PUDUCHERRY TECHNOLOGICAL UNIVERSITY,

Puducherry – 605014

(A Technological University of Government of Puducherry)

Curriculum and Syllabi

for

B. Tech (Electronics and Communication Engineering)

(Effective from Academic year 2024-25)

(Subject to the Approval of the Fifth Academic Council meeting of Puducherry Technological University)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Department Vision

To develop globally competitive graduates in Electronics and Communication Engineering through skill-based education and cutting-edge research to excel as innovators and successful entrepreneurs to serve industry and society.

Department Mission

- To provide quality and contemporary education in the domain of Electronics and Communication Engineering through periodically updated curriculum and effective teaching - learning process.

- To develop problem-solving skills with essential domain expertise through the best of breed laboratory facilities and collaborative ventures with Industries to promote innovation and research.

- To inculcate a professional, ethical and sustainable outlook to excel as successful entrepreneurs, industry-ready engineers and holistic individuals

CURRICULUM AND SYLLABUS

The Curriculum of B. Tech (Electronics and Communication Engineering) is designed to fulfil the Program Educational Objectives (PEO) and the Program Outcomes (PO) listed below.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	Producing knowledgeable and contributive engineering graduates in the twin core areas of Electronics and Communication Engineering through contemporary curriculum and Co-curricular programmes.
PEO2	Nurturing students' Intellectual potential towards pursuing higher studies and research in interdisciplinary areas of Electronics and Communication Engineering domain.
PE03	Equipping students to excel as industry-ready professionals, driven by innovation, creativity, and independent thinking in delivering effective solutions.
PE04	Cultivating a mind-set in students with sustainability, ethical values, and societal awareness, while encouraging them to develop interpretation skills, life skills and embrace lifelong learning

PROGRAM OUTCOMES (PO)

PO1	**Engineering Knowledge:** Apply the knowledge of Mathematics, Natural science, Computing, Engineering Fundamentals and an Engineering Specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems
PO2	**Problem Analysis:** Identify, formulate review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1-WK4)
PO3	**Design / Development of solutions:** Design creative solutions for complex engineering problems and design / develop systems / components / processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).
PO4	**Conduct Investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis and interpretation of data to provide valid conclusions. (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 & WK6).
PO6	**The Engineer and the world**: Analyse and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7).

PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values. Diversity and inclusion, adhere to national and international laws. (WK9).
PO8	**Individual and Collaborative Team Work:** Function effectively as an individual, and as a member or leader in diverse / multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations considering cultural, language, and learning differences
PO10	**Project Management and Finance**: Apply knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-long learning**: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

KNOWLEDGE AND ATTITUDE PROFILE (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and

	respect, and of inclusive attitudes.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	To acquire expertise in the emerging areas of VLSI, Embedded Systems and Artificial Intelligence
PSO2	To effectively apply domain knowledge to design, develop and implement innovative solutions using modern tools in Signal Processing and Communication Networks to address real world problems.

Distribution of credits among the subjects grouped under various categories:

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Basic science courses	20	BSC
2	Engineering science courses	15	ESC
3	Professional core courses	84	PCC
4	Professional elective courses	12	PEC
5	Ancillary Stream Courses	12	ANC
6	Ability enhancement courses	10	AEC
7	Skill enhancement courses	6	SEC
8	Value added courses	4	VAC
	Total	**163**	

Semester-wise Courses and Credits

Semester I

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	3 weeks compulsory Induction Program					
MAUC101	Mathematics I	BSC	3	1		4
ECUC101	Electronic Devices and Circuits	PCC	3	1		4
PHUC101	Physics	BSC	3			3
MEUC101	Engineering Graphics	ESC	1		4	3
HSUA101	English for Communication	AEC	2			2
GEUS101	Basic Engineering Skills Laboratory - I	SEC	1		4	3
GEUV101	NSS, Yoga and Health	VAC			2	1
PHUC102	Physics Laboratory	BSC			2	1
Total			13	2	12	-
			27			21

CCC - Course Category Code, L-Lecture, T – Tutorial, P – Practical

Semester II

Course Code	Course	CCC*	Periods			Credits
			L	T	P	
MAUC102	Mathematics II	BSC	3	1		4
ECUC102	Analog Communication	PCC	3	1		4
CYUC101	Chemistry	BSC	3			3
CSUC101	Programming for Problem Solving	ESC	2			2
HSUA102	Professional English	AEC	2			2
GEUS102	Basic Engineering Skills Laboratory - II	SEC	1		4	3
GEUV102	Essence of Indian Traditional Knowledge	VAC	1			1
CYUC102	Chemistry Laboratory	BSC			2	1
CSUC102	Computer Programming Laboratory	ESC			2	1
Total			15	2	8	
			25			21

Exit Option for the students who opt to exit after completion of first year of B. Tech Programme and have secured a minimum of 42 credits will be awarded a UG certificate in a discipline if, in addition they complete one vocational course of 4 credits during the summer vacation of the first year

Semester III

Course Code	Course	CCC	Periods			Credits
			L	T	P	
MAUC105	Probability and Stochastic Processes	BSC	3	1		4
ECUC103	Circuits and Networks	PCC	3	1		4
ECUC104	Electronic Circuit Design	PCC	3			3
ECUC105	Digital System Design	PCC	3			3
CSUC137	Data Structures and Object- Oriented Programming	ESC	3			3
HSUA103	Entrepreneurship	AEC	2			2
GEUV103	Environmental Education	VAC	1			1
ECUC106	Electronic Devices and Circuit Design Laboratory	PCC			3	1.5
CSUC138	Data Structures and Object- Oriented Programming Laboratory	ESC			3	1.5
Total			18	2	6	-
			26			23

Semester IV

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUC107	Signals and Systems	PCC	3	1		4
ECUC108	Control Systems Engineering	PCC	3			3
ECUC109	Electromagnetic Fields and Waveguides	PCC	3			3
ECUC110	Digital Communication	PCC	3			3
HSUA104/ HSUA106	Modern Indian Language/Foreign language (or) Design Thinking (or) Cybercrime and laws	AEC	2			2
GEUV104	Universal Human values	VAC	1			1
ECUC111	Digital System Design Laboratory	PCC			3	1.5
ECUC112	Analog and Digital Communication Laboratory	PCC			3	1.5
Total			15	1	6	
			22			19

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	Ancillary stream course 1	ANC	3			3
ECUH101	Semiconductor Technology and Design	HNC	3	1		4

Exit Option for the students who opt to exit after completion of second year of B. Tech Programme and have secured a minimum of 87 credits will be awarded a UG Diploma in a discipline if, in addition they complete one vocational course of 4 credits during the summer vacation of the second year.

Semester V

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUC113	Digital Signal Processing	PCC	3	1		4
ECUC114	VLSI Design	PCC	3	1		4
ECUC115	Data Communication Networks	PCC	3			3
HSUA105	Industrial Economics and Management	AEC	2			2
ECUEXXX	Professional Elective 1	PEC	3	1		4
ECUC116	Digital Signal Processing laboratory	PCC			2	1
ECUC117	VLSI Design Laboratory	PCC			3	1.5
ECUC118	Data Communication Networks Laboratory	PCC			3	1.5
Total			14	3	8	
			25			21

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	Ancillary stream course 2	ANC	3			3
ECUH102	Advanced Digital System Design	HNC	3	1		4

Semester VI

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUC119	Microwave and Optical Engineering	PCC	3			3
ECUC120	Embedded system	PCC	3			3
CSUC117	Microprocessors and Microcontrollers	ESC	3			3
ECUEXXX	Professional Elective 2	PEC	3	1		4
ECUC121	Advanced Communication Laboratory	PCC			3	1.5
ECUC122	Embedded system laboratory	PCC			2	1
CSUC120	Microprocessors and Microcontrollers laboratory	ESC			3	1.5
ECUC123	Internship	PCC				2
Total			12	1	8	
			21			19

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	Ancillary stream course 3	ANC	3			3
ECUH103	Simulation of Communication Systems	HNC	3	1		4

Exit Option for the students who opt to exit after completion of third year of B.Tech Programme and have secured a minimum of 133 credits will be awarded a B.Sc. (Engg.) in a discipline.

Semester VII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUC124	Wireless Communication	PCC	3	1		4
ECUC125	Information Theory and Coding	PCC	3	1		4
ECUC126	Artificial Intelligence and Machine Learning	PCC	3	1		4
ECUEXXX	Professional Elective 3	PEC	3	1		4
ECUC127	Mini project	PCC			4	2
ECUC128	Comprehensive viva	PCC				1
Total			12	4	4	
			20			19

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	Ancillary stream course 4	ANC	3			3
ECUH104	Next Generation Networks	HNC	3	1		4

Semester VIII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUC129	Project work	PCC			16	8
			16			8

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ECUH105	Honours course 5 (Seminar)	HNC				2

List of Professional Elective Courses

Professional Elective	Course code	Course	**Semester**
Professional Elective I	ECUE101	Computer Architecture and Organization	**V**
	ECUE102	Verilog programming	
	ECUE103	Cryptography and Network Security	
	ECUE104	Medical Electronics and Informatics	
Professional Elective II	ECUE105	Digital Image and Video Processing	**VI**
	ECUE106	Antennas and wave propagation	
	ECUE107	Satellite Communication Systems	
	ECUE108	Microwave Integrated Circuit Design	
Professional Elective III	ECUE109	Deep learning	**VII**
	ECUE110	Internet of Everything	
	ECUE111	Advanced Mobile Communication	
	ECUE112	Cognitive Radio Networks	

List of Ancillary Stream Courses

Ancillary Stream Title	Course Code	Course	Semester
Applied Electronics (*For all branches except ECE*)	ECUN101	Analog and Digital Electronics	**IV, V, VI, VII**
	ECUN102	Consumer Electronics	
	ECUN103	Medical Electronics	
	ECUN104	Embedded System	
Communication Systems and Networks (*For all branches except ECE*)	ECUN105	Analog and Digital Communication	
	ECUN106	Communication Technologies	
	ECUN107	Wireless Communication Networks	
	ECUN108	Industrial IoT	
Sensors and Computing Technologies (*only for ECE students*)	ECUI101	Principles of Sensors and actuators	
	ECUI102	IoT Architecture and Protocols	
	ECUI103	Mobile Adhoc and Wireless Sensor Networks	
	ECUI104	Edge and Cloud computing	

Courses offered under various categories:

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MAUC101	Mathematics – I	I	4	20
	PHUC101	Physics	I	3	
	CYUC101	Chemistry	II	3	
	PHUC102	Physics laboratory	I	1	
	CYUC102	Chemistry Laboratory	II	1	
	MAUC102	Mathematics –II	II	4	
	MAUC105	Probability And Stochastic Processes	III	4	
ESC	MEUC101	Engineering Graphics	I	3	15
	CSUC101	Programming for Problem Solving	II	2	
	CSUC102	Computer Programming Laboratory	II	1	
	CSUC137	Data Structures and Object- Oriented Programming	III	3	
	CSUC138	Data Structures and Object- Oriented Programming Laboratory	III	1.5	
	CSUC117	Microprocessors and Microcontrollers	VI	3	
	CSUC120	Microprocessors and Microcontrollers Laboratory	VI	1.5	
PCC	ECUC101	Electronic Devices and Circuits	I	4	84
	ECUC102	Analog Communication	II	4	
	ECUC103	Circuits and Networks	III	4	
	ECUC104	Electronic Circuit Design	III	3	
	ECUC105	Digital System Design	III	3	
	ECUC106	Electronic Devices and Circuit Design Laboratory	III	1.5	
	ECUC107	Signals and Systems	IV	4	
	ECUC108	Control Systems Engineering	IV	3	
	ECUC109	Electromagnetic Fields and Waveguides	IV	3	
	ECUC110	Digital Communication	IV	3	
	ECUC111	Digital System Design Laboratory	IV	1.5	
	ECUC112	Analog and Digital Communication Laboratory	IV	1.5	
	ECUC113	Digital Signal processing	V	4	
	ECUC114	VLSI Design	V	4	

	ECUC115	Data Communication Networks	**V**	3	
	ECUC116	Digital Signal Processing laboratory	**V**	1	
	ECUC117	VLSI Design Laboratory	**V**	1.5	
	ECUC118	Data Communication Networks laboratory	**V**	1.5	
	ECUC119	Microwave and Optical Engineering	**VI**	3	
	ECUC120	Embedded system	**VI**	3	
	ECUC121	Advanced Communication Laboratory	**VI**	1.5	
	ECUC122	Embedded system Laboratory	**VI**	1	
	ECUC123	Internship	**VI**	2	
	ECUC124	Wireless Communication	**VII**	4	
	ECUC125	Information Theory and Coding	**VII**	4	
	ECUC126	Artificial Intelligence and Machine Learning	**VII**	4	
	ECUC127	Mini project	**VII**	2	
	ECUC128	Comprehensive viva	**VII**	1	
	ECUC129	Project work	**VIII**	8	
PEC	ECUEXXX	Professional Elective – I	VI	4	**12**
	ECUEXXX	Professional Elective – II	VI	4	
	ECUEXXX	Professional Elective – III	VII	4	
AEC	HSUA101	English for Communication	I	2	**10**
	HSUA102	Professional English	II	2	
	HSUA103	Entrepreneurship	III	2	
	HSUA104/ HSUA106	Design Thinking / Language -French	IV	2	
	HSUA105	Industrial Economics and Management	V	2	
SEC	GEUS101	Basic Engineering Skills Laboratory - I	I	3	6
	GEUS102	Basic Engineering Skills Laboratory - II	II	3	
VAC	GEUV101	NSS, Yoga and Health	I	1	**4**
	GEUV102	Essence of Indian Traditional Knowledge	II	1	
	GEUV103	Environmental Education	III	1	
	GEUV104	Universal Human Values	IV	1	
ANC		Ancillary Stream Elective course	**IV-VII**	12	**12**
Total					**163**

Curriculum and Syllabi of the B.Tech (*Electronics and Communication Engineering*) Programme effective from the Academic year 2024-25

SEMESTER – III

Department : Mathematics			Programme : B. Tech.(ECE)						
Semester : III			Course Category Code: BSC				Exam Type:TY		
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
MAUC105	Probability And Stochastic Processes		3	1	0	4	40	60	100
Prerequisite	Basic Integration and probability								
Outcome:	Upon completion of the course, the students will be able to								
	CO1	Classify random variables and discuss discrete distributions.							
	CO2	Develop the concept of reliability and continuous distributions.							
	CO3	Change one random variable into another random variable.							
	CO4	Categorize stochastic processes and use Markov chain to obtain bounds on probability of events							
	CO5	Discuss various Poisson queueing models and evaluate its performance measures.							
UNIT – I	Probability And Discrete Distributions						Hours: 12		
Random Variables - Probability mass function, Distribution functions, Special discrete distributions: Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hyper geometric, Probability Generating function-Characteristic function.									CO 1
UNIT – II	Continuous Distributions						Hours: 12		
Reliability, Failure density and Hazard function - Some important Continuous distributions: Exponential, Hypo exponential, Erlang, Gamma, Hyper exponential, Weibull, Gaussian, Uniform and Pareto distributions.									CO 1, CO 2
UNIT – III	Transformation of Random Variables						Hours: 12		
Transformation of Random Variables: Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.									CO 1, CO 3
UNIT – IV	Random Processes						Hours:12		
Stochastic Processes: Definition, Classification of Stochastic Processes - Strictly Stationary Process, Wide Sense Stationary, Bernoulli Process, Poisson process, Markov Process , Markov Chain.									CO 1, CO 2, CO 4
UNIT – V	Poisson Queueing Models						Hours: 12		

The Birth and Death process: M/M/1, M/M/c, M/M/1/N, M/M/c/N (c < N), M/M/c/c, M/M/∞ models only - derivation of mean number of customer in the system, queue and waiting time - Simple applications. Special case of Birth and Death model.	CO 1, CO 5

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: 00**	**Total Hours: 60**

Reference Books:

1. Kishore S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, John Wiley & Sons Inc. Second Edition, 2016..
2. D.Gross and C.M.Harris, Fundamentals of Queuing Theory, Wiley Students Edition, Third Edition, 2008.
3. J. Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 2002.
4. T. Veerarajan, Probability and Statistics, Random Processes and Queueing Theory" McGraw-Hill Education(India) Private Limited, 2018.

MAUC105 CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	3	2	-	1	2	1	3	1	1
CO2	3	3	2	3	3	2	-	1	2	1	3	2	1
CO3	3	3	2	3	3	2	-	1	2	1	3	3	3
CO4	3	3	2	3	3	2	-	1	2	1	3	2	3
CO5	3	3	2	3	3	2	-	1	2	1	3	2	3
	3	3	2	3	3	2	-	1	2	1	3	2	2.2

Score: **3** – High; **2** – Medium; **1** – Low

Department : ECE		Programme : B.Tech.ECE						
Semester : Third		Course Category Code: PCC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC103	Circuits and Networks	3	1	0	4	40	60	100
Prerequisite	Nil							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1 Able to explain the fundamental laws and Theorems of electric circuits							
	CO2 Apply appropriate theorem to obtain steady state response of electric circuits							
	CO3 Able to explain the need for transient analysis and effect of mutual coupling.							
	CO4 Analyze Transient behavior and mutual coupling of electrical circuits							
	CO5 Analyze networks using network parameters							
	CO6 Design filters, attenuators, and equalizers.							
UNIT – I	Circuit Analysis and Resonance				Hours: 12			
Analysis of AC circuits using Superposition, Thevenin' s, Norton's, Reciprocity and Maximum power transfer theorems. Source transformation. Resonance-Series resonance and Parallel resonance -Resonant frequency- Bandwidth – Q factor - Selectivity.								CO1 & C02
UNIT – II	Transient Analysis				Hours: 12			
Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by DC sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.								CO3 & CO4
UNIT – III	Magnetically Coupled Circuits				Hours: 12			
Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi winding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.								CO3 & CO4
UNIT – IV	Network Parameters				Hours: 12			
Open circuit impedance (Z) parameters - short circuit admittance (Y) parameters - transmission (ABCD) parameters and inverse transmission parameters -Hybrid (h) parameters and inverse hybrid parameters - Conversion between parameters - interconnection of two-port networks.								CO5
UNIT – V	Filters, Attenuators and Equalizers				Hours: 12			
Classification of filters - characteristic impedance- constant K filters – m-derived filters – LPF, HPF, BPF and BSF- T section and Pi section filters – Twin-T Notch Filter-Lattice and Bridged-T Attenuators – Series and Shunt Equalizers.								CO6
Lecture Hours: 45	Tutorial Hours:15	Practical Hours:			Total Hours: 60			
Reference Books:								

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuit Analysis”, McGraw Hill Science Engineering, 8th Edition, 2013.
2. Umesh Sinha, “Transmission Lines and Networks: Networks, Filters & Transmission Lines”, Satya Prakashan Publishing Company, New Delhi 2010.
3. Joseph Edminister and Mahmood Nahvi, “Electric Circuits”, Tata McGraw Hill Publishing Company, Schaum‘s Outline Series, Fourth Edition New Delhi, 2003.
4. John. D. Ryder, “Network lines and fields”, PHI Learning, Second Edition, 2005.
5. M.E. Van Valkenburg, “Network Analysis”, PHI, Third Edition, 2008.

ECUC103 Circuits and Networks

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	2	1	-	-	-	1	-	-	1	1
CO2	3	3	2	3	2	-	-	1	-	-	-	3	3
CO3	2	1	2	2	2	-	-	-	1	-	1	1	1
CO4	3	3	2	3	1	-	-	1	1	-	2	3	3
CO5	3	3	2	2	2	-	-	1	-	-	2	3	3
CO6	3	3	3	3	2	2	1	3	2	3	3	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department : ECE				**Programme :**B.Tech.ECE				
Semester :Third				**Course Category Code: PCC**				
Course Code	**Course**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECUC104	Electronic Circuit Design	3	-		3	40	60	100
Prerequisite	Electronic Devices							
	Upon completion of the course, the students will be able to							
Course Outcome	CO1 Demonstrate the understanding of amplifier circuits							
	CO2 Analyse the oscillators circuits							
	CO3 Acquire knowledge on multi-stage amplifiers							
	CO4 Analyse power amplifier circuits							
	CO5 Demonstrate the understanding of Linear Integrated Circuits							
	CO6 Apply the Linear Integrated circuits to study the applications							
UNIT – I	**Feedback Amplifiers**				**Hours: 9**			
Concept of feedback- Features of negative feedback amplifiers – Feedback topologies –Analysis of voltage series feedback amplifiers, voltage shunt feedback amplifiers, Current series feedback amplifiers, Current shunt feedback amplifiers								CO1
UNIT – II	**Oscillators**				**Hours: 9**			
Concept of positive feedback –Bharkausen's criterion for sustained oscillation- qualitative and quantitative analysis of Hartley oscillator, Colpitts Oscillator, RC phase shift oscillator ,Wien Bridge oscillator, Crystal oscillator –Frequency stability								CO2
UNIT – III	**Multistage Amplifiers**				**Hours: 9**			
Need for multistage amplification –qualitative and quantitative analysis of Cascade amplifier, Cascode amplifier , Darlington pair, qualitative transistorized differential amplifier- Qualitative approach of single tuned amplifier and double tuned amplifier								CO1, CO3
UNIT – IV	**Power Amplifiers**				**Hours: 9**			
Need for power amplifiers- Classification of power amplifiers –qualitative and quantitative analysis of Class A direct coupled and transformer coupled amplifiers, Class B power amplifier, Cross –over distortion, Class C power amplifier-Heat sink – Construction and working of Class C, Class D and Class S amplifiers								CO4
UNIT – V	**Linear Integrated circuits and applications**				**Hours: 9**			
Block diagram of op-amp – voltage follower -inverting and non-inverting amplifier – Summer –Subtractor- Differentiator - Integrator – LPF and HPF- Miller integrator – Bootstrap ramp generator- 555 timer block diagram – 555 timer as Astable multivibrator –Block diagram of NE565 PLL- Application of NE565 for AM detection- Weighted resistor and R-2R ladder DAC- Flash type A to D convertor – Successive approximation A to D convertor								CO5,CO6
Lecture Hours: 45	**Tutorial Hours: NIL**		**Practical Hours: NIL**		**Total Hours: 45**			
Reference Books:								

1. J.Millman, C. Halkias ,Satyabrata," Electronic Devices and Circuits", Third Edition, Mcgraw Hill, 2010
2. Robert.F, Coughlin and Frederick F.Driscoll, " Operational Amplifiers and Linear Integrated Circuits,PHI Learning Pvt, Ltd.,Sixth edition, 2008
3.David A.Bell ,"Electronic Devices and Circuits", Prentice Hall of India, Fifth Edition , 2008
4, Ramakant Gayakwad, "Op-amps and Linear Integrated Circuits", Prentice Hall, Fourth Edition, 2000
5. Roy Choudhry, " Linear Integrated Circuits", New Age International Publishers, Fifth Edition, 2017

ECUC104 Electronic Circuit Design

CO-PO/PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	-	–	–	–	–		–		1
CO2	2	1	1	1		–	–	–	–	–	–		1
CO3	2	1	-	1		–	–	–	–	–	–		1
CO4	2	1		1		–	–	–	–	–	–		1
CO5	2	1		1		–	–	–	–	–	–		1
CO6	2	1		1									1
ECUC104	2	1.16	1	1		–	–	–	–	–	–		1

Communication Engineering								
Semester :III		**Course Category Code:**PCC						
Course Code	**Course**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECUC105	**Digital System Design**	3			3	40	60	100
Prerequisite								
	Upon completion of the course, the students will be able to							
Course Outcome	CO1	Demonstrate the understanding of Boolean functions and their minimizations.						
	CO2	Translate a circuit's functional statements to Boolean functions and then to a logic circuit.						
	CO3	Demonstrate the understanding of the design of basic combinational circuits						
	CO4	Analyze the basic synchronous sequential circuits and design simple synchronous sequential circuits						
	CO5	Analyze the construction of logic gates under the various logic families. Demonstrate the understanding of memory and the role of PLDs in implementation of large scale logic functions.						
	CO6	Assess the functions of basic digital circuits using Verilog HDL						
UNIT – I	**Boolean Functions**				**Hours: 9**			
Decimal, Binary, Octal, Hexadecimal; Signed binary numbers-Addition and Subtraction. **Boolean Algebra**–Basic theorems- Postulates- Duality; Canonical forms - standard forms-conversion between the forms; Minimization of 3,4 and 5- variable Boolean Functions and incompletely specified functions using Karnaugh map method; Two-Level NAND- and NOR - Gate Circuits								CO1 CO2
UNIT – II	**Combinational Circuits**				**Hours: 9**			
Half adder/subtractor - Full adder/subtractor; Ripple Carry Adder- Carry Look Ahead Adder- Adder/subtractor; BCD Adder, Magnitude Comparator, Encoder, Priority Encoder, Decoder/ Demultiplexers, multiplexers - implementation of combinational circuits using multiplexers, Decoders.								CO2 CO3
UNIT – III	**Synchronous Sequential Circuits**				**Hours: 9**			
Latches- Flip-Flops (RS, JK, D, T and Master Slave)- Analysis of clocked sequential circuits –State equations, State table, State diagram, FF input equations Set-up time, Hold Time, and Clock skew. Analysis of clocked sequential circuits –State equations, State table, State diagram, FF input equations, State reduction. **Registers and Counters-**Shift registers, serial adder, Ring Counter, Johnson counter, Universal Shift Register- PN sequence generator. Asynchronous Counters, Synchronous Counters, Timing diagrams								CO2 CO4
UNIT – IV	**Digital IC Technology, Semiconductor Memories and PLDs**				**Hours: 9**			
Logic families- Characteristics; TTL- Open Collector output, Totem-pole output and tri-state output, ECL, CMOS. Basic memory cell, RAM, Memory decoding, Static and Dynamic memories Simple PLDs: PROM, PLA and PAL.								CO5
UNIT – V	**Introduction to Verilog HDL simulator**				**Hours: 9**			
Representation of basic digital circuits–Full adder, Multiplexers, Decoders, DFF, Registers, Counters. Usage of structural specification, behavioural specification-For loop, If-else, Case, Casex, Casez statements, continuous assignments, procedural assignment- blocking- and								CO6

nonblocking assignments. Hierarchical design.			
Lecture Hours: 45	**Tutorial Hours:-**	**Practical Hours:-**	**Total Hours: 45**

Reference Books:

1. M.Morris Mano and Michael Ciletti, "Digital Design",6th edition, Pearson India Education Services Pvt.Ltd.,2018.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd ed., 2014, Tata McGraw-Hill Publishing company Ltd. NewDelhi.
3. John F Wakerly, "Digital Design Principles and Practices", Prentice Hall of India, New Delhi,2005.
4. Roth Jr, C.H., Kinney, L.L. and John, E.B., *Fundamentals of logic design*, 6th Edn., Cengage Learning, 2020.

ECUC105 **Digital System Design**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	1	-
CO3	2	1	2	1	-	-	-	-	-	-	-	1	-
CO4	2	1	2	3	-	-	-	-	-	-	-	2	-
CO5	2	1	2	2	-	-	-	-	-	-	-	-	-
CO6	2	1	2	1	2	-	-	-	-	-	-	1	-

Semester: **Third**			Course Category Code: **ESC**			Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC137	**Data Structures and Object – Oriented Programming**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Analyze and implement various searching and sorting techniques.						
	CO2	Choose appropriate data structures to solve real world problems data structures.						
	CO3	Explain the basics Concepts of Object-Oriented Programming.						
	CO4	Develop C++ programs by applying the concepts Inheritance and Polymorphism.						
UNIT-I	**Arrays, Searching and Sorting**				**Periods: 09**			
Algorithm: Characteristics – Representation – Efficiency of Algorithms – Data Structures: Characteristics – Types – Arrays: Introduction – Types – Representation – Operations – Applications: Sparse Matrix –Searching: Linear Search and Binary Search – Sorting techniques: Insertion Sort, Selection Sort, Bubble Sort, Quick Sort and Heap Sort.								**CO1**
UNIT-II	**Linear Data Structures**				**Periods: 09**			
Stacks: Introduction – Operations – Applications: Evaluation of Expressions – Queues: Introduction – Operations – Circular queues – Priority queues – Double ended queues – Applications: Job Scheduling – Linked List: Introduction – Singly Linked List – Circularly Linked List and Doubly Linked List – Applications: Polynomial Addition.								**CO2**
UNIT-III	**Non-Linear Data Structures**				**Periods: 09**			
Trees: Introduction – Terminology – Binary tree – Representation – Traversals– Graph: Introduction – Terminology – Representation – Traversals – Single Source and All Pairs Shortest path algorithms.								**CO2**
UNIT-IV	**Introduction to Object-Oriented Programming**				**Periods: 09**			
Basics Concepts of Object-Oriented Programming – Structure of C++ – Tokens-Expressions-Control Structures – Functions in C++: Inline Functions – Recursion– Function Overloading – Classes and Objects – Constructors and Destructors – Friend Functions.								**CO3**
UNIT-V	**Concepts of Object-Oriented Programming**				**Periods: 09**			
Operators Overloading: Unary and Binary Operators – Type Conversions – Inheritance –Types – Polymorphism – Virtual Functions – Exception Handling: Basics and Mechanism.								**CO3, CO4**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**			**Total Periods: 45**		
Reference Books:								
1. E. Balagurusamy, “Data Structures”, McGraw Hill Education (India) Private Limited, 2018. 2. G. A. Vijayalakshmi Pai, *A Textbook of Data Structures and Algorithms, Volume 1: Mastering Linear Data Structures*, Wiley, August 2022.								

3. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, “Fundamentals of Data Structures in C”, Second Edition, Universities Press (India) Private Limited,2018.
4. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education (India) Private Limited, Seventh Edition, 2019.

CSUC137 CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	1	1	-	2	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Semester :Third			Course Category Code: AEC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSUA103	**Entrepreneurship**		2	-	-	2	40	60	100
Prerequisite:									
		Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Understand entrepreneurial mindset, problem identification, customer segmentation, and value proposition development.							
	CO2	Develop and validate business models, test solutions, and create a Minimum Viable Product (MVP) through iterative feedback.							
	CO3	Analyze financial planning, revenue models, pricing strategies, and investor expectations for startup funding.							
	CO4	Apply sales, branding, digital marketing, automation, and teamwork strategies to successfully launch and scale a venture.							
UNIT-I	**Problem Identification and Customer Discovery**					**Periods: 6**			
Entrepreneurial mindset – Identifying business opportunities – Effectuation principles – Design Thinking for problem-solving – Consumer segmentation and customer persona – Value Proposition Canvas (VPC) – Unique Value Proposition (UVP) – Market research techniques – Emerging trends: AI in market research.									**CO1**
UNIT-II	**Business Model and Lean Startup**					**Periods: 6**			
Types of business models – Lean Canvas vs. Business Model Canvas – Competitor analysis – Blue Ocean Strategy – Building and testing Minimum Viable Product (MVP) – Build-Measure-Learn feedback loop – Digital Prototyping tools – Rapid Experimentation – Agile startup methodology.									**CO1, CO2**
UNIT-III	**Revenue Models, Costing, and Financial Planning**					**Periods: 6**			
Revenue models: Subscription, Freemium, and Pay-per-use – Unit economics: Cost structures and pricing strategies – Funding sources: Bootstrapping, Crowdfunding, Venture Capital – Investor expectations and funding rounds – Pitching to investors – Financial forecasting and break-even analysis – Government startup incentives.									**CO2, CO3**
UNIT-IV	**Digital Marketing and Sales Strategies**					**Periods: 6**			
Brand positioning and storytelling – Social media marketing and digital presence – SEO, SEM, and paid advertising – Data-driven marketing strategies – Sales funnels – Unique Sales Proposition (USP) – B2B vs. B2C sales – CRM tools for customer engagement – Customer retention strategies.									**CO3, CO4**
UNIT-V	**Team Building, Compliance, and Scaling**					**Periods: 6**			
Building and managing startup teams – Remote collaboration tools – Business registration and legal compliance – Intellectual Property Rights (IPR) for startups – Growth hacking and automation – Scaling strategies: Expansion and franchising – Emerging trends: AI in entrepreneurship, blockchain applications – Exit strategies: Mergers, acquisitions, IPOs.									**CO5**
Lecture Periods: 30	**Tutorial Periods:**		**Practical Periods:**				**Total Periods: 30**		
Reference Books:									

1. **Eric Ries,** *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses* by Crown Business, **1st Edition (2011)**.

2. **Alexander Osterwalder& Yves Pigneur,** *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, Wiley, **1st Edition (2010)**.
3. **Ash Maurya,** *Running Lean: Iterate from Plan A to a Plan That Works*, O'Reilly Media, **2nd Edition (2019)**.
4. **Steve Blank** and **Bob Dorf**,*The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*, K&S Ranch, **1st Edition (2012)**.

CO-PO Mapping

HSUA103 Entrepreneurship

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	1	3	2	2	2	2	1	1		
CO2	3	3	3	2	3	2	2	3	3	2	2		
CO3	1	2	3	3	2	1	1	2	3	3	2		
CO4	2	2	2	3	2	2	2	3	3	2	2		

Score: 3 – High; 2 – Medium; 1 – Low

		VAC						
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
GEUV103	**Environmental Education**	1	-	-	1	100	-	100
Prerequisite:	**-**							
		Upon completion of the course, the students will be able to						
Course Outcome	**CO1**	Recall the concept of environment ecology and Education.						
	CO2	Summarise the effect of population explosion, degradation of environment and global problem due to the anthropogenic activities.						
	CO3	Justify the need of pollution control and sustainable development for future.						
UNIT-I	**Introduction to Environmental Education**				**Periods: 5**			
Concept, scope and importance of Environmental Education - Objectives of Environmental Education - Concept of an Ecosystem: Structure and functions, Types of ecosystem (aquatic and terrestrial) - Biodiversity: Levels, values, threats and conservation - Natural resources: Renewable and Non-renewable resources.								**CO1**
UNIT-II	**Environmental degradation and impact**				**Periods: 5**			
Human population growth and its impact on environment - Deforestation: Causes and effects due to expansion of agriculture, firewood, mining and building of new habitats - Pollution: Definition, different types of Pollution - Air and water pollution: Causes and effect on environment - Climate change, Global warming, Ozone layer depletion and impacts on human communities.								**CO2**
UNIT-III	**Conservation of environment**				**Periods: 5**			
Control measures for various types of Pollution: use of renewable and alternate source of energy - Environmental laws: Environmental Protection Act (1986), Water Act (1974), Air Act (1981) - International agreements: Montreal and Kyoto Protocol, Paris Agreement - Concept of sustainable development and SDGs - Role of government, NGOs and individual in environmental conservation.								**CO3**
Lecture Periods: 15	**Tutorial Periods:**	**Practical Periods:**			**Total Periods:**			

Reference Books:

- Singh, J.S., Singh, S.P. and Gupta, S.R., 2014. "Ecology, Environmental Science and Conservation", S. Chand Publishing, New Delhi.
- Sharma, P. D., 2011. "Ecology and Environment", Rastogi Publications.
- Erach Bharucha, 2010. "Text Book of Environmental Studies", University Grants Commission, Universities Press (India) Pvt.Ltd., Hyderabad.

CO-PO Mapping

GEUV103**Environmental Education**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1					3	1				1		
CO2	1					3	1				1		
CO3					1	3	2	1			2		

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Electronics and Communication Engineering**		Programme: **B.Tech(ECE)**						
Semester : THIRD		Course Category Code:PCC				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC106	**Electronic Devices and Circuit Design Laboratory**	-	-	3	1.5	40	60	100

Prerequisite	-	
Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Analyse the frequency and phase response of passive networks, including filters, attenuators, and resonant RLC circuits.
	CO2	Analyse the characteristics of semiconductor devices (BJT and JFET) and evaluate their behavior in different configurations.
	CO3	Design and test analog amplifier circuits including negative feedback and power amplifiers to assess performance parameters such as gain, bandwidth, input/output impedance, and frequency response.
	CO4	Demonstrate the use of operational amplifiers (IC 741) in various linear and nonlinear applications such as amplifiers, filters, waveform shaping, and digital-to-analog conversion.
	CO5	Construct and analyse waveform generating circuits such as oscillators and multivibrators using discrete components and ICs (e.g., IC 555), and examine their

List of Experiments	
1. Frequency and phase response of constant K low pass and m derived high pass filters.	**CO1**
2. Design and analysis of attenuators under given load impedance and attenuation parameters.	**CO1**
3. Measurement of frequency response, bandwidth and Q-factor of series resonant RLC circuits.	**CO1**
4. Transient response of RC circuit for DC and sinusoidal excitations using simulation and experiment.	**CO1**
5. Input and output characteristics of CE transistor configuration.	**CO2**
6. Drain and Transfer Characteristics of N-Channel JFET.	**CO2**
7. To obtain the frequency Vs. power and load Vs. power characteristics of Class A and Class B power amplifier.	**CO3**
8. To design, construct and measure the frequency response, input impedance and output impedance of: a) Voltage shunt b) Voltage series negative feedback amplifiers	**CO3**
9. To design, construct and study the following oscillator circuits: a) RC Oscillator b) LC Oscillator	**CO3**
10. To study the applications of op-amp IC741 as: •Inverting amplifier and Non-inverting amplifier	**CO4**

•Integrator and Differentiator •Schmitt trigger	
11. To design and test the performance of BPF and BSF using Op-amp IC741	**CO4**
12. To construct and study the performance of R-2R DAC circuit	**CO4**
13. To design and study the working of: a) Astable Multivibrator b) Monostable Multivibrator using IC 555	**CO5**

Lecture Periods:-	**Tutorial Periods: -**	**Practical Periods:45**	**Total Periods:45**

Reference Books:

1. J.Millman,.C.Halkias and Satyabrata,"Electronic devices and Circuits",Third edition, McGraw Hill,2010.
2. William H.Hayt,Jr. Jack E.Kemmerly and Steven M.Durbin,"Engineering Circuit Analysis", McGraw Hill Science Engineering, 8th Edition, 2013.
3. Robert. F.Coughlin and Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits", PHI Learning Pvt. Ltd,S ixth Edition,2008.

ECUC106 Electronic Devices and Circuit Design Laboratory

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	-	-	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	3	-
CO3	3	3	2	2	1	-	-	-	-	-	-	3	-
CO4	3	2	2	2	2	-	-	-	-	-	-	3	-
CO5	3	2	2	2	3	-	-	-	-	-	-	3	-

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE/EEE/EIE/MT)**						
Semester: **Third**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC138	**Data Structures and Object – Oriented Programming Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Select and implement appropriate Searching/sorting algorithms for an application.						
	CO2	Implement linear/non-linear data structures using C.						
	CO3	Apply OOP principles of classes, object and encapsulation to real time problems.						
	CO4	Apply inheritance and polymorphism to build modular and reusable code to real time applications.						

Ex. No.	**Experiment Name/Brief Description**	
Data Structures Experiments		
1. 2.	Implementation of Linear search and binary search. Implementation Insertion sort, Selection sort, Bubble sort, Quick sort and Heap Sort.	**CO1**
3. 4.	Array implementation of Stacks and Queues. Implementation of Singly and Doubly Linked List.	**CO2**
5. 6.	Implementation of Binary Tree Traversals. Implementation of Graph Traversals and shortest path Algorithms.	**CO2**
C++ Experiments		
7. 8.	Programs to implement classes and objects. Programs to implement constructors and destructors.	**CO3**
9. 10.	Programs to implement different types of inheritance. Programs to implement virtual functions to demonstrate the use of run time polymorphism.	**CO4**

Lecture Periods: 00	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, “Fundamentals of Data Structures in C”, Second Edition, Universities Press (India) Private Limited, 2018.
2. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education (India) Private Limited, 8th Edition, 2021.

CSUC138 CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	1	1	-	2	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

SEMESTER – IV

Semester : Fourth		Course Category Code: PCC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC107	Signals and Systems	3	1	-	4	40	60	100
Prerequisite								
	Upon completion of the course, the students will be able to							
Course Outcome	CO1 Demonstrate the understanding of continuous/discrete time signals and systems.							
	CO2 Analyse continuous time signals							
	CO3 Analyse continuous time LTI systems							
	CO4 Analyse discrete time signals							
	CO5 Analyse discrete time LTI systems							

UNIT – I	Classification of Signals and Systems	Hours: 12
Continuous time and discrete time signals- Deterministic and random signals, Even and odd signals , Ramp and exponential signals, Energy and Power signals, Unit step function – Impulse signal-Time Shifting and Time scaling -LTI system- System with memory and without memory-Invertible and Non-invertible systems – Causal and non-causal systems – stable and Unstable systems – Time variant and Time –invariant systems		CO1
UNIT – II	**Analysis of Continuous time signals**	**Hours: 12**
Trigonometric and Exponential Fourier series representation of periodic signals – Properties of CT Fourier series-Parsavel's Theorem for periodic signals -Fourier Transform -properties of CT FT – Parsavel's Theorem for Fourier transform-Convolution theorem		CO1,CO2
UNIT – III	**Analysis of continuous time LTI systems**	**Hours: 12**
Laplace transform –Properties of Laplace Transform- Analysis of CT LTI system using Laplace Transform -Transfer function and Impulse response –Covolutional Integral		CO1,CO3
UNIT – IV	**Analysis of Discrete time signals**	**Hours: 12**
Z-transform-Properties of Z-Transform-Inverse Z-Transform: Contour integral method, , Partial Fraction method		CO4
UNIT – V	**Analysis of Discrete time LTI Systems**	**Hours: 12**
Analysis of discrete time system using Z-transform -Transfer function and Impulse response – Convolution Sum-DTFT –properties of DTFT- DFT –Properties of DFT		CO1,CO4, CO5

Lecture Hours: 45	Tutorial Hours:15	Practical Hours: NIL	Total Hours: 60

Reference Books:

1, Simon Haykins and Barry Van Veen, "Signals and Systems", Second Edition, Wiley, 2007.

2. Allan V.Oppenheim, Allan S.Willsky and S.Hamid Nawab, "Signals and Systems", Pearson, Second Edition, New Delhi, 2015.

3. H.P.Hsu and R.Ranjan, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Second Edition, 2017.

4. B.P.Lathi, “Principles of Linear Systems and Signals”, Oxford, Second Edition, 2009.
5. P. Ramesh Babu and R.Anandanatarajan, “Signals and Systems”, Scitech Publishers, Fifth Editio

ECUC107 Signals and Systems

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1									1
CO2	2	1	1	1									1
CO3	2	1		1									1
CO4	2	1		1									1
CO5	2	1		1									1
ECUC107	2	1.2	0.4	1									1

Department: **Electronics and Communication Engineering**			Programme: **B.Tech.(ECE)**						
Semester :Fourth			Course Category Code: **PCC**				Semester Exam Type: **TY**		
CourseCode	Course		Periods/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC108	**Control Systems Engineering**		3	-	-	3	40	60	100
Prerequisite	-								
		Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Describe the fundamentals of control systems, including types, components, and mathematical modeling of electrical and mechanical systems using transfer functions.							
	CO2	Develop and simplify system representations using block diagrams and signal flow graphs for analyzing control system behavior.							
	CO3	Analyze time-domain responses of control systems and evaluate system performance using error coefficients and controllers (P, PI, PD, PID).							
	CO4	Interpret frequency-domain characteristics using Bode and Polar plots and determine system stability using standard frequency analysis tools.							
	CO5	Assess system stability using Routh-Hurwitz, Nyquist, and Root Locus methods, and model systems using state-space representation to evaluate controllability and observability.							
UNIT-I	**Control System Modelling**					**Periods:9**			
Introduction to control system-Basic elements of control system-Open and closed loop control systems-Differential equation representation of physical systems-Transfer function-Mathematical modelling of electrical and mechanical systems (Translational and Rotational)-Analogous system-Block diagram reduction techniques-Signal flow graph.									**CO1, CO2**
UNIT-II	**Time Domain Analysis**					**Periods:9**			
Time response analysis-transient and steady state behavior of control systems-Standard test signals – Time response of First order system-step, ramp and impulse response analysis-Second order system – step responseanalysis-steadystateerror-generalizederrorco-efficient–ResponsewithP,PI,PDandPID controllers.									**CO3**
UNIT-III	**Frequency Domain Analysis**					**Periods:9**			
Frequency response-Frequency domain specifications-Correlation between time domain and frequency domain specifications-Bodeplot-Stability analysis using Bode plot- transfer function from Bode plot-Polar plot.									**CO4**
UNIT-IV	**Stability Analysis**					**Periods:9**			
Concepts of stability-Location of poles on s-plane for stability-Routh-Hurwitz stability criterion-Nyquist Stability criterion-Root locus Techniques.									**CO5**
UNIT-V	**State Space Analysis**					**Periods:9**			
Concepts of state, state variables and state model–Relationship between the State equation and Transfer function- State space model for Electrical and Mechanical systems and phase variables- State space representation for Signal Flow Graph and Block Diagram techniques.									**CO1, CO5**
Lecture Periods:45	**Tutorial Periods:-**		**Practical Periods:-**			**Total Periods: 45**			

Reference Books:

1. I.J. Nagrath, M. Gopal, “Control Systems Engineering”, Seventh Edition, New Age International, New Delhi, 2021.
2. K. Ogata, “Modern Control Engineering”, Fifth Edition, Pearson Education, 2010.
3. Farid Golnaraghi and Benjamin C. Kuo, “Automatic Control Systems”, Ninth Edition, Wiley, 2014.
4. R. Ananda Natarajan and P. Ramesh Babu, “Control Systems Engineering”, Fourth Edition, SciTech Publications (India) Pvt. Limited, Chennai, 2013.
5. Norman S. Nise, “Control Systems Engineering”, Seventh Edition, Wiley, 2015.

Department : **Electronics and Communication Engineering**	Programme : **B.Tech. (ECE)**

ECUC108 **Control Systems Engineering**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	2	-	-	-	-	-	-	3	3
CO3	2	3	3	2	2	-	-	-	-	-	-	2	3
CO4	2	3	3	2	2	-	-	-	-	-	-	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3

Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC109	**Electromagnetic Fields and Waveguides**		3	-	-	3	40	60	100
Prerequisite	-								
	Upon completion of the course, the students will be able to								
Course Outcome	**CO1**	State the different Laws and fundamental terms in electromagnetics							
	CO2	Solve static electric field and magnetic field related parameters for the given source conditions							
	CO3	Derive the Maxwell equations for time-varying fields using fundamental laws of electric and magnetic fields							
	CO4	Analyze the wave propagation related parameters for different boundary conditions							
	CO5	Solve impedance conversion and matching problems using Smith chart							
	CO6	Analyze the radio propagation in guided systems							

UNIT-I	**Static Electric and Magnetic Fields**	**Periods: 9**
Static Electric Field - Coulomb's Law, Gauss Law, Electric Field due to a System of Discrete Charges and Continuous Distribution of Charges, Electric Potential difference. **Steady Electric Currents and Capacitance** - Characteristics of Conductors, Dielectrics and Boundary conditions. Capacitance – definition, examples - capacitance of parallel plate capacitor, coaxial cable and two-wire line. **Static Magnetic Field -** Biot-Savart Law, Ampere's Circuital law, Magnetic Flux and Magnetic Flux density, Force between differential current elements, Magnetic materials and Magnetic Boundary Conditions, Inductance.		**CO1, CO2**
UNIT-II	**Time-Varying Fields and Maxwell's Equations**	**Periods: 9**
Faraday's law of EM induction-Stationary circuit in time varying magnetic field, Moving conductor in a magnetic field , Moving circuit in time varying magnetic field, Displacement current, Maxwell's equations in point form and integral form, Electromagnetic boundary conditions, Potential functions-Solutions of wave equations; Time harmonic fields-Time-harmonic electromagnetics.		**CO1, CO3**
UNIT-III	**Plane Electromagnetic Waves**	**Periods: 9**
Plane Waves in Lossless media-Doppler effect-Transverse Electromagnetic Waves –Polarization of plane waves; Plane waves in lossy media-Low loss dielectrics, Good conductors; Group velocity; Flow of electromagnetic power and the Poynting vector; Normal incidence of plane waves at plane boundaries- Normal incidence on a good conductor; Oblique incidence of plane waves at plane boundaries-Total reflection, Perpendicular polarization, Parallel polarization, Brewster angle of no reflection.		**CO1, CO4**
UNIT-IV	**Transmission Line Theory**	**Periods: 9**
Types of transmission lines, Characteristic impedance, propagation constant, attenuation and phase constants, Reflection and Distortion in transmission lines - Reflection coefficient- Standing waves and standing wave ratio – Quarter wave line and impedance matching – Half-wave line. Smith Chart – Application of the Smith Chart – Impedance Conversion, single stub matching and double stub matching.		**CO1, CO5**
UNIT-V	**Wave Guides**	**Periods: 9**
General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TE and TM waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TE and TM waves in Circular wave guides		**CO6**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. W H Hayt and J A Buck, “Engineering Electromagnetics”, Seventh Edition, 2010, McGraw Hill Education (India)Pvt. Ltd.
2. David K.Cheng ,“Fundamentals of Engineering Electromagnetics”, Pearson,2014 .
3. John D Ryder, “Networks lines and fields”, Prentice Hall of India, New Delhi, 2005.
4. Fawwaz T. Ulaby, “Electromagnetics for Engineers”, volume 1 ,Pearson/Prentice Hall, 2005.
5. Umesh Sinha, “Transmission Lines and Network”, Satya Prakashan Publishing Company, New Delhi, 2012.

CO-PO Mapping

Course Code: ECUC109

Course Name; Electromagnetic Fields and Waveguides

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	1	2	-	-	-	-	-	1	1
CO2	3	2	1	-	1	2	-	-	-	-	-	1	1
CO3	3	2	1	-	1	2	-	-	-	-	-	1	1
CO4	3	2	1	-	1	2	-	-	-	-	-	1	1
CO5	3	2	1	-	1	2	-	-	-	-	-	1	1
CO6	3	2	1	-	1	2	-	-	-	-	-	1	1

Score: 3 – High; 2 – Medium; 1 – Low

Semester : IV			Course Category Code: PCC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC110	**Digital Communication**		3	0	0	3	40	60	100
Prerequisite:	Nil								
Upon completion of the course, the students will be able to									
Course Outcome	**CO1**	Observe and distinguish the basic formatting steps and basic building blocks of Baseband communication systems.							
	CO2	Provide review of signalling techniques and their impact on digital receivers.							
	CO3	Determine and Analyse the BER performance of various bandpass communication systems.							
	CO4	Associate and choose appropriate Multiplexing, Multiple access and spread spectrum techniques based on the applications.							
	CO5	Articulate and Relate different synchronisation methods							
UNIT-I	**Formatting and baseband Modulation**					**Periods: 9**			
Digital vs Analog Transmissions- Sampling Theory, Quantization and its Statistical Characterization, uniform and non-uniform Quantisers Pulse-Code Modulation, Noise Considerations in PCM Systems, Concept of Prediction-Error Filtering for Redundancy Reduction, Differential Pulse-Code Modulation, Delta Modulation and Adaptive Delta Modulation.									**CO1**
UNIT-II	**Baseband Signalling**					**Periods: 9**			
Need for line shaping of signals, Signaling formats-RZ/NRZ, Duobinary, Manchester, Binary N-zero substitution codes - PSDs– ISI – Nyquist Criterion for distortion less transmission – Pulse shaping – Correlative coding- Matched filters – channel equalization and Eye pattern.									**CO1, CO2**
UNIT-III	**Bandpass Transmission & Reception**					**Periods: 10**			
BASK, BFSK, and BPSK- Structure of Transmitter and Receiver (coherent and non-coherent), Signal space diagram, analysis of Error probabilities. M-ary encoding approach, M-ary PSK, M-ary FSK, QAM, MSK and GMSK-Optimum detector, Signal constellation, error probability-OFDM.									**CO3**
UNIT-IV	**Synchronisation, Multiplexing And Multiple Access**					**Periods: 10**			
Synchronization: Need for synchronization-Synchronization methods-Bit, word and frame synchronization–Network synchronization. Allocation of the Communications Resource, Frequency-Division Multiplexing/Multiple Access, Time-Division Multiplexing/Multiple Access, Code Division Multiple Access, Space-Division and Polarization-Division Multiple Access									**CO5, CO4**
UNIT-V	**Spread Spectrum Techniques**					**Periods: 7**			
Introduction to Spread Spectrum Techniques-Pseudo noise sequences and its Properties, Discrete sequence spread spectrum with coherent BPSK, Signal space dimensionality and processing gain, Frequency hop spread spectrum modulation, performance comparison of DS-SS and FH-SS.									**CO4**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods:-**				**Total Periods: 45**		

Reference Books:

1. Simon Haykin,"Digital Communications", John Wiley & Sons ,Inc.Singapore,2011.
2. Bernard Sklar,“DigitalCommunications-Fundamentalsandapplications”,Pearson Education, New Delhi,2009.
3. John G. Proakis and Masoud Salehi, “Digital Communications “, Tata McGraw Hill, 5th Edition

4. Lathi BP" Modern Digital and Analog communication Systems", Oxford University Press,2010.

ECUC110

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	1	0	2
CO2	2	3	3	2	2	-	-	-	-	-	1	1	2
CO3	3	3	3	2	2	-	-	-	-	-	1	1	3
CO4	3	3	3	2	2	-	-	-	-	-	-	1	3
CO5	2	3	3	2	2	-	-	-	-	-	-	1	3
ECUC110	2.6	3	3	2	2						1	0.8	2.6

Score: 3 – High; 2 – Medium; 1 – Low

Semester : Fourth			Course Category Code: AEC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSUA106	**Foreign Language - FRENCH**		2	-	-	2	40	60	100
Prerequisite:									
Course Outcome	**CO1**	To acquire the basics of the French language							
	CO2	To apply the acquired basics of the language in expressing oneself							
	CO3	To develop basic conversation skills							
	CO4	To communicate their student life in the University context							
	CO5	To equip the students to communicate within technical contexts							
UNIT-I	**INTRODUCTION TO FRENCH AND BASICS**					**Periods: 6**			
French alphabets and pronunciation – Greetings and Introductions (Bonjour ça va?) – Numbers, days of the week, months, seasons – Classroom expressions and instructions – Articles (Definite and Indefinite) – Basic sentence structure (Subject – Verb Agreement)									**CO 1**
UNIT-II	**PERSONAL IDENTITY AND EXPRESSIONS**					**Periods: 6**			
Introducing oneself and others (Je me présente……) – Nationalities and Professions – Describing people (Physical appearance and Personality) – Possessive adjectives (mon, ma, mes…) – Gender and number agreement of adjectives									**CO 2**
UNIT-III	**DAILY LIFE AND ROUTINES**					**Periods: 6**			
Talking about daily activities and schedules (Je me lève à 7 heures…) – Telling the time and discussing time tables – Common verbs in the present tense (ER, IR, RE verbs) – Reflexive verbs (Se lever, s'habiller…)									**CO 3**
UNIT-IV	**DIRECTIONS AND UNIVERSITY LIFE**					**Periods: 6**			
Asking for and giving directions (Où est….? A gauche, A droite…) – Describing locations (Près de, loin de….)- Talking about University courses and subjects (J'éudie l'ingénierie…) - Prepositions of place (sur, sous, devant….) – Using Il y a and C'est for descriptions									**CO 4**
UNIT-V	**FUTURE PLANS, BASIC TECHNICAL PRESENTATIONS AND TECHNICAL AND ENGINEERING CONTEXTS**					**Periods: 6**			
Talking about future career goals (Je veux devenir ingénieur…..) Using future proche for near future plans- Vocabulary related to Engineering disciplines – Talking about machines and materials (Acier, moteur, circuit….) – Giving simple presentations on technical topics – Introduction to passive voice (La machine est réparée….)									**CO 5**
Lecture Periods: 30	**Tutorial Periods: -**		**Practical Periods:-**				**Total Periods: 30**		

Reference Books:

1. Nouvelle Generations A1, Luca Giachino, Carla Baracoo, Didier FLE, 2020, Paris
2. Tech French – French for Science and Technology, Ingrid Le Gargasson, Shariva Naik et Claire Chaize, Goyal Publishers, 1 April 2011.
3. Écho – Méthode de Français, A1 , Girardet, Pecheur, CLE International,2013.
4. Écho Cahier personnel d'apprentissage, A1, Girardet, Pecheur, CLE International, 2013.

CO-PO Mapping

HSUA106 Foreign Language - FRENCH

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1								3	3		3		
CO2								3	3		3		
CO3								3	3		3		
CO4								3	3		3		
CO5								3	3		3		

Score: 3 – High; 2 – Medium; 1 – Low

Department :Common to all			Programme: **B.Tech.**						
Semester :Fourth			Course Category Code: VAC				Semester Exam Type:		
Course Code	Course Name:		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
GEUV104	**Universal Human Values**		1	0	0	1	100	0	100
Prerequisite:	-								
	Upon completion of the course, the students will be able to								
Course Outcome	**CO1**	**Develop a Holistic Understanding of Value Education**							
	CO2	**Foster Personal and Social Harmony**							
	CO3	**Enhance Awareness of Universal Co-existence**							
	CO4	**Apply Ethical and Humanistic Principles in Professional and Personal Life**							
Module--**I**	Introduction to Value Education					**Periods: 3**			
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations									**CO1**
Module-**II**	Harmony in the Human Being					**Periods: 3**			
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health									**CO2**
Module-**III**	Harmony in the Family and Society					**Periods: 3**			
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-toHuman Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order									**CO2**
Module-**IV**	Harmony in the Nature/Existence :					**Periods: 3**			
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence									**CO3**
Module-**V**	Implications of the Holistic Understanding					**Periods: 3**			
A Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession									**CO4**
Lecture Periods: 15	**Tutorial Periods: 0**		**Practical Periods:0**				**Total Periods: 15**		
Reference Books:									

1. Student Induction Program Handbook v2 by AICTE NCC-IP sub-committee: Dr. Rajneesh Arora, Chairman NCC-IP, Dr.Shishir Gaur, Convener NCC-IP, Dr.Ruchir Gupta, Member NCC-IP.
2. a foundation course in R R Gaur R Asthana G P Bagaria HUMAN VALUES and professional ethics

, R R Gaur R Asthana G P Bagaria
3. Understanding Human Being, Nature and Existence Comprehensively By UHV Team (https://uhv.org.in/uhve)
4. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics RR Gaur, R Asthana, GP Bagaria

CO-PO Mapping

GEUV104 **Universal Human Values**

Score: 3 – High; 2 – Medium; 1 – Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						3	3	2	2	2	3
CO2						3	3	3	3	2	3
CO3						3	3	2	2	2	3
CO4						3	3	2	2	3	3

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (ECE)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC111	Digital System Design Laboratory	-	-	3	1.5	40	60	100
Prerequisite	Digital System Design							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1** Design, implement and experimentally verify the working of the required code converter using logic gates.							
	CO2 Interpret the data sheets of MSI combinational circuit ICs to apply them for designing higher level logic circuits and experimentally verify their working.							
	CO3 Interpret the data sheets of ICs of FFs, counters, shift registers and to design, implement and test any synchronous sequential logic circuits using these ICs.							
	CO4 Ability to write behavioural and synthesizable coding in Verilog for important basic combinational and sequential circuits and to test them by simulations.							

List of Experiments

1. Design and implementation of any two Code convertors(Code X to code Y and vice-versa). Implementation of the designed circuits using i. Basic gates(OR,AND and NOT) ii. Only NAND gates	**CO1**
2. Design and implementation of Adder/Subtractor i. 4 bit binary Adder/ Subtractor using IC7483 ii. BCD adder using IC7483 3. Multiplexers i. Experimental verification of the function table of an 8×1 multiplexer IC ii. Realization of a 4-variable Boolean function using 8×1 multiplexer IC iii. Construction and study of a simple Priority Encoder 4. Decoders and Demultiplexers i. Experimental verification of the function table of a 3 to 8 line decoder ii. Experimental verification of the function of a 3 to 8 line decoder as demultiplexer iii. Realization of 3-variable combinational circuits using a 3 to 8 line decoder IC	**CO2**
6. Shift register i. Experimental verification of the function of a universal shift register IC ii. Construction of ring counter and Johnson counter using a shift register IC and study of their timing diagrams iii. Designing a PN Sequence Generator using a shift register IC	**CO3**

7. Ripple Counters and their timing diagrams i. 3-bit binary up counter ii. 3-bit binary down counter iii. A modulo-N-counter where N is not a power of 2($N \neq 2^n$) iv. BCD counter using mod-10 counter ICs 8. Design and implementation of Synchronous Counters and study of their timing diagrams i. 3-bit binary up counter ii. A modulo-N-counter where N is not a power of 2($N \neq 2^n$) iii.Non-sequential binary counter iv.Experimental verification of the function of IC 74193 or any synchronous counter IC with parallel loading facility	**CO3**
9. Writing Verilog code for the following circuits and verification their timing diagram using simulation tool: i. Full Adder ii. priority encoder iii.2×1 MUX iv.4×1 MUX using 2×1 MUX module instatiation v. 2-to-4 line binary decoder vi.4-to-16 line binary decoder using 2-to-4 line binary decoder module instatiation 10. Writing Verilog code for the following sequential circuits and verification their timing diagram using simulation tool: vii. DFF with asynchronous reset viii. n-bit binary Up-Counter ix.n-bit binary Up-down Counter x. n-bit left-to-right Shift Register	**CO4**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd ed., 2014, Tata McGraw-Hill Publishing company Ltd. New Delhi.

ECUC111 Digital System Design Laboratory

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	3	-	-	-	3	3	-	-	1	-
CO2	2	2	1	3	-	-	-	3	3	-	-	1	-
CO3	2	3	2	3	1	-	-	3	3	-	-	1	-
CO4	-	3	3	3	3	-	-	3	3	-	-	1	-

Department : ECE			Programme: **B.Tech.ECE**						
Semester : Fourth Semester			Course Category Code: PCC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC112	Analog and Digital Communication Laboratory		-	-	3	1.5	40	60	100
Prerequisite:	-								
		Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Design and test various analog and digital modulators and demodulators circuits							
	CO2	Construct and test various pulse modulator circuits							
	CO3	Design and test various circuits used in transmitters and receivers							
	CO4	Differentiate the various Line coding formats							

Analog Communication Module	
• Design and testing of Amplitude Modulation and Demodulation circuits. • Design and testing of Frequency Modulation and Demodulation circuits. • Design and testing of Preemphasis and De-emphasis circuits. • Implementation and testing of Simple and Delayed Automatic Gain Control circuits. • Design and Testing of Single tuned amplifier. • Analysis of Frequency Response of Mixer Circuit. • Implementation and testing of PAM circuit. • Implementation and testing of PWM and PPM circuit. • Simulation of AM/FM/PM modulation and Demodulation system.	**CO1, CO2, CO3**
Digital Communication Module	
• Study and analyse the Pulse code modulator and demodulator module for the given sine wave. • Construct and test the working of the Delta modulator and demodulator circuit. • To study the different line coding techniques NRZ unipolar format NRZ polar format, NRZ bipolar format and Manchester format. Obtain the wave forms of the different formats. • Construct and test the Amplitude Shift Keying(ASK)modulator and demodulator circuit. • Construct and test the Frequency Shift Keying(FSK) modulator and demodulator circuit. • Construct and test the Binary Phase Shift Keying(BPSK)modulator and demodulator circuit.	**CO1, CO2, CO3, CO4**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Simon Haykin,"Communication Systems", Wiley Publication,NewDelhi,2011.
2. Kennedy G,"Electronic Communication systems",Tata McGraw Hill, NewDelhi,2009.
3. Bernard Sklar, "Digital Communications−Fundamentals and applications", Pearson Education, NewDelhi,2009.

ECUC112

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	2	3	3	2	3	0	2
CO2	3	3	3	3	3	2	2	3	3	2	3	0	2
CO3	3	3	3	3	3	2	2	3	3	2	3	0	2
CO4	2	2	3	2	3	2	2	3	3	2	2	0	2
CO5	-	-	-	-	-	-	-	-	-	-	-		
ECUC112	2.75	2.75	3	2.75	3	2	2	3	3	2	2.75	0	2

SEMESTER – V

Department : ECE			Programme: **B.Tech.ECE**					
Semester : V			Course Category Code: PCC			Semester Exam Type:		
ECUC113	Digital Signal processing		Periods / Week			Credit	Maximum Marks	
			L	T	P	C	CA	SE	TM
			3	1	-	4	40	60	100
Prerequisite:	Signals and Systems							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Apply FFT algorithms for design of communication systems						
	CO2	Evaluate DFT using FFT						
	CO3	Design and simulate different types of digital IIR filters						
	CO4	Design and simulate different types of digital FIR filters						
	CO5	Draw the implementation structure of FIR and IIR filters						
	CO6	Design multistage sampling rate converter for different applications and implement algorithms and filter structures using DSP processors						
UNIT-I	**Fast Fourier transform**					**Periods: 12**		
Basic elements of digital signal Processing: Concept of frequency in continuous time and discrete time signals –Fast Fourier Transform – Decimation in time & Decimation in frequency FFT algorithms – Inverse DFT using FFT. Use of FFT algorithms in Linear Filtering and correlation.								**CO1, CO2**
UNIT-II	**IIR Filters**					**Periods: 12**		
IIR filters - advantages and disadvantages - Design of IIR filters from analog Butterworth and Chebyschev filters - Impulse invariance and bilinear transformation methods of IIR digital filter design – Design of IIR filter for the given specifications and study its frequency response characteristics Realization of IIR filters – Direct form I, II, cascade, parallel realization								**CO3, CO5**
UNIT-III	**FIR filters**					**Periods: 12**		
FIR filters – Introduction - Symmetric and asymmetric FIR filters – Linear phase FIR filters – Design of FIR using frequency sampling techniques – Design of FIR filters using windowing technique. Design of FIR filter for the given specifications and study its frequency response characteristics. Realization of FIR filters – Transversal, linear phase and cascade realization structures .								**CO4, CO5**
UNIT-IV	**Multirate DSP**					**Periods: 12**		
Principles of multirate DSP – Decimation and Interpolation by integer factors – Direct form Structures for FIR decimators and interpolators - Multistage Decimators and Interpolators. Applications - subband coding of speech signals and 2 channel Quadrature mirror filter bank.								**CO6**
UNIT-V	**DSP Processors**					**Periods: 12**		
Introduction to programmable DSP processors – MAC unit- Modified Bus structures and memory access schemes ,multiported memory - VLIW architecture –pipelining.- Special addressing modes in P-DSPs- On chip peripherals. Implementation of FFT using DSP processors, IIR and FIR filter design for the given specifications using DSP processors								**CO6**
Note: Every student should carry out a mini project for this course and submit the report instead of assignment.								

Lecture Periods: 45	Tutorial Periods: 15	Practical Periods:	Total Periods: 60

Reference Books:

1. Vinay K.Ingle and John G.Proakis, "Digital Signal Processing using MATLAB" CL Engineering, Third Edition, 2011.
2. B.Venkataramani and M.Bhaskar, "Digital Signal Processors- Architecture, programming and Applications", Tata McGraw Hill, Fourth Edition, 2005

CO-PO Mapping

ECUC113 Digital Signal processing

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	3	3
CO2	2	2	1	3	-	-	-	-	-	-	-	3	3
CO3	2	3	3	3	3	-	-	3	3	-	-	3	3
CO4	2	3	3	3	3	-	-	3	3	-	-	3	3
CO5	2	1	1	1	-	-	-	-	1	-	-	3	3
CO6	2	3	3	3	3	-	-	3	3	-	-	3	3
ECUC113	2	2.33	2.17	2.5	1.5	-	-	1.5	1.67	-	-	3	3

Department : ECE		Programme :B.Tech ECE						
Semester :Fifth		Course Category Code: PCC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC114	VLSI Design	3	1	-	4	40	60	100
Prerequisite								
Course Outcome	Upon completion of the course, the students will be able to							
	CO1 - Design the basic building blocks of CMOS analog circuits considering the electrical properties.							
	CO2 – Analyze the characteristics of CMOS logic circuits.							
	CO3 - Design the basic combinational and sequential logic circuits using CMOS.							
	CO4 – Design the basic arithmetic functional blocks using CMOS.							
	CO5- Analyze the hardware complexity of the subsystem design.							
	CO6- Determine the faults in the given circuit.							
UNIT – I	**MOS Technology**				**Hours: 12**			
MOS, CMOS, BiCMOS Technology, Basic Electrical Properties of MOS Circuits: Ids–Vds relationships, Threshold Voltage Vth, Gm, Gds and ωo, Body Effect, Latch-up in CMOS circuits, Short-Channel Effects, Channel Length modulation and Device Scaling, Current Mirrors-Current mirror with BetaHelper, Degeneration, Cascode current Mirror, Widlar and Wilson Current Mirror – Sensitivity and Fractional Temperature co-efficient analysis.								CO1
UNIT – II	**CMOS Circuit Characterization**				**Hours: 12**			
Moore'sLaw-CMOSInverter–DCandSwitchingCharacteristicsofCMOSInverter–PropagationDelay–SheetResistance–InverterPairDelay–NMOS, CMOS–Power Dissipation–Realization of Combinational Logic Functions using static CMOS–CMOS Layers–Stick Diagram–Design Rules-CMOS Layout.								CO2, CO3
UNIT – III	**Design of Logic Circuits and Array Subsystem**				**Hours: 12**			
PassTransistor-TransmissionGate-RealizationofCombinationalLogicUsingPassTransistorandTransmission Gate – NAND, NOR, XOR, Multiplexers - NAND and NOR based PLA using NMOS and CMOS, Finite State Machine Design– Dynamic, Pseudo NMOS and Domino Based CMOS Logic Circuits. Inverter, NAND and NOR using BiCMOS. Realization of Sequential Circuits using Transmission Gate– Registers-D-Latch–D-Flip-Flop–Memory elements–DRAM–SRAM.								CO3, CO5
UNIT – IV	**Datapath Subsystem Design**				**Hours: 12**			
Realization of Adders using CMOS-Full Adder–Ripple Carry Adder–Carry Look-Ahead Adder–Carry Select Adder–Carry Save Adder–Design of signed Parallel Adders-Comparators–Magnitude Comparator–Code Converters–Parity and Gray Codes-Multipliers–Serial Multiplier–Parallel Multipliers–Unsigned array multiplier–Signed Multipliers–2's Complement multiplier–Booth Encoding–Modified Booth Encoding–Radix-2, Radix –4 and Radix –8-Wallace Tree Multiplier–Systolic Pipelined Multiplier–Barrel								CO4, CO5

Shifter.			
UNIT – V	**Fault Models and Physical Design Automation**	**Hours: 12**	
Need for testing- Test Procedure, Design for Testability – Ad Hoc Testing – Scan-Based Test- Boundary-Scan Design–Built-in-Self-Test(BIST)-Test-Pattern Generation–Fault Models– Automatic Test Pattern Generation –Fault Simulation–Introduction to VLSI Physical Design Cycle.			CO6
Lecture Hours: 45	**Tutorial Hours: 15**	**Practical Hours: -**	**Total Hours: 60**

Reference Books:

1. Philip E.Allen and Douglas R.Holberg, "CMOS Analog Circuit Design", Oxford University Press, International Third Edition/Indian Edition,2017.
2. Neil H.E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI design -A circuits and Systems Perspective", Dorling Kindersley(India) Pvt Ltd, Fifth edition, 2024.
3. Naveed A.Sherwani,"Algorithms for VLSI Physical Design Automation", Springer, Fifth Edition,2013.
4. Paul.R.Gray, Paul.J.Hurst,S.Lewis and R.G.Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International, Sixth Edition,2024.
5. Jan M.Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits–A Design Perspective", Prentice Hall of India, Second Edition ,2016.

CO-PO Mapping

ECUC114 VLSI Design

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	3	2	-	-	-	2	-	2	2	3
CO2	2	3	1	3	2	-	-	-	-	-	2	2	3
CO3	2	3	3	3	2	-	-	-	3	-	2	2	3
CO4	2	3	3	3	2	-	-	-	3	-	2	2	3
CO5	2	3	3	3	2	3	-	-	-	-	2	2	3
CO6	2	2	1	2	1	-	-	-	-	-	-	2	2
ECUC114	2	2.83	2.33	2.83	1.833	3	-	-	2.67	-	2	2	2.83

Department :**Electronics and Communication Engineering**		Programme :**B.Tech. (ECE)**						
Semester :**Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC115	**Data Communication Networks**	3	-	-	3	40	60	100
Prerequisite	-							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Demonstrate understanding of the data transmission concepts and the need for layered network architecture						
	CO2	Analyse the issues and solutions related to subnet communication						
	CO3	Analyse the issues and solutions related to end-to-end host-based communication						
	CO4	Analyse the requirements for a given organizational structure and select appropriate network protocol and architecture.						

UNIT-I	**Communication Networks**	**Periods: 9**
Data Communications – Network Criteria- Network Types- Network Models- TCP/IP Protocol Suite, OSI Model. Digital Transmission - Transmission Media – Multiplexing and Carrier systems- Switching Techniques - Circuit and Packet switching. Overview of networks- PSTN, Internet, connection oriented networks: X.25 networks, Frame relay and ATM, Ethernet, Wireless LANs, wireless WANs, telephone networks for data.		**CO1**
UNIT-II	**Link control and Medium Access Layer**	**Periods: 9**
Data link layer: error detection & correction methods: Parity, Cyclic redundancy codes, checksum codes, Hamming codes. Flow control Protocols, High level Data link Control Protocols, operation modes, ATM protocols. Medium access Control: TDMA, FDMA, CDMA, random access protocols, contention based protocols. MAC layer for Wireless LAN, Wireless WAN.		**CO2, CO4**
UNIT-III	**Network and Transport Layer**	**Periods: 9**
Network layer: Internetworking & devices, IP protocol and associated protocols (ARP,RARP,ICMP,IGMP) - Classfull and Classless addressing, Routing algorithms: Distance vector routing, link state routing; Path-vector Routing, network layer in the internet:OSPF,BGP, Mobile IP, IPV6. Transport Layer: Process to process delivery; UDP; TCP; open and closed loop Congestion control algorithm. TCP/IP Socket API – Client-Server model.		**CO2, CO3, CO4**
UNIT-IV	**Mobile IP & TCP**	**Periods: 9**
Goals, assumptions and requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimizations, Reverse tunnelling, IPv6, IP micro-mobility support, Dynamic host configuration protocol. Classical TCP improvements, Indirect TCP,Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction-oriented TCP, TCP over wireless networks. Support for mobility: World wide web -Hypertext transfer protocol - Hypertext markup language-System architecture-Wireless application protocol - Architecture, Wireless telephony application.		**CO2, CO3, CO4**

UNIT-V	Application Layer	Periods: 9	
Application Layer: The Domain Name System – Name space, Resource records and Name servers; Electronic Mail - Architecture and Services, The User Agent, Message formats, transfer, and delivery; The World Wide Web – Architecture, Static and Dynamic Web Pages, The Hyper Text Transfer Protocol, The Mobile Web, and Web Search; Streaming Audio And Video; Content Delivery.			**CO3, CO4**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Behrouz A Forouzan , "Data Communication and Networking", Tata McGraw-Hill, New Delhi, 2013.
2. Jochen Schiller, "Mobile Communication", Pearson education, 2nd edition 2005.
3. Andres S. Tanenbaum, David J. Wetherall, Computer Networks, Fifth Edition, Prentice Hall, 2011.
4. Aftab Ahmad, "Data Communication Principles -For Fixed And Wireless Networks", Kluwer Academic Publishers, 2003.
5. Gurudeep S. Hura, Mukesh Singhal , "Data and Computer Communication - Networking and Internetworking", CRC Press, 2001.
6. William Stallings, "Data and Computer Communication", Tenth Edition., Prentice Hall, Int. Ed., 2013.
7. Lewis Van Winkle, "Hands-On Network Programming with C", Packt Publishing Ltd, 2019.

CO-PO Mapping

Course Code: ECUC115

Course Name; Data Communication Networks

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	1	-	-	-	-	-	-	2	1
CO2	2	2	1	-	1	-	-	-	-	-	-	2	1
CO3	2	2	1	-	1	-	-	-	-	-	-	2	1
CO4	2	1	1	-	1	-	-	-	-	-	-	2	1

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Humanities & Social Sciences**		Programme: **B.Tech(ECE)**						
Semester : **Fifth**		Course Category Code: AEC				Semester Exam Type: **TY**		
Course Code	Course Name	Periods/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HSUA105	**Industrial Economics and Management**	2	-	-	2	40	60	100
Pre-requisite	**Nil**							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Demonstrate economic theories, revenue and cost concepts and set of analytical techniques applied to a variety of economic (and non-economic) and financial management issues.						
	CO2	Implement various management techniques based on the needs						
	CO3	Apply financial planning and Interpret company's income statements and balance sheets to ascertain the financial position of a company.						
	CO4	Apply production planning, project scheduling and financial analysis to economic investment and project management problems.						
	CO5	Understand fundamental marketing concepts, apply them to real-world scenarios, and develop effective marketing strategies.						

UNIT-I	**Micro and Macro Economics and its Applications**	**Periods:6**
Nature and Scope of Economic science – Micro Economics: Economic decisions and Technical decisions, Demand and Supply concepts, Market Equilibrium, Elasticity of Demand, Various concepts of Cost – Break Even Analysis – Market structure. Macro Economics: Measures of National Income – Inflation – Business Cycle.		**CO1**
UNIT-II	**Management Techniques**	**Periods:6**
Introduction to Management – Functions of Management –F.W.Taylor'sScientific Management – Henry Fayol's Principles of Management. Forms of Business Organization, and Types of (Ownership) of a firm.		**CO2**
UNIT-III	**Industrial Finance**	**Periods:6**
Need for Finance –Types of finance – Sources of finance. Final Accounts - Preparation of Trading, Profit and loss Account and Balance Sheet.		**CO3**
UNIT-IV	**Production Management**	**Periods:6**
Types of Production system – Production Planning and control: Planning, Routing, Scheduling, Inspection and Dispatches. Concepts of Productivity – Measurement of Productivity.		**CO4**
UNIT-V	**Marketing Management**	**Periods:6**
Core Concepts of Marketing – Marketing Vs Selling – Channels of Distribution – Promotion Vs. Advertising – Market Research Vs Marketing Research.		**CO5**

Lecture Periods: 30	**Tutorial Periods:** –	**Practical Periods:**–	**Total Periods: 30**

Reference Books

1. Varshney Maheswari, Managerial Economics, S Chand & Co, New Delhi, 2011.
2. Dutt & Sundaram, Indian Economy, S Chand & Co, New Delhi, 2015.
3. Pandey I.M, Elements of Financial Management Wiley Eastern Ltd, New Delhi, 2015.
4. H.L. Ahuja, Macro Economics for Business and Management, S Chand & Company Ltd, 2011.
5. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai and Sons, 2009.
6. Philip B Kotler, Marketing Management, Mac Millan, NewYork, 2011.

CO-PO

HSUA105 Industrial Economics and Management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		1				3					2		
CO2										3	2		
CO3		1								3	2		
CO4										3	2		
CO5										3	2		

Score: 3 – High; 2 – Medium; 1 – Low

Department : **ECE**			Programme: **B.Tech.ECE**						
Semester : Fifth			Course Category Code: PCC				Semester Exam Type:		
ECUC116	**Digital Signal Processing Laboratory**		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
			-	-	2	1	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Gain knowledge of FFT algorithms and applying it for different applications							
	CO2	Practically design IIR filters and analyse the frequency response							
	CO3	Practically design FIR filters and analyse the frequency response							
	CO4	Understand the design of sampling rate converters.							
	CO5	Implement the designed filters in a DSP kit							
List of experiments									
1. Perform frequency analysis of signals using FFT algorithms. 2. Obtain Linear Convolution of two finite length sequences 3. Perform correlation of two signals using FFT									**CO1**
4. Design of IIR filter for the given specifications and study its frequency response characteristics									**CO2**
5. Design of FIR filter for the given specifications and study its frequency response characteristics.									**CO3**
6. Perform Decimation on a given signal. 7. Perform Interpolation on a given signal 8. Implementation of I/D sampling rate converters.									**CO4**
9. Implementation of FFT using DSP processor kit 10. Implementation of IIR and FIR filters using DSP processor kit									**CO5**
Lecture Periods: -			**Practical Periods:30**				**Total Periods: 30**		
Reference Books:									
1. Vinay K.Ingle and John G.Proakis, "Digital Signal Processing using MATLAB" CL Engineering, Third Edition, 2011. 2. B.Venkataramani and M.Bhaskar, "Digital Signal Processors- Architecture, programming and Applications", Tata McGraw Hill, Fourth Edition, 2005.									

Department : ECE		Programme :B.Tech ECE						
Semester :Fifth		Course Category Code: PCC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC117	VLSI Design Laboratory	-	-	3	1.5	40	60	100
Prerequisite								
	Upon completion of the course, the students will be able to							
Course Outcome	CO1 - Examine the functionality of thecombinational and sequential logic circuits using EDA tools							
	CO2 - Analyze static timing analysis using EDA tools.							
	CO3 - Develop Verilog HDL programs and emulate using FPGA.							
	CO4 - Build the layoutof the given schematic using EDA tools							

Part – I VLSI Front End Design

Using HDL based design entry, perform the synthesis/simulation of following combinational/sequential lcircuits using EDA tools and generate Technology schematic and Synthesis Report. 1. Design of Decoders and Encoders. 2. Design of multiplexers and Demultiplexers. 3. Design of sequential logic circuits – Flipflops, Latches, Serial Data Transfer System and Frequency Divider Circuits. 4. Design and verify the functionality of a 4-bitripplecounter and Switch Debounce system. 5. a. Design and verify the functionality of an 8-BitSerialandParalleladder/Subtractor. b. Design and verify the functionality of a 4-bitunsigned and signed array multiplier. 6. a. Design of Finite State Machines–Vending Machine System b. Sequence Detector(Mealy and Moore) 7. a. Design of memory elements - ROM/RAM b. Perform place and route back annotation of 4-bit counter and observe the static timing analysis.	CO1 , CO2

Part – II Implementation using FPGA

8. a. Implementation of Seven Segment Display b. Implementation of a 4-bit ripple carry adder. c. Implementation of UART communication.	CO3

Part – III VLSI Back End Design

9. Using EDA tools, generate the layout of 4-bit counter and 4-bit multiplier. 10. Using EDA tools, generate the layout of CMOS NOT, NAND and NOR gates.	CO4

Lecture Hours: -	Tutorial Hours: -	Practical Hours: 45	Total Hours: 45

Reference Books:

1. Laboratory Manual, Department of ECE, Puducherry Technological University, Puducherry.
2. Stephen Brown and Zvonko Vranesic,"Fundamentals of Digital Logic with Verilog Design", Third Edition, 2016, Tata McGraw-Hill Publishing company Ltd. New Delhi.

CO-PO Mapping

ECUC117 VLSI Design Laboratory

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	3	3	–	–	–	2	-	2	3	3
CO2	2	3	3	3	3	–	–	–	2	–	2	3	3
CO3	2	3	3	3	3	–	–	–	2	–	2	3	3
CO4	2	3	3	3	3	–	–	–	2	–	2	3	3
ECUC117	2	3	3	3	3	–	–	–	2	–	2	3	3

Department :**Electronics and Communication Engineering**		Programme :**B.Tech. (ECE)**						
Semester :V		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC118	**Data Communication Networks Laboratory**	-	-	3	1.5	40	60	100
Prerequisite	Familiarity with basic C programming							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Implement error detection and correction codes						
	CO2	Implement different encryption and decryption algorithms						
	CO3	Simulate shortest path, congestion and flow control algorithms						
	CO4	Implement data communication between computers using socket programming						
	CO5	Implement a packet sniffer to identify the type of packet from IP packet header						

Programs to be written in C language and to be conducted in Unix based platform (e.g. Ubuntu)

List of Experiments

a) Write and execute a C program to implement the following error detection codes. a. Parity generation and checking b. Cyclic Redundancy Check	**CO1**
b) Write and execute a C program to implement Hamming error detection and correction code.	**CO1**
c) Write and execute a C program to implement the following encryption algorithms. a. Caesar cipher b. Vigenere Cipher c. RSA algorithm	**CO2**
d) Write and execute a C program to implement Dijkstra's algorithm and compute the shortest path between nodes for a sample network.	**CO3**
e) Write and execute a C program to simulate the following congestion control algorithms. a. Leaky bucket b. Token bucket	**CO3**
f) Write and execute a C program to simulate the following flow control algorithms. a. Stop and Wait b. Go Back N algorithm c. Selective Repeat algorithm	**CO3**
g) Write a C program to establish a connection between two computers using TCP/IP socket and share data between them.	**CO4**
h) Write a C program to make the Server send the content of the requested file to the Client if the file is present.	**CO4**
i) Write a C program to establish a connection between two computers using TCP/IP socket and to make the Server send the content of the requested file to the Client if the file is present.	**CO4**
j) Write a C program to implement a basic packet sniffer and identify packet type by parsing the IP packet header.	**CO5**

Lecture Periods: -	Tutorial Periods: -	Practical Periods: 45	Total Periods: 45

Reference Books:

1. Behrouz A Forouzan , “Data Communication and Networking”, Tata McGraw-Hill, New Delhi, 2013.
2. William Stallings, “Data and Computer Communication”, Pearson Education, Eighth edition, 2007.
3. Lewis Van Winkle, “Hands-On Network Programming with C: Learn socket programming in C and write secure and optimized network code”, Packt Publishing Ltd., UK, First Edition, 2019

CO-PO Mapping

Course Code: **ECUC118**

Course Name : Data Communication Networks Laboratory

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	-	1	1	-	-	-	-	-	-	1	2
CO2	2	2	-	1	1	-	-	-	-	-	-	1	2
CO3	2	2	-	1	1	-	-	-	-	-	-	1	2
CO4	2	1	-	-	1	-	-	-	-	-	-	1	2
CO5	2	1	-	1	1	-	-	-	-	-	-	1	2

Score: 3 – High; 2 – Medium; 1 – Low

SEMESTER – VI

Department: ECE			Programme:B.Tech(ECE)						
Semester :**Sixth**			Course Category Code:**PCC**				Semester ExamType:**TY**		
Course Code	Course Name		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC119	**Microwave and Optical Engineering**		3	-	-	3	40	60	100
Prerequisite	-								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Demonstrate the understanding of microwave devices							
	CO2	Analyze microwave components using S-parameters							
	CO3	Demonstrate the understanding of microwave measurements							
	CO4	Summarize the signal degradation mechanisms in optical fiber							
	CO5	Design a fiber optic link with light sources, detectors and amplifiers.							
	CO6	Demonstrate the working principle of optical networks.							
UNIT-I	**Microwave Devices**					**Periods:9**			
Gunn diode and its modes of operation, IMPATT and TRAPATT diodes, MESFET and Parametric amplifiers. Two cavity klystron amplifier – Power and efficiency considerations. Reflex Klystron oscillators – Modes and efficiency considerations. Operation and applications of cylindrical Magnetrons and Helix TWT.									**CO1**
UNIT-II	**S-Parameters and Microwave Measurements**					**Periods:9**			
Scattering parameters: Properties of S matrix, Operation and applications of Hybrid Tee, Hybrid rings (rat-race), attenuators, matched load, waveguide corners, bends and twists. S matrix derivation for Directional couplers, Circulators and Isolators. **Microwave Measurements :** VSWR, power, frequency, impedance, scattering parameters and dielectric constant measurements. Antenna radiation pattern and gain measurements.									**CO2, CO3**
UNIT-III	**Optical Fibers**					**Periods:9**			
Element of an Optical Fiber Transmission link, Propagation of light, Optical fiber structures, acceptance angle, Numerical aperture. Fiber attenuation-absorption, scattering and bending losses. Dispersion – Material and waveguide dispersion. Signal distortion in SM fibers, Polarization Mode dispersion, Design Optimization of SM fibers-RI profile and cut-off wavelength.									**CO4**
UNIT-IV	**Optical Sources, Detectors and Amplifiers**					**Periods:9**			
LED - LED structures -Light source materials -Quantum efficiency and LED power, Modulation of LED. Laser Diode Modes and Threshold condition -Rate equations -External Quantum efficiency - Resonant frequencies, single mode laser. **Optical detectors:** PIN diode and APD–operation and characteristics. Erbium Doped Fiber Amplifiers-Principle, Operation and Applications.									**CO5**
UNIT-V	**Optical Networks**					**Periods:9**			
Systemdesignconsideration-Point–to–Pointlinkdesign–Linkpowerbudget–rise time budget. Principle Of SONET/SDH and WDM, Basic principle and architectures of Broadcast- and- select WDM Networks and Wavelength Routed Networks. Solitons, Optical CDMA, PON and FTTH.									**CO5, CO6**
Lecture Periods:45		**Tutorial Periods:**		**Practical Periods:-**			**Total Periods: 45**		
Reference Books:									

1. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson Education, Third Edition,2003.
2. Gerd Keiser, “Optical Fiber Communications”, Tata McGraw Hill, Fifth Edition,2013.
3. Annapurna Das and Sisir K.Das, “Microwave Engineering”, Tata McGraw Hill, Second Edition,2009.
4. Subal Kar, “Microwave Engineering Fundamentals, Design and Applications”, University Press,2016.
5. Rajiv Ramaswami, Kumar N.Sivarajan and G.H.Sasaki, “Optical Networks–A Practical Perspective”, Elsevier, Third Edition,2010.

COURSE ARTICULATION MATRIX

Course: ECUC119 Microwave and Optical Engineering

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	-	1	1	-	-	-	1	-	1		2
CO2	3	3	2	3	2	-	-	1	1	-	1		2
CO3	2	1	1	1	2	-	-	-	1	-	1		2
CO4	3	1	1	1	1	-	-	-	1	-	2	1	2
CO5	3	3	3	3	2	2	-	1	1	-	2	1	2
CO6	2	1	2	1	1	2	-	1	1	-	3	1	2

Department : ECE		Programme : B.Tech(ECE)						
Semester : Sixth		Course Category Code: PCC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC120	Embedded System	3	-	-	3	40	60	100
Prerequisite								
	Upon completion of the course, the students will be able to							
Course Outcome	CO1 - Classify the different types of I/O devices and the protocols used for serial communication.							
	CO2 – Interpret the programming concepts and develop C programs for embedded systems.							
	CO3 - Evaluate the performance of real time operating system.							
	CO4 – Evaluate the embedded system using fault tolerant analysis.							
	CO5 - Develop low power embedded system models using power reductions techniques.							
	CO6 – Analyze the challenges involved in embedded system design.							
UNIT – I	Introduction				Hours: 9			
Introduction to Embedded Systems - Design Metrics – Challenges in Embedded system Design - Design flow -Embedded Processors – IC Terminology – Full-Custom/VLSI – Semi-Custom ASIC - PLD Introduction to RISC architecture, VLIW and DSP processors. Introduction to I/O Devices – Types - Synchronous, Iso-synchronous and Asynchronous Communications – Serial Communication – I2C, USB, CAN – Wireless Communication – IrDA.								CO1, CO6
UNIT – II	Programming for Embedded Systems				Hours: 9			
Programming in assembly language (ALP) vs High Level Language - C Program Elements:- Macros and functions, Use of Date Types, Structure, Pointers, Function Calls – Program Modeling Concepts – ProgramModels - DFG Models – FSM Models – Modeling of Multiprocessor Systems.								CO2, CO5
UNIT – III	Real-time Operating Systems				Hours: 9			
Real Time Operating Systems – Structure of a RTOS – Process – Task – Threads – Task Scheduling – Classification of Scheduling Algorithms – Event Driven Scheduling –Rate monotonic scheduling – Earliest deadline first scheduling. Inter Process Communication:- Shared data problem, Use of Semaphore(s), Priority Inversion Problem and Deadlock Situations - Evaluating operating system performance – Power optimization strategies for processes.								CO3, CO5
UNIT – IV	Reliability Evaluation Techniques				Hours: 9			
Introduction to Reliability Evaluation Techniques – Reliability Models for Hardware Redundancy – Permanent faults only - Transient faults. Introduction to clock synchronization – A Non-Fault-Tolerant Synchronization Algorithm - Fault-Tolerant Synchronization in Hardware – Completely connected zero propagation time system – Sparse interconnection zero propagation time system – Fault tolerant analysis with Signal Propagation delays.								CO4
UNIT – V	Low Power Design				Hours: 9			
Sources of Power Dissipation–Power Reduction Techniques–Algorithmic Power Minimization– Architectural Power Minimization– Logic and Circuit Level Power Minimization – Control Logic Power Minimization – System Level Power Management. Internet of Things –								CO5, CO6

Requirements, Characteristics and Applications – Smart Lighting – Smart Traffic Light Control – Smart Parking and Smart Irrigation.			
Lecture Hours: 45	**Tutorial Hours:**	**Practical Hours: -**	**Total Hours: 45**
Note : Every student should carry out a mini project for this course and submit the report instead of assignment.			

Reference Books:

1. Rajkamal, "Embedded Systems Architecture", Programming and Design, TATA McGraw Hill, Third reprint,2017.
2. C.M.Krishna and Kang G. Shin, "Real Time Systems", TATA McGraw-Hill, Third reprint, 2010.
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufmann Publishers, Third reprint, Harcourt India, 2012.
4. Santanu Chattopadhyay, "Embedded System Design", Prentice Hall of India Learning, 2016.
5. David E.Simon, "An Embedded Software Primer", Pearson Education Asia, First Indian Reprint, 2000.

CO-PO Mapping

ECUC120 Embedded System

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2
CO1	2	3	3	2	2	-	–	–	–	–	–	3	1
CO2	3	3	3	3	3	-	–	–	-	2	–	3	3
CO3	2	3	3	3	3	-	–	–	–	–	–	3	3
CO4	2	3	3	3	2	-	–	–	–	–	–	3	3
CO5	2	3	3	3	3	-	–	–	-	-	–	3	3
CO6	2	2	3	2	2	-	–	–	2	2	1	3	3
ECUC120	3	2.5	3	2.33	2.33	-	-	-	0.7	0.7	-	3	2.67

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE)**						
Semester: **Sixth**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC117	**Microprocessors and Microcontrollers**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Describe basics of microprocessors and microcontrollers architectures and its functionalities						
	CO2	Outline the operation of microprocessors/ microcontrollers, machine language programming & interfacing techniques						
	CO3	Identify the functionality of ARM microcontroller & its Peripherals.						
	CO4	Explain peripherals devices, interfacing and Embedded programming						
	CO5	Design Microprocessor/ microcontroller-based systems for real-time applications						
UNIT-I	**16-bit Microprocessor Architecture and Programming**				**Periods: 09**			
Introduction - Evolution of Microprocessors- Intel 8086 Microprocessor Architecture – Pin description. – Minimum and Maximum mode signals – BUS cycles- Addressing Modes - Instruction Set – Directives – Assembly Language Programming.								**CO1**
UNIT-II	**Memory and Peripheral Interfacing**				**Periods: 09**			
Introduction – Memory Interfacing - I/O interfacing - Parallel communication interface 8255 PPI, and Serial communication interface USART 8251 using 8086 Microprocessor –Interrupt Structure of 8086- Programmable Interrupt Controller 8259, Timer 8254– Direct Memory Access 8237 - DOS interrupt (21H) functions for console.								**CO2**
UNIT-III	**Introduction to ARM Microcontroller**				**Periods: 09**			
RISC versus CISC – ARM Processor Fundamentals -ARM 7 Architecture – LPC2148 microcontroller introduction – Internal memory map –Thumb/ARM instructions – Assembly Language Programming								**CO2, CO3**
UNIT-IV	**ARM Peripherals and Embedded Programming**				**Periods: 09**			
Peripheral details – Implementation of GPIO, Timer/Counter, UART, Interrupt architecture – ADC and DAC. SPI, I2C and USB features of LPC2148 – Embedded Programming - Firmware development using Embedded C – introduction to data types – conditional statements – loops								**CO3, CO4**
UNIT-V	**Applications of Microcontrollers/Microprocessor**				**Periods: 09**			
Simple programs using Embedded 'C', Applications - D/A and A/D Interface - Printer Interface - Traffic Light control system – DC Motor Speed control – LCD Interfacing								**CO3, CO4, CO5**

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Reference Books:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt. Ltd., Second Edition, 2013.
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, and Janice Mazidi, "ARM Assembly Language Programming & Architecture", II Edition, 2016
3. Andrew N. Sloss Dominic Symes and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaughmann Publisher, 2024.
4. Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, III Edition, 2017.

CSUC117CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	-	3	-	-	-	3	-	-	-
CO2	2	3	3	3	2	-	3	-	-	-	2	-	-	-
CO3	1	3	3	3	3	3	3	-	2	3	3	-	-	-
CO4	2	3	3	3	3	3	3	-	2	3	3	-	-	-
CO5	2	3	3	3	3	3	3	-	3	3	3	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Department : ECE			Programme: **B.Tech(ECE)**						
Semester : 6			Course Category Code: PCC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC121	Advanced Communication Lab		-	-	3	1.5	40	60	100
Prerequisite:									
	Upon completion of the course, the students will be able to								
	CO1	Perform VSWR, impedance and gain measurements for microwave components and antennas.							
	CO2	Characterize the performance of microwave components and different antennas using Network analysers.							
	CO3	Acquire practical skills to measure the light propagation characteristics of optical fiber and analyse the error performance of mobile radio links for digital modulation scheme.							
	CO4	Establish digital optical fiber link.							
	CO5	Practically assess the working of GSM, CDMA, WLAN and Zigbee PAN networks							
List of experiments									
1. Determination of VSWR and impedance of unknown load a) To plot standing wave pattern of SC and OC. b) To measure impedances of load such as capacitive iris, horn antenna, etc 2. Characteristics of microwave components – to study characteristics of given passive microwave components such as directional coupler, circulator and isolator. 3. Study the characteristics of MIC components using Vector Network Analyser .									**CO1, CO2**
4. Study Radiation pattern of given antenna – to plot the radiation pattern and determine FNBW, HPBW and side lobe level of the given antenna. 5. Determination of gain of an antenna a) To determine gain of identical horn antenna. b) To determine gain of unknown parabolic reflector 6. 10. a). Design and testing of Yagi antenna & Microstrip antenna using Vector Network Analyzer.									**CO1, CO2**
7. Study of optical fiber characteristics a) Frequency response of fiber b) Attenuation c) Coupling loss and bending loss d) Numerical aperture and acceptance angle									**CO3, CO4**

8. Characteristics of digital link using optical fiber a) To establish a digital fiber optic link and obtain its frequency response. b)To set up a TDM link using fiber optics and transmit the multiplexed audio and data and receive demultiplexed signal.	
9. Simulate the effect of noise on Quadrature Phase Shift Keying and Quadrature Amplitude Modulation, and compute symbol error rate, bit error rate and a scatter plot of the modulated signal. 10. Simulate and study the performance of error detection and correction codes: a) Cyclic redundancy check and b) Hamming codes for a Binary symmetry channel with varying error probabilities.	**CO3**
11. Simulation of Hand off mechanisms in Cellular Mobile Communications. 12. Design and implementation of Zigbee PAN and WAN Networks.	**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:45**	**Total Periods: 45**

Reference Books:

1. Annapurna Das and Sisir K. Das, "Microwave Engineering", Tata McGraw Hill, Second Edition, 2009.
2. Gerd Keiser, "Optical Fiber Communications", Tata McGraw Hill, Fifth Edition, 2013.
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press (2005)
4. Lab Manual – prepared by the Dept. of ECE, PTU

CO-PO Mapping

ECUC121 Advanced Communication Lab

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	3	3	-	-	3	3	-	-	2	2
CO2	2	3	2	3	3	-	-	3	3	-	-	2	2
CO3	2	3	2	3	3	-	-	3	3	-	-	2	2
CO4	2	3	2	3	3	-	-	3	3	-	-	2	2
CO5	2	3	2	3	3	-	-	3	3	-	-	2	2
ECUC121	2	3	2	3	3	-	-	3	3	-	-	2	2

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="3">Department : Electronics and Communication Engineering</td><td colspan="5">Programme: B.Tech (Electronics and Communication Engineering)</td></tr>
<tr><td colspan="3">Semester : Sixth</td><td colspan="3">Course Category Code: PCC</td><td colspan="3">Semester Exam Type:</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="4">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>ECUC122</td><td>Embedded System Laboratory</td><td>-</td><td>-</td><td>2</td><td>1</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="5">Course Outcome</td><td>CO1</td><td colspan="7">Examine the issues involved in embedded system design.</td></tr>
<tr><td>CO2</td><td colspan="7">Apply microcontroller programming and interfacing skills.</td></tr>
<tr><td>CO3</td><td colspan="7">Design, develop and test the embedded systems.</td></tr>
<tr><td>CO4</td><td colspan="7">Develop the program and analyse codes using an IDE.</td></tr>
<tr><td>CO5</td><td colspan="7">Implement and test small scale embedded systems.</td></tr>
<tr><td colspan="8">1. Introduction to the development environment - Blinking LEDs
2. Serial Communication between the microcontroller and PC
3. Digital Clock
4. Digital Voltmeter
5. Automatic Intensity Controlled Light
6. DC Motor Interfacing using microcontroller
7. Velocity Control using Timer module in microcontroller
8. Obstacle Detector
9. Multiple Task creation using FreeRTOS
10. Mutex semaphore using FreeRTOS
11. Deadlock situation using FreeRTOS</td><td>CO1, CO2, CO3, CO4, CO5</td></tr>
<tr><td colspan="3">Lecture Periods: -</td><td colspan="2">Tutorial Periods: -</td><td colspan="2">Practical Periods: 45</td><td colspan="2">Total Periods: 45</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. M. Morris Mano and Michael Ciletti, Digital Design, Sixth Edition, Pearson India Education Services, Pvt.
Ltd., 2018.
2. Samir Palnitkar, “Verilog HDL”, Second Edition, Pearson Education, 2003.
3. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL”, Second Edition, Pearson Education, 2010.
4. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Tata McGraw-Hill Publishing Company Ltd., 2007.</td></tr>
</table>

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE)**						
Semester: **Sixth**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC120	**Microprocessors and Microcontrollers Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Develop variety of assembly language programs in 8086 microprocessor.						
	CO2	Implement interfacing of peripheral with microprocessor.						
	CO3	Analyze the programming aspects of ARM microcontroller.						
	CO4	Illustrate standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.						
	CO5	Design Microcontroller/Microprocessor based systems.						
	CO6	Implement microcontroller-based real-time applications.						

Ex. No.	**Experiment Name/Brief Description**	
	A) Experiments Using 8086 Microprocessor with MASM	
1	Arithmetic operations: Multi-byte Addition, Subtraction, Multiplication, Division.	**CO1, CO2, CO5**
2	Searching and Sorting	
3	String Operations	
4	Traffic light control	
5	Stepper motor control	
6	Serial and Parallel Interface	
7	Dos and Bios Interrupts programming	
	B) Experiments Using ARM Controller	
8	Implementation of Simple Programs in LPC2141 14.	**CO3, CO4, CO5**
9	Implementation of Interrupts in LPC2148.	
10	Implementation of UART features of ARM LPC2148.	
11	Implementation of SPI and I2C communication using LPC2148	
	C) Implements Real Time Applications using Controller	
12	Interfacing Graphical LCD using LPC2148.	**CO3, CO6**
13	Implementation of USB communication using LPC2148	
14	Implementation of Traffic light control using LPC2148	
15	Implementation of Stepper motor control using LPC2148	

Lecture Periods: 00	Tutorial Periods: -	Practical Periods: 45	Total Periods: 45

Reference Books:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt. Ltd., Second Edition, 2013.
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, and Janice Mazidi, "ARM Assembly Language Programming & Architecture", II Edition, 2016
3. Andrew N. Sloss Dominic Symes and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaughmann Publisher, 2024.
4. Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, III Edition, 2017.

CSUC120 CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	-	2	1	3	-	-	-
CO2	2	3	2	3	3	2	2	-	2	1	3	-	-	-
CO3	2	3	2	3	3	2	2	1	2	1	3	-	-	-
CO4	2	3	2	3	3	2	2	3	2	1	3	-	-	-
CO5	2	3	2	3	3	2	-	1	3	-	3	-	-	-
CO6	2	3	2	3	3	2	-	3	3	-	3	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="3">Department :ECE</td><td colspan="5">Programme: B.Tech.</td></tr>
<tr><td colspan="3">Semester :Sixth</td><td colspan="3">Course Category Code: PCC</td><td colspan="3">Semester Exam Type:</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>ECUC123</td><td>Internship</td><td></td><td></td><td></td><td>2</td><td>100</td><td></td><td>100</td></tr>
<tr><td>Prerequisite :</td><td colspan="7"></td></tr>
<tr><td></td><td colspan="7">Upon completion of the course, the students will be able to</td></tr>
<tr><td rowspan="4">Course Outcome:</td><td>CO1</td><td colspan="6">Apply theoretical knowledge gained during coursework to real-world projects and tasks.</td></tr>
<tr><td>CO2</td><td colspan="6">Develop soft skills such as communication, teamwork, problem-solving, and time management.</td></tr>
<tr><td>CO3</td><td colspan="6">Demonstrate proficiency in relevant industry technologies or platforms.</td></tr>
<tr><td>CO4</td><td colspan="6">Handle the demands and challenges of a professional setting</td></tr>
<tr><td colspan="7">The student is required to undergo ‘internship’ in industry / research laboratory / higher learning institution for a period of at least 4 weeks in a maximum of 2 spells during vacations. Each spell of internship shall be for a period of not less than 2 weeks. The main purpose of internship is to enhance the general professional outlook and capability of the student to advance his chances of improving the career opportunities. The student should get prior approval from the Head of the Department before undertaking the internship and submit a detailed report after completion for the purpose of assessment. A departmental committee shall evaluate the performance of the students.</td><td>CO1, CO2, CO3, CO4</td></tr>
</table>

CO-PO Mapping

ECUC123 **Internship**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	2
CO2	-	-	-	-	2	2	2	2	2	2	-	2	2
CO3	-	-	-	-	-	2		2	2	2	-	2	2
CO4			1							1	1	2	2
ECUC123	0.8	0.5	0.5	0.3	0.3	1.5	1	1	1	1	0.5	2	2

Score: 3 – High; 2 – Medium; 1 – Low

SEMESTER – VII

Department : ECE		Programme: **B.Tech.**						
Semester : VII		Course Category Code: PCC				Semester Exam Type:		
Course Code	Course Name:	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC124	Wireless Communication	3	1		4	40	60	100
Prerequisite:	Digital communication fundamentals							
Course Outcome	**CO1**	To understand the basic concepts of cellular system design.						
	CO2	To study the requirements for the design of different types of wireless technologies.						
	CO3	Analyse the different multipath fading models.						
	CO4	To understand the different small scale fading channels.						
	CO5	Summarise the different diversity and equalization techniques of multipath environment.						
UNIT-I	**Cellular system design - fundamentals**				**Periods: 12**			
Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing, Handoffs, Practical Handoff Considerations. Interference And System Capacity: Co-Channel, Interference And System Capacity-Channel Planning For Wireless Systems, Adjacent Channel Interference, Power Control For Reducing Interference, Trunking And Grade Of Service. Improving Coverage And Capacity In Cellular Systems: Cell Splitting, Sectoring. Case study - design of cellular system for a practical scenario.								**CO-1**
UNIT-II	**Wireless Services**				**Periods: 12**			
Applications and Requirements for wireless services - Types of Wireless services, Requirements for services, Technical Challenges. Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, LTE, LTE-A, Wi-Max, Wireless Local Loop (WLL), Wireless Local Area network (WLAN), Bluetooth and Personal Area Networks.								**CO-2**
UNIT-III	Large Scale Multipath Propagation				**Periods: 12**			
Large scale Path loss and shadowing: Wireless communication Environment, Radio Wave Propagation, Transmit and Receive Signal Models, Doppler shift, shadowing, Free-Space Propagation model, Ray Tracing – 2 Ray tracing model and general ray tracing model. Design of an indoor propagation model – Case study .								**CO-3**
UNIT-IV	Small Scale Multipath Propagation				**Periods: 12**			
Small Scale Multipath propagation: Impulse response of a multipath model, Multipath Parameters- Time Dispersion , Coherence bandwidth, Doppler spread and coherence time. Types of small scale fading – Fading effects due to Delay and Doppler spread. Statistical Multipath								**CO-4**

Channel Models: Rayleigh and Rician channel models. Comparison of AWGN,Rayleigh and Rician fading channels and study of Bit Error Rate performance. Capacity of flat and frequency selective channels.			
UNIT-V	Performance Enhancement Techniques (Qualitative Treatment only)	**Periods: 12**	
Diversity – Micro and Macro diversity, Transmit Diversity with and without Channel state Information. Diversity combining techniques. Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Introduction to MIMO Wireless Communications, MIMO System Model.			**CO-5**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Andreas F.Molisch," Wireless Communications", John Wiley Press,second Edition,2011.
2. Andrea Goldsmith, " Wireless Communications", Cambridge University Press, 2005
3. Theodore S.Rappaport, "Wireless Communication: Principles and Practice", PHI, Second Edition, 2024.
4. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communications", Cambridge University Press,2006.
5. Aditya.K.Jegannathan, "Principles of ModernWireless Communication Systems",Tata McGraw Hill, 2016.
6. Yi-Bing Lin and Imrich Chlante, "Wireless and Mobile Network Architecture ", 1 st Edition John Wiley 2006.

ECUC124 **CO-PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	1	1						1	1
CO2	3	1	3	2	1	1	1						2	2
CO3	3	3	3	2	2	1	1						2	2
CO4	3	2	3	2	2	1	1						1	1
CO5	3	1	1	1	1	1	1						1	1

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Electronics and Communication Engineering**			Programme: **B.Tech(ECE).**						
Semester **:VII**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC125	**Information Theory and Coding**		3	1	-	4	40	60	100
Prerequisite	Probability and Statistical analysis								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Interpret the concepts of Information Theory							
	CO2	Acquire knowledge of Linear Block Codes for error detection and error correction							
	CO3	Acquire knowledge of cyclic codes							
	CO4	Apply BCH and RS codes for error detection and error correction							
	CO5	Design convolutional codes.							
	CO6	Analyze Concatenated codes and Turbo codes.							
UNIT-I	**Information Theory**					**Periods:12**			
Introduction to Information theory- Uncertainty and Information –Entropy-Joint and conditional entropies – Average mutual information –Discrete memory less channels-Channel capacities of Noiseless channel-Lossless channel, deterministic channels-BSC channel –BEC channel- Shannon Hartley theorem and its implications-Shannon Hartley limit									**CO1**
UNIT-II	**Linear Block Codes**					**Periods:12**			
Generator matrix-Parity check matrix, Hamming weight –Hamming distance, Generation of linear block codes -error detection cum error correction-Syndrome decoding –LDPC codes- perfect codes- space time block codes									**CO2**
UNIT-III	**Cyclic Codes**					**Periods:12**			
Systematic and non-systematic methods of cyclic codes generation- -Syndrome calculation using polynomial division method- Matrix description of cyclic codes- Circuit implementation of Cyclic encoder and Syndrome calculator –Golay codes- Cyclic redundancy check codes									**CO2 CO3**
UNIT-IV	**Bose Chaudhuri Hocquenghem (BCH) codes**					**Periods:12**			
Primitive elements-minimal polynomials-generator polynomials in terms of minimal polynomial-decoding of BCH codes-Reed Solomon Codes –Implementation of Reed Solomon encoders and decoders									**CO4**

UNIT-V	Convolutional codes	Periods:12	
Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm- Soft–output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding. Turbo codes- Concatenated codes			CO5 CO6
Lecture Periods:45	**Tutorial Periods:15 -**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Das, S.K.Mullick and P.K.Chatterjee, "Principles of Digital Communication", Wiley Eastern Limited, 1986.
2. Shu Lin &Daniel J. Costello, Jr, "Error Control Coding", Pearson / Prentice Hall, Second Edition, 2004.
3. R Bose, "Information Theory, Coding and Cryptography", TMH 2007. (For units-3,4&5)
4. K.SamShanmugam, "Digital and Analog Communication Systems", John Wiley and Sons, 1985.
5. Simon Haykin, "Communication Systems", John Wiley and Sons, Fourth Edition.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1									1
CO2	2	1	1	1									1
CO3	2	1		1									1
CO4	2	1		1									1
CO5	2	1		1									1
CO6	2	1		1									1
ECUC125	2	1.17	1	1									1

Department : ECE			Programme: **B.Tech.**						
Semester : VII			Course Category Code: PCC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUC126	**Artificial Intelligence and Machine Learning**		3	1	0	4	40	60	100
Prerequisite:	Linear Algebra and Probability fundamentals								
Upon completion of the course, the students will be able to									
Course Outcome	**CO1**	Represent the intelligent agent frameworks using suitable agents and apply search algorithms for problem solving							
	CO2	Distinguish and Developsupervised learning models.							
	CO3	Apply ensemble approaches and Construct unsupervised learning algorithms.							
	CO4	Construct a Multilayered Perceptron models and to evaluate them using appropriate metrics.							
UNIT-I	**Introduction to AI**					**Periods: 10**			
Introduction – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies. Knowledge-based agents. Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning.									**CO1**
UNIT-II	**Problem Solving**					**Periods: 11**			
Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments									**CO1**
UNIT-III	**Supervised Learning**					**Periods: 15**			
Review of Linear Algebra for machine learning; Examples of machine learning applications. Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests.									**CO2**
UNIT-IV	**Ensemble Techniques And Unsupervised Learning**					**Periods: 15**			
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization. Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation. ReLU, hyperparameter tuning, batch normalization, regularization, dropout.									**CO3, CO4**
UNIT-V	**Design And Analysis Of Machine Learning Experiments**					**Periods: 9**			

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test. Case studies in Healthcare applications.	**CO4**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
4. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014
5. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	1	-	-	-	3	2	2
CO2	3	3	3	3	3	2	1	-	-	-	3	2	2
CO3	0	3	3	3	3	2	1	-	-	-	3	3	3
CO4	3	3	3	3	3	2	1	-	-	-	3	3	3
ECUC126	2.25	3	3	3	3	2	1	-			3	2.5	2.5

<table>
<tr><td colspan="3">Department : ECE</td><td colspan="6">Programme : B.Tech.</td></tr>
<tr><td colspan="3">Semester : Seventh</td><td colspan="3">Course Category Code: PCC</td><td colspan="3">Semester Exam Type: PR</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="2">Periods / Week</td><td colspan="2">Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>ECUC127</td><td colspan="2">Mini Project</td><td>-</td><td>-</td><td>4</td><td>2</td><td>100</td><td>-</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8"></td></tr>
<tr><td rowspan="4">Course Outcome
At the end of the course students will be able to</td><td>CO1</td><td colspan="7">Carry out literature survey, understand state of art techniques.</td></tr>
<tr><td>CO2</td><td colspan="7">Identify and apply appropriate tools to solve a problem.</td></tr>
<tr><td>CO3</td><td colspan="7">Transform knowledge into an algorithmic/experimental process.</td></tr>
<tr><td>CO4</td><td colspan="7">Prepare and present reports on the project work.</td></tr>
<tr><td></td><td colspan="7">The objective of this course is to enable the students to carry out the mini-project in a group. The topic shall be chosen in consultation with the Faculty coordinators. Each group of students is expected to make a detailed review of the literature, formulate the problem, carry out the mini project and prepare a report on the work done. The mini project can be a small project work or it can be a part of the work planned for the main project. The students should present the results of the work in the review committee meetings. A departmental committee shall evaluate the performance of the students</td><td>CO1, CO2, CO3, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: -</td><td colspan="2">Tutorial Periods: -</td><td colspan="3">Practical Periods: 60</td><td>Total Periods: 60</td></tr>
</table>

CO-PO Mapping

ECUC127 **Mini Project**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	-	3	1	3	3
CO2	3	3	3	3	3	1	1	1	-	-	1	3	3
CO3	3	3	3	3	3	1	1	1	-	-	-	3	3
CO4	-	-	-	-	-	-	-	-	3	-	3	3	3

ECUC127	3	3	3	3	3	1	1	1	-	3	1	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department: ECE			**Programme : B.Tech.**					
Semester : Seventh			**Course Category Code: PCC**			**Semester Exam Type:**		
Course Code	**Course Name**		**Periods / Week**		**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECUC128	**Comprehensive Viva**		**-**	**-**	**2**	**1**	**100**	**-**	**100**
Prerequisite:								
Course Outcome At the end of the course students will be able to	**CO1**	Demonstrate a broad understanding of the subject area						
	CO2	Present complex concepts in an easy-to-understand way, answering questions confidently						
	CO3	Handle unexpected and challenging questions						
	CO4	Respond thoughtfully to feedback, and participate actively in discussions.						
	Comprehensive viva is an oral examination conducted to evaluate the critical thinking, analytical abilities, and how well a student can discuss and apply concepts learned throughout their studies. A committee comprising of five faculty members will conduct the comprehensive viva examination and evaluate the students. Experts from the industry may also be included in this committee. The Head of the Department shall constitute this committee							CO1, CO2, CO3, CO4
Lecture Periods: -	**Tutorial Periods: -**		**Practical Periods: 30**			**Total Periods: 30**		

CO-PO Mapping

ECUC128**Comprehensive Viva**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	3	3	-	3	3	3
CO2	3	3	2	-	-	-	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	-	3	3	-	3	-	-
CO4	-	-	-	-	-	-	-	3	3	-	3	-	-
ECUC128	1.5	1.5	1	-	-	-	-	3	3		3	0.8	0.8

Score: 3 – High; 2 – Medium; 1 – Low

SEMESTER – VIII

<table>
<tr><td colspan="3">Department: ECE</td><td colspan="5">Programme : B.Tech.</td></tr>
<tr><td colspan="3">Semester : Eighth</td><td colspan="3">Course Category Code: PCC</td><td colspan="3">Semester Exam Type: PR</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>ECUC129</td><td>Project Work</td><td>-</td><td>-</td><td>16</td><td>8</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome
At the end of the course students will be able to</td><td>CO1</td><td colspan="7">Carry out literature survey, understand state of art techniques.</td></tr>
<tr><td>CO2</td><td colspan="7">Identify and apply appropriate tools to solve a problem.</td></tr>
<tr><td>CO3</td><td colspan="7">Transform knowledge into an theoretical/experimental process.</td></tr>
<tr><td>CO4</td><td colspan="7">Prepare and present reports on the project work.</td></tr>
<tr><td></td><td colspan="8">In this project work, the team would solve the problem taken up for study. Simulation studies and/or hardware development would be completed. Necessary inferences have to be drawn from the studies carried out and the same should be presented before the committee members. If the project involves intensive analytical procedure, the analysis has to be completed and suitable comparison to existing methodologies reported in literature should be done to validate the correctness as well as effectiveness of the work.
Rigorous review by the committee will be carried out in the process to ascertain whether the work qualifies as a suitable project at the graduate level. Each team is expected to present their work at National/International conferences or at the students' technical symposiums. Team that has come out with novel contribution will be encouraged to publish their work in any referred journals.</td></tr>
<tr><td colspan="2">Lecture Periods: -</td><td colspan="2">Tutorial Periods: -</td><td colspan="2">Practical Periods: 240</td><td colspan="2">Total Periods: 240</td></tr>
</table>

CO-PO Mapping

ECUC129 **Main Project**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	-	3	1	3	3
CO2	3	3	3	3	3	1	1	1	-	-	1	3	3
CO3	3	3	3	3	3	1	1	1	-	-	-	3	3
CO4	-	-	-	-	-	-	-	-	3	-	3	3	3

ECU129	2.3	2.3	2.3	2.3	2.3	0.8	0.8	0.8	0.8	0.8	1.3	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Professional Electives – I

Department : **Electronics and Communication Engineering**			Programme : **B.Tech. (ECE)**						
Semester : **Fifth**			Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUE101	**Computer Architecture andOrganization**		3	1	-	4	40	60	100
Prerequisite									
Course Outcome	**CO1**	Demonstrate understanding of the operational concepts of various functional units of a computer							
	CO2	Create a block diagram for the given arithmetic, logical or transfer operation expressed in RTL							
	CO3	Illustrate the instruction cycle and control unit design of a basic computer							
	CO4	Illustrate the function of different arithmetic hardware algorithms							
	CO5	Demonstrate understanding of the concepts of Cache memory, Virtual memory and DMA transfer							
	CO6	Demonstrate understanding of the concepts of inter processor arbitration, communication and synchronization							
UNIT-I	**Structure of Computers and Register Transfer andMicro-Operations**					**Periods: 12**			
Computer types, functional units, basic operational concepts, Von-Neumann architecture, bus structures, software, performance, multiprocessors and multicomputer, data representation, fixed and floating point and error detecting codes. Register transfer language, register transfer, bus and memory transfers,arithmetic micro-operations, logic micro-operations, shift micro-operations, arithmetic logic shift unit.									**CO1, CO2**
UNIT-II	**Basic Computer Organization and Design**					**Periods: 12**			
Instruction codes, computer registers, computer instructions, instruction cycle, timing and control, memory-reference instructions, input-output and interrupt. Central processing unit: stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, Reduced Instruction SetComputer (RISC).									**CO1, CO3**
UNIT-III	**Micro-programmed Control and Computer Arithmetic**					**Periods: 12**			
Control memory, address sequencing, micro-program example, Design of control unit. Addition and subtraction, multiplication and division algorithms, floating-point arithmetic operation,decimal arithmetic unit, decimal arithmetic operations.									**CO1, CO4**
UNIT-IV	**Memory System**					**Periods: 12**			
Basic concepts, semiconductor RAM types of Read Only Memory (ROM), cache memory, performance considerations, virtual memory, secondary storage raid, Direct Memory Access (DMA).									**CO1, CO5**
UNIT-V	**Multiprocessors**					**Periods: 12**			
Characteristics of multiprocessors, interconnection structures, inter processor arbitration, inter processor communication and synchronization, cache coherence, shared memory multiprocessors.									**CO1, CO6**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods: -**			**Total Periods: 60**			
Reference Books:									

1. M. Moris Mano, "Computer System Architecture", 3rd edition, Pearson/PHI, India, 2006.
2. Carl Hamacher, Zvonks Vranesic, SafeaZaky, "Computer Organization", 5th edition, McGraw Hill, New Delhi, India, 2002.
3. William Stallings, "Computer Organization and Architecture- designing for performance", 8th edition, Prentice Hall, New Jersy, 2010.
4. Andrew S. Tanenbaum , "Structured Computer Organization", 5th edition, Pearson Education Inc, New Jersy, 2006.
5. Sivarama P. Dandamudi, "Fundamentals of Computer Organization and Design", Springer Int. Edition, USA, 2003.

CO-PO Mapping

Course Code: ECUE101

Course Name; Computer Architecture and Organization

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	2	2	1	-	1	-	-	-	-	-	-	1	1
CO 2	2	2	1	-	1	-	-	-	-	-	-	1	1
CO 3	2	2	1	-	1	-	-	-	-	-	-	1	1
CO 4	2	2	1	-	1	-	-	-	-	-	-	1	1
CO 5	2	1	1	-	1	-	-	-	-	-	-	1	1
CO 6	2	1	1	-	1	-	-	-	-	-	-	1	1

Score: 3 – High; 2 – Medium; 1 – Low

Department : **Electronics and Communication Engineering**				Programme: **B.Tech**				
Semester : V				Course Category Code: PEC			Semester Exam Type:	
Course Code	Course Name			Periods / Week			Credit	Maximum Marks		
				L	T	P	C	CA	SE	TM
ECUE102	**Verilog Programming**			4	-	-	4	40	60	100
Prerequisite:	-									
Course Outcome	**CO1**	Demonstate knowledge on HDL design flow, digital circuits design ,switch de-bouncing, metastability, memory devices applications.								
	CO2	Design and develop the combinational and sequential circuits using different styles of modelling.								
	CO3	Solving algorithmic state machines using hardware description language.								
	CO4	Analyze the process of synthesizing the combinational and sequential descriptions.								
	CO5	Realize PLDs using Verilog HDL.								
UNIT-I	**Introduction to logic design with Verilog**						**Periods: 12**			
Module definition - Ports, - data types - gate delays, operators, operands, operator types. Dataflow modelling of combinational logic, continuous assignments delays. Logic simulation, design verification, test methodology, Structural models of combinational logic, propagation delay, truth table models of combinational and sequential logic with verilog modules										**CO1, CO2**
UNIT-II	**Logic design with behavioural models of combinational and sequential logic**						**Periods: 12**			
Behavioral modelling – always and initial block, data types for behavioral modeling, behavioral models of combinational logic, propagation delay and continuous assignments, Blocking and non-blocking assignments – behavioural models of sequential circuits –latches (level triggered) and flip-flops (edge detection).										**CO1, CO2**

UNIT-III	Logic design of sub-system design	Periods: 12	
Behavioral models of multiplexers, encoders and decoders - data flow model of LFSR with multicycle operations, algorithmic state machine charts for behavioral modeling, , behavioral models of counters, shift registers, switch debounce, Design of ROM, RAM with Verilog - metastability, synchronizers for asynchronous signals.			**CO1, CO2, CO3**
UNIT-IV	**Introduction to Synthesis**	**Periods: 12**	
Synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic.			**CO1, CO2, CO4**
UNIT-V	**Programmable logic devices**	**Periods: 12**	
Introduction to Programmable logic devices, storage devices, programmable logic array (PLA) - programmable array logic (PAL), programmability of PLDs and CPLDs.			**CO1, CO2, CO5**
Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009.
2. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.
3. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
4. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **V**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUE103	**Cryptography and Network Security**	3	1	-	4	40	60	100
Prerequisite	Wireless Communication							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Understand the basics of cryptography and network security protocols						
	CO2	Apply cryptographic algorithms and evaluate network security protocols in real-world scenarios.						
	CO3	Analyze Wireless Network Security Vulnerabilities and Protocols.						
	CO4	**Understand and assess cellular network security** challenges and solutions.						

UNIT-I	**Basics of Cryptography and Finite Fields**	**Periods: 12**
The OSI Security Architecture, Security Attacks, Services and Mechanisms-Symmetric Key Cryptography-Block and Stream Ciphers, Block Cipher Principles, DES Algorithm-Basic Concepts of Finite Fields, Euclidean Algorithm, Modular Arithmetic, Groups, Rings and Fields, Polynomial Arithmetic-AES Algorithm- Block CipherModes and its Operation		**CO1 CO2**
UNIT-II	**Number Theory, PKC, Data Integrity andAuthentication**	**Periods: 12**
Introduction to Number Theory, Fermat's and Euler's Theorems, Chinese Remainder Theorem, Discrete Logarithms-Public Key cryptography, Diffie-Hellman Key Exchange, RSA and ECC algorithms-Data Integrity Algorithms, Hash and MAC Functions-Digital Signatures-Protocols for Key management and Distribution-Authentication, Kerberos V4.		**CO1, CO2**
UNIT-III	**Network Security**	**Periods: 12**
Secure Sockets Layer and Transport Layer Security- Electronic Mail Security, Pretty Good Privacy, IP Security: Overview, IP security Architecture, ESP and Authentication Header Formats, Intruders, Intrusion Detection System, Password Management- Viruses, Worms-Firewalls and its types -Trusted Systems		**CO1, CO2**
UNIT-IV	**Wireless Network Security**	**Periods: 12**
WLAN Vulnerabilities and Threats-IEEE 802.11i Wireless LAN security, Wireless Transport Layer Security, WAP End- to-End Security-Vulnerabilities. Security and Authentication in Ad Hoc Networks- Secure Electronic Transaction, Security of Mobile Payments, Privacy and Anonymity in Electronic Payment, Mobile Payment Systems-Securing Copyright in Mobile Networks.		**CO3**
UNIT-V	**Cellular Network Security**	**Periods: 12**
Threats and Attacks in Cellular Systems-Mobile Malware- Prevention Techniques in Cellular Systems-GSM, UMTS and LTE-Security Architecture, Attacks and Security Model, LTE- AKA (Authentication and Key Agreement) Protocols, Security in 5G Networks.		**CO4**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. William Stallings, "Cryptography and Network Security-Principles and Practice", Pearson, 8th Edition, 2020.
2. Noureddine Boudriga, "Security of Mobile Communications", CRC Press, Taylor& Francis Group, 2010.
3. T. S. Rappaport, "Wireless Communication: Principles and Practice", Pearson Education, 2nd Edition, 2024.
4. Bruce Schneier, "Applied Cryptography", John Wiley & Sons, 2nd Edition, 1996.
5. Charles P. P fleeger, Shari Lawrence, "Security in computing", Prentice Hall of India, 6th Edition, 2023.

COURSE ARTICULATION MATRIX

Course: ECUE103 **Cryptography and Network Security**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	-	3	3	2	2	1	3
CO2	3	3	3	3	3	2	-	3	3	2	2	1	3
CO3	3	3	3	3	3	2	1	3	3	-	1	3	3
CO4	3	3	3	3	3	2	-	3	3	-	2	3	3

Department: **Electronics and Communication Engineering**			Programme:**B.Tech.(EC)-Honours**						
Semester :**V**			Course Category Code:**PEC**				Semester Exam Type:**TY**		
Course Code	Course Name		Periods/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUE104	**Medical Electronics and Informatics**		3	1	-	4	40	60	100
Prerequisite	-								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Develop a comprehensive understanding of medical bio-signals and measurement techniques to analyze, interpret, and process data for diagnosis and treatment.							
	CO2	Evaluate the application of various medical imaging techniques, integrating knowledge of image processing, segmentation, and prediction in medical diagnosis.							
	CO3	Apply medical informatics principles to manage healthcare data, ensuring privacy, security, and ethical standards in decision-making and healthcare delivery.							
	CO4	Integrate emerging technologies such as AI, virtual reality, and telemedicine to enhance healthcare delivery and patient care.							
	CO5	Critically assess the impact of modern medical technologies on healthcare systems, patient care, and medical decision-making, emphasizing system interoperability and user experience.							
UNIT-I	**Electrodes and Lead Systems**					**Periods:12**			
The origin of Bio-potentials; bio-potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics. Cardiac pace makers.									**CO1, CO5**
UNIT-II	**Measurements**					**Periods:12**			
Measurements-Blood flow meter, cardiac output, Respiratory rate, Blood pressure, temperature, pulse, Blood Cell Counters.									**CO1, CO5**
UNIT-III	**Medical Imaging Techniques**					**Periods:12**			
Computer assisted medical imaging-ultrasound imaging, ultrasonography-computed X-ray tomography, Nuclear Magnetic Resonance, Endoscopy, Angiography, Nuclear imaging techniques. Acoustic Radio Force Impulse imaging . Case study : Medical Diagnosis using any one type of imaging - segmentation, feature extraction and prediction.									**CO2, CO5**
UNIT-IV	**Medical Informatics**					**Periods:12**			
Introduction - Structure of Medical Informatics, Hospital management and information system, HMIS structure and functions. Medical data–Acquisition, Storage, Decision making. National standards in health informatics, Ethics, privacy and security in access. Bioinformatics. Data analytics in medical applications									**CO2-CO5**
UNIT-V	**Informatics–Present and the Future**					**Periods:12**			
Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation Telemedicine– Need, Materials and methods. Consumer health Informatics, Internet and medicine, Mobile technology for patients, clinicians and tracking habits–Electrical safety of patients. Role of Artificial Intelligence in medical applications.									**CO3-CO5**
Lecture Periods:45	**Tutorial Periods:15**		**Practical Periods:-**			**Total Periods: 60**			
Reference Books:									

1. Leslie Cromwell," Biomedical Instrumentation and Measurement", Prentice Hall of India, NewDelhi,2007.
2. John G.Webster," Medical Instrumentation Application and Design", Wiley India Edition,3rdEdition,2007.
3. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill,NewDelhi,2005.
4. Mohan Bansal, "Medical informatics",Tata Mcgraw Hill, NewDelhi,2003.
5. Khandpur,R.S,"Handbook of Biomedical Instrumentation",Tata McGraw Hill, NewDelhi,2003.

COURSE ARTICULATION MATRIX

Course: **ECUE104 Medical Electronics and Informatics**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	2	2
CO2	2	3	3	3	3	2	2	3	3	3	3	2	2
CO3	2	2	3	3	2	2	-	3	3	-	3	2	2
CO4	2	3	3	3	3	2	2	3	2	3	-	3	3
CO5	1	2	1	1	-	3	2	1	-	-	1	2	3

Professional Electives – II

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (ECE)**						
Semester : Sixth		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUE105	**Digital Image and Video Processing**	3	1	-	4	25	75	100
Prerequisite								
Course Outcome	**CO1**	Interpret the fundamentals of Image and Video processing						
	CO2	Demonstrate the understanding of different techniques for image and video enhancement and recovery						
	CO3	Acquire knowledge on image and video segmentation						
	CO4	Acquire knowledge of techniques for image and video compression						
	CO5	Apply the basics of image and video representation and description techniques						

UNIT-I	**Introduction to Digital image and video processing**	**Periods: 12**
Fundamental steps in image processing – Components of an image processing system-Image sensing and acquisition-Image formation model-Image sampling and quantisation-Representation of digital images-Types of images-Image interpolation-Fudamentals of Digital video-Digital video interpolation		CO1
UNIT-II	**Image and video enhancement and restoration**	**Periods: 12**
-Image Histogram, Linear Point and Nonlinear point operations on images, Arithmetic and Geometric image operation-Basic linear filtering and nonlinear filtering for image analysis and enhancement. Basics of video enhancement and restoration-Blur Models – Motion Estimation -Motion Models, Estimation Criteria , Search Strategies-		CO1, CO2
UNIT-III	**Image and video segmentation**	**Periods: 12**
Point, Line and edge detection –Thresholding- Region based segmentation - video segmentation - Change Detection, Spatiotemporal Change Detection, Motion Segmentation-semantic video segmentation		CO1, CO3
UNIT-IV	**Image and video compression**	**Periods: 12**
Basics of lossless nd Lossy image compression - Image compression models-Image formats and compression standards-Huffmann coding –Arithmetic coding – LZW coding –Run length coding –Bit plane coding Basics of video compression – video compression standards		CO1, CO4
UNIT-V	**Image representation and description**	**Periods: 12**
Boundary following –chain codes-Basics of boundary descriptors and regional descriptors –Basics of video descriptors		CO1, CO5

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Ed. Al Bovik , "Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Prentice Hall, 2008.

3. J. W. Woods, “Multidimensional Signal, Image and Video Processing and Coding”, 2nd Edition, Academic Press, 2011.
4. A. M. Tekalp, “Digital Video Processing”, 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, “Digital Image Processing”, 2nd Edition, Oxford University Press, 2016.

ECUE105 Digital Image and Video Processing

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	-							-	1
CO2	2	1	2	1								-	1
CO3	2	1	2	1								-	1
CO4	2	1	2	3								-	1
CO5	2	1	2	2	2	2						-	1
	2	1	2.2	1.4	0.4	0.4						-	1

<table>
<tr><td>Department</td><td colspan="2">ECE</td><td colspan="8">Programme: B.Tech.ECE</td></tr>
<tr><td>Semester :</td><td colspan="2">VI</td><td colspan="4">Course Category Code: PEC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="4">Hours/ Week</td><td colspan="4">Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">ECUE106</td><td rowspan="2">Antennas and Wave Propagation</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="10">Electromagnetic waves, Transmission lines and Waveguides</td></tr>
<tr><td></td><td colspan="10">Upon completion of the course, the students will be able to</td></tr>
<tr><td rowspan="4">Course Outcome</td><td>CO1</td><td colspan="9">Understand antennas principles, design, and applications, including analyzing radiation characteristics, simulating antenna prototypes, and examining antenna performance</td></tr>
<tr><td>CO2</td><td colspan="9">Design, analyze, and test various antenna types, understanding their applications in emerging fields</td></tr>
<tr><td>CO3</td><td colspan="9">Analyse pattern multiplication principle in array antennas</td></tr>
<tr><td>CO4</td><td colspan="9">Understand how radio signals travel, including factors affecting their behavior and propagation methods,</td></tr>
<tr><td>UNIT-I</td><td colspan="7">Fundamental of Radiation</td><td colspan="3">Periods: 12</td></tr>
<tr><td colspan="9">Radiation from Small Electric Dipole, Radiation from Quarter Wave Monopole and Half Wave Dipole- Near and Far fields – Antenna parameters-Gain, Directivity, Effective Aperture, Radiation resistance, Bandwidth, Beamwidth, Input impedance, Effective area, Antenna Noise Temperature- Folded Dipole antenna- Radiation from small loop antenna and its radiation resistance and large loop antenna- Helical antenna</td><td>CO1
CO2</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Aperture Antennas.</td><td colspan="4">Periods: 12</td></tr>
<tr><td colspan="9">Fields as sources of radiation-Horn antennas. Types-Babinet’s Principle-Corner reflector antenna-Parabolic reflector antenna–Geometry, Pattern Characteristics, Feed Methods, Reflector Types-Microstrip antennas. Lens Antennas –Geometry of Non-metallic Dielectric Lenses, Zoning, Applications,</td><td>CO1
CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Antenna arrays</td><td colspan="4">Periods: 12</td></tr>
</table>

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Array factorization. Array parameters. Broad side and end fire arrays. Yagi Uda arrays, Log-periodic arrays.			CO1 CO2 CO3
UNIT-IV	Special Antennas	Periods: 12	
Smart antennas for mobile communication- UWB Antenna-Antennas for bio medical applications-Diversity antennas-Wide band and Multiband antennas for wireless applications-reconfigurable antennas-Antennas for infrared detectors			CO1 CO2
UNIT-V	Radio wave propagation	Periods: 12	
Plane Earth Reflections, Ground Wave Propagation, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Super Refraction, Duct Propagation, Tropospheric Propagation.Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multihop Propagation.			CO1 CO4
Lecture Periods:45	Tutorial Period: 15	Practical Periods: - --	Total Periods:60

Text Books:

1. R.E.Collin, "Antennas and Radio Wave Propagation" McGraw-Hill
2. W.L. Stutzman & G.A. Thiele, "Antenna Theory and Design", Wiley

Reference Books:

1.K.F.Lee, "Principles of Antenna Theory", Wiley. 1984

2.J.R.James, P.S.Hall and C.Wood, "Microstrip Antenna Theory and Design", IEE 1981

3.C.A.Balanis, "Modern Antenna Handbook", Wiley India Pvt. Limited 2008

COURSE ARTICULATION MATRIX

Course: ECUE106 Antennas and Wave Propagation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	2	-	3	-	-	3	3	2	3	3
CO2	2	1	2	2	-	3	-	-	3	3	2	3	3
CO3	2	1	2	2	-	3	-	-	3	3	2	3	3
CO4	2	1	-	-	-	3	-	-	3	3	2	3	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (ECE)**						
Semester : **Sixth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUE107	**Satellite Communication Systems**	3	1	-	4	40	60	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the basic concepts of satellite communication.
	CO2 Analyze orbital mechanics and satellite earth communications.
	CO3 Design a satellite link for various orbits and capacity enhancement
	CO4 Acquire knowledge on different types of satellite access schemes.
	CO5 Demonstrate the understanding of optical satellites, microsatellites, nanosatellites and its applications.
	CO6 Analyze the recent trends and technologies of satellite communication.

UNIT-I	**Basic Concepts of Satellite Communication**	**Periods: 12**
Types of satellites- Satellite orbit- satellite constellation- orbital mechanics- equation of orbit-orbital elements look angles determination - limits of visibility - sub satellite point - spacecraft technology- structural, primary power, attitude and orbit control, thermal, propulsion, telemetry, tracking and command, communication and antenna subsystems – earth eclipse of satellite - sun transit outage- launching procedures and launch vehicles –In orbit test- emerging trends in mission control.		**CO1 CO2**
UNIT-II	**Orbital Mechanics and Satellite Link Attributes**	**Periods: 12**
Types of earth station- earth station design requirements-terrestrial interface, subsystems of earth station - receive and transmit chain, antenna systems –satellite ground communication equipment - system reliability and design life time. Basic transmission theory-satellite link attributes- combined uplink and down link model design, Link budget and Eb/No calculation. Performance impairments – system noise, inter modulation and interference – Propagation characteristics and frequency consideration.		**CO2, CO3**
UNIT-III	**Multiple Access Schemes**	**Periods: 12**
Satellite Access – Types - concepts - FDMA – pre assigned and demand assigned - inter modulation and backoff-SPADE system - TDMA - frame and burst structure- frame efficiency- channel capacity - satellite switch TDMASDMA-CDMA - DS & FH CDMA system- comparison of multiple access schemes.		**CO3, CO4**
UNIT-IV	**Optical Communication**	**Periods: 12**
Inter satellite links- frequency band- optical communication for satellite networks - optical sources and detectors-block diagram of optical satellite cross link- optical beam acquisition, tracking and pointing- satellite system for global mobile telecommunication system – architecture - frequency band allocation.		**CO5**
UNIT-V	**Future Trends and its Applications**	**Periods: 12**
Packet satellite networks and services, fixed satellite services, broadcast satellite services, mobile satellite services-VSAT- Radar SAT, global positioning satellite system - maritime satellite services, local broadband networks-ATM over satellite, IP over satellite, microsatellites, nanosatellites, CUBESAT, role of satellite infuture network.		**CO5, CO6**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Pritchend and Sciulli, "Satellite communication systems engineering", PHI Learning, 1986.
2. M. Richharia, "Satellite communication system design and analysis", McMillan Publishers, 1996.
3. Dennis Roddy, "Satellite Communications", Tata McGraw Hill, Fourth Edition, 2010.
4. Timothy Pratt, Charles Bostian, Jeremy Allnutt, "Satellite Communications", Wiley Second Edition.
5. Tri. T. HA, "Digital Satellite Communications", McGraw Hill, Second Edition.

COURSE ARTICULATION MATRIX

Course: ECUE107 **Satellite Communication Systems**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	1	1
CO2	2	3	3	3	3	-	-	-	2	-	1	3	2
CO3	3	3	3	3	3	-	-	-	2	-	1	3	2
CO4	2	-	1	-	-	-	-	-	-	-	1	1	1
CO5	1	-	-	-	-	-	-	-	-	-	-	1	1
CO6	2	1	1	2	2	-	-	-	-	-	1	1	1
ECUE107	1.83	1.17	1.33	1.33	1.33	-	-	-	0.67	-	0.67	1.67	1.33

ECUE108	**Microwave Integrated Circuit Design**	3	1	-	4	40	60	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Analyze the behavior of microwave components and lines using mathematical tools						
	CO2	Design various microwave IC transmission lines and passive components						
	CO3	Analyze the characteristics of active microwave devices using equivalent circuit						
	CO4	Design microwave oscillators and amplifiers for the given specifications						
	CO5	Demonstrate understanding of the various fabrication techniques of MMC's/ MMIC's						

UNIT-I	**Transmission Lines**	**Periods: 12**
Characteristics of conventional transmission structures, various planar transmission lines for MICs, comparison of various MIC transmission media. Design of stripline and microstrip transmission lines. Design of coupled striplines and microstrip lines. Stripline and microstrip discontinuity. Losses of microstrip lines and frequency effects. Review of scattering, ABCD, impedance and admittance matrices for two port networks.		**CO1, CO2**
UNIT-II	**Microwaves Integrated Circuits Components**	**Periods: 12**
Design of lumped elements, design of inductors, capacitors and resistors. Resonators: Resonator parameters, resonant frequency, quality factor, rectangular microstrip resonator. Hybrids and couplers: Basics of hybrids and couplers, types of hybrids and couplers, design of hybrids, directional couplers usingaperture coupled lines.		**CO1, CO2**
UNIT-III	**Active Microwave Devices**	**Periods: 12**
Microwave transistor, equivalent circuit .Basic operation principles of FET, MESFET model, power FETs. Introduction, equivalent circuit and figure of merit of schottky barrier junctions, varactor diodes, step recovery diodes and pin diodes.		**CO3**
UNIT-IV	**Microwave Semiconductor Sources and Amplifiers**	**Periods: 12**
Oscillators: Introduction, concept of negative resistance, three port S-parameter characterization of transistors, oscillation and stability conditions, design of fixed frequency oscillators. Amplifiers: Two port representation of transistor, stability consideration, amplifier characterization, Non-linear behavior, biasingnetworks, and linear amplifier design.		**CO1, CO3, CO4**
UNIT-V	**Fabrication of MMC's/MMIC's**	**Periods: 12**
Introduction, materials, mask layouts and mask fabrication, hybrid MIC, MMICs- design considerations,design procedures and MMIC fabrication. Hybrid versus MMICs .		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. K. C. Gupta, "Microwave Integrated circuit", John Wiley & Sons, 1984.
2. Samuel Y. Liao, "Microwave Devices & Circuits", Third Edition, Prentice Hall, 1990.
3. G.D.Vendelin, A.M.Pavio and U.L.Rohde, "Microwave circuits design using linear and non- linear techniques",John Wiley and Sons, 1990.
4. Ivan Kneppo, J. Fabian, P. Bezousek, "Microwave Integrated Circuits," Chapman & Hall, 1993.
5. Hoffman R.K "Handbook of microwave integrated circuits", Artech House, Bostan, 1987.

COURSE ARTICULATION MATRIX

Course: **ECUE108 Microwave Integrated Circuit Design**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	-	-	-	2	1
CO2	2	2	1	1	1	-	-	-	-	-	-	2	1
CO3	2	2	1	1	1	-	-	-	-	-	-	2	1
CO4	2	2	1	1	1	-	-	-	-	-	-	2	1
CO5	1	1	1	1	1	-	-	-	-	-	-	2	1

Professional Electives – III

Engineering									
Semester : **SEVENTH**			Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUE109	**Deep Learning**		3	1	-	4	40	60	100
Prerequisite	Knowledge in programming and Machine Learning								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Apply fundamental and advanced machine learning techniques to solve real-world classification, regression, and recognition problems.							
	CO2	Analyze the strengths and limitations of deep learning models in terms of generalization, optimization, and computational efficiency.							
	CO3	Design and implement neural network architectures using appropriate training strategies and							
	CO4	Evaluate and compare different dimensionality reduction and feature extraction techniques in the context of high-dimensional data.							
	CO5	Demonstrate the ability to interpret and apply state-of-the-art deep learning models in diverse application domains.							
UNIT-I	**Machine Learning and its Basic Concepts**					**Periods: 12**			
Introduction to machine learning- Linear models (SVMs and Perceptrons, Perceptron learning algorithm, Multi-layer Perceptrons (MLP), Representation of power MPLs, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.									**CO1, CO3**
UNIT-II	**Overview of Deep Learning**					**Periods: 12**			
History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.									**CO1, CO2**
UNIT-III	**Dimensionality Reduction Techniques**					**Periods: 12**			
Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.									**CO3, CO4**
UNIT-IV	**Optimization Methodologies**					**Periods: 12**			
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational &Artificial Neuroscience.									**CO2 CO3**
UNIT-V	**Case Studies and its Applications**					**Periods: 12**			
ImageNet- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection- Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions.									**CO1, CO5**
Lecture Periods: 45		**Tutorial Periods: 15**		**Practical Periods: -**			**Total Periods: 60**		

Reference Books:

1. Cosma Rohilla Shalizi, "Advanced Data Analysis from an Elementary Point of View", 2025.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2014.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

COURSE ARTICULATION MATRIX

Course: ECUE109 **Deep Learning**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	2	-
CO2	2	2	2	2	2	-	-	-	-	-	3	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3	-
CO4	2	1	1	2	2	-	-	-	-	-	-	-	2
CO5	1	2	2	2	1	3	3	3	3	3	3	3	-

Department: **Electronics and Communication Engineering**			Programme: **B.Tech(ECE).**						
Semester **:VII**			Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods/Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUE110	**Internet of Everything**		3	1	-	4	40	60	100
Prerequisite	-								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Describe the evolution, components, architecture, and ecosystem of the Internet of Everything (IoE).							
	CO2	Explain the working and selection of sensors, transducers, actuators, and their interfacing in IoE systems.							
	CO3	Analyse IoE protocols and access technologies at different network layers for optimized communication.							
	CO4	Apply data analytics techniques, edge computing, and application protocols in IoE for smart communication.							
	CO5	Demonstrate the implementation of IoE in real-world applications such as smart cities, healthcare, and Industry.							
	CO6	Evaluate the challenges and security requirements in the design and deployment of secure, scalable, and energy-efficient IoE systems.							
UNIT-I	**IoE Introduction and Fundamentals**					**Periods:12**			
Evolution of Internet of Everything-Benefits/Challenges of deploying an IoE, IoE components: Digital Signal Processing, Data transmission, Choice of channel (wired/wireless), back-end data analytics. IoE Architectures: IoT - A, IoT - RA, IoE and AI- Fog, Edge and Cloud in IoE – Functional blocks of an IoE Ecosystem									**CO1 CO4**
UNIT-II	**Signals, Sensors, Actuators and Interfaces**					**Periods:12**			
Introduction to sensors and transducers, Introduction to electrodes and biosensors, Different types of sensors, Selection criteria for sensors / transducers, Signal conditioning modules of IoE system, Energy and power considerations, Introduction to actuators, Different types of actuators, Interfacing challenges, Modules of data acquisition system.									**CO2**
UNIT-III	**IoE Protocols**					**Periods:12**			
IoE Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e,1901.2a,802.11 ah and LoRa WAN Network Layer: IP Versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks Application Transport Methods: Supervisory Control and Data Acquisition.									**CO3 CO4 CO5**
UNIT-IV	**IoE Data analytics and Edge Computing**					**Periods:12**			
Data analytics**,** Communication Models, Data Exchange Formats, Application Layer - MQTT and CoAP Protocol, RESTFul Architecture, HTTP REST Model,, IoT security, Gateway Design & Characteristics, Principles of Edge Computing and IoT platforms & IoT in Machine Learning Applications									**CO3 CO4 CO5**
UNIT-V	**IoE Applications**					**Periods:12**			

Smart Lighting-Smart Parking – Smart Traffic Control- Home Intrusion Detection-Smart Grids- Smart Payments-Smart Irrigation-Health and Fitness Monitoring-Industry 5.0.	**CO3 CO5 CO6**

Lecture Periods:45	**Tutorial Periods:15 -**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grosse tete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press,2017.
2. B.K.Tripathy and J.Anuradha, "Internet of Things– Technologies, Applications, Challenges and Solutions", Taylor& Francis, CRC Press, 2018.
3. Qusay F.Hassan, Attaur RehmanKhan, Sajjad A.Madani, "Internet of Things Challenges, Advances, and Applications", Taylor & Francis, CRCPress,2017.

Course: **ECUE110 Internet of Everything**

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	2	-	-	3	3
CO2	2	3	2	1	-	-	-	-	-	-	-	-	1	1
CO3	2	3	1	1	-	-	-	-	-	-	-	-	1	2
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO5	3	1	2	2	-	-	-	-	2	2	-	-	1	2
CO6	2	2	2	3	2	-	2	1	3	3	-	-	2	3
	2.17	2.2	1.6	1.6	2	-	2	1	2.5	2.33	-	-	1.67	2.2

Score: 3 – High; 2 – Medium; 1 – Low

Department : ECE		Programme: **B.Tech.**						
Semester :VII		Course Category Code: PEC				Semester Exam Type:		
Course Code	Course Name:	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUE111	Advanced Mobile Communication	3	1		4	40	60	100
Prerequisite:	Digital communication							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	To gain knowledge of the principles of mobile communication systems, and the evolution from 1G to advanced systems like 5G.						
	CO2	To gain insights about the underling technologies in the 5G network design.						
	CO3	To apply the principles of artificial intelligence techniques in the design of 5G radio technologies.						
	CO4	To analyse the vision of 5G in the development of developing countries and providing creative solutions to improve the quality of life in rural areas of the country.						
UNIT-I	**Mobile communication standards**				**Periods: 12**			
Digital radio systems, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000, 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates, IMT Advanced, 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+), IMT2020, enhancements in comparison to IMT Advanced.								**CO-1**
UNIT-II	**Introduction to 5G Communication**				**Periods: 12**			
Building Blocks of 5G, 5GArchitecture, 5G for IoT Applications ,5G potential and applications, Usage scenarios, enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications, Spectrum for 5G, spectrum access/sharing, millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity..								**CO-1, CO2**
UNIT-III	**5G Network technologies**				**Periods: 12**			
New Radio (NR), Standalone and non-standalone mode, non-orthogonal multiple access (NOMA), massive MIMO, beam formation, PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC); Introduction to software defined networking (SDN), network function virtualization (NFV), network slicing; restful API for service-based interface, private networks.								**CO-2,CO3**
UNIT-IV	**5G use cases**				**Periods: 12**			
MTC, D2D Communication, Multihop D2D, Multi-carrier D2D: Machine-type communications: Fundamental techniques for MTC – Massive MTC – Ultra-reliable low-latency MTC – Device-to-device (D2D) communications – Multi-hop D2D communications – Multi-operator D2D communication – Simulation methodology: Evaluation methodology –								**CO3, CO4**

Department : **Electronics and Communication Engineering**	Programme : **B.Tech. (ECE)**	

Calibration, New challenges in the 5G modelling, Case study : Design of 5g mobile network scenario.

UNIT-V	**Current state of 5G and Challenges ahead**	**Periods: 12**	
Vision of 5G to the development of socio-economic standards of a country. 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, large cell usage, LMLC, possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV.			**CO4**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1.Harri Holma, Antti Toskala, LTE for UMTS: Evolution to LTE-Advanced, John Wiley and Sons, 2011
2. 5G Technology Evolution Recommendations, 4G Americas, 2015
3. 5G Mobile and Wireless Communications Technology, Afif Osseiran, Jose F. Monserrat, Patrick Marsch Cambridge University Press , Second Edition , 2011
4. 5G NR: The Next Generation Wireless Access Technology, Erik Dahlman, Stefan Parkvall, Johan Sko¨ld Elsevier, First Edition, 2016
5. Fundamentals of 5G Mobile Networks Jonathan Rodriguez Wiley First Edition ,2010
Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson
6. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGraw Hill Education , 1995
7. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.
8. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson
9. An Introduction to 5G Wireless Networks : Technology, Concepts and Use-cases, Saro Velrajan,Notion press, 2020.

CO-PO MAPPING

ECUE111 Advanced Mobile Communication

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	1	-	2	2	-	1	1	2	3	
CO2	2	2	3	1	-	-	-	-	1	1	2	3	
CO3	3	3	1	2	1	2	2	-	1	1	1	3	
CO4	3	3	3	2	1	-	-	-	1	1	1	3	

Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**				**Total Periods: 45**		
ECUE112	**Cognitive Radio Networks**	3	1	-	4	40	60	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Evaluate cognitive radio system performance using knowledge of propagation, spectrum, and protocols.						
	CO2	Design cognitive radio networks integrating channel models, modulation, and architecture.						
	CO3	Analyze regulatory, hardware, and security aspects in cognitive radio solutions.						
	CO4	Apply signal processing and system design to optimize spectrum use and reduce interference.						
	CO5	Solve problems by integrating concepts from propagation, communication, and networking.						

UNIT-I	**Cognitive Radio Technology**	**Periods: 12**
Introduction - Software-Defined Radio - Cognitive Radio – Spectrum policy - Applications of cognitive radio -Cognitive radio network design - Hardware and system design considerations - Spectrum coexistence – Standardization - Cognitive radio network paradigms -performance limits of wireless networks - Interference channels.		**CO1, CO3, CO5**
UNIT-II	**Propagation Issues for Cognitive Radio**	**Periods: 12**
Introduction - Generic channel response - path loss - Path loss models - Small-scale fading and the Rician*K*-factor - Small-scale fading and the Doppler spectrum - Delay dispersion - Angle dispersion – Polarization - Special environments - key model parameters.		**CO1, CO2, CO4, CO5**
UNIT-III	**Spectrum Management**	**Periods: 12**
Spectrum sensing and identification - Introduction - Primary Signal Detection - Detecting Spectrum Opportunities - Trade-offs - Spectrum access and sharing – Introduction - Unlicensed Spectrum Sharing - Licensed Spectrum Sharing - Secondary Spectrum Access - Non-Real-Time SSA - Real-Time SSA – Dynamic Spectrum access – water filling – game theory.		**CO1, CO2, CO4, CO5**
UNIT-IV	**Cognitive Radio Communication Techniques**	**Periods: 12**
Radio frequency spectrum and regulation – Spectrum - Emerging Regulatory Challenges and Actions - Regulatory Issues of Cognitive Access - Digital communication fundamentals for cognitive radio – Introduction - Data Transmission - Digital Modulation Techniques - Probability of Bit Error - Multicarrier Modulation - Multicarrier Equalization Techniques - Intersymbol Interference – Pulse shaping -Agile transmission techniques.		**CO2-CO5**
UNIT-V	**Cognitive Radio Network Architectures and Security**	**Periods: 12**
Fundamentals of communication networks – Architecture and Building Blocks - New Challenges in Wireless Networks - Mobility Modeling - Power Control and Multiuser Diversity - Multiple Access Schemes - Routing,Energy Efficiency, Network Lifetime Congestion Control. Cognitive Radio Network Architectures - Topology-Aware CRN Architectures - Publish-Subscribe CRN Architecture Cognitive radio network security – Introduction - Primary-User Emulation Attacks- Security Vulnerabilities in IEEE 802.22 - Security Threats to the Radio Software.		**CO1, CO2, CO3, CO5**

Reference Books:

1. Biglieri, E., Goldsmith, A. J., Greenstein, L. J., Mandayam, N. B., & Poor, H. V., Principles of Cognitive Radio, Cambridge University Press, 2012.
2. Wyglinski, A. M., Nekovee, M., & Hou, Y. T., Cognitive Radio Communications and Networks: Principles and Practice, Academic Press, 2009.
3. Fette, B. A., Cognitive Radio Technology, 2nd ed., Elsevier, 2009.
4. Zhang, Y., Zheng, J., & Chen, H., Cognitive Radio Networks: Architectures, Protocols, and Standards, CRC Press, 2019.

ECUE112 Cognitive Radio Networks

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	3	3	3	3	3	3	1	3	1	3
CO2	2	3	3	3	3	3	3	3	3	1	3	1	3
CO3	2	3	3	3	3	3	3	3	3	1	3	1	3
CO4	3	3	3	3	3	3	3	3	3	2	3	1	3
CO5	1	3	3	3	3	3	3	3	3	3	3	1	3

Syllabi of the *Ancillary Stream Elective courses* offered by the Electronics and Communication Engineering Department and syllabi of the courses offered by the Electronics and Communication Engineering Department in the B. Tech programmes of other departments

Ancillary Stream 1: **Applied Electronics**

(*For all branches except ECE*)

Department : ECE			Programme: **B.Tech.**						
Semester :IV			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUN101	Analog and Digital Electronics		3	-	-	3	40	60	100
Prerequisite:	NIL								
	Upon completion of the course, the students will be able to								
Course Outcome	**CO1**	Understanding the basic theory of semiconductors and diodes.							
	CO2	Knowledge about various transistor configurations and also could comprehend the need for proper biasing of devices.							
	CO3	Understanding the operation of Field Effect Transistor devices.							
	CO4	Develop and implement the Boolean expressions of simple combinational circuits.							
	CO5	Demonstrate the understanding of basic combinational and sequential circuits.							
	CO6	Realize digital circuits using PLDs.							
UNIT-I	**Semiconductor Fundamentals and PN Junction Diode**					**Periods: 9**			
Introduction to semiconductors-Types of Semiconductors-Energy band diagram of semiconductor-Diode equivalent circuit- Diode Construction, working and VI characteristics of PN Junction diode. Energy band structure of open circuited PN junction-Effect of temperature on PN junction diodes- Types of breakdown-Zener diode-Application of diode as half wave, full wave and bridge rectifiers. Regulators-Zener diode as voltage regulator.									**CO1**
UNIT-II	**Bipolar Junction Transistor**					**Periods: 9**			
Construction-Types of configurations: Operation of NPN and PNP transistors-working and characteristics of CE, CB and CC configurations- Early effect -Thermal runaway -Heat sinks -Need for transistor biasing-dc load line- Q point- Application of BJT as amplifier and switch.									**CO2**
UNIT-III	**Field Effect Transistor**					**Periods: 9**			
Types – Construction and operation of N-channel and P-channel JFET – characteristics and parameters of JFET-JFET biasing circuits- fixed bias and potential divider bias (derivations not required) Construction, working and characteristics of E-MOSFET and Depletion MOSFET									**CO3**
UNIT-IV	**Boolean Algebra and Combinational Logic**					**Periods: 9**			
Boolean algebra – Basic operations – Basic Theorems – Boolean functions-Canonical forms – Simplification ofBoolean functions-Karnaugh maps – Tabulation method. Adders – subtractors – code converters – binaryparallel adder –decimal adder – magnitude comparator – encoders – decoders – multiplexers – de-multiplexers.									**CO4, CO5**
UNIT-V	**Sequential Circuits and Memory**					**Periods: 9**			
Sequential Circuits –latches – flip flops –Registers and Counters: Registers – shift registers – ripple counters –synchronous counters. Random access memory – memory decoding – Read only memory –Programmable Logic Array – Programmable Array Logic.									**CO5, CO6**
Lecture Periods: 45	**Tutorial Periods:**		**Practical Periods:-**			**Total Periods: 45**			
Reference Books:									
1. J.Millman,C.Halkias and Satyabrata, ”Electronic devices and Circuits” ,Thirdedition,McGraw									

Hill,2010.
2. Robert L.Boylestead and Louis Nashelsky, “Electron Devices and Circuits Theory”,Prentice Hall of India,11th Edition,2013.
3. David A.Bell,”Electronic Devices and Circuits”,Prentice Hall of India, 5th Edition, 2008.
4. M. Morris Mano and Michael D. Ciletti, “Digital Systems: With an Introduction to the Verilog HDL”, Fifth Edition, Prentice Hall of India, 2012.
5. Thomas L. Floyd and R.P. Jain, “Digital Fundamentals”, Pearson Education, Tenth edition, 2008.
6. Leach Malvino, “Digital Principles and Applications”, Tata McGraw Hill, Fifth edition, 2005.

CO-PO Mapping

ECUN101 Analog and Digital Electronics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	2	-	-	-	1	-	1	1	-
CO2	3	2	2	3	2	-	-	-	1	-	1	1	-
CO3	3	2	2	3	2	-	-	-	1	-	1	1	-
CO4	2	3	3	3	2	-	-	-	2	-	1	2	2
CO5	2	3	3	3	2	-	-	-	2	-	1	2	2
CO6	2	3	3	3	2	-	-	-	2	-	1	2	2

Score: 3 – High; 2 – Medium; 1 – Low

Department :Electronics and Communication Engineering		Programme :B.Tech.						
Semester :V		Course Category Code: **ANC**				Semester Exam Type: **TY**		
Course Code	**Course**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECUN102	**Consumer Electronics**	3	-	-	3	40	60	100
Prerequisite	-							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Introduce basics of Modern Consumer Entertainment Electronics						
	CO2	Examine on various Domestic Appliances						
	CO3	Elucidates Smart Home Sensors						
	CO4	Gain knowledge on Smart OS Communications						
UNIT – I	**Audio Entertainment Systems**					**Hours: 9**		
Audio systems: Construction and working principle of: Microphone, Loud speaker, AM and FM receiver, stereo, Home theatre.								**CO1**
UNIT – II	**Video Entertainment Systems**					**Hours: 9**		
Display systems: CRT, LCD, LED and Graphics displays Video Players: DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.								**CO1**
UNIT – III	**Modern Home Appliances**					**Hours: 9**		
Home Enablement Systems: RFID Home, lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave Oven, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart floor, Smart locks.								**CO2**
UNIT – IV	**Smart Home Sensors**					**Hours: 9**		
Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.								**CO3**
UNIT – V	**Smart OS Communications**					**Hours: 9**		
Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems. Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches.								**CO4**
Lecture Hours: 45	**Tutorial Hours: -**	**Practical Hours: -**			**Total Hours: 45**			

Reference Books:

1. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2019.
2. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2021.
3. Philp Hoff "Consumer Electronics for Engineers" - Cambridge University Press.2008.
4. Jordan Frith, "Smartphones as Locative Media ", Wiley. 2014.
5. Dennis C Brewer, "Home Automation", Que Publishing 2013.
6. Nick vandome, Smart homes in easy steps, - Master smart technology for your home 2018.

COURSEARTICULATIONMATRIX

Course: ECUN102 **Consumer Electronics**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	3	-	-	1	-	--	--	--	--	2	1
CO2	2	-	3	-	-	1	-	-	-	-	-	2	1
CO3	2	-	3	-	-	1	-	-	-	-	-	2	1
CO4	2	-	3	-	-	1	-	-	-	-	-	2	1
ECUN102	2	-	3	-	-	1	-	-	-	-	-	2	1

Department : ECE			Programme: **B.Tech.**						
Semester : VI			Course Category Code: ANC				Semester Exam Type:		
Course Code	**Course**		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUN103	Medical Electronics		3	-	-	3	40	60	100
Prerequisite:	Basics of Electronic devices and circuits								
	Upon completion of the course, the students will be able to								
Course Outcome	**CO1**	Understand the origin and nature of bio-potentials, and apply the eletronics in the working principles of electrodes, lead systems, and biological signal acquisition techniques such as ECG, EEG, and EMG.							
	CO2	Analyze various biomedical measurement systems used for monitoring physiological parameters such as blood pressure, cardiac output, respiratory rate, and temperature.							
	CO3	To understand the principles and applications of computer-assisted medical imaging modalities including ultrasound, CT, MRI, and nuclear imaging, along with assistive medical devices such as pacemakers and dialysis machines.							
	CO4	To analyse and create awareness of recent trends in medical electronics including virtual reality in healthcare, telemedicine, mobile health technologies, and assistive technologies for elderly and differently-abled individuals.							
UNIT-I	**ELECTRODES AND LEAD SYSTEMS**					**Periods: 9**			
The origin of Bio-potentials; bio-potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics. Electrical safety of patients.									**CO1**
UNIT-II	**BIO-MEDICAL MEASUREMENTS**					**Periods: 9**			
Measurements - Blood flow meter, cardiac output, Respiratory rate, Blood pressure, temperature, pulse, Blood Cell Counters,									**CO2**
UNIT-III	**Medical Imaging Techniques**					**Periods: 9**			
Computer assisted medical imaging- ultrasound imaging,-computed X-ray tomography, Magnetic Resonance Imaging, Endoscopy, Angiography, Nuclear imaging techniques.									**CO3**
UNIT-IV	**Assistive devices**					**Periods: 9**			
Cardiac pacemakers, DC Defibrillator, Dialyser, Radio pill, Hearing Aids , Visual Aids, Augmentative and Alternative Communication (AAC). Assistive technologies for old page peoples.									**CO3**
UNIT-V	**Recent advances in medical electronics**					**Periods: 9**			
Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation Telemedicine – Need, Materials and methods. Internet and medicine, Mobile technology forpatients, clinicians and tracking habits.									**CO4**

Lecture Periods: 45	Tutorial Periods:	Practical Periods:	Total Periods: 45

Reference Books:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. John G.Webster, "Medical Instrumentation Application and Design", Wiley India Edition, 3rd Edition,2007.
3. D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill, New Delhi, 2005.
4. Khandpur, R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

5.Electronics, Biomedical Engineering, and Health Informatics (3rd edition) (Scientific Books Collection, Volume 57, 2023.

CO-PO Mapping

ECUN103 Medical Electronics

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	3	
CO2	3	3	2	2	-	2	-	-	-	-	-	3	
CO3	3	2	1	-	-	-	-	-	-	-	-	1	
CO4	3	2	3	2	-	3	2	-	2	-	1	3	1

Score: 3 – High; 2 – Medium; 1 – Low

Department : **Electronics and Communication Engineering**		Programme: **B.Tech**						
Semester : : VII		Course Category Code: ANC				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUN104	**Embedded System**	3	-	-	3	40	60	100
Prerequisite:	-							
Course Outcome	**CO1**	Understand the concept of embedded system and its architectural features.						
	CO2	Develop embedded software using Embedded C and Python.						
	CO3	Construct real world signals using suitable data converters for control applications.						
	CO4	Use the power of RTOS for embedded applications.						
	CO5	Apprehend the various concepts in Multi-Tasking.						
	CO6	Design embedded systems with the right choice of microcontroller and the associated peripherals for a given embedded application.						
UNIT-I	**Introduction to Embedded Systems**				**Periods: 9**			
Embedded system- Definition, Categories, Requirements. Challenges and issues in embedded software development, Trends in embedded software development, Applications of embedded systems. Hardware Architecture – CISC, RISC - Introduction to ARM - LPC4088 Architecture.								**CO1, CO2**
UNIT-II	**Communication Interfaces**				**Periods: 9**			
Wired Communication protocols:- Serial communication interface:- RS232, I2C, CAN and USB - Parallel communication interface - IEE 488 - Wireless communication protocols: - Bluetooth classic, BLE, IEEE 802.15.4, Zigbee, IEEE 802.11 and LoRaWAN.								**CO3, CO6**
UNIT-III	**Real Time Operating System**				**Periods: 9**			
RTOS vs General purpose OS, Kernel Architecture and Functions of RTOS - Task, process and Threads, Interrupt handling, Multiprocessing & Multitasking - Context Switching , Inter-process Communication (Shared Memory, Mail Box, Message Queue), Inter Task Synchronization – Resource Management (Semaphore, Mutex), Dead Lock, Priority Inversion and Task scheduling – Rate monotonic and Earliest Deadline first scheduling.								**CO4, CO5**

UNIT-IV	Embedded Programming and Peripheral Interfacing	Periods: 9	
Embedded C and Python Programming for Embedded Applications - Input and output devices Interface, ADC Interface - DAC Interface - PWM Generation - sensor Interface.			**CO2, CO3, CO6**
UNIT-V	**Applications of Embedded Systems**	**Periods: 9**	
Introduction to embedded system applications using case studies – Role in agricultural sector, Automotive electronics, Consumer electronics, Industrial controls and Medical electronics.			**CO3, CO6**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TataMcgraw Hill,2011.
2. David.E. Simon, "An Embedded Software primer", Pearson Education Inc., 2012.
3. Tammy Noergaard, "Embedded systems architecture: a comprehensive guide for engineers and programmers" Berlin: Elsevier, 2014.
4. Peckol, "Embedded System Design", John Wiley,2010.
5. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
6. Shibu.k.v, "Introduction to Embedded Systems", TataMcgraw Hill, 2009

Ancillary Stream 2:

Communication Systems and Networks

(For all branches except ECE)

Department :Electronics and Communication Engineering		Programme:B.Tech.						
Semester :IV		Course Category Code:ANC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUN105	Analog and Digital Communication	3	-	-	3	40	60	100
Prerequisite	-							
	Upon completion of the course, the students will be able to							
Course Outcome	CO1	Understand the fundamentals and characteristics of Amplitude Modulation and Angle Modulation Systems.						
	CO2	Demonstrate the understanding of transmitters and receivers						
	CO3	Demonstrate the understanding of Baseband Modulation Systems						
	CO4	Analyze digital modulation systems						

UNIT – I	Amplitude Modulation Systems	Hours: 9
Need for Modulation - Amplitude Modulation - Spectra and Power Equations for AM - Generation and Demodulation of AM, DSBSC, SSB and VSB Signals-Principle of FDM.		CO1
UNIT – II	**Angle Modulation Systems**	**Hours: 9**
Frequency and Phase Modulation - Narrow band and Wideband FM- Transmission Bandwidth - Generation and Demodulation of FM Signal-Operation of FM receivers.		CO1
UNIT – III	**Transmitter sand Receivers**	**Hours: 9**
Low level and high level AM transmitters – FM transmitter – Super heterodyne AM receiver – Receiver characteristics - Communication receiver – Diversity reception – FM receivers.		CO2
UNIT – IV	**Baseband Modulation Systems**	**Hours: 9**
Sampling Theorem, Basics of PAM, PWM and PPM, Base Band transmission - Wave form representation of Binary Digits - PCM, DPCM, DM and ADM systems-Principle of TDM.		CO3
UNIT – V	**Digital Modulation Systems**	**Hours: 9**
Transmitter and Receiver of Coherent BASK,BPSK, BFSK, QPSK, QAM and MSK systems -Principle and Operation of DPSK and Non coherent FSK-Need for Synchronization.		CO4

Lecture Hours: 45	Tutorial Hours:-	PracticalHours:-	Total Hours: 45

Reference Books:

1. George Kennedy, Bernard Davis and S.R.M. Prasanna, “Electronic Communication systems”, Mc. Graw Hill Education (India) Private Limited, Seventh edition, 2022.
2. D.Roddy and Coolen, Electronic Communications, Fourth edition, Pearson Education, 2008.
3. Simon Haykin and Michael Moher “Communication Systems”, John Wiley & Sons, New York, Fifth Edition, 2009.

4. Bernard Sklar and Pabitra Kumar Ray, “Digital Communication”, Pearson, Second Edition, 2009.
5. Wayne Tomasi, “ Electronic Communication Systems”, Pearson Education, Sixth edition, 2015.

COURSEARTICULATION MATRIX

Course: ECUN105 **Analog and Digital Communication**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	1	-	--	--	--	1	2	3
CO2	3	3	2	-	-	1	-	-	-	-	1	2	3
CO3	3	3	2	-	-	1	-	-	-	-	1	2	3
CO4	3	3	2	-	-	1	-	-	-	-	1	2	3
ECUN105	3	3	2	-	-	1	-	-	-	-	1	2	3

Department : ECE				**Programme :**B.Tech				
Semester :V				**Course Category Code: ANC**				
Course Code	**Course**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECUN106	**Communication Technologies**	3		0		40	60	100
Prerequisite	Nil							
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Demonstrate understanding of the principle of operation and building blocks of various communication systems						
	CO2	Demonstrate understanding of the different transmission channels						
	CO3	Analyse power budgeting of different communication links						
	CO4	Demonstrate understanding of the spread spectrum and Multiple-access techniques						
	CO5	Demonstrate understanding of the concepts, use and significance of Computer networks						

UNIT – I	**Satellite Communication systems**	**Hours: 9**	
Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model and link budget calculations, satellites used for mobile networks and personal communication systems-GPS services.			**CO1, CO2, CO3**
UNIT – II	**Spread Spectrum Communication**	**Hours: 9**	
Introduction-PN sequences-Direct sequence spread spectrum systems- Frequency hopping spread spectrum systems- slow and fast frequency hopping- RAKE receivers-principle of code division multiple access-applications.			**CO4**
UNIT – III	**Cellular Mobile Communication concepts**	**Hours: 9**	
Basic cellular concept-frequency reuse-interference-uniqueness of mobile radio environment - Performance metrics in cellular system-Elements of cellular mobile radio-Handoff- Frequency management and channel assignment-concepts of cell splitting and cell sectoring.			**CO1, CO2**
UNIT – IV	**Data Networks**	**Hours: 9**	
Introduction to Computer networks - Uses of computer networks, social issues, Network hardware - Personal Area Networks, Local Area Networks, Wireless LANs, Metropolitan Area Networks, Wide Area Networks, and Internetworks, Network software - Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented Versus Connectionless Service, Service Primitives, The Relationship of Services to Protocols, Reference Models - The OSI Reference Model and The TCP/IP Reference Model, The Internet, Network Standardization			**CO5**
UNIT – V	**Optical fibre Communication Systems**	**Hours: 9**	
Need for fiber optics, introduction to optical fiber, principle of light transmission through a fiber, fiber characteristics and classification, various fiber losses– Light sources and photo detectors -Block diagram of fiber optic system- Power budget analysis for an optical link-Recent applications of fiber optics.			**CO1, CO2, CO3**

Lecture Hours: 45	**Tutorial Hours:**	**Practical Hours:**	**Total Hours: 45**

Reference Books:

1. D. Roddy, Satellite Communications, Tata Mc GrawHill, Fourth Edition, 2009.
2. T.S.Rappaport,WirelessCommunication,Pearsoneducation,secondedition,2010
3. Simon Haykin, Communication Systems, Fourth edition, Wiley, 2013
4. A.S.Tanenbaum, D.J. Wetheral, Computer Networks, Fifth edition, Prentice Hall, 2011.
4. Gerd Keiser, Optical fiber Communications, McGrawHill, Fifth edition, 2013.
5. T.Prattand,C.W.Bostain,SatelliteCommunication,JohnWileyandSons,Secondedition,2006
6. Wayne Tomasi, " Electronic Communication systems", Pearson

COURSEARTICULATIONMATRIX

Course: **ECUN106 Communication Technologies**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	2	1
CO2	2	1	1	1	-	-	-	-	-	-	-	2	1
CO3	2	2	1	1	1	-	-	-	-	-	-	2	1
CO4	2	1	1	1	-	-	-	-	-	-	-	2	1
CO5	2	1	1	1	-	2	-	-	-	-	-	2	1

Department :Electronics and Communication Engineering		Programme :B.Tech.						
Semester :VI		Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUN107	Wireless Communication Networks	3	-	-	3	40	60	100
Prerequisite	-							
	Upon completion of the course, the students will be able to							
Course Outcome	CO1	Outline the evolution of technological trends in Cellular Wireless and Short Range Radio Access Networks.						
	CO2	Understand the concepts and Characteristics of Wireless Propagation Channels.						
	CO3	Identify suitable architecture for advanced applications.						
	CO4	Explore the avenues for Smart Health Applications						
UNIT – I	Cellular Wireless Networks				Hours: 9			
Principles of cellular network, First, second, third, fourth and fifth generation wireless systems and protocols. Mobile IP and Wireless access Protocol.								CO1
UNIT – II	Short Range Radio Access Networks				Hours: 9			
Architecture of WiFi, Bluetooth, ZigBee. Ultra wideband, Cordless systems – DECT, Infra-Red transmission, Wireless Sensor networks, 6Lowpan, Adhoc and Sensor Networks.								CO1
UNIT – III	Wireless Propagation Channels (Qualitative Treatment only)				Hours: 9			
Free space propagation model- basic propagation mechanisms –reflection- ground reflection model diffraction-scattering-outdoor and indoor propagation models. Large and Small scale multipath propagation small scale multipath measurements –parameters of mobile multipath channels - Types of small scale fading.								CO2
UNIT – IV	Advanced Technologies				Hours: 9			
Evolution of 5G and 6G Technologies,IEEE802.16 family networks, Software Defined Radio, IoT and IoE, Smart Grid Technology.								CO3
UNIT – V	Smart Health Applications				Hours: 9			
Smart Health care, smart health vs ubiquitous health- smart health applications, vision for smart health. Wearable Wireless Vital Monitoring Technology for Smart Health Care- Introduction to WBAN–its applications- types of devices used-challenges in WBAN- research issues in WBAN design.								CO4
Lecture Hours: 45	Tutorial Hours: -	Practical Hours: -			Total Hours: 45			

Reference Books:

1. William Stallings, “Wireless Communications and Networks”, Prentice Hall, Second Edition, 2005.
2. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Pearson Education, Second Edition, 2024.
3. T. L. Singal, “Wireless Communications”, Tata McGraw-Hill education, 2010.

4. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 08-Aug-2005.
5. P.Muthuchidambaranathan, “Wireless Communication”, PHI Learning, 2008.

COURSEARTICULATIONMATRIX

Course: ECUN107 **Wireless Communication Networks**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	2	-	-	1	-	--	--	--	1	2	3
CO2	2	2	2	-	-	1	-	-	-	-	1	2	3
CO3	2	-	2	-	-	1	-	-	-	-	1	2	3
CO4	2	-	2	-	-	1	-	-	-	-	1	2	3
	2	-	2	-	-	1	-	-	-	-	1	2	3

Department : ECE		Programme :B.Tech						
Semester : VII		Course Category Code:ANC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUN108	Industrial IoT	3		-	3	40	60	100
Prerequisite								
Course Outcome	CO1 - **Fundamentals of Industrial IoT (IIoT),** differentiate between IoT and IIoT, and describe its components, trends, challenges, and benefits.							
	CO2 – **Analyze and compare various IIoT architectures,** components, and their roles in building an effective IIoT system.							
	CO3 - **Apply analytics and programming tools like R, Julia, and Hadoop** for data visualization, statistical analysis, and big data management in IIoT environments.							
	CO4 – **Evaluate security risks and privacy challenges** in IIoT systems and propose appropriate solutions using modern security models and governance techniques.							
	CO5- **Interpret and assess real-world IIoT case studies** across different industries and demonstrate how IIoT enhances automation and monitoring.							
UNIT – I	**Introduction Industrial IoT**					**Hours: 9**		
Introduction to Industrial IoT(IIoT), IoT vs. IIoT, History of IIoT, Components of IIoT - Sensors, Interface, Networks, People &Process, Hype cycle, IIoT Market, Trends& future. Real life examples: Mining &Manipulation; Role of IIoT in Manufacturing Processes, Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools, Challenges & Benefits in implementing IIoT								CO1
UNIT – II	**IIoT ARCHITECTURES**					**Hours: 9**		
Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration Business Model and Reference Architecture: IIoT- Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.								CO2, CO3
UNIT – III	**IIoT ANALYTICS**					**Hours: 9**		
IoT Analytics: Role of Analytics in IoT, IoT Platform, Interfaces, API, clouds, Data Management Analytics. Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Data Management with Hadoop, Fog computing in IIoT, Cloud computing in IIoT.								CO3, CO5
UNIT – IV	**IIoT Privacy, Security and Governance**					**Hours: 9**		
Introduction to web security, Conventional web technology and relationship with IIoT, Vulnerabilities of IoT & IIoT, Security model for IoT. Security in IIoT: Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message								CO4, CO5

integrity, Non-repudiation and availability, Management aspects of cyber security.				
UNIT – V	**IIoT CASE STUDY**		**Hours: 9**	
Real case studies of Industrial IoT- Application Domains: Oil, Chemical and Pharmaceutical industry, Plant Automation, City Automation, Automotive Applications, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Sector, energy, healthcare, logistics and agriculture				CO5
Lecture Hours: 45	**Tutorial Hours:**	**Practical Hours: -**	**Total Hours: 45**	

Reference Books:

1. Sudip Misra,Chandana Roy,Anadarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0,CRC Press, 2021
2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017
3. Giacomo Veneri,Antonio Capasso, Hands on Industrial Internet of Things, , Packt Press, 2018.
4. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
5. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems ,Springer, 2017
6. Giacomo Veneri, Antonio Capasso, Hands-On Industrial Internet of Things: Create a powerful Industrial IoT , Packt press, 2018.

ECUN108 Industrial IoT

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	3	1
CO2	3	3	3	3	2	-	-	-	-	-	-	2	3	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	1
CO4	3	3	3	3	2	-	-	-	-	-	-	2	3	1
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	1
CO6	2	2	2	2	2	-	-	-	-	-	-	2	3	1
	2.66	2.66	2.66	2.66	2	-	-	-	-	-	-	2	3	1

Ancillary Stream 3:

Sensors and computing Technologies (only For ECE students)

Department: **Electronics and Communication Engineering**		Programme :**B.TECH(ECE)**						
Semester IV		Course Category Code: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUI101	**Principles of Sensors and Actuators**	3	-	-	3	40	60	100
Prerequisite	Electronic Devices							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Understand the fundamentals of measurement systems and sensors						
	CO2	Analyze the principles and applications of various sensors and select appropriate sensors for specific applications.						
	CO3	Describe the types and operating principles of actuators and analyze their applications, advantages, and limitations.						
	CO4	Understand the working principles of smart actuators and apply basic control methods with sensors and feedback in actuator systems.						
	CO5	Apply sensor and actuator principles to design, troubleshoot, and analyze systems for real-world applications and emerging technologies.						
UNIT-I	**Introduction to Sensors and Measurement Systems**				**Periods: 9**			
Measurement systems and their components-Types of sensors: Active vs. passive sensors-Basic sensor operation and principles- Measurement of physical quantities (e.g., temperature, pressure, force, position, etc.) -Characteristics and specifications of sensors- Calibration methods and error analysis								**CO1**
UNIT-II	**Sensors and Their Principles**				**Periods: 9**			
Principle, Operation and Applications of different types of sensors: Temperature Sensors, Mechanical Sensors, Optical sensors, Chemical and gas sensors, Position and displacement sensors, Sensor Selection Criteria, Practical examples of sensor selection								**CO2**
UNIT-III	**Fundamentals of Actuators**				**Periods: 9**			
Definition, classification, and role in automation and control systems-Key performance parameters like force, torque, speed and displacement-Electric, Pneumatic and Hydraulic Actuators-Operating principle-applications-Advantages and Limitations.								**CO3**
UNIT-IV	**Advanced Actuation Systems and Applications**				**Periods: 9**			
Smart Actuators-Piezoelectric Actuators-Electroactive polymers and micro-actuators-Emerging technologies and their applications, **Control of Actuators-**Basic control methods -Open and Closed loop control-Sensors and feedback in actuator systems								**CO4**

UNIT-V	Practical Applications and Case Studies	Periods: 9	
Practical Sensor Systems: Design considerations for industrial, automotive, and medical applications- Interface of actuators with microcontrollers and PLCs- Case Studies: Integrated Sensor and Actuator system in Industries and Health monitoring Systems, Robotics, Automotive systems and Aerospace.			CO5
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Sensors and Signal Conditioning by Ramón Pallás-Areny and John G. Webster, Wiley Publisher, 2nd Edition, 2012.

2. Introduction to Sensors and Signal Conditioning by John H. Lienhard V, Cambridge University Press, 1st Edition, 2015.

3. Actuators: Basics and Applications by Hans Janocha,Springer, 1st Edition, 2004

4. Piezoelectric Actuators: Materials, Technologies, and Applications – Kenji Uchino, Springer, 1st Edition, 2010.

5. Mechatronics: Principles and Applications – Godfrey C. Onwubolu, Elsevier, 1st Edition, 2005.

COURSE ARTICULATION MATRIX

Course: **ECUI101 Principles of Sensors and Actuators**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	1	2	—	—	—	1	2	2
CO2	3	3	2	3	3	2	1	2	—	—	—	1	2	2
CO3	3	3	2	3	3	2	1	2	—	—	—	1	2	2
CO4	3	2	1	3	2	2	1	2	—	—	—	1	2	2
CO5	3	1	1	3	2	2	1	2	—	—	—	1	2	2

	3	2.4	1.6	3	2.6	2	1	2	—	—	—	1	2	2

Department :**ElectronicsandCommunication Engineering**		Programme: **B.Tech.(ECE)**						
Semester V		Course Category Code: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUI102	**IoT Architecture and Protocols**	3	-	-	3	40	60	100
Prerequisite:								
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Understand the fundamental concepts, architecture, and design principles of the Internet of Things (IoT), including enabling technologies and real-world applications.						
	CO2	Analyze different IoT architectures and functional stacks, with a focus on integration of devices, edge and cloud computing, and real-time data processing.						
	CO3	Evaluate the performance and applicability of various data link, network, transport, and session layer protocols in IoT systems.						
	CO4	Investigate secure communication protocols and management strategies in IoT environments, addressing challenges such as authentication, encryption, and device lifecycle management.						
	CO5	Apply knowledge of IoT frameworks and technologies to design and implement domain-specific IoT solutions for sectors like healthcare, agriculture, smart cities, and industrial automation.						
UNIT-I	**INTRODUCTION TO INTERNET OF THINGS (IoT)**				**Periods: 9 Hrs**			
Basics of Internet of Things (IoT): Definition, evolution, and applications - Physical and Logical Design of IoT: Architecture, device interaction, sensor integration - IoT Levels: Edge, Fog, and Cloud IoT, along with real-time processing - IoT Enabling Technologies: Wireless Sensor Networks (WSNs), Cloud Computing, Big Data Analytics, Artificial Intelligence (AI) and Machine Learning (ML) in IoT, Communication Protocols: Low power protocols and emerging standards - Domain-specific IoT Applications: Smart Homes and Buildings, Smart Cities, Smart Healthcare, Agriculture and Precision Farming, Industrial IoT (IIoT), Smart Retail and Logistics, Environmental Monitoring and Energy Management								**CO1**
UNIT-II	**IoT ARCHITECTURE AND DESIGN**				**Periods: 9 Hrs**			
IoT Architecture Models: oneM2M, IoT World Forum (IoTWF), Industrial IoT (IIoT) models - Simplified IoT Architecture: Integration of sensors, actuators, and communication protocols - IoT Functional Stack: Data Acquisition, Data Processing and Edge Computing, Cloud Integration and Remote Monitoring - IoT Data Management and Compute Stack: Fog and Edge Computing: Role in reducing latency and improving efficiency, Cloud Computing in IoT: Scalability, storage, and analytics - Real-Time IoT Data Processing: Integration with Big Data platforms, AI, and ML frameworks								**CO2**
UNIT-III	**IoT DATA LINK AND NETWORK LAYER PROTOCOLS**				**Periods: 9 Hrs**			
Data Link Layer Protocols: IEEE 802.15.4e, IEEE 802.11, Wireless HART, Z-Wave, Bluetooth Low Energy (BLE), Zigbee and Smart Energy, DASH7, HomePlug, G.9959, LTE-A, LoRaWAN, Weightless, 5G IoT Integration: Low latency and massive IoT connectivity - Network Layer								**CO3**

Protocols: IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, Low Power Wide Area Networks (LPWAN), NB-IoT: Cellular IoT for wide-area networks, Network Slicing for IoT: Enabling isolated networks for specific applications		
UNIT-IV	**TRANSPORT AND SESSION LAYER PROTOCOLS**	**Periods: 9 Hrs**
Transport Layer Protocols: TCP, UDP, DCCP, SCTP, MPTCP, TLS/DTLS for secure communication - Session Layer Protocols: HTTP/2, CoAP, XMPP, AMQP, MQTT, SMQTT, DDS (Data Distribution Service), QUIC Protocol for faster data exchange in IoT systems, WebSockets and WebRTC for real-time communication. Service Discovery and IoT Communication		**CO3, CO4**
UNIT-V	**IoT MANAGEMENT AND SECURITY PROTOCOLS**	**Periods: 9 Hrs**
IoT Device Management: Provisioning, Configuration, and Monitoring, Device Lifecycle Management, Interconnection of Heterogeneous Data Links and Protocols, Device Virtualization and Edge Device Management - IoT Security Protocols: Secure IoT Communication: MAC 802.15.4, 6LoWPAN, RPL, TLS, SSL, IoT Authentication and Authorization, Public Key Infrastructure (PKI), End-to-End IoT Encryption and Secure Data Transmission, IoT Security Challenges: Network attacks, Data privacy, and Intrusion Detection - Blockchain for IoT Security: Distributed ledger for IoT data integrity and device authentication - AI and ML for IoT Security: Anomaly detection, predictive security models		**CO1, CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods:-**	**Total Periods: 45**

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", Second Edition, University Press, 2021.
2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Architecture and Applications", Wiley, 2016.
3. Hakima Chaouchi, "The Internet of Things: Connecting Objects to the Web", Wiley, 2010.
4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, 2017.
5. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016.
6. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013.
7. Olivier Hersent, David Boswarthick, Omar Elloumi, "Internet of Things: From Research and Innovation to Market Deployment", Wiley, 2012.
8. Vijay Madisetti, Arshdeep Bahga, "IoT: Architectures, Protocols, and Applications", CRC Press, 2014.
9. S. Srinivasan, G. Sankaranarayanan, "Blockchain for IoT and Industrial IoT", Springer, 2020.
10. Jamil Y. Khan, Salman Ali, Amir Ali, "The Internet of Things: A Survey", Springer, 2021.

CO-PO Mapping

ECUI102 **IoT Architecture and Protocols**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	2	3	2	-	2	-	-	-	1	2	-	3	3
CO3	2	2	3	2	2	-	-	-	-	2	-	3	3
CO4	2	3	2	3	2	2	1	-	-	2	-	3	3
CO5	3	3	3	3	2	-	-	-	2	3	3	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (ECE)**						
Semester : **VI**		Course Category Code: **ANC**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUI103	**Mobile Adhoc and Wireless Sensor Networks**	3		-		40	60	100
Prerequisite	Knowledge in communication Engineering							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Apply knowledge of basic principles of computer networking and wireless communication to understand the architecture and components of a MANET.						
	CO2	Analyse the problem of network design in a mobile, infrastructure-less environment, identifying challenges in topology, routing, and communication.						
	CO3	Demonstrate the understanding of the design issues and requirements of routing Examine the impact of mobility patterns, node density, and external interference on network performance, employing both theoretical analysis and experimental methods.						
	CO4	Evaluate the sustainability of mobile networks in resource-constrained environments, considering power consumption, communication overhead, and energy-efficient protocols.						
	CO5	Investigate security challenges in MANETs, including vulnerability to attacks such as denial of service (DoS), eavesdropping, and secure routing.						
	CO6	Recognize the importance of ensuring security and privacy in advanced technologies and its application in MANETs, especially in applications like military, healthcare, and emergency response systems.						
UNIT-I	**Basic Concepts of MANETS**				**Periods: 9**			
Generations in Wireless Systems, Cellular and Adhoc Networks - Mobile Ad Hoc Networks (MANETS), Characteristics of MANETs -Classification of Mobile Data Networks- Heterogeneity in Mobile devices – Types of Mobile Host movements – Challenges in Ad hoc Mobile Networks – Ad hoc wireless Internet.								**CO1, CO2, CO3**
UNIT-II	**Challenges and MAC Protocols**				**Periods: 9**			
Challenges in Providing QoS in Ad hoc Wireless Networks - Issues in designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols - Contention-based protocols – CSMA protocol - Schedule-based protocols – LEACH protocol.								**CO2, CO3. CO4**
UNIT-III	**Routing Protocols**				**Periods: 9**			
Issues in designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV)– Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) – Location Aided Routing (LAR).								**CO1, CO2, CO3, CO4**
UNIT-IV	**Wireless Sensor Networks**				**Periods: 9**			

Need for Wireless Sensor Networks- Characteristic requirements for WSN - Challenges for WSNs – WSN vs Ad hoc Networks - Sensor node architecture –Physical layer and transceiver design considerations in WSNs – Energy scavenging - Data Gathering and Dissemination.	**CO1, CO2, CO5**

UNIT-V	**Advanced Technologies and its Applications**	**Periods: 9**

Basic wireless sensor technologies–Hardware and Software - Advanced Radio concepts –The IEEE Standard 802.15.4 –Operating Environment - Energy usage profile-Commercially available sensor nodes.	**CO1, CO4, CO6**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. Holger Karl, Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006.

CO-PO Mapping

Course Code: ECUI103

Course name: Mobile Adhoc and Wireless Sensor Networks

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	1	-	-	-	-	3	3
CO2	3	3	3	2	2	-	1	-	-	-	-	3	3
CO3	3	3	3	2	2	-	1	-	-	-	-	3	3
CO4	3	3	3	2	2	-	1	-	-	-	-	3	3
CO5	3	3	3	2	2	-	1	-	-	-	-	3	3
CO6	3	3	3	2	2	-	1	-	-	-	-	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department : ECE		Programme :B.TechECE						
Semester : VII		Course Category Code:ANC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUI104	Edge and Cloud Computing	3	-	-	3	40	60	100
Prerequisite								
Course Outcome	CO1 - To introduce edge computing and how it differs from cloud computing							
	CO2 - Acquire knowledge on Edge devices and its platforms							
	CO3 - Learn Edge Data Processing and integration with cloud							
	CO4 - Acquire Knowledge on the concepts and technologies of Cloud Computing							
	CO5 - Learn Cloud Computing Architecture, Services and its Case Studies							
UNIT – I	Introduction to Edge Computing					Hours: 9		
Definition, Evolution, and Need, Edge vs Fog vs Cloud Computing, Benefits and Challenges, Architecture of Edge Computing Systems								CO1
UNIT – II	Edge Devices and Platforms					Hours: 9		
Types of Edge Devices (Sensors, Gateways, Raspberry Pi, NVIDIA Jetson, etc.), Hardware Accelerators (TPU, FPGA), Edge Platforms: Azure IoT Edge, AWS Green grass, Google Edge TPU, Operating Systems for Edge Devices: RIOT, EdgeX Foundry, TinyOS								CO2
UNIT – III	Communication Protocols and Data Handling					Hours: 9		
MQTT, CoAP, HTTP, WebSockets, Edge Data Processing: Stream Processing vs Batch Real-time Data Analytics at the Edge, Integration with Cloud and Hybrid Models								CO3, CO5
UNIT – IV	Introduction to Cloud Computing					Hours: 9		
Overview of Computing Paradigms- Distributed Systems Models and Enabling Technologies - Cloud Computing Properties and Characteristics - Business Drivers for Adopting Cloud Computing								CO4
UNIT – V	Cloud Computing Architecture and Service					Hours: 9		
Cloud Computing Architecture - Cloud Computing Service Delivery Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models: Public cloud, Private cloud, Hybrid cloud - Data Centre								CO5

Design and Management - Service Level Agreements (SLAs) – Pricing Models of Cloud - Migrating to Cloud – Cloud Simulators - Cloud Security Risks - Case Studies: Amazon AWS, Microsoft Azure, Amazon EC2, Google Cloud			
Lecture Hours: 3	**Tutorial Hours: -**	**Practical Hours: -**	**Total Hours: 45**

Reference Books:

1. **Edge Computing: A Primer – Jie Cao, Quan Zhang, Weisong Shi, Springer Series**
2. **Fog and Edge Computing: Principles and Paradigms – Rajkumar Buyya, Satish Narayana Srirama, John Wiley and Sons 2019**
3. **Perry Lea, "IoT and Edge Computing for Architects", Packt publishers, 2020.**
4. **Ajit Singh, "Edge Computing", Shroff Publishers, 2019.**

5. Kai Hwang, Jack Dongarra, and Geoffrey C. Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2013.

6. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill, 2017.

Syllabi of the courses offered by the Electronics and Communication Engineering Department in the B. Tech programmes of other departments

Department : **Electronics and Communication Engineering**		Programme: **B.Tech (Computer Science and Engineering)**						
Semester : Third		Course Category Code: ESC				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC130	**Fundamentals of VLSI System**	4	-	-	4	40	60	100
Prerequisite:	-							
Course Outcome	**CO1**	Understand the working principle of Bipolar Junction Transistor, Junction Field effect Transistor and Metal Oxide Semiconductor Field effect Transistor.						
	CO2	Design the basic circuits using CMOS logic.						
	CO3	Apply Boolean simplification techniques to design a combinational circuit.						
	CO4	Design and analyse the given combinational circuit.						
	CO5	Design and analyse the given sequential circuit.						
	CO6	Design and implement the given digital systems using Verilog.						
UNIT-I	**Introduction to CMOS Circuits**				**Periods: 12**			
Principle of Operation of BJT, JFET and MOSFET – MOS Transistor as Switches - Realization of logic elements using DTL, TTL, ECL. Introduction to CMOS - CMOS vs Bipolar – Fabrication of CMOS Technology – Realization of NOT, NAND and NOR using CMOS – Need for scaling in MOSFET.								**CO1, CO2**
UNIT-II	**Boolean Algebra**				**Periods: 12**			
Binary codes - Weighted and non-weighted Binary arithmetic - Boolean algebra -Basic operations -Basic Theorems - Boolean functions - Canonical and standard boolean expressions - Simplification of Boolean functions-Karnaugh maps – Don't care conditions - Tabulation method. Code conversion algorithms - Design of code converters.								**CO3, CO4**
UNIT-III	**Combinational Circuits**				**Periods: 12**			
Adders / Subtractors - Carry lookahead adder - Binary/Decimal Parallel Adder/Subtractor for signed numbers - Magnitude comparator - Decoders / Encoders - Multiplexers / Demultiplexers - Boolean function implementation using multiplexers.								**CO3, CO4, CO6**
UNIT-IV	**Sequential Circuits**				**Periods: 12**			
Sequential logic - Basic latch - Flip-flops (SR - D - JK - T - Master-Slave) - Triggering of flip-flops - Counters - Design procedure - Ripple counters - BCD and Binary - Synchronous counters - Registers - Shift registers - Registers with parallel load - Reduction of state and flow tables - Race-free state assignment - Hazards								**CO5, CO6**
UNIT-V	**Verilog Concepts**				**Periods: 12**			
Verilog Concepts - Lexical Conventions – Data Types – System tasks –Module definition – Port Declaration – Gate Level modeling using basic Verilog gate primitives – Dataflow Modeling – Behavioral Modeling – Structured Procedures – always and initial block – blocking and non-blocking assignments – conditional statements – multi-way branching – loops –– Modelling techniques for efficient circuit design – Verilog codes – 4-bit Adder / subtractors, Carry look ahead adder, Parity Generator, Magnitude Comparator, Latches and Flip flops, Shift Registers and Ripple Counters.								**CO4, CO5, CO6**
Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 60**			

Reference Books:

1. Robert L.Boylestead and Louis Nashelsky, “Electron Devices and Circuits Theory”,Prentice Hall of India,11th Edition,2013.
2. David A.Bell,”Electronic Devices and Circuits”,Prentice Hall of India, 5 th Edition, 2008.
3. M. Morris Mano and Michael Ciletti, Digital Design, Sixth Edition, Pearson India Education Services, Pvt.
4. Ltd., 2018.
5. Samir Palnitkar, “Verilog HDL”, Second Edition, Pearson Education, 2003.
6. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL”, Second Edition, Pearson Education, 2010.
7. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Tata McGraw-Hill Publishing Company Ltd., 2007.

Department : Electronics and Communication Engineering		Programme: **B.Tech (Computer Science and Engineering)**						
Semester : Third		Course Category Code: ESC				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUC131	**VLSI System Laboratory**	-	-	3	1.5	40	60	100
Prerequisite:	-							

Course Outcome	**CO1**	Understand the characteristics of BJT and FET and also able to determine its parameters.
	CO2	Design and develop basic digital systems.
	CO3	Demonstrate the troubleshooting in digital circuits.
	CO4	Implement and verify combinational and sequential circuits.
	CO5	Simulate and verify the functionality of combinational and sequential circuits.

1. Design and verification of Transistor as a Switch. 2. Observe the voltage transfer characteristics of a CMOS inverter. 3. i. Verification of DeMorgan's theorems using basic logic gates ii. Implementation and experimental verification of the truth tables of full adder and full subtractor. iii. Implementation of 4×1 Multiplexer and 2×4 decoder using logic gates and verification of their truth tables. 4. i. Verification of the truth tables of SR, JK and D FFs. ii. Implementation of shift-register and Ring counter and verification of their function tables and timing diagrams. 5. Design and implementation of 3-bit asynchronous counters (up counter, down counter and Mod-N($N \neq 2^n$, where n is an integer) and verification of their function tables and timing diagrams. 6. Design and implementation of synchronous binary counters and a random sequence counter and verification of their function tables. 7. Verification of the design functionality of Full Adder, Full subtractor and a 4-bit binary Adder/subtractor using Verilog HDL. 8. Verification of the design functionality of a 2×1 MUX, 4×1 MUX, 2×4 decoder 9. Verification of the design functionality of Parity Generator/Checkers and Magnitude Comparators using Verilog HDL. 10. Verification of the design functionality of flip flops, ripple counters and shift registers using Verilog HDL.	**CO1, CO2, CO3, CO4, CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. M. Morris Mano and Michael Ciletti, Digital Design, Sixth Edition, Pearson India Education Services, Pvt.
2. Ltd., 2018.
3. Samir Palnitkar, "Verilog HDL", Second Edition, Pearson Education, 2003.
4. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Second Edition, Pearson Education, 2010.

5. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Tata McGraw-Hill Publishing Company Ltd., 2007.

Department : ECE			Programme: **B.Tech.CSE**						
Semester : VII			Course Category Code: ANC			Semester Exam Type:			
ECUI105	Wireless Communication Technologies		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
			3			3	40	60	100
Prerequisite:	Basics of Communication systems.								
Course Outcome	**CO1**	Understand the fundamental concepts of signal transmission techniques used in wireless communication systems.							
	CO2	Analyze the architecture and design strategies of cellular wireless systems applying mechanisms to improve coverage and capacity.							
	CO3	Compare the different generations of cellular networks (1G to 5G) and evaluate their evolution based on technological advancements and communication standards.							
	CO4	Apply performance enhancement techniques such as diversity, equalization, and advanced modulation schemes like OFDM, MIMO and Into improve the quality and efficiency of wireless communication systems.							
UNIT-I	**Technical background of wireless communication**					**Periods: 9**			
Transmission Fundamentals – Signals for conveying information - Signal Encoding Techniques – Transmission media - Antennas and Propagation – Channel capacity- Spread Spectrum - Multiplexing.									**CO1**
UNIT-II	**Cellular wireless Technology - system design**					**Periods: 9**			
Cellular system - Cell geometry - Frequency Reuse - Channel assignment strategies - Handoff Strategies -Interference and System capacity - Improving coverage and system capacity in cellular systems.Trunking and grade of service- Case study - Design of cellular system for an urban scenario by applying the above mentioned strategies.									**CO2**
UNIT-III	**Modern wireless communication systems**					**Periods: 9**			
Cellular Networks - 1G cellular networks , 2G cellular networks - GSM , GPRS,EDGE , 3G Cellular networks - UMTS , CDMA 2000 . 4G - LTE , 4G - LTE-A , 5G cellular networks.									**CO3**
UNIT-IV	**Performance Enhancement Techniques**					**Periods: 9**			
Multipath radio propagation, Inter Channel Interference and fading in mobile radio channel- Channel Impairments combating mechanisms - Diversity – Micro and Macro diversity, Transmit Diversity with and without Channel state Information.Diversity combining techniques. Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms.									**CO3.CO4**
UNIT-V	**Modern wireless technologies**					**Periods: 9**			
OFDM , OFDMA , Introduction to MIMO Wireless Communications, MIMO System Model, Alamouti code, SVD of MIMO, MIMO Capacity Analysis, Introduction to Multiuser MIMO. Cognitive Radio - Transceiver ARchitecture. Role of Artificial Intelligence and Machine Learning techniques in modern cellular wireless networks.									**CO4**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**			**Total Periods: 45**			

Reference Books:

1. Wireless Communication and Networks , William stallings , Pearson, Second edition, 2009
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
3. Fundamentals of Wireless Communications, David Tse, Pramod Viswanath,Cambridge, 2005
4. *Wireless Communications*, A. Molisch,John Wiley & Sons, 2005.
5. *Modern Wireless Communications*, S. Haykin and M. Moher,Pearson Education, 2005.
6. *Wireless Communications*, T. S. Rappaport,Prentice Hall, 1996.
7. Wireless Communication systems , Randy L.Haulpt, John Wiley & Sons, 2020.

CO-PO Mapping

Course Code:

Course Name; Wireless Communication Technologies

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2	2	1	-	-	-	-	-	-	-	1	
CO 2	3	3	3	3	2	-	1	-	1	-	-	1	
CO 3	3	3	3	3	2	3	1	-	-	-	2	3	
CO 4	3	3	3	2	1	-	-	-	-	-	2	3	

Score: 3 – High; 2 – Medium; 1 – Low

Syllabi of the *Honour Courses* offered by the Electronics and Communication Engineering Department

Department : ECE			Programme: **B.Tech. ECE**						
Semester :Fourth			Course Category Code: HNC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ECUH101	**Semiconductor Technology and Design**		3	1		4	40	60	100
Prerequisite:	Basics of Electronic devices and VLSI								
	Upon completion of the course, the students will be able to								
Course Outcome	**CO1**	**To understand** the CMOS process flow and fundamental semiconductor fabrication steps including substrate selection, well formation, gate, and interconnect formation.							
	CO2	**To Apply** principles of crystal growth, wafer fabrication, and photolithography in semiconductor manufacturing.							
	CO3	**To compare and analyze** oxidation, diffusion, and implantation processes and their impact on device characteristics.							
	CO4	**To implement and Evaluate** thin film deposition techniques, etching processes, and measurement methods for process optimization in IC fabrication.							
UNIT-I	**Introduction to Modern CMOS Technology**					**Periods: 12**			
Semiconductor devices Technology Families. CMOS process Flow – Choosing substrate –N-well and P-wellformation –Gate formation – source and drain formation – contact and local interconnect formation –Multilevel metal formation.									**CO1**
UNIT-II	**Crystal Growth and Wafer Fabrication**					**Periods: 12**			
Crystal structure, Crystal growth methods, wafer preparation and specification. Measurement methods –Electrical measurements, physical measurements.									**CO2**
UNIT-III	**Lithography, Thermal Oxidation and Interface**					**Periods: 12**			
Light sources, Wafer exposure systems, photoresist – measurement methods. Thermal oxidation and Si/SiO2interface – Basic concepts, manufacturing methods, measurement methods – physical, optical and electricalmeasurements.									**CO2,CO3**
UNIT-IV	**Dopant Diffusion**					**Periods: 12**			
Diffusion from macroscopic viewpoint, Effect of successive steps, Design and evaluation of diffused layers,Manufacturing methods and equipment, Measurement methods.									**CO3**
UNIT-V	**Ion Implantation and Thin Film Deposition**					**Periods: 12**			
Implants in real silicon, manufacturing methods and equipment, measurement methods. chemical vapour deposition and physical vapour deposition, types of etching, contact formation.									**CO3,co4**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:**				**Total Periods: 60**		
Reference Books:									
1. James D. Plummer Michael Deal, Peter D. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and									

Modeling", Pearson Education, 2009.
2. 2. R. L. Geiger, P. E. Allen and N. R. Strader, "VLSI Design Techniques for Analog and Digital Circuits", New York, Mc-Graw Hill, 1990.
3. P. E. Allen and D. R. Holberg, "CMOS Analog CircuitDesign", New York,Oxford University Press, 2002.
4. M. Ismail and T. Fiez, "Analog VLSI Signal and Information Processing", New York, McGraw-Hill, 1994.

ECUH101 Semiconductor Technology and Design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	1	-	-	-	-	3	-	-	3	
CO2	2	2	2	1	-	-	-	-	3	-	1	3	
CO3	2	3	3	3	2	2	1	-	1	1	1	3	
CO4	2	3	3	3	2	2	1	-	1	1	-	3	

Department : Electronics and Communication Engineering		Programme : B.Tech. (ECE)						
Semester : 5		Course Category Code:HNC						
Course Code	Course	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECUH102	Advanced Digital System Design	3	1	-	4	40	60	100
Prerequisite	Digital System Design							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Apply the basic digital circuit design concepts to design clocked synchronous sequential circuits and analyze the timing issues						
	CO2	Apply the knowledge of data path components to realize a register transfer level schematic which will lead to a complete design of a digital system.						
	CO3	Justify the design and working of a digital circuit/system as per the specifications using HDL simulations						
	CO4	Demonstrate the basic testing methods applied for digital systems						

UNIT – I	Clocked Synchronous Sequential Circuit Design and Timing Issues	Hours: 12	
Basic Design steps-Modeling of CSSN-Sate diagram- state table-State Reduction and Assignment - Choice of Flip-Flops and Derivation of Next-State and Output Expressions -Design of iterative circuits-Sequential Circuit Design using CPLDs and FPGAs- Clock Synchronization–Clock Distribution–Flip-Flop Timing Parameters–Synchronous and Asynchronous inputs to Flip-Flops–Switch debouncer.			CO1
UNIT – II	**Register Transfer Level(RTL)Design**	**Hours: 12**	
Introduction–High Level State Machines–RTL Design Process–RTL Design using Memories, Registers and Timers–Determining Clock Frequency–Behavioral Level Design–Memory Components–Queues–Multiple Processors.			CO1, CO2
UNIT – III	**Digital System Design Using Verilog HDL**	**Hours: 12**	
Bus Structure–Using Tristate Drivers to implement a Bus–Using Multiplexers to implement a Bus–Verilog Code for specification of Bus Structures–Simple Processor Design–A Bit-Counting Circuit–Shift and Add Multiplier–Divider–Arithmetic Mean–Sort Operation.			CO3
UNIT – IV	**Verilog Programming with State diagram and ASM charts**	**Hours: 12**	
Introduction to finite state machine and ASM Charts – Components of ASM charts – Verilog programming - Sequence detector using FSM and ASM chart – Booth serial multiplier design using ASM chart – Booth serial multiplier design using datapath and control unit.			CO3
UNIT – V	**Design for Testability**	**Hours: 12**	
Fault Models – Test Generation (Stuck-at Faults) - Path Sensitization – D-Algorithm – Test Generation for other Fault Models – Test Generation with an example – Sequential Circuit Testing – Design for Testability – Built-in-Self-Test – Enhancing Testability.			CO4

Lecture Hours: 45	Tutorial Hours:15	Practical Hours:-	Total Hours: 60

Reference Books:

1. Charles H.Roth,Jr.and Larry L.Kinney,"Fundamentals of Logic Design",Seventh Edition,Cengage Learning,2014.
2. Stephen Brown and Zvonko Vranesic,"Fundamentals of digital logic with Verilog Design",McGrawHill Publication,Third Edition,2014.
3. Frank Vahid,"Digital Design with RTL Design,VHDL and Verilog",Second Edition,2011,John Wiley and Sons.
4. John Wiley , "Digital System Designs and Practices Using Verilog HDL and FPGAs",2008,.

CO-PO Mapping

ECUH102 Advanced Digital System Design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	3	-	-	-	-	-	-	-	1	-
CO2	2	2	1	3	-	-	-	-	-	-	-	1	-
CO3	2	3	2	3	2	-	-	-	-	-	-	1	-
CO4	1	3	2	3	2	-	-	-	-	-	-	1	-

Department : ECE			Programme: **B.Tech.ECE**					
Semester : 6			Course Category Code: HNC			Semester Exam Type:		
ECUH103	Simulation of Communication Systems		Periods / Week			Credit	Maximum Marks	
			L	T	P	C	CA	SE	TM
			3	1		4	40	60	100
Prerequisite:								
	Upon completion of the course, the students will be able to							
Course Outcome	**CO1**	Gain knowledge on different methods for generating random sequences and testing using parameters.						
	CO2	Understand source, line and channel coding models and application of filtering techniques						
	CO3	Generate models for analog and digital communication						
	CO4	Analyze communication channels using models						
	CO5	Identify parameters for estimating and evaluating performance of a communication system.						
	CO6	Perform testing of random number generators using the given parameters.						
UNIT-I	**Random Number generation**					**Periods: 12**		
Random number Generation – Generation of uniform random numbers- Generation of Gaussian random numbers, Generating independent random sequences, generating pseudo random number sequences and M-ary pseudo noise sequences, Generation of correlated random sequences – Spectral factorization method, Testing of random number generators- Stationarity, uncorrelatedness & Goodness of fit tests.								**CO1,** CO6
UNIT-II	**Modeling of Information sources and filters**					**Periods: 12**		
Information sources – single test tone and multiple test tones, Source coding - base band modulation – Line coding formats , Channel coding methods- Filtering – filters for spectral shaping, filters for pulse shaping, Linear minimum MSE filters, Filters for minimizing noise and distortion, Matched filters, Adaptive filters								**CO2, CO4**
UNIT-III	**Modulation and Detection**					**Periods: 12**		
RF and optical modulation – Quadrature representation of analog modulation schemes, Digital Quadrature modulation. Multiplexing and Simulation of Multiple access methods - Detection/demodulation - Carrier and timing recovery for BPSK . Carrier and timing recovery for QPSK .Modeling considerations for the PLL.								**CO3, CO5**
UNIT-IV	**Communication Channel modeling**					**Periods: 12**		
Fading and multipath channels- Shadow fading and Multipath fading, statistical characterization of multipath channels - WSSUS model – delay power profile and coherence bandwidth. Time-varying channels with Doppler effects – Discrete multipath channel model- Finite state channel models – channels with and without memory. Methodology for Simulating Communication Systems Operating over Fading Channels.								**CO4, CO5**
UNIT-V	**Estimation of Parameters in simulation**					**Periods: 12**		
Parameter estimation: Estimating mean – variance - confidence interval - Estimating the Average Level of a Waveform - Estimating the Average power of a waveform –Estimating Power Spectral Density of a process –Estimating Delay and Phase. Estimating Performance measures- SNR estimation. Estimating Performance Measures for Digital Systems. Monte Carlo method and Quasianalytical estimation								**CO5**
Lecture Periods: 3	**Tutorial Periods: 1**		**Practical Periods:**			**Total Periods: 4**		
Reference Books:								

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (ECE) -Honours**							
Semester : **Seventh**		Course Category Code: **HNC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
ECUH104	**Next Generation Networks**	3	1	-	4	40	60	100	
Prerequisite	-								

1. M.C. Jeruchim, Philip Balaban, and K.Sam shanmugam, "Simulation of communication systems", Plenum press, New York, 2007.
2. M.Law and W.DavidKelton , "Simulation Modelling and analysis", Tata McGraw Hill, New York, 2008.
3. Banks, J.S.Carson, Nelson and D.M.Nicol, "Discrete Event system simulation", 4th Edition, Prentice Hall of India, 2005.

CO-PO Mapping

ECUH103 Simulation of Communication Systems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	-	-	-	2	-	1	3	2
CO4	3	3	3	3	3	-	-	-	2	-	1	3	2
CO5	1	3	3	3	-	-	-	-	1	-	1	3	2
CO6	2	3	3	3	3	-	-	-	2	-	1	3	2
ECUH103	1.83	2.17	2	2	1.5	-	-	-	1.17	-	0.67	2.5	1.83

Score: 3 – High; 2 – Medium; 1 – Low

Course Outcome	Upon completion of the course, the students will be able to			
	CO1	Understand the integration of wireless IP, IMS, MPLS, and multicast technologies in next-gen		
	CO2	Analyze and design scalable network architectures with IP-based services, QoS, and VPN		
	CO3	Apply network management techniques for QoS, performance monitoring, and security in NGNs.		
	CO4	Evaluate emerging technologies' impact on network performance, scalability, and reliability.		
	CO5	Assess network provisioning, authentication, and self-healing mechanisms for robust communication systems.		
UNIT – I	**Wireless IP**		**Periods: 12**	
Evolution of public mobile services - motivations for IP based services, Wireless IP network architecture – 3GPP packet data network architecture. Introduction to next generation networks – changes, Opportunities ad challenges. Technologies, networks and services, future trends.				**CO1, CO4**
UNIT – II	**IMS and Convergent Management**		**Periods: 12**	
IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture - standards importantto OSS architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.				**CO2, CO3**
UNIT – III	**MPLS and VPN**		**Periods: 12**	
Technology overview –MPLS & QoS, MPLS services and components –layer 2 VPN, layer 2 internetworking, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN - GMPLS.				**CO2, CO4**
UNIT – IV	**Multicast**		**Periods: 12**	
MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS- Technology overview, Future of MPLS –Integrating IP and optical networks, Future layer 3 services, future layer 2 services.				**CO1, CO4**
UNIT – V	**NGN Management**		**Periods: 12**	
Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self-healing networks.				**CO3, CO5**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**	

Reference Books:

1. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”, Wiley & IEEE Press Publications,2011.
2. Neill Wilkinson, *Next Generation Network Services: Technologies & Strategies*, 1st ed., Wiley, 2002.
3. Monique J. Morrow & Azhar Sayeed, MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization, 1st ed., Cisco Press, 2006.
4. Robert Wood, “MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press,2006.

COURSE ARTICULATION MATRIX

Course: **ECUH104 Next Generation Networks**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	3	3	3	1	3
CO2	3	3	3	3	3	3	3	3	3	3	3	1	3
CO3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	1	3

Department :ECE		Programme: **B.Tech.**		
Semester :Eighth		Course Category Code: HNC		Semester Exam Type: LB
Course Code	Course Name	Periods / Week	Credit	Maximum Marks

		L	T	P	C	CA	SE	TM
ECUH105	**Seminar**	-	-	-	2	100	-	100
Prerequisite:	NIL							
	Upon completion of the course, the students will be able to							
Course Outcome:	**CO 1**	Identify and explore a recent topic through literature review.						
	CO 2	Apply theoretical knowledge to real-world scenarios or case studies.						
	CO 3	Explore topics beyond the curriculum and developing self-directed research habits.						
	CO 4	Deliver an effective oral presentation of complex ideas concisely and clearly.						
The objective of the seminar is to enable the students to present a seminar on any chosen topic related to their field of study. The topic shall be chosen in consultation with the Faculty coordinators. The student will present a Seminar on a topic in an emerging area in his/her discipline of Engineering. The student will make the presentation for duration of 20 to 25 minutes and also submit a brief report on the seminar topic for the purpose of evaluation. A departmental committee shall evaluate the performance of the students.								CO1, CO2, CO3, CO4

Syllabi of the courses offered by other departments in the B.Tech. (*Electronics and Communication Engineering*) Programme.

Department : Mathematics		Programme : B. Tech.(ECE)		
Semester : III		Course Category Code: BSC		Exam Type:TY
Course Code	Course Name	Hours / Week	Credit	Maximum Marks

		L	T	P	C	CA	SE	TM
MAUC105	**Probability And Stochastic Processes**	**3**	**1**	**0**	**4**	**40**	**60**	**100**

Prerequisite	Basic Integration and probability	
	Upon completion of the course, the students will be able to	
Outcome:	**CO1**	Classify random variables and discuss discrete distributions.
	CO2	Develop the concept of reliability and continuous distributions.
	CO3	Change one random variable into another random variable.
	CO4	Categorize stochastic processes and use Markov chain to obtain bounds on probability of events
	CO5	Discuss various Poisson queueing models and evaluate its performance measures.

UNIT – I	**Probability And Discrete Distributions**	**Hours: 12**
Random Variables - Probability mass function, Distribution functions, Special discrete distributions: Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hyper geometric, Probability Generating function-Characteristic function.		CO 1
UNIT – II	**Continuous Distributions**	**Hours: 12**
Reliability, Failure density and Hazard function - Some important Continuous distributions: Exponential, Hypo exponential, Erlang, Gamma, Hyper exponential, Weibull, Gaussian, Uniform and Pareto distributions.		**CO 1, CO 2**
UNIT – III	**Transformation of Random Variables**	**Hours: 12**
Transformation of Random Variables: Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.		**CO 1, CO 3**
UNIT – IV	**Random Processes**	**Hours:12**
Stochastic Processes: Definition, Classification of Stochastic Processes - Strictly Stationary Process, Wide Sense Stationary, Bernoulli Process, Poisson process, Markov Process , Markov Chain.		**CO 1, CO 2, CO 4**
UNIT – V	**Poisson Queueing Models**	**Hours: 12**
The Birth and Death process: M/M/1, M/M/c, M/M/1/N, M/M/c/N (c < N), M/M/c/c, M/M/∞ models only - derivation of mean number of customer in the system, queue and waiting time - Simple applications. Special case of Birth and Death model.		CO 1, CO 5

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: 00**	**Total Hours: 60**

Reference Books:

1. Kishore S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, John Wiley & Sons Inc. Second Edition, 2016..
2. D.Gross and C.M.Harris, Fundamentals of Queuing Theory, Wiley Students Edition, Third Edition, 2008.
3. J. Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 2002.
4. T. Veerarajan, Probability and Statistics, Random Processes and Queueing Theory" McGraw-Hill Education(India) Private Limited, 2018.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	3	2	-	1	2	1	3	1	1
CO2	3	3	2	3	3	2	-	1	2	1	3	2	1
CO3	3	3	2	3	3	2	-	1	2	1	3	3	3
CO4	3	3	2	3	3	2	-	1	2	1	3	2	3
CO5	3	3	2	3	3	2	-	1	2	1	3	2	3
	3	3	2	3	3	2	-	1	2	1	3	2	2.2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE/EEE/EIE/MT)**						
Semester: **Third**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC137	**Data Structures and Object – Oriented Programming**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	NIL							

Course Outcome: At the end of the course students will be able to	**CO1**	Analyze and implement various searching and sorting techniques.	
	CO2	Choose appropriate data structures to solve real world problems data structures.	
	CO3	Explain the basics Concepts of Object-Oriented Programming.	
	CO4	Develop C++ programs by applying the concepts Inheritance and Polymorphism.	
UNIT-I	**Arrays, Searching and Sorting**		**Periods: 09**
Algorithm: Characteristics – Representation – Efficiency of Algorithms – Data Structures: Characteristics – Types – Arrays: Introduction – Types – Representation – Operations – Applications: Sparse Matrix –Searching: Linear Search and Binary Search – Sorting techniques: Insertion Sort, Selection Sort, Bubble Sort, Quick Sort and Heap Sort.			**CO1**
UNIT-II	**Linear Data Structures**		**Periods: 09**
Stacks: Introduction – Operations – Applications: Evaluation of Expressions – Queues: Introduction – Operations – Circular queues – Priority queues – Double ended queues – Applications: Job Scheduling – Linked List: Introduction – Singly Linked List – Circularly Linked List and Doubly Linked List – Applications: Polynomial Addition.			**CO2**
UNIT-III	**Non-Linear Data Structures**		**Periods: 09**
Trees: Introduction – Terminology – Binary tree – Representation – Traversals– Graph: Introduction – Terminology – Representation – Traversals – Single Source and All Pairs Shortest path algorithms.			**CO2**
UNIT-IV	**Introduction to Object-Oriented Programming**		**Periods: 09**
Basics Concepts of Object-Oriented Programming – Structure of C++ – Tokens-Expressions-Control Structures – Functions in C++: Inline Functions – Recursion– Function Overloading – Classes and Objects – Constructors and Destructors – Friend Functions.			**CO3**
UNIT-V	**Concepts of Object-Oriented Programming**		**Periods: 09**
Operators Overloading: Unary and Binary Operators – Type Conversions – Inheritance –Types – Polymorphism – Virtual Functions – Exception Handling: Basics and Mechanism.			**CO3, CO4**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. E. Balagurusamy, “Data Structures”, McGraw Hill Education (India) Private Limited, 2018.
2. G. A. Vijayalakshmi Pai, *A Textbook of Data Structures and Algorithms, Volume 1: Mastering Linear Data Structures*, Wiley, August 2022.
3. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, “Fundamentals of Data Structures in C”, Second Edition, Universities Press (India) Private Limited,2018.
4. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education (India) Private Limited, Seventh Edition, 2019.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	1	1	-	2	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE/EEE/EIE/MT)**						
Semester: **Third**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC138	**Data Structures and Object – Oriented Programming Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**

Prerequisite:	NIL	
Course Outcome: At the end of the course students will be able to	**CO1**	Select and implement appropriate Searching/sorting algorithms for an application.
	CO2	Implement linear/non-linear data structures using C.
	CO3	Apply OOP principles of classes, object and encapsulation to real time problems.
	CO4	Apply inheritance and polymorphism to build modular and reusable code to real time applications.

Ex. No.	**Experiment Name/Brief Description**	
Data Structures Experiments		
1. 2.	Implementation of Linear search and binary search. Implementation Insertion sort, Selection sort, Bubble sort, Quick sort and Heap Sort.	**CO1**
3. 4.	Array implementation of Stacks and Queues. Implementation of Singly and Doubly Linked List.	**CO2**
5. 6.	Implementation of Binary Tree Traversals. Implementation of Graph Traversals and shortest path Algorithms.	**CO2**
C++ Experiments		
7. 8.	Programs to implement classes and objects. Programs to implement constructors and destructors.	**CO3**
9. 10.	Programs to implement different types of inheritance. Programs to implement virtual functions to demonstrate the use of run time polymorphism.	**CO4**

Lecture Periods: 00	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, “Fundamentals of Data Structures in C”, Second Edition, Universities Press (India) Private Limited, 2018.
2. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education (India) Private Limited, 8th Edition, 2021.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	2	-	-	-

CO3	3	2	2	-	2	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	1	1	-	2	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE)**						
Semester: **Sixth**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC117	**Microprocessors and**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

	Microcontrollers							
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Describe basics of microprocessors and microcontrollers architectures and its functionalities						
	CO2	Outline the operation of microprocessors/ microcontrollers, machine language programming & interfacing techniques						
	CO3	Identify the functionality of ARM microcontroller & its Peripherals.						
	CO4	Explain peripherals devices, interfacing and Embedded programming						
	CO5	Design Microprocessor/ microcontroller-based systems for real-time applications						
UNIT-I	**16-bit Microprocessor Architecture and Programming**				**Periods: 09**			
Introduction - Evolution of Microprocessors- Intel 8086 Microprocessor Architecture – Pin description. – Minimum and Maximum mode signals – BUS cycles- Addressing Modes - Instruction Set – Directives – Assembly Language Programming.								**CO1**
UNIT-II	**Memory and Peripheral Interfacing**				**Periods: 09**			
Introduction – Memory Interfacing - I/O interfacing - Parallel communication interface 8255 PPI, and Serial communication interface USART 8251 using 8086 Microprocessor –Interrupt Structure of 8086- Programmable Interrupt Controller 8259, Timer 8254– Direct Memory Access 8237 - DOS interrupt (21H) functions for console.								**CO2**
UNIT-III	**Introduction to ARM Microcontroller**				**Periods: 09**			
RISC versus CISC – ARM Processor Fundamentals -ARM 7 Architecture – LPC2148 microcontroller introduction – Internal memory map –Thumb/ARM instructions – Assembly Language Programming								**CO2, CO3**
UNIT-IV	**ARM Peripherals and Embedded Programming**				**Periods: 09**			
Peripheral details – Implementation of GPIO, Timer/Counter, UART, Interrupt architecture – ADC and DAC. SPI, I2C and USB features of LPC2148 – Embedded Programming - Firmware development using Embedded C – introduction to data types – conditional statements – loops								**CO3, CO4**
UNIT-V	**Applications of Microcontrollers/Microprocessor**				**Periods: 09**			
Simple programs using Embedded 'C', Applications - D/A and A/D Interface - Printer Interface - Traffic Light control system – DC Motor Speed control – LCD Interfacing								**CO3, CO4, CO5**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**			**Total Periods: 45**		

Reference Books:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt. Ltd., Second Edition, 2013.
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, and Janice Mazidi, "ARM Assembly Language Programming & Architecture", II Edition, 2016
3. Andrew N. Sloss Dominic Symes and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaughmann Publisher, 2024.
4. Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, III Edition, 2017.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	-	3	-	-	-	3	-	-	-
CO2	2	3	3	3	2	-	3	-	-	-	2	-	-	-
CO3	1	3	3	3	3	3	3	-	2	3	3	-	-	-
CO4	2	3	3	3	3	3	3	-	2	3	3	-	-	-
CO5	2	3	3	3	3	3	3	-	3	3	3	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Department: **Computer Science and Engineering**		Programme: **B.Tech. (ECE)**						
Semester: **Sixth**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC120	**Microprocessors and**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**

	Microcontrollers Laboratory							
Prerequisite:	NIL							
Course Outcome: At the end of the course students will be able to	**CO1**	Develop variety of assembly language programs in 8086 microprocessor.						
	CO2	Implement interfacing of peripheral with microprocessor.						
	CO3	Analyze the programming aspects of ARM microcontroller.						
	CO4	Illustrate standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.						
	CO5	Design Microcontroller/Microprocessor based systems.						
	CO6	Implement microcontroller-based real-time applications.						

Ex. No.	**Experiment Name/Brief Description**	
	D) Experiments Using 8086 Microprocessor with MASM	
1	Arithmetic operations: Multi-byte Addition, Subtraction, Multiplication, Division.	**CO1, CO2, CO5**
2	Searching and Sorting	
3	String Operations	
4	Traffic light control	
5	Stepper motor control	
6	Serial and Parallel Interface	
7	Dos and Bios Interrupts programming	
	E) Experiments Using ARM Controller	
8	Implementation of Simple Programs in LPC2141 14.	**CO3, CO4, CO5**
9	Implementation of Interrupts in LPC2148.	
10	Implementation of UART features of ARM LPC2148.	
11	Implementation of SPI and I2C communication using LPC2148	
	F) Implements Real Time Applications using Controller	
12	Interfacing Graphical LCD using LPC2148.	**CO3, CO6**
13	Implementation of USB communication using LPC2148	
14	Implementation of Traffic light control using LPC2148	
15	Implementation of Stepper motor control using LPC2148	

Lecture Periods: 00	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt. Ltd., Second Edition, 2013.
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, and Janice Mazidi, "ARM Assembly Language Programming & Architecture", II Edition, 2016
3. Andrew N. Sloss Dominic Symes and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaughmann Publisher, 2024.
4. Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, III Edition, 2017.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	-	2	1	3	-	-	-
CO2	2	3	2	3	3	2	2	-	2	1	3	-	-	-
CO3	2	3	2	3	3	2	2	1	2	1	3	-	-	-
CO4	2	3	2	3	3	2	2	3	2	1	3	-	-	-
CO5	2	3	2	3	3	2	-	1	3	-	3	-	-	-
CO6	2	3	2	3	3	2	-	3	3	-	3	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low