.
2. P. Sing and S.D. Sapre, “Communication Systems: Analog and Digital”, Tata McGraw Hill, Third Edition.
3. Simon Haykin, Michel Moher, “Introduction to Analog and Digital Communication”, Wiley, second Edition.
4. Dennis Roddy and John Coolen, “Electronic Communication”, Pearson, Fourth Edition.
5. Louis Frenzel, “Communication Electronics”, Tata McGraw Hill, Third Edition.

Online References:

Analog Communication by Prof. Goutam Das (IIT Kharagpur).
https://swayam.gov.in/nd1_noc20_ee69/preview

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.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
ETC403	Linear Integrated Circuits	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETC403	Linear Integrated Circuits	20	20	60	-	-	100

Pre-requisite:

1. FEC103: Basic Electrical &Electronics Engineering
2. ETC302: Electronic Devices and Circuits

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PSO1: Achieve eminence in domains like signal processing, VLSI, embedded IoT, RF & microwave.

Course Objectives:

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

Course Outcomes:

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

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

Module No.	Unit No.	Topics	Hrs	CO
1.0		**Introduction to Operational Amplifier**	**05**	**CO1**
	1.1	Basics of Differential Amplifier, Block diagram of Op-Amp, Ideal and practical characteristics of op-amp.		
	1.2	Configurations of OpAmp: Operational amplifier open loop and closed loop configurations, Inverting and Non-inverting configuration of Op-ampand voltage follower.		
		Self learning: Configurations of differential amplifier.		
2.0		**Linear Applications of Operational Amplifier**	**09**	**CO2**
	2.1	Summing and difference amplifier, Integrator & differentiator (ideal & practical), Instrumentation amplifier.		
	2.2	Active Filters: First and Second order active low pass, high pass, band pass.		
	2.3	Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.		
		Self learning: Voltage to current converter and current to voltage converter		
3.0		**Non-Linear Applications of Operational Amplifier**	**07**	**CO3**
	3.1	Comparators: Inverting comparator and non-inverting comparator, zero crossing detectors, window detector.		
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.		
	3.3	Waveform Generators: square wave generator and triangular wave generator.		
		Self learning: Basics of Precision Rectifiers peak detector, sample and hold circuit		
4.0		**Timer IC 555 and it's applications**	**07**	**CO4**
	4.1	Functional block diagram and working of IC 555.		
	4.2	Design of Astable and Monostable multivibrator using IC 555.		
	4.3	Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator.		
		Self learning: Bistable multivibrator and its applications		
5.0		**Analog to Digital and Digital to Analog Convertors**	**05**	**CO5**
	5.1	Specifications of DAC converter,DAC techniques: weighted resistor DAC and R-2R ladder DAC.		
	5.2	Specifications of ADC converter, ADC techniques:flash ADC, dual slope ADC, successive approximation ADC.		
	5.3	**Self-learning:** Applications of DAC and ADCconverter		
6.0		**Special Purpose Integrated Circuits**	**06**	**CO6**
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM317) voltage regulators.		
	6.2	Functional block diagram and working of VCO IC 566 andapplication as frequency modulator.		
	6.3	Functional block diagram and working of PLL IC 565 and applicationas FSK Demodulator.		
		Self learning: Application of IC 566 as frequency modulator and application of PLL IC 565 as FSK Demodulator.		
		Total	**39**	

Textbooks:

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

Reference books:

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

Online References:

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

Course Assessment:

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

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

End Semester Examination:

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC404	Critical Thinking and Design	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETC404	Critical Thinking and Design	15	15	45	-	-	75

Pre- requisite: --

Program Outcomes Addressed

1. PO2: Problem analysis
2. PO3: Design/development of solutions
3. PO5: Modern Tool Usage
4. PO6: The Engineer and Society
5. PO7: Environment and Sustainability
6. PO9: Individual and Team Work
7. PO10: Communication
8. PO11: Project Management and Finance
9. PO12: Life Long Learning

Course Objectives:

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

Course Outcomes: Learners will be able to

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

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Critical Thinking**	**4**	**CO1**
	1.1	**Introduction:** Start-up definition of Critical Thinking, How skilled are you as a Thinker? Hard Work, Concept of Critical Thinking, Establish new habits of thoughts, Develop confidence		
	1.2	**Fair-minded Thinker:** Weak Vs Strong Critical Thinking. Requirement of Fairmindedness Intellectual: Humility, Courage, Empathy, Integrity, Perseverance, Autonomy. Interdependence of Intellectual Virtues.		
		Self learning: Role of Intellectual Humility in Decision-Making, How to Overcome Cognitive Biases for Stronger Reasoning, Practical Techniques to Develop Fair-Minded Thinking. Case Study: The Challenger Disaster: How Ignoring Critical Thinking Led to Catastrophe		
2.0		**Four Stages of Development, Game Plan**	**3**	**CO2**
	2.1	**Four Stages of Development:** Stage 1: Unreflective thinker, Stage 2: Challenged thinker, Stage 3: Beginning thinker, Stage 4: Practicing thinker		
	2.2	**Game Plan:** Purpose & Key Components of Game Plan, Integrating of Game Plan Strategies		
		Self learning: Characteristics and challenges at each stage, Common obstacles and how to address them, Practical ways to enhance critical thinking in work and academics. Case Study: Explores how a student progresses through four stages using self-reflection& discipline.		
3.0		**Self-Understanding, Parts & Universal Standards**	**3**	**CO3**
	3.1	**Three Distinctive Functions:** Recognize the Mind's Three Distinctive Functions; Special Relationship		
	3.2	**Thoughts & Intellectual Standards:** Fundamental structures of thought, The elements of thought, Universal Intellectual Standards: Clarity, Accuracy, Precision, Relevance, Depth, Breadth, Logic, Significance, Fairness.		
		Self learning: Recognizing biases and promoting ethical decision-making, Case Study: Analyzes how a company applied intellectual standards to refine its business strategies.		
4.0		**Design Thinking & its Key Tenets**	**5**	**CO4**
	4.1	**Design Thinking Basics:** Traditional Model vs. Design Thinking, Five Stages: Inspire, Empathize, Define, Ideate, Prototype & TestScale Thinking: Lean Thinking, Critical Thinking, Lateral Thinking, Design Thinking.		
	4.2	**Key Tenets:** Customer-Centric Approach, Thinking Beyond Products, Balancing Desirability, Feasibility & Viability, Broad & Compartmentalized Thinking, Visual Thinking & Hands-on Approach.		
		Self learning: Understanding the shift from conventional problem-solving to iterative design processes, Designing solutions with user needs at the core while balancing business feasibility. Case Study: How a global brand used design thinking to enhance customer experience and increase engagement.		

5.0		**Inspire, Empathize and Define**	**5**	**CO5**
	5.1	**Generating & Broadening Ideas:** Creating Stretch Goals, Power of Metaphors & Widening Perspectives, Importance of Diversity in Ideation		
	5.2	**Empathize & Define:** New Channels for Customer Insights, Deep Customer Empathy & Stakeholder Analysis, Leveraging Technology for Insights, Mind Mapping: Stakeholders, Journey Mapping, Problem Framing		
		Self learning: Using metaphors and ideation techniques to expand creative possibilities, How diverse teams enhance innovation and problem-solving,Visualizing stakeholder journeys and structuring problem statements for better solutions. Case Study: How Airbnb used empathy mapping and customer insights to redefine its business model.		
6.0		**Ideate, Prototype and Test**	**6**	**CO5,6**
	6.1	Ideate: Brainstorming & Hybrid Ideation Techniques, Challenging Assumptions & Breaking Patterns, Cross-Industry Inspiration (Analogous Design), Designing for Extreme Users & Ideation Triggers		
	6.2	Prototype & Test: Rapid Prototyping & Hypothesis Validation, Storyboarding & Scenario Visualization, Collecting Feedback & Managing Failed Prototypes		
		Self learning: Exploring structured and unstructured brainstorming approaches, Testing ideas quickly through prototypes and data-driven validation, Using visual storytelling to map user experiences and refine concepts. Case Study: Explore Apple's iterative prototyping process in designing user-friendly products.		
		Total	**26**	

Textbooks:

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

Reference books:

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

Online References:

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

Course Assessment:

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

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

End Semester Examination:

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC4011	Artificial Intelligence	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC4011	Artificial Intelligence	20	20	60	--	--	100

Pre-requisite:

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

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PSO2: Become technocrats capable of working in multi-disciplinary fields

Course Objectives:

1. To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2. To make students understand and explore the mechanism of mind that enables intelligent thought and action.
3. To make students understand advanced representation formalism and search techniques.
4. To make students understand how to deal with uncertain and incomplete information.

Course Outcomes:

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

1. to understand the fundamental concepts, evolution, and applications of AI.
2. to analyze intelligent agents, their structures, and problem-solving approaches using search methods.
3. to evaluate different AI problem-solving techniques, including uninformed, informed, and optimization-based search algorithms.
4. to apply logical reasoning and knowledge representation techniques for AI-based inference and decision-making.
5. to understand AI planning methods and different learning paradigms, including reinforcement learning.
6. to explore AI applications in real-world domains such as NLP, robotics, healthcare, retail, and banking.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to AI**	**05**	**CO1**
	1.1	Introduction to Artificial Intelligence, Brief history and evolution of AI, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI		
		Self learning: Applications of AI, Current trends in AI		
2.0		**Intelligent Agents and Environments**	**09**	**CO2**
	2.1	Definition of an agent and its environment, Structure of Intelligent Agents, Types of agents, Learning Agent.		
	2.2	Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems.		
		Self learning: The concept of rationality		
3.0		**Problem Solving Techniques in AI**	**07**	**CO3**
	3.1	Uninformed search methods: Breadth-First Search (BFS) and Depth-First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID)		
	3.2	Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search.		
		Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Genetic algorithms.		
		Self learning: Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning		
4.0		**Knowledge Representation and Logical Reasoning**	**07**	**CO4**
		Logical Agents: Knowledge based Agents, Fundamentals of logic: propositional logic basics, Representation of knowledge using rules, First Order Logic (FOL): Syntax and Semantic, Basic inference techniques: forward chaining and backward chaining, Simple rule-based systems and examples		
		Knowledge Engineering in First-Order Logic, Propositional vs. First-Order Inference, Unification, Resolution		
		Self Learning: Representing knowledge in an uncertain domain, The semantics of belief network		
5.0		**Planning and Learning**	**05**	**CO5**
		The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning.		
		Learning: Forms of Learning, Theory of Learning, PAC learning. Introduction to statistical learning (Introduction only) Introduction to reinforcement learning: Learning from Rewards		
		Self-learning: Passive and Active Reinforcement Learning		
6.0		**AI Applications**	**06**	**CO6**
		Introduction to NLP- Language models, Grammars, Parsing Robotics - Robots, Robot hardware, Problems Robotics can solve AI applications in Healthcare, Retail, Banking		
		Self-learning: AI applications inRetail, Banking		
		Total	**39**	

Textbooks:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition" Pearson Education, 2020.
2. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education, 2005
3. Lavika Goel, "Artificial Intelligence: Concepts and Applications," Wiley 2021.

Reference books:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.
3. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
4. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
5. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.

Course Assessment:

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

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

End Semester Examination

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

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

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

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

Pre-requisite: Knowledge of
1 CSC301- Applied Mathematics-III

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

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

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

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Linear Algebra**	05	
	1.1	Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigen values and Eigen Vectors, The Singular Value Decomposition(SVD).		CO1
		Self-Learning: Applications of Eigen values and Eigenvectors in Machine Learning		
2.0		**Probability and Statistics**	07	
	2.1	Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.		CO2

		Self-Learning: Bayesian Statistics and its Applications		
3.0		**Introduction to Graphs**	**05**	
	3.1	Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, plotting data usingBargraph,Piechart,Histogram,StemandLeafplot,Dotplot,Scatterplot,Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.		**CO3**
		Self-Learning: Graph-Based Data Structures in Python		
4.0		**Exploratory Data Analysis**	**08**	
	4.1	Needofexploratorydataanalysis,cleaningandpreparingdata,Featureengineering, Missingvalues,understandingdatasetthroughvariousplotsandgraphs,drawconclusions, deciding appropriate machine learningmodels.		**CO4**
		Self-Learning: Handling Imbalanced Datasets in Machine Learning		
5.0		**Optimization Techniques**	**07**	
	5.1	Types of optimization-Constrained and Unconstrained optimization,Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method.		**CO5**
		Self-Learning: Hyperparameter Tuning in Machine Learning Models		
6.0		**Dimension Reduction Algorithm**	**07**	
	6.1	Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis.		**CO6**
	6.2	Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial		
		Self-Learning: Principal Component Analysis (PCA) vs. Linear Discriminant Analysis (LDA)		
		Total	**39**	

Textbooks:

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

Reference books:

1 Introduction to Linear Algebra – Gilbert Strang, Wellesley-Cambridge Press, 5th Edition, 2016.
2 Advanced Engineering Mathematics – Erwin Kreyszig, Wiley, 10th Edition, 2011.
3 Foundations of Machine Learning – Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, 2nd Edition, 2018.
4 Understanding Machine Learning: From Theory to Algorithms – Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014.
5 Mathematics and Programming for Machine Learning with R – William B. Claster, CRC Press, 1st Edition, 2020.

Online References:

1 https://math.mit.edu/gs/linearalgebra/
2 https://www.coursera.org/learn/probability-theory-statistics
3 https://nptel.ac.in/courses/111/105/111105090/
4 https://onlinecourses.nptel.ac.in/noc21_ma01/preview

5 https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

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

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

1. Question paper will comprise of 03 questions.
2. 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. 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
MDM C4061	Cost Management	03	-	-	03	-	-	03

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

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

Program Outcomes addressed: PO1, PO2, PO11

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

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

Module No.	Unit No.	Topics	Hrs.	CO
1.0	1	**Module 1: Introduction to Cost Accounting**	04	
		Meaning of Cost, Cost Accounting & its Objectives, Comparison between Cost accounting and Financial Accounting, Comparison between Cost Accounting and Management Accounting, Types of cost, Methods of costing & Techniques of costing.		CO1
		Self-Learning: Basic cost accounting concepts		
2.0	2	Classification of Costs and Cost Sheet	05	
		Elements of Cost, Classification of Costs, Cost center and cost unit, Preparation of Cost Sheet & Estimated Cost Sheet.		CO2
		Self-Learning: Purpose and importance of cost sheet.		
3.0		**Material Management and Accounting for materials**	06	
		Managing Purchase Functions, Cost of Material, Storing of materials		CO3

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

Textbooks:

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

Reference books:

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

Online References:

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

Course Assessment:

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

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

End Semester Examination:

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

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL401	Principles of Communication Engineering Lab	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL401	Principles of Communication Engineering Lab	-	-	-	25	25	50

Pre-requisite:

1. FEL102: Basic Electrical& Electronics Engineering Lab.
2. ETL301: Electronic Devices and circuits Lab.

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution
4. PO5: Modern tool usage
5. PO9:Individual and Team work
6. PO12: Lifelong Learning
7. PSO1:Achieve eminence in domains like signal processing, VLSI, embedded IOT, RF & microwave.

Lab Objectives:

1. To give an understanding of Time and Frequency domain representation of signals.
2. To demonstrate continuous wave modulation and demodulation.
3. To demonstrate analog pulse communication and multiplexing.
4. Able to use simulation software to build communication circuits.

Lab Outcomes:

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

1. Analyze analog CW modulation techniques.
2. Analyze sampling theorem.
3. Analyze analog pulse modulation.
4. Demonstrate multiplexing techniques.

Suggested List of Experiments:		
Sr.No.	**TitleofExperiments**	**LO**
1	AMDSBFC modulation and demodulation.	LO1
2	AMDSBSC modulation and demodulation.	LO1
3	FM modulation and demodulation.	LO1
4	Analyse the output waveforms of each block of AM transmitter /receiver	LO1
5	Analyse the output waveforms of each block of FM transmitter /receiver	LO1
6	Design and implementation of Pre-emphasis and De-emphasis circuit.	LO1
7	Verification of sampling theorem.	LO2
8	Design of PAM modulator and demodulator.	LO3
9	Design of PWM modulator and demodulator.	LO3
10	Design of PPM modulator and demodulator.	LO3
11	TDM multiplexing and de-multiplexing signals.	LO4
12	FDM multiplexing and de-multiplexing signals.	LO4

Term Work:
The term work should include at least 8 experiments. The experiments should be students' centric, and an attempt should be made to make experiments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:
25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Group project/Presentation/Poster/ Assignment based on self learning topics) + 05 Marks (Attendance)
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

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

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL402	Linear Integrated Circuit Lab	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL402	Linear Integrated Circuit Lab	-	-	-	25	25	50

Pre-requisite:

1. FEC103: Basic Electrical &Electronics Engineering
2. ETL301: Electronic Devices and Circuits

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: Achieve eminence in domains like signal processing, VLSI, embedded IoT, RF & microwave.

Lab Objectives:

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

Lab Outcomes:

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

1. Explain the basic building blocks and fundamentals of operational amplifiers.
2. Design linear applications of op-amp.
3. Design nonlinear applications of op-amp.
4. Design various ADC and DAC techniques.
5. Design multivibrators using timer IC 555, PLL IC 565 and VCO IC 566
6. Demonstrate various voltage regulator integrated circuits.

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

Simulation Experiments

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

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

Term work Marks:

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

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

Practical Exam: (2 hours/ 25 Marks)
End-semester Practical and oral exam will be held based on the above syllabusand 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
ETL403	Skill Lab: Linux	-	2*+2	-	-	02	-	02
* Theory class to be conducted for full class								

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
ETL403	Skill Lab: Linux	-	-	-	25	25	50

Course pre-requisite:

1. FEL103: C-Programming

Program Outcomes addressed:

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

Lab Objectives:

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

Lab Outcomes:

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

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

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

6		Advanced Operating Systems	05	LO6
		Case Study: • IoT OS Requirements: Resource Constraints, Real-time Capabilities, Low Power Consumption • Contiki OS: Features, RPL Protocol, Simulation with Cooja • RIOT OS: Architecture, Multi-threading, Energy Efficiency • FreeRTOS: Task Scheduling, Inter-process Communication, Memory Management • TinyOS: NesC Language, Event-driven Programming		
		Case Study: • Characteristics of Cloud OS: Scalability, Virtualization, Multi-tenancy • Virtualization Technologies: Hypervisors (Type 1 & 2), Docker, Kubernetes • AWS, Azure, and Google Cloud OS Architectures • OpenStack: Components and Use Cases • Serverless Computing and OS Implications		
		Total	26	

Textbooks:

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

Reference Books:

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

Software Tools:

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

Online Repository (browser-based terminals)

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

Online Resources: (Study Resources)

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

Suggested List of Programming Assignments/laboratory Work:	
Sr. No.	**Title of Experiments**
1	Installation of Red HAT/Centos/Fedora Linux operating system using following method CD-ROM, Network Installation or Kickstart Installation. a. Partitioning drives b. Configuring boot loader (GRUB/LILO) c. Updating and upgrading the system d. Shutting down and reboot
2	Learning and executing Linux commands for a. Interacting with BASH shell and built-in shell variables b. Navigation c. File and directory management d. Working with links e. Searching files f. creates users, groups, change permission, software selection and installation and make changes in Grub file. Creating, modifying and deleting users Creating, modifying and deleting groups g. Managing file permissions, attributes and ownerships h. Setting Default Permissions with umask i. Setting up access control list for files and directories
3	Learning and executing Linux commands for Process management tasks like a. Executing a process b. Getting process info c. Killing a process d. Changing process attributes e. Managing foreground and background processes f. Scheduling automated jobs using CRON jobs
4	Learning and executing Linux commands for managing Storagedrives in Linux environment

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

Suggested List of Course project:	
Sr. No.	**Title of Experiments**
1	Develop a scientific calculator using shell script.
2	Installation of Contiki /RIOT Operating System.
3	Install and set up KVM to run isolated instances of other operating systems inside a Linux host system
4	Creation of a network bridge.
5	Configuration of Linux box as a router or a packet forwader.
6	Case Study on Docker, Kubernetes
7	Case Study on AWS, Azure, and Google Cloud OS Architectures
8	Network Attached Storage(NAS)
9	Network monitoring service.
10	Automation using Bash.

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

Term Work:

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

Oral & Practical exam

Based on the entire syllabus of ETL403: Skill Laboratory: Linux Networking & Server Configuration 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
ETL404	Value Education (UHV)	-	04	-	-	02	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETL404	Value Education (UHV)	-	-	-	50	-	50

Pre-requisite: --

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution
4. PO4: Conduct investigations of complex problems
5. PO5: Modern tool usage
6. PO6: The engineer and society
7. PO7: Environment and sustainability
8. PO8: Ethics
9. PO9:Indiviual and Team work
10. PO10: Communication
11. PO11: Project management and finance
12. PO12: Life-Long Learning

Course Objectives:

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

Course Outcomes:

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

Module No.	Unit No.	Topics	LO
1.0		**Introduction to Human Values and Their Relevance in IT**	**LO1, LO4**
	1.1	Definition, Intrinsic & Extrinsic values, Shalom Schwartz's Theory of Basic Human Values, Value education: Need, Basic Guidelines and Scope, Self-exploration, Happiness and Prosperity, Harmony, Self-awareness: JOHARI window and SWOT analysis	LO1
	1.2	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	LO4
2.0		**Understanding Human Beings and Harmony at Various Levels of Existence**	**LO3, LO6**
	2.1	Human beings as a combination of the conscious 'I' and material body, Abraham Maslow's Hierarchy of Needs, Classification between I & Body, Co-existence, Harmony in Self: Swasthya and Sanyama	LO3
	2.2	Harmony in the Family -- Understanding Values in Human Relationships, Differentiation in relationships, Values in relationships	LO3
	2.3	Harmony in the Society -- From Family order to World Family Order, Comprehensive Human Goal, Harmony in Nature -- Understanding the Interconnectedness and Mutual Fulfilment, Understanding the Four Orders of Nature	LO3, LO6
3.0		**Professional Ethics in IT**	**LO4**
	3.1	Definition, Characteristics, Profession, Professionalism, Morality, Moral issues in the IT profession, Understanding Ethics, Ethical Standards, Work Ethics, Engineering Ethics	LO4
	3.2	Types of Inquiries, Kohlberg's Theory, Heinz Dilemma, Gilligan's Theory, and Ethical Theories	LO4
	3.3	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	LO4
4.0		**Ethics, Integrity, and Aptitude in IT**	**LO5**

Module No.	Unit No.	Topics	LO
	4.1	Essence, determinants, and consequences of ethics in human actions, Dimensions of ethics, Ethics in private and public relationships	LO5
	4.2	Key contributions from Indian and global moral thinkers and philosophers, emphasizing integrity, impartiality, and non-partisanship in professional settings	LO5
	4.3	Upholding objectivity and dedication to public service, Cultivating empathy, tolerance, and compassion, with a focus on their application in IT and public welfare	LO5
5.0		**Understanding Harmony in Nature and Sustainable IT Practices**	**LO6**
	5.1	Concept of harmony in Nature: Meaning of harmony in nature, Disharmony with Nature -- causes, Implications of disharmony with nature	LO6
	5.2	Maintaining harmony with nature: Harmony through mutual fulfilment of the four orders in nature, Harmony through symbiotic relationship with nature, Achieving competence in maintaining harmony with nature in professional life	LO6
	5.3	Sustainable IT Practices: Green computing, energy-efficient algorithms, and eco-friendly technology development	LO6
6.0		**Practicum Project -- Community Engagement and IT for Social Good**	**LO2, LO5, LO6**
	6.1	Students carry out a community engagement project to benefit the local community through IT-based initiatives (e.g., developing apps for social causes, organizing digital literacy camps, or creating awareness about cybersecurity).	LO2, LO5, LO6
	6.2	Students write a reflective report on how the understanding of universal human values has been integrated into their IT project.	LO5, LO6

Textbooks:

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

Reference Books:

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

Online References:

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

Course Assessment:

Internal Assessment Method (With Rubrics)

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

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

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

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

Digital Literacy Program for Underprivileged Communities

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

Implementation:

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

Human Values & Ethics Integration:

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

AI-Based Cyberbullying Detection for Schools & Colleges

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

Implementation:

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

Human Values & Ethics Integration:

- **Respect & Non-Partisanship** – Encourage online respectful interactions.
- **Fairness & Objectivity** – Ensure non-biased AI in content moderation.
- **Safety & Privacy** – Protect users' personal data and identity.

Green Computing Awareness & E-Waste Management App

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

Implementation:

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

Human Values & Ethics Integration:

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

Cybersecurity Awareness Chatbot for Senior Citizens

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

Implementation:

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

Human Values & Ethics Integration:

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

AI Ethics Awareness in IT Companies & Colleges

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

Implementation:

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

Human Values & Ethics Integration:

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

Mobile App for Volunteer & Donation Matching

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

Implementation:

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

Human Values & Ethics Integration:

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

Ethical Hacking & Cybersecurity Training for Students

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

Implementation:

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

Human Values & Ethics Integration:

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

AI-Powered Sign Language Recognition System

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

Implementation:

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

Human Values & Ethics Integration:

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

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

1. **Project Objective & Problem Statement**
2. **Implementation Details & Challenges Faced**
3. **Human Values & Ethics Integrated**
4. **Impact Assessment & Learning Outcomes**
5. **Future Improvements & Scalability**

Evaluation Rubric:

- **Excellent (5):** Clear objectives, strong ethical integration, significant social impact.
- **Good (4):** Good ethical integration, minor improvement areas.
- **Satisfactory (3):** Basic implementation lacks depth in ethical application.
- **Needs Improvement (2):** Minimal social impact, weak ethical connection.

Poor (1): Unclear project execution, little relevance to human values.

SIES Graduate School of Technology
Department of Electronics and Telecommunication Engineering
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETM401	Mini Project 1B	-	02$	-	-	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
ETM401	Mini Project 1B	-	-	-	25	25	50

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

Pre-requisite:
ETM301: Mini Project 1A

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: Modern Tool Usage
6. PO6: The Engineer & Society
7. PO7: Environment & Sustainability
8. PO8: Ethics
9. PO9: Individual & team work
10. PO10: Communication
11. PO11: Project Management & Finance
12. PO12: Life-long learning
13. PSO1: Achieve eminence in domains like signal processing, VLSI, embedded IoT, RF & microwave

Objectives
1. To acquaint with the process of identifying needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.
5. To enhance written and oral communication skills.
6. To foster ethical leadership and responsible decision making

Course Outcomes:
After successful completion of the course student will be able to
1. Identify problems based on societal /research needs.
2. Develop interpersonal skills to work as member of a group or leader.
3. Apply Knowledge and skill to solve societal problems in a group.
4. Analyze available results through theoretical/ experimental/simulations
5. Excel in written and oral communication.
6. Apply standard norms of engineering practices and demonstrate project management principles during project work.

Guidelines for Mini Project:

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Mini project 1B should be hardware and software based. Boards like NodeMcU,ESP32 etc.other than Arduino and Rpi preferred.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format.

Guidelines for Assessment of Mini Project:

Term Work (CIAP)

- The review /progress monitoring committee shall be constituted by head of department of each institute, the progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Review/progress monitoring committee may consider following points for assessment based general guidelines.

Assessment:

- Students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalization of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution

5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the standard format.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points:

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

Term Work:

The term work should include 1 project. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Distribution of Term work (25 Marks)shall be as below:

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee :10
- Quality of Project report :05

The final certification and acceptance of term work ensures satisfactory performance of project 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 demonstration of the project and will be conducted as End Semester Examination Practical (ESEP).

InternalAssessment:
For 03 credit - 80 marks subject Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conductedbased on 50 %syllabus with duration of one hour.
For 02 credit - 60 marks subject Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conductedbased on 50 %syllabus with duration of one hour.
In Semester Examination (ISE)
ISE 20 marks = 05 marks attendance +15 marks for Activities. **ISE 15 marks = 05 marks attendance +10 marks for Activities.** The Rubrics for activities are as follows. The activities willbe decided by course in charge and approved by HoD.

Sr.No	Rubrics	Marks
1	MultipleChoiceQuestions(Quiz)	05Marks
2	Literaturereviewofpapers/journals	05Marks
3	Participation in event/ workshop/ talk / competitionfollowedbysmallreportand certificate of participation relevant to the subject	05Marks
4	ExtraExperiments/VirtualLab	05 marks
5	Contentbeyondsyllabuspresentation	05 marks
6	Winsintheevent/competition/hackathonpertainingtothecourse	10Marks
7	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10Marks
8	NPTEL/Coursera/Udemy/anyMOOCCertificatecoursefor4weeksormore	10Marks
9	CreatingProofofConcept	10Marks
10	MiniProject/	10Marks
11	GATEBasedAssignmenttest/Tutorialsetc.	10Marks

*Forsr.no.8,thedateofcertificationexamshouldbewithinthetermandincaseastudentisunable complete the certification, the grading has to be done accordingly.