PUDUCHERRY TECHNOLOGICAL UNIVERSITY

PUDUCHERRY–605014

(A Technological University of Government of Puducherry)

NOTES ON AGENDA

of

the fifth meeting of

BOARD OF STUDIES

In

ELECTRONICS AND COMMUNICATION ENGINEERING

(Both offline and virtual mode)

Held on Thursday, 24th August 2023

Venue: Department of Electronics and Communication Engineering
Puducherry Technological University

Time: 02:00 pm

I N D E X

1	For Approval

Item 1.1	Curriculum and Syllabi for B.Tech – Electronics and Communication Engineering offered in Constituent and Affiliated Colleges under Puducherry Technological University *(Effective from the Academic Year 2022 – 23)*

The curriculum and syllabi of B.Tech. (Electronics and Communication Engineering) programme offered in Constituent and Affiliated Colleges under Puducherry Technological University have been prepared and placed for approval of BoS. The same is enclosed in Annexure I.

Item 1.2	Course Outcomes (COs) and CO-PO Articulation Matrix revised for all subjects in the B.Tech- ECE Syllabi of both PTU and Constituent / Affiliated Colleges

The course outcomes(COs) and course outcome - program outcome (CO-PO) articulation matrix have been revised for all courses in the B.Tech –ECE syllabi of both PTU and Constituent/affiliated Colleges according to modified Bloom's taxonomy and placed for approval of BoS. The same is enclosed in Annexure I.

2	Annexure

Annexure I	Curriculum and Syllabi of B.Tech - Electronics and Communication Engineering offered in Constituent / Affiliated Colleges under PTU *(Effective from the Academic Year 2022 – 23)*

Annexure I

Curriculum and Syllabi of B.Tech – Electronics and Communication Engineering offered in Constituent / Affiliated Colleges under PTU *(Effective from the Academic Year 2022 – 23)*

PUDUCHERRY TECHNOLOGICAL UNIVERSITY

Applicable to the Constituent and Affiliated Colleges of Puducherry Technological University

REGULATIONS 2022-2023

B.TECH. ELECTRONICS AND COMMUNICATION

ENGINEERINGCURRICULUM

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 Engineering and Communication Engineering by grooming the students to be practitioners of concepts and designers.
PEO2	Preparing the students to function as successful professionals as well as public spirited human beings serving the society/working for the welfare of society.
PEO3	Developing interpretation skills, life skills, ethical spirit, and sensitivity to safety issues in the minds of students.
PEO4	Training the students to be adaptive portable human resource through contemporary curriculum and co-curricular programmes.
PEO5	Nurturing the intellectual potential of the students towards pursuing their higher studies and research in the frontier areas of the domain both in India and abroad.
PEO6	Inculcating the spirit of innovation, creativity, independent thinking, risk taking ability, entrepreneurship and attitude to approach challenges with confidence.

PROGRAM OUTCOMES (PO)

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	Competency in using electronic design automation tools for the design and analysis of complex electronic systems in furtherance to research activities.
PSO2	Ability to apply embedded systems knowledge for real time applications in various fields.

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 asfollows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Humanities, Social Sciences and Management Courses	6 + 2 / 3 *	HSM
2	Basic Science Courses (Mathematics, Physics, Chemistry and Biology)	25	BSC
3	Engineering Science Courses (Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc.,)	23.5	ESC
4	Professional Core Courses	66.5	PCC
5	Professional Elective Courses (from chosen discipline)	15	PEC
6	Open Elective Courses (from other technical/ emerging disciplines)	10	OEC
7	Professional Activity Courses (Project Work, Entrepreneurship, Seminar, Internship, Comprehensive Test)	14	PAC
8	Mandatory non-Credit Courses (Environmental Sciences, Induction, Indian Constitution, Essence of Indian Traditional Knowledge, Professional Ethics)	Non-credit	MCC
	Total	**160**	

***included in the 10 credits under open elective category**

Semester-wise Courses and Credits

Semester I

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
FYA101	Induction Programme	MCC	-	-	-	-	0
MAA101	Mathematics I	BSC	TY	3	1	0	4
EEA101	Basic Electrical Engineering	ESC	TY	3	1	0	4
CSA101	Programming for problem Solving	ESC	TY	3	0	0	3
MEA102	Engineering Graphics And Computer Aided Drawing	ESC	TY	2	0	4	3
CEA101	Environmental Science	MCC	-	3	0	0	0
EEA102	Electrical Engineering Laboratory	ESC	LB	0	0	3	1.5
CSA102	Programming Laboratory	ESC	LB	0	0	3	1.5
Total				14	2	10	17
				26			

Semester II

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MAA102	Mathematics II	BSC	TY	3	1	0	4
PHA101	Physics	BSC	TY	3	1	0	4
CYA101	Chemistry	BSC	TY	3	1	0	4
HSA101	English for Communication	HSM	TY	2	0	2	3
MEA101	Workshop and Manufacturing Practice	ESC	LB	0	0	3	1.5
PHA102	Physics Laboratory	BSC	LB	0	0	3	1.5
CYA102	Chemistry Laboratory	BSC	LB	0	0	3	1.5
Total				11	3	11	19.5
				25			

CCC - Course Category Code, **SET** – Semester Exam Type, **TY** – Theory, **LB** – Laboratory, **PR** - Project

Semester III

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MAA105	Linear Algebra, Numerical Methods and Random Processes	BSC	TY	3	1	0	4
ECA101	Circuits and Networks	PCC	TY	3	0	0	3
ECA102	Electronic Devices and Circuits	PCC	TY	3	0	0	3
ECA103	Electromagnetic Waves and Fields	PCC	TY	3	0	0	3
ECA104	Digital System Design	PCC	TY	3	0	0	3
CSA134	Data Structures and Object- Oriented Programming	ESC	TY	3	0	0	3
ECA105	Electronic Devices and Networks Laboratory	PCC	LB	0	0	3	1.5
CSA135	Data Structures and Object- Oriented Programming Laboratory	ESC	LB	0	0	3	1.5
SHA102	Indian Constitution	MCC	-	3	0	0	0
Total				21	1	6	**22**
				28			

Course Code	Open Elective	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX*	Open Elective	OEC	TY	3	0	0	3

Semester IV

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ECA106	Transmission Lines and Waveguides	PCC	TY	3	0	0	3
ECA107	Electronic Circuit Design	PCC	TY	3	0	0	3
ECA108	Signals and Systems	PCC	TY	3	1	0	4
ECA109	Analog Communication	PCC	TY	3	0	0	3
ECA2XX	Professional Elective – I	PEC	TY	3	0	0	3
SHA101	Biology for Engineers	BSC	TY	3	0	0	2
ECA110	Digital System Design Laboratory	PCC	LB	0	0	3	1.5
ECA111	Electronic Circuit Design Laboratory	PCC	LB	0	0	3	1.5
ECA112	Analog Communication Laboratory	PCC	LB	0	0	3	1.5
Total				18	1	9	**22.5**
				28			

Course Code	Open Elective	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX*	Open Elective	OEC	TY	3	0	0	3

***ZZ in ZZA3XX is the Department Code of the department offering Open Elective**

Semester V

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ECA113	Digital Signal processing and DSP Processors	PCC	TY	3	1	0	4
ECA114	Digital Communication	PCC	TY	3	0	0	3
ECA2XX	Professional Elective – II	PEC	TY	3	0	0	3
CSA136	Microprocessors and Microcontrollers	ESC	TY	3	0	0	3
EPA101	Entrepreneurship	PAC	TY	3	0	0	2
ECA115	Digital Signal Processing Laboratory	PCC	LB	0	0	3	1.5
ECA116	Digital Communication Laboratory	PCC	LB	0	0	3	1.5
CSA137	Microprocessors and Microcontrollers Laboratory	ESC	LB	0	0	3	1.5
Total				15	1	9	**19.5**
				25			

Course Code	Open Elective	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

Semester VI

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ECA117	Microwave and Optical Engineering	PCC	TY	3	0	0	3
ECA118	Data Communication Networks	PCC	TY	3	0	0	3
ECA119	VLSI Design	PCC	TY	3	0	0	3
ECA2XX	Professional Elective - III	PEC	TY	3	0	0	3
HSA102	Industrial Economics and Management	HSM	TY	3	0	0	3
ECA120	Microwave and Optical Engineering Laboratory	PCC	LB	0	0	3	1.5
ECA121	Data Communication Networks Laboratory	PCC	LB	0	0	3	1.5
ECA122	VLSI Design Laboratory	PCC	LB	0	0	3	1.5
SHA103	Essence of Indian Traditional Knowledge	MCC	-	3	0	0	0
Total				18	0	9	**19.5**
				27			

Course Code	Open Elective	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

Semester VII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ECA123	Wireless Communication	PCC	TY	3	0	0	3
ECA124	Information Theory and Coding	PCC	TY	3	0	0	3
ECA125	Embedded System	PCC	TY	3	0	0	3
ECA2XX	Professional Elective - IV	PEC	TY	3	0	0	3
ECA2XX	Professional Elective - V	PEC	TY	3	0	0	3
ECA126	Wireless Communication Laboratory	PCC	LB	0	0	3	1.5
ECA127	Embedded System Laboratory	PCC	LB	0	0	3	1.5
ECA128	Mini Project	PAC	-	0	0	2	1
ECA129	Professional Ethics	MCC	-	2	0	0	0
Total				17	0	8	**19**
				25			

Course Code	Open Elective	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

Semester VIII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
SWA3XX	Open Elective through SWAYAM	OEC	-	-	-	-	2
SWA3XX	Open Elective through SWAYAM	OEC	-	-	-	-	2
ECA130	Comprehensive Test	PAC	-	-	-	2	1
ECA131	Internship	PAC	-	-	-	-	2
ECA132	Project Work	PAC	PR	-	-	8	8
Total				-	-	10	**15**
				10			

List of Professional Elective Courses (PEC)

Professional Electives	Course Code	Course	Semester
Professional Elective – I	ECA201	Random Variable and Random Processes	IV
	ECA202	Computer Architecture and Organization	
Professional Elective – II	ECA203	Antennas and Wave Propagation	V
	ECA204	Deep Learning	
Professional Elective – III	ECA205	Control Systems Engineering	VI
	ECA206	Digital Image and Video Processing	
	ECA207	Wavelet Transforms and its Applications	
	ECA208	Satellite Communication Systems	
Professional Elective – IV / V	ECA209	Microwave Integrated Circuit Design	VII
	ECA210	Intelligent Networks	
	ECA211	Cellular Mobile Communication	
	ECA212	Mobile Adhoc and Wireless Sensor Networks	
	ECA213	Optical Networks	
	ECA214	Cryptography and Network Security	
	ECA215	LTE Technology and Network Design	
	ECA216	Cognitive Radio Networks	
	ECA217	Multimedia Compression	
	ECA218	Radar and Navigational Aids	
	ECA219	Internet of Everything	
	ECA220	Advanced Mobile Communication	

List of Open Elective Courses (OEC)

Course Code	Course
ECA301	Consumer Electronics
ECA302	Communication Engineering
ECA303	CMOS VLSI Design
ECA304	Internet of Things
ECA305	Wireless Communication Networks
ECA306	Cyber Security

Courses offered under various categories:

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MAA101	Mathematics – I	I	4	25
	PHA101	Physics	II	4	
	CYA101	Chemistry	II	4	
	PHA102	Physics laboratory	II	1.5	
	CYA102	Chemistry Laboratory	II	1.5	
	MAA102	Mathematics –II	II	4	
	MAA105	Linear Algebra, Numerical Methods and Random Processes	III	4	
	SHA101	Biology for Engineers	IV	2	
ESC	EEA101	Basic Electrical Engineering	I	4	23.5
	CSA101	Programming for Problem Solving	I	3	
	MEA102	Engineering Graphics & Computer Aided Drawing	I	3	
	MEA101	Workshop and Manufacturing Practice	II	1.5	
	EEA102	Electrical Engineering Laboratory	I	1.5	
	CSA102	Programming Laboratory	I	1.5	
	CSA134	Data Structures and Object – OrientedProgramming	III	3	
	CSA135	Data Structures and Object - OrientedProgramming Laboratory	III	1.5	
	CSA136	Microprocessors and Microcontrollers	V	3	
	CSA137	Microprocessors and MicrocontrollersLaboratory	V	1.5	
PCC	ECA101	Circuits and Networks	III	3	66.5
	ECA102	Electronic Devices and Circuits	III	3	
	ECA103	Electromagnetic Waves and Fields	III	3	
	ECA104	Digital System Design	III	3	
	ECA105	Electronic Devices and NetworksLaboratory	III	1.5	
	ECA106	Transmission Lines and Waveguides	IV	3	
	ECA107	Electronic Circuit Design	IV	3	
	ECA108	Signals and Systems	IV	4	
	ECA109	Analog Communication	IV	3	
	ECA110	Digital System Design Laboratory	IV	1.5	
	ECA111	Electronic Circuit Design Laboratory	IV	1.5	
	ECA112	Analog Communication Laboratory	IV	1.5	
	ECA113	Digital Signal processing and DSP Processors	V	4	
	ECA114	Digital Communication	V	3	
	ECA115	Digital Signal Processing Laboratory	V	1.5	
	ECA116	Digital Communication Laboratory	V	1.5	
	ECA117	Microwave and Optical Engineering	VI	3	
	ECA118	Data Communication Networks	VI	3	
	ECA119	VLSI Design	VI	3	
	ECA120	Microwave and Optical Engineering Laboratory	VI	1.5	
	ECA121	Data Communication Networks Laboratory	VI	1.5	
	ECA122	VLSI Design Laboratory	VI	1.5	
	ECA123	Wireless Communication	VII	3	

	ECA124	Information Theory and Coding	VII	3	
	ECA125	Embedded System	VII	3	
	ECA126	Wireless Communication Laboratory	VII	1.5	
	ECA127	Embedded System Laboratory	VII	1.5	
PEC	ECA2XX	Professional Elective – I	IV	3	**15**
	ECA2XX	Professional Elective – II	V	3	
	ECA2XX	Professional Elective – III	VI	3	
	ECA2XX	Professional Elective – IV	VII	3	
	ECA2XX	Professional Elective – V	VII	3	
OEC	ZZA3XX	Open Electives offered by other Departments	III -VII	6	**10**
	SWA3XX	Open Electives offered under SWAYAM	-	4	
PAC	EPA101	Entrepreneurship	V	2	**14**
	ECA128	Mini Project	VII	1	
	ECA130	Comprehensive Test	VIII	1	
	ECA131	Internship	VIII	2	
	ECA132	Project Work	VIII	8	
HSM	HSA101	English for Communication	II	3	**6+3*/2***
	HSA102	Industrial Economics and Management	VI	3	
	HSA3XX	Humanities Open Elective offered by HSS Department	-	3*	
	SWA3XX	Humanities Open Elective offered under SWAYAM	-	2*	
		Total			**160**

***Included in the 10 credits under Open Elective**

Department : **First year**		Programme: **B.Tech**						
Semester : **First**		Course Category Code: **MCC**			Semester Exam Type: -			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
FYA101	**Induction Programme**	-	-	-	Non-Credit	-	-	-
Prerequisite	**-**							
Course Outcome	The course will enable the student to							
	CO1 Acquire social awareness & knowledge for self-development							
	CO2 Be aware of nature & environment conscious and of Innovative nature.							
	CO3 Develop holistic attitude and harmony in the individual, family, and society							
	CO4 Know about the art and culture, language and literature of this vast secular nation							
	CO5 Integrating technical Education for betterment of society							
UNIT-I	**Proficiency in English**				**Periods: 12**			
Communication skills – Diagnostic test on Grammar – Synonyms, Antonyms, Tenses, Sentence Completion, Idioms & Phrases, One word substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb agreement – Writing – Paragraph writing, Letter writing, Essay writing, Story Development.								**CO1**
UNIT-II	**Bridge course in Mathematics**				**Periods: 12**			
Fundamentals of differential and integral calculus: Theory, Practice & Test. Limit of function-Fundamental results on limits-Continuity of a function- Concept of differentiation- Concept of derivative- Slope of a curve-Differentiation Techniques- Derivatives of elementary functions from first principle-Derivatives of inverse functions-Logarithmic differentiation- Method of substitution- Differentiation of parametric functions-Differentiation of implicit functions- Higher order derivatives. Integrals of functions containing linear functions-Method of integration (Decomposition method, method of substitution, integration by parts) - Definite integrals. Simple definite integrals- Properties of Definite integrals- Reduction formulae- Area and volume- Length of curve- surface area of a solid.								**CO2**
UNIT-III	**Universal human values**				**Periods: 12**			
Current Status of the society (Sources of fear)-Reformation through education-Sanskar-What is success (getting good marks, college admission, Job etc)-What is aim of life (happiness, Prosperity and continuity of happiness and prosperity)-What is required for happiness (relationship, physical facilities)-Relationship involves all emotions and feelings-Physical facility-material things required for life-Difference between animal and human consciousness-Animal consciousness-depending on money, accumulating money by wrong means etc.-Human consciousness-right thinking, right understanding, right feeling-Happiness through Harmony in the individual, family, society and nature, leading to fearlessness in the society is the purpose of holistic education or value education.								**CO3**
UNIT-IV	**Literary activities**				**Periods: 12**			
Team building activities – Quiz – Oral Exercises – Group discussion, Debate, Extempore, Role play.								**CO4**
UNIT-V	**Creative arts**				**Periods: 12**			
Introduction to painting & renowned artworks – Documentary & Short films – Music – Vocal, Instrumental – Dance – Classical, Cinematic – Mimicry – Mime.								**CO5**
Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 60**			
Reference Books								
-								

Department : **Mathematics**		Programme: **B.Tech.**						
Semester : **First**		Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MAA101	**Mathematics-I**	3	1	-	4	40	60	100
Prerequisite:	-							

Course Outcome	**CO1**	Apply differential calculus to notions of curvature, evolutes and utilize Beta and Gamma functions to solve improper integrals.
	CO2	Make use of mathematical tools in evaluating multiple integrals and their applications.
	CO3	Solve problems of first order differential equations of various types.
	CO4	Determine solution of higher order ODE and simultaneous differential equations.
	CO5	Estimate gradient, divergence, curl and use Gauss, Stokes and Green's theorem to simplify evaluation of integrals.

UNIT-I	**Differential Calculus**	**Periods: 12**
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.		**CO1**
UNIT-II	**Multi variable calculus**	**Periods: 12**
Multiple Integrals, change of order of integration in double integrals, Applications: Plane areas (double integration), Change of variables (Cartesian to polar), Double and triple integrations, Volumes by triple integration – Mass, Center of mass and Gravity (constant and variable densities).		**CO2**
UNIT-III	**First order Ordinary Differential Equation**	**Periods: 12**
Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree, equations solvable for p, equations solvable for y, equations solvable for x - Clairaut's type - simple applications, orthogonal trajectories, growth and decay.		**CO3**
UNIT-IV	**Higher Order Ordinary Differential Equation**	**Periods: 12**
Linear differential equations of higher order - with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method.		**CO4**
UNIT-V	**Vector Calculus**	**Periods: 12**
Gradient, divergence and curl, their properties and relations. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integral, Theorems of Green, Stokes and Gauss divergence (without proof). Simple applications involving cubes, sphere and rectangular parallelepipeds.		**CO5**

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

Reference Books:

1. Veerarajan T, Engineering Mathematics I , McGraw-Hill Education(India) Private Limited, 2014
2. Veerarajan T, Engineering Mathematics II , McGraw-Hill Education(India) Private Limited, 2015
3. Venkataraman M.K., Engineering Mathematics, Vol. I&II, The National Publishing Company, Chennai, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics (9 th Ed), John Wiley & Sons, New Delhi, 2011.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
6. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2011.

COURSE ARTICULATION MATRIX

Course: **MAA101 Mathematics-I**

Regulation: 2022-23

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2							2			
CO2	3	3	3	3	2							2			
CO3	3	3	3	3	2							2			
CO4	3	3	3	3	2							2			
CO5	3	3	3	2	2							2			

Department : **Electrical and Electronics Engineering**		Programme : **B.Tech**						
Semester : **First/Second**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA101	**Basic Electrical Engineering**	3	1	-	4	40	60	100
Prerequisite	-							

Course Outcome	**CO1**	To understand the basic concepts of DC circuits and theorems.
	CO2	To explain the concepts of AC circuits and resonance.
	CO3	To understand the basic concepts of magnetic circuits and transformer.
	CO4	To explain the working principle, construction, applications of electrical machines.
	CO5	To Gain knowledge of working of power plants and fundamentals of switch gear and earthing.

UNIT-I	**DC Circuits**	**Periods: 12**
Electrical circuit elements (R, L and C) - Definition of Voltage, Current, Power and Energy – Ohm's law, Kirchoff current and voltage laws, analysis of simple circuits with DC voltage – Division of current in series and parallel circuits – Star-delta conversion – Node and mesh method of analysis of DC circuits – Network Theorems: Thevenin, Norton and Superposition Theorems.		**CO1**
UNIT-II	**AC Circuits**	**Periods: 12**
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Resonance: Series and parallel resonance. Three-phase balanced circuits: voltage and current relations in star and delta connections – Power measurement by two Wattmeter method.		**CO2**
UNIT-III	**Transformers**	**Periods: 12**
Laws of Electromagnetic induction – Ampere's circuital law, Faraday's law and Lenz law – Dot rule. Magnetic materials, B-H characteristics. Single phase transformer: Construction and working, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.		**CO3**
UNIT-IV	**Electrical Machines**	**Periods: 12**
Elementary concept of rotating machines – Flemming's right hand and left hand rule – DC Machines: Construction and working of DC Machines - Generator and Motors – Emf equation of DC generator and back emf of DC motor –characteristics - Types of DC Machines. AC Machines: Construction and working of Single phase & three phase induction motors and synchronous generator (qualitative approach only).		**CO4**
UNIT-V	**Power Plants and LT Switch gear**	**Periods: 12**
Power Plants: Layout of thermal, hydro and nuclear power generation (block diagram approach only). Components of AC transmission and distribution systems – One-line diagram. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables. Earthing. Elementary calculations for energy consumption.		**CO5**

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

Reference Books

1. D. P. Kothari and L. J. Nagrath, "Basic Electrical Engineering", 3rd Edition, Tata McGraw Hill, 2017.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2011.
3. Rajendra Prasad, "Fundamentals of Electrical Engineering", 3rd Edition, PHI Learning Private Limited, 2014.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
6. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Department : **Computer Science and Engineering**			Programme : **B.Tech**						
Semester : **First/Second**			Course Category Code: **ESC**			Semester Exam Type: **TY**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CSA101	**Programming for Problem Solving**		3	-	-	3	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	Understood the phases of problem solving techniques for simple problems.							
	CO2	Able to write programs using the basic language constructs.							
	CO3	Able to build a larger programs using function oriented approaches.							
	CO4	Could write efficient programs using advanced concepts to optimize the memory.							
	CO5	Could write programs to access data from the secondary storage efficiently.							

UNIT-I	**Algorithmic Problem Solving**	**Periods: 9**
History and Classifications of Computers – Components of Computer – Working Principle of Computer – Hardware – Software and its Types – Applications of Computers. Generations of Programming Languages – Introduction to Number System. Problem solving techniques: Program development life-cycle – Algorithms – building blocks of algorithms - Algorithmic problem solving-Flowchart– Pseudo code.		**CO1**
UNIT-II	**Data, Expressions, Statements**	**Periods: 9**
Introduction to C –C Program Structure – C Tokens: Keyword, Identifiers, Constants, Variables and Data types (simple and user-defined) – Operators and its types – Operator Precedence – Expression Evaluation – Type Conversion –Managing Input/output operations-Branching Statements – Looping Statements.		**CO2**
UNIT-III	**Arrays and Functions**	**Periods: 9**
Arrays – Two dimensional arrays, Multidimensional arrays. Character arrays. Functions: Function Prototype, Passing Arguments to Function – Call by Value and Call by Reference – Nested function call – Library Functions – User-defined Functions – Recursion. Strings – String I/O functions, String Library functions – Storage classes.		**CO3**
UNIT-IV	**Structures, Unions and Pointers**	**Periods: 9**
Structures – Arrays and structures – Nested structures – Structure as argument to functions–Union. Pointers – Declaration, Initialization and Accessing Pointer variable – Pointers and arrays – pointers as argument and return value – Pointers and strings - Pointers and structures.		**CO4**
UNIT-V	**File Management**	**Periods: 9**
Introduction to File Concepts in C – File types – I/O operations on files – File modes – Random access to files – Command line arguments. Dynamic Memory Allocation: MALLOC, CALLOC, FREE, REALLOC. Introduction to preprocessor: Macro substitution directives – File inclusion directives –Compiler Control directives – Miscellaneous directives.		**CO5**

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

Reference Books

1. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, Seventh Edition, 2017.
2. Byron Gottfried & Jitender Chhabra, “Programming with C”, Schaum's Outlines Series, 2017.
3. Brian W. Kernighan & Dennis Ritchie. “The C Programming Language”, Pearson Education India; Second Edition, 2015.
4. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Edition, 2012.

Department : **Mechanical Engineering**			Programme : **B.Tech**						
Semester : **First/Second**			Course Category Code: **ESC**			Semester Exam Type: **TY**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
MEA102	**Engineering Graphics and Computer Aided Drawing**		2	-	4	3	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	Students learn to properly dimension and annotate engineering drawings as per standards of engineering drawing practice.							
	CO2	Students are made to follow and understand the basics of engineering drawing with simple solids.							
	CO3	Students can properly apply and produce sectional views.							
	CO4	Students are able to properly create multi-view orthographic drawings from three dimensional diagrams. Students are able to present a drawing in orthographic and isometric projections.							
	CO5	Students learn the application of engineering graphics through computer-aided drafting.							
UNIT-I						**Periods: 18**			
Introduction to Engineering graphics, Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning, Projection of Lines, Projection of Planes									**CO1**
UNIT-II						**Periods: 18**			
Projections of simple solids									**CO2**
UNIT-III						**Periods: 18**			
Sections of solids and Development of surfaces									**CO3**
UNIT-IV						**Periods: 18**			
Isometric Projections and Orthographic Projections									**CO4**
UNIT-V						**Periods: 18**			
Introduction to Computer Graphics and Drafting, Auto CAD, 2-D diagrams of simple geometries using Auto-CAD script.									**CO5**
Lecture Periods: 30		**Tutorial Periods: -**			**Practical Periods: 60**			**Total Periods: 90**	

Reference Books

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. K.Venugopal, Engineering Drawing & Graphics + Auto CAD, 4th edition, New Age Int'lPublication Ltd., 2004.
3. BIS, Engineering Drawing practices for Schools & College, SP 46: 2003.
4. T. Jeyapoovan, Engineering Graphics using AUTOCAD, 7th edition, VIKAS Publishing House (P) Ltd., 2015.
5. N.D. Bhatt, Engineering Drawing, 49th edition, Charotar Publishing House, 2014.
6. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
7. M. B. Shah and B. C. Rana, Engineering Drawing, 2nd edition, Pearson Publications, 2018.
8. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
9. http://www.3ds.com/products/catia/
10. http://en.wikipedia.org/wiki/CATIA

Department : **Civil Engineering**		Programme : **B.Tech**						
Semester : **First/Second**		Course Category Code: **MCC**			Semester Exam Type: -			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEA101	**Environmental Science**	3	-	-	Non-Credit	-	-	-
Prerequisite	-							
Course Outcome	**CO1**	Relate to the environment and learn about available natural resources.						
	CO2	Designing methods for rainwater harvesting and recycling and reusing of domestic water						
	CO3	Address environmental issues like pollution, depletion of natural resources and degrading ecosystem						
	CO4	Develop environment friendly models for resource and energy management, and work for sustainable development.						
	CO5	Participate in energy conservation, tree plantation and other green initiatives.						
	CO6	Segregate solid waste and participate in events related to environmental issues.						

Activity – 1	**Periods: 9**	
Water resources- Water Cycle, Distribution, Groundwater flow, Demand for water, Water pollution- causes and effects, Water Act (1974).		**CO1**
Activity – 2	**Periods: 9**	
Rainwater Harvesting-Methodology, components, design of rainwater harvesting system for a single house (as per IS:15797-2008)		**CO2**
Activity – 3	**Periods: 9**	
Domestic waste water- Definition, Characteristics, Recycling and Reuse of domestic waste water.		
Activity – 4	**Periods: 9**	
Air Pollution- definition, classification, causes, Sources, effects and control measures, Air Act (1981)		
Activity – 5	**Periods: 9**	**CO3**
Solid Waste management – Causes– effects and control measures of Urban and industrial waste, Waste management initiatives in India for human well-being.		
Activity – 6	**Periods: 9**	**CO4**
Renewable and non–renewable energy resources– use of alternating energy sources – Energy management.		
Activity – 7	**Periods: 9**	
Green Buildings- Definition, Importance, building envelope, Problems in existing buildings, Energy use in Buildings, Greenhouse gas emissions and indoor air pollution, green construction materials, Green building assessment system, Case study		**CO5**
Activity – 8	**Periods: 9**	
Importance of Tree Plantation, Display of usefulness of trees, Method of tree planting, Identify the trees available in the PTU campus, Mass Plantation inside/outside the campus in association with the H2EC /NSS of PTU, Store the trees to the planted by the dignitaries with the help of horticulture of PTU.		
Activity – 9	**Periods: 9**	
Collection and segregation of solid waste in the PTU campus in association with the H2EC /NSS of PTU		
Activity – 10	**Periods: 9**	
Invite guest Lectures from the Environmental experts of DSTE (for environmental issues)/REAP (for energy efficient buildings)/Town and Country Planning/PWD of Puducherry, conducting competitions to students in the topics of slogan making, poster and seminar presentations, debate and observing the important national and international days on environmental issues to bring awareness among the students and public.		**CO6**

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

Reference Books

1. P.Yugananth, R.Kumaravelan, Environmental Science and Engineering, Scitech Publications (Inida) P.Ltd., Delhi,2017.
2. John Pichtel, Waste Management Practices: Municipal, Hazardous and Industrial, CRC Press,2014
3. V.S.K.V.Harish, Arunkumar, Green Building Energy Simulation and Modeling, Elsevier Science & Technology,2018

Department : **Electrical and Electronics Engineering**			Programme : **B.Tech.**						
Semester : **First/Second**			Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EEA102	**Basic Electrical Engineering Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	To understand the principles of domestic wiring and electrical components.							
	CO2	To illustrate handling of measuring instruments and demonstrate the concepts of network theorems							
	CO3	To analyze RL,RC,RLC circuits							
	CO4	To introduce concepts of single/three phase circuits							
	CO5	To demonstrate the working principle of electrical machines							

Any 10 experiments

1. Study of: Basic safety precautions. Concepts of domestic wiring- wires, switches, plugs, sockets, fuses and lamp holders. 2. Study of fan and tube light connections and earthing 3. Stair case wiring. 4. Bedroom wiring.	**CO1**
5. Use of measuring instruments. Verification of Kirchoff's voltage and current law 6. Verification of Thevenin and Norton theorems 7. Verification of Superposition Theorem.	**CO2**
8. Impedance calculation of R-L, R-C & R-L-C circuits and verification. 9. Measurement of power & power factor in a single phase AC circuit using three Ammeter Method 10. Resonance: Series and parallel.	**CO3**
11. Measurement of various line and phase quantities for a three phase star/delta ac circuit. 12. Measurement of three phase power using two wattmeter method. 13. Energy measurement using single phase energy meter.	**CO4**
14. Load test on a single phase transformer. 15. Load test on a single phase induction motor.	**CO5**

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

Reference Books

1. Laboratory Manual, Department of Electrical and Electronics Engineering, Puducherry Technological University.

Department : **Computer Science and Engineering**			Programme : **B.Tech**						
Semester : **First/Second**			Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CSA102	**Programming Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	Understood the program editing and compilation environment.							
	CO2	Able to write simple C programs using most frequently used control structures.							
	CO3	Apply the methods problems using arrays and functions.							
	CO4	Learnt to handle data processing using structures for simple applications.							
	CO5	Write programs that could handle file i/o and pointers.							

Programming Using C

1. Study of Compilation and execution of simple C programs 2. Basic C Programs a. Arithmetic Operations b. Area and Circumference of a circle c. Swapping with and without Temporary Variables	**CO1**
3. Programs using Branching statements a. To check the number as Odd or Even b. Greatest of Three Numbers c. Counting Vowels d. Grading based on Student's Mark 4. Programs using Control Structures a. Computing Factorial of a number b. Fibonacci Series generation c. Prime Number Checking d. Computing Sum of Digit	**CO2**
5. Programs using Arrays a. Sum of 'n' numbers b. Sorting an Array c. Matrix Addition, Subtraction, Multiplication and Transpose 6. Programs using Functions a. Computing nCr b. Factorial using Recursion c. Call by Value and Call by Reference	**CO3**
7. Programs using String Operations a. Palindrome Checking b. Searching and Sorting Names 8. Programs using Structure a. Student Information System b. Employee Pay Slip Generation c. Electricity Bill Generation	**CO4**
9. Programs using Pointers a. Pointer and Array b. Pointers as argument and return value c. Pointer and Structure 10. Programs using File Operation a. Counting No. of Lines, Characters and Black Spaces b. Content copy from one file to another c. Reading and Writing Data in File	**CO5**

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

Reference Books

Department : **Mathematics**			Programme : **B. Tech.**						
Semester : **Second**			Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
MAA102	**Mathematics-II**		3	1	-	4	40	60	100
Prerequisite:	-								
Course Outcome	**CO1**	Define and explain the basic concepts of Matrices and make use of it to solve system of equations.							
	CO2	Analyze the continuous and discrete functions in terms of Fourier series expansion.							
	CO3	Explain the concept of Fourier Transform and make use of it to evaluate Integrals.							
	CO4	To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.							
	CO5	Explain the concepts of complex integration techniques and contour integration techniques which can be used in real integrals.							

UNIT-I	**Matrices**	**Periods: 12**
Inverse and rank of a matrix, System of linear equations, Symmetric, Skew Symmetric and Orthogonal matrices, Eigenvalues and Eigenvectors of a real matrix, Characteristic equation, Properties of Eigenvalues. Cayley-Hamilton Theorem (statement only), Diagonalization of matrices.		**CO1**
UNIT-II	**Fourier Series**	**Periods: 12**
Dirichlet's conditions - Expansion of periodic functions into Fourier series- Change of interval- Half-range Fourier series. Complex form of Fourier series - Root mean square value - Parseval's theorem on Fourier coefficients - Harmonic analysis.		**CO2**
UNIT-III	**Fourier Transform**	**Periods: 12**
Fourier Integral Theorem(statement only)- Fourier transform, Inverse Fourier transform, definition and properties - Evaluation of integrals- Fourier cosine and sine transform, definitions and evaluation of integrals using cosine and sine transforms.		**CO3**
UNIT-IV	**Complex Valued function and Conformal Mapping**	**Periods: 12**
Definition of a Complex valued function f(z) and its derivative - Analytic functions -Necessary condition for a function f(z) to be analytic (in Cartesian) - Cauchy-Riemann equation - statement of C-R equation in polar form -sufficient condition for f(z) to be analytic(statement only)- harmonic function- Harmonic and orthogonal properties of analytic function – Construction of analytic functions. Conformal mapping – Simple and standard transformations like $w = z^2$, e^z, z+c, cz, sinz, 1/z, Bilinear transformation (excluding Schwarz- Christoffel transformation).		**CO4**
UNIT-V	**Complex Integration**	**Periods:12**
Cauchy's Integral theorem, Cauchy's integral formula (without proof) and problems, Taylor's and Laurent's theorem (without proof), Classification of singularities. Residues and evaluation of residues – Cauchy's Residue theorem, Contour integration – Evaluation of real integrals – unit circle and semi-circular contour (excluding poles on boundaries).		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. Veerarajan T., Engineering Mathematics II , McGraw-Hill Education(India) Private Limited, 2018
2. Veerarajan T., Transforms and Partial Differential Equations , McGraw-Hill Education(India) Private Limited, 2016
3. Venkataraman M.K., Engineering Mathematics, Vol. II and III, The National Publishing Company, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics (Ninth Edition), John Wiley & Sons, New Delhi, 2011
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
6. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, Ninth Edition, 2011.

COURSE ARTICULATION MATRIX

Course: **MAA102 Mathematics-II**

Regulation: 2022-23

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3							2			
CO2	3	3	3	3	3							2			
CO3	3	3	3	3	2							2			
CO4	3	3	3	3	3							2			
CO5	3	3	3	3	3							2			

Department: **Physics**			Programme: **B.Tech.**						
Semester : **First/Second**			Subject Category: **BSC**						
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
PHA101	**Physics**		3	1	-	4	40	60	100
Prerequisite:	-								
	At the end of the course, the students should be able to:								
Outcome:	**CO1**	Illustrate the concepts of electromagnetic theory, dielectric properties, wave mechanics, optical phenomena, lasers and fiber optics.							
	CO2	Develop the skills to identify and solve the problems related to field theory of electricity and magnetism, mechanism of polarization, matter waves, optics and laser & fiber optics.							
	CO3	Classify the electrostatics and magnetostatics, types of polarization, time dependent and independent Schrodinger wave equation, optical phenomena, types of laser and fiber optics.							
	CO4	Explain the acquired information on the respective topics.							
	CO5	Compile the basic concepts of physics in various field for different applications.							
UNIT-I	**Electromagnetic theory**					**Hours: 12**			
Brief review of electrostatics, electric field and potential – divergence and curl of electrostatic field – Gauss law and its applications, Laplace's equation in one, two and three dimension. Brief review of magnetostatics, Biot-Savart law – divergence and curl of static magnetic field – Ampere's law – magnetic vector potential – comparison of electrostatics and magnetostatics.									CO1, CO2, CO3, CO4, CO5
UNIT-II	**Dielectrics**					**Hours: 12**			
Dielectric polarization and its mechanisms – dielectric loss – dielectric breakdown – calculation of electronic polarizabilities and ionic polarizabilities – temperature and frequency dependence of polarization – internal field in solids – Clausius-Mossotti relation – ferroelectricity – ferroelectric hysteresis.									CO1, CO2, CO3, CO4, CO5
UNIT-III	**Quantum mechanics**					**Hours: 12**			
Matter Waves – de Broglie hypothesis – uncertainty principle – Schrödinger wave equations – time dependent – time independent – physical significance of wave function – application to particle in a one-dimensional potential box – concept of quantum mechanical tunneling (without derivation) – applications of tunneling (qualitative) to alpha decay, tunnel diode, scanning tunneling microscope.									CO1, CO2, CO3, CO4
UNIT-IV	**Wave optics**					**Hours: 12**			
Interference: Air wedge – Newton's rings – Michelson's interferometer – types of fringes – determination of wavelength of a light source. **Diffraction:** concept of resolution of spectral lines – Rayleigh's criterion – resolving power of grating, prism & telescope. **Polarisation:** Basic concepts of double refraction – circular and elliptical polarization – quarter and half wave plates – optical rotation – specific rotatory power – Laurent's half shade polarimeter.									CO1, CO2, CO3, CO4, CO5
UNIT-V	**Lasers and Fiber optics**					**Hours: 12**			
Lasers: Principles of laser – spontaneous and stimulated emissions – Einstein's theory of matter radiation interaction – A and B coefficients – population inversion and laser action – optical resonators(qualitative) – types of lasers –Nd: YAG, CO_2 laser, GaAs laser – industrial & medical applications of lasers (any two). **Fiber optics:** Principle and propagation of light in optical fiber – numerical aperture and acceptance angle – step index and graded index fiber22qualitative ideas of attenuation in optical									CO1, CO2, CO3, CO4, CO5

fibers – fiber optic communication (schematic), active and passive fiber optic sensors, endoscope.			
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Reference Books:

1. David Griffiths, Introduction to Electrodynamics, 3rd Edition, Eastern Economy Edition., 2011
2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co, 2006.
3. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
4. V. Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011
5. Avadhanulu M. N. , Engineering Physics, S. Chand & Co, 2007
6. David Halliday, Robert Resnick and Jearl Walker, Fundamentals of Physics, Wiley publications, 2013
7. H.J. Pain, The physics of vibrations and waves, Wiley publications, 2005
8. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012
9. Orazio Svelto,2nd Edition, plenum Press, Principles of Lasers, 1982.
10. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.

Department : **Chemistry**		Programme : **B.Tech**						
Semester : **First/Second**		Course Category Code: **BSC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CYA101	**Chemistry**	3	1	-	4	40	60	100
Prerequisite:	-							

Course Outcome		
	The course will enable the student to:	
	CO1	**Analyse** chemical structures in terms of chemical bonding and isomerism
	CO2	**Examine** the properties and processing of bulk materials in the content of adsorption, kinetic behaviour
	CO3	**Discover** the fundamental concepts of electrode potential in verw of practical applications
	CO4	**Illustrate** the organic reaction mechanisms with respect to the synthesis of drugs
	CO5	**Interpret** the fundamental principle of spectroscopy and electrochemistry towards appropriate applications

UNIT-I	**Chemical bonding and isomerism**	**Periods: 12**
Chemical bonding-valence bond theory, overlapping of orbitals. Hybridization in carbon compounds-sp, sp^2 and sp^3. Electron pair repulsion. Hybridization and shape of water and ammonia molecules. Molecular orbital theory-combination of atomic orbitals. Bond order. Molecular orbital diagrams for homonuclear diatomic molecules-(hydrogen to neon). Ionic, dipolar and van der Waals interactions. Structural and stereo isomerism-geometrical isomerism in alkenes. Optical isomerism-optical activity, chiral carbon. Optical isomerism in lactic acid and tartaric acid. Enantiomers, diastereomers and meso compounds. Resolution of racemic mixtures, racemization, asymmetric synthesis, Walden inversion.		**CO1**
UNIT-II	**Water chemistry and reaction kinetics**	**Periods: 12**
Water chemistry-hard and soft water, removal of hardness by ion exchange and zeolite processes.Determination of hardness by EDTA method. Desalination-Reverse osmosis. Adsorption-adsorption of gases on solids-Freundlich and Langmuir adsorption isotherms. Factors affecting adsorption of gases on solids. Chemical kinetics-rate of a reaction, factors affecting rate of reaction, first and second order rate equations. Half-life of reactions.		**CO2**
UNIT-III	**Electrode potential and corrosion**	**Periods: 12**
Electrode potential, electromotive force, reference electrodes-hydrogen, Ag/AgCl, calomel and glass electrodes. Nernst equation and applications. Electrolyte concentration cell. Batteries-Primary and secondary batteries. Dry cell, alkaline battery, Ni-Cd battery and lead-acid battery. Fuel cell-Hydrogen-oxygen fuel cell. Corrosion-dry and wet corrosion, mechanism of electrochemical corrosion, galvanic, pitting and concentration cell corrosion. Factors influencing corrosion. Corrosion control by cathodic protection. Anodization.		**CO3**
UNIT-IV	**Introduction to reaction mechanism**	**Periods: 12**
Introduction to reaction mechanism-factors influencing a reaction, homolytic and heterolytic bond fission. Reaction intermediates-carbonium ion, carbanion, free radicals and carbenes. Electrophiles and nucleophiles. Mechanism of free radical substitution-chlorination of methane. Mechanism of electrophlic substitution-bromination of benzene. Nucleophilic substitution-S_N2-hydrolysis of methyl bromide, S_N1-hydrolysis of t-butyl bromide. Elimination reactions-E1 and E2. Addition reactions-nucleophilic and electrophilic. Synthesis of aspirin, paracetamol, sulfanilamide and chloroquine.		**CO4**
UNIT-V	**Analytical techniques**	**Periods: 12**
Absorption and emission of radiation. Beer-Lamberts law. Ultraviolet and visible spectroscopy-basic principles and instrumentation. Basic principles and instrumentation of atomic absorption spectrometry, hollow cathode lamp. Conductivity-equivalent and molar conductance, cell constant. Conductometric titration-types of conductometric titrations. Potentiometry-principle of acid base titration. Chromatography- Principles and instrumentation of gas Chromatograph.		**CO5**

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

Reference Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2016.
2. S.S. Dara and S.S Umare, A Textbook of Engineering Chemistry, S. Chand & Co., Ltd. New Delhi, 2013.
3. Arun Bahl, B.S. Bahl and G.D. Tuli, Essentials of Physical Chemistry, S. Chand and Company Ltd, New Delhi, 2016
4. Arun Bahl and B.S. Bahl, A Text Book of Organic Chemistry, S. Chand and Company Ltd, New Delhi, 2011
5. B.R. Puri, L.R. Sharma and K.C Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi, 2007
6. G.R. Chatwal and S.K. Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House Pvt Ltd, New Delhi, 2005
7. D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd, Singapore, 2004.

COURSE ARTICULATION MATRIX

Course: **CYA101 Chemistry**

Regulation: 2022-23

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2		2	2	1	3					1
CO2	3	2		2	2	1	3					1
CO3	3	2		2	2	1	3					1
CO4	3	2		2	2	1	3					1
CO5	3	2		2	2	1	3					1
Average	3	2		2	2	1	3					1

Department : **Humanities and Social Sciences**		Programme : **B.Tech**						
Semester : **First/Second**		Subject Category: **HSM**				Semester Exam Type: **TY**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HSA101	**English for Communication**	2	-	2	3	40	60	100
Prerequisite:	-							

Outcome:		
	CO1	Apply various strategies to foster advanced technical communication skills.
	CO2	Interpret reading materials, thereby enhancing comprehension and critical thinking skills.
	CO3	Illustrate ideas in diverse writing forms, through well developed writing skills.
	CO4	Demonstrate effective speaking skills through clear and coherent articulation.
	CO5	Apply advanced vocabulary and grammatical structures for accurate and effective communication

UNIT-I	**TECHNICAL COMMUNICATION**	**Hours: 12**
Nature of technical communication – Forms of technical communication – General and technical communication(differences) – Importance and need –Organization in technical communication – Style – ABC of technical communication –Technical communication skills.		**CO1**
UNIT-II	**COMPREHENSION AND ANALYSIS**	**Hours: 12**
Technical and Non-Technical passages – Reading methods – Skimming – Scanning– Extensive and Intensive reading – Predicting, Inferring – Contextual meaning – summarizing – Note making/ Note taking.		**CO2**
UNIT-III	**PRACTICE IN WRITING**	**Hours: 12**
Sentence structures – Use of phrases and clauses in sentences – Coherence in writing – Hints development- Principles of paragraph writing –Essay writing – Describing – Defining – Classifying –Formal letters – Memorandum – Instructions - Recommendations – E- mail –Reports(feasibility and accident)		**CO3**
UNIT-IV	**SPEAKING PRACTICE**	**Hours: 12**
Pronunciation –– Short conversations and Dialogues –Formal presentations – Group discussions – Extempore speaking – Debates- Role plays– Interview skills.		**CO4**
UNIT-V	**GRAMMAR AND VOCABULARY BUILDING**	**Hours: 12**
Word formation – Root words from foreign languages and their use in English – Prefixes and suffixes – Subject-verb agreement – Articles – Voice – Preposition– Importance of punctuation – Error correction– Synonyms, Antonyms and standard abbreviations.		**CO5**

Total contact Hours: 30	**Total Tutorials: -**	**Total Practical Classes: 30**	**Total Hours: 60**

Reference Books:

1. Sudarshana, N.P and C. Savitha. English for Technical Communication. Noida: CUP, 2016.
2. Shoba, K N and Lourdes JoavaniRayen. Communicative English. Chennai: CUP, 2017.
3. **Rizvi, Ashraf, M. Effective Technical Communication. New Delhi: McGraw, 2017.**
4. Michael Swan. Practical English Usage. Oxford: OUP,2014
5. Dutt, Kiranmai P and Geetha Rajeevan. Basic Communication Skills. New Delhi: CUP,2013
6. Sanjay Kumar and Pushpalata. Communication Skills. New Delhi: OUP, 2011.
7. Mohan, Krishna and Meera Banerji. Developing Communication Skills. 2nd edition. Delhi: Macmillan, 2012.
8. Relevant material from newspapers, magazines and journals will be used for integrated practice.
9. Websites
   i) www.onestopenglish.com
   ii) www. learnenglish.com
   iii) www.englishforeveryone.com
   iv) www. esllounge.com

COURSE ARTICULATION MATRIX

Course: **HSA101 English for Communication**

Regulation: 2022-23

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

Department : **Mechanical Engineering**			Programme : **B.Tech**						
Semester : **First/Second**			Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
MEA101	**Workshop and Manufacturing Practice**		0	0	3	1.5	40	60	100
Prerequisite									
Course Outcome	**CO1**	To convey the basics of mechanical tools used in carpentry section and establish hands on experience in making the different carpentry joints							
	CO2	To gain knowledge on types of tools and machines used in sheet metal shop and perform some exercises							
	CO3	To develop basic welding and fitting joints using the hand tools and establish the importance of joints and fitting in engineering applications							
	CO4	To gain knowledge of the different machines used in manufacturing processes which are commonly employed in the industry, to fabricate components using different materials							
	CO5	To carry out simple manufacturing operations in lathe, drilling and shaping machine							
UNIT-I	**Carpentry**						**Periods: 9**		
Study of tools and machines in carpentry Practice on :1.Half Lap joint 2.Corner Mortise joint and 3.Dovetail joint									**CO1**
UNIT-II	**Sheet Metal**						**Periods: 9**		
Study of tools and machineries in sheet metal shop 1.Frustum of cone 2.Waste collection tray and 3.Rectangular box									**CO2**
UNIT-III	**Welding and Fitting**						**Periods: 9**		
Lectures/demonstrations/videos on Welding and fitting operations with simple exercise. 1. Filing and Job preparation 2. V-Fitting and 3. Simple lap joint									**CO3**
UNIT-IV	**Study of tools and machines**						**Periods: 6**		
Study of tools and machines in manufacturing lab 1. Lathe machine 2.Drilling machine and 3.Shaping machine									**CO4**
UNIT-V	**Simple Exercises in Lathe/Drilling machine/Shaper**						**Periods: 12**		
Simple operations in lathe, drilling and shaping 1.Facing and Turning 2.Step Turning 3.Drilling in a flat plate with different drill dimensions and 4.Cube in Shaping									**CO5**
Lecture Periods: 3		**Tutorial Periods: -**			**Practical Periods: 42**			**Total Periods: 45**	

Reference Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001.

Department : **Physics**		Programme : **B.Tech.**						
Semester : **First/Second**		Subject Category: **BSC**						
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
PHA102	**Physics Laboratory**	-	-	3	1.5	40	60	100
Prerequisite:	-							
Outcome:	At the end of the course, the students should be able to:							
	CO1 Recall the physical parameters related to Physics theory.							
	CO2 Extend the concepts and executing the experimental setup.							

	CO3	Experiment with optics, thermal conductivity, magnetic field and laser.
	CO4	Analyze and interpret the measured values through calculations.
	CO5	Conclude the experimental findings.

Choice of 10-12 experiments from the following:

1. Radius of curvature of a Lens - Newton's rings 2. Thickness of a thin object by air – wedge 3. Spectrometer – resolving power of a prism 4. Spectrometer – resolving power of a transmission grating 5. Spectrometer - hollow prism / ordinary & extraordinary rays by calcite prism* 6. Lorent's Half shade polarimeter – determination of specific rotatory power 7. Determination of wavelength of a laser source using transmission grating, reflection grating (vernier calipers) & particle size determination 8. Determination of numerical aperture & acceptance angle of an optical fiber 9. Determination of optical absorption coefficient of materials using laser* 10. Michelson's interferometer*	CO1, CO2, CO3, CO4, CO5
11. Coefficient of thermal conductivity - radial flow method 12. Coefficient of thermal conductivity – Lee's disc method 13. Jolly's bulb apparatus experiment – determination of α*	CO1, CO2, CO3, CO4, CO5
14. Magnetism: I – H curve 15. Field along the axis of a coil carrying current 16. Vibration magnetometer – calculation of magnetic moment & pole strength 17. Electrical conductivity of semiconductor – two probe / four probe method* 18.Hall effect in a semiconductor*	CO1, CO2, CO3, CO4, CO5
19. Determination of Young's modulus and rigidity modulus 20. Acceleration due to gravity - compound pendulum *Demonstration experiments	CO1, CO2, CO3, CO4, CO5

Total contact Hours: 45	**Total Tutorials: -**	**Total Practical Classes: -**	**Total Hours: 45**

Reference Books:

Physics Practical Observation Manual Book issued by Dept. of Physics, Pondicherry Engineering College.

Department : **Chemistry**		Programme : **B.Tech.**						
Semester : **First/Second**		Course Category Code: **BSC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CYA102	**Chemistry Laboratory**	-	-	3	1.5	40	60	100
Prerequisite	-							

Course Outcome	The students will learn to:	
	CO1	**Determine** the rate constants and order of chemical reactions — L5
	CO2	**Examine** the molecular/system properties such as surface tension, viscosity, partition coefficient, hardness of water, adsorption, saponification value and acid value — L4
	CO3	**Test** for the quality parameters by Titrimetry methods. — L4
	CO4	**Estimate** the quality parameters by conductometry, potentiometry and chromatography — L5
	CO5	**Analyse** the inorganic salt in terms of appropriate cations and anions — L4

Choice of 10-12 experiments from the following:

1. Kinetic study of acid hydrolysis of ethyl acetate	**CO1**
2. Determination of surface tension and viscosity 3. Partition of benzoic acid between benzene and water 4. Total hardness of water - Determination by EDTA method 5. Freundlich adsorption isotherm - Adsorption of acetic acid on charcoal 6. Saponification value and acid value of an oil	**CO2**
7. Chloride content of water - Determination by Mohr's method 8. Determination of oxalic acid by permanganometry 9. Determination of ferrous by permanganometry 10. Determination of ferrous and ferric by dichrometry 11. Determination of carbonate and bicarbonate in a mixture 12. Beer-Lamberts law - Determination of ferrous by colorimetry 13. Magnesium content in water - Determination by EDTA method 14. Acetic acid content in vinegar 15. Dissolved oxygen content in water - Determination by Winkler's method. 16. Determination of available chlorine in bleaching powder.	**CO3**
17. Conductometric titration 18. Potentiometric titration 19. Thin layer chromatography	**CO4**
20. Chemical analysis of salt for cations and anions	**CO5**

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

Reference Books

1. Lab Manual, Department of Chemistry, Puducherry Technological University, Puducherry, 2018.
2. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand &Sons, New Delhi, 2001.
3. J. Mendham, R.C. Denney, J.D. Barnes and M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, PearsonEducation, New Delhi, 2002.

COURSE ARTICULATION MATRIX

Course: **CYA102 Chemistry Laboratory**

Regulation: 2022-23

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	1	3	3	1	3					1
CO2	3	2	1	3	3	1	3					1
CO3	3	2	1	3	3	1	3					1
CO4	3	2	1	3	3	1	3					1
CO5	3	2	1	3	3	1	3					1
Average	3	2	1	3	3	1	3					1

Department : **Mathematics**		Programme : **B.Tech(EC)**						
Semester : **Third**		Course Category Code: **BSC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MAA105	**Linear Algebra, Numerical Methods and Random Processes**	3	1	-	4	25	75	100
Prerequisite	Basic Integration and probability							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Apply Linear Algebra concepts						
	CO2	Solve integrals and ordinary differential equations numerically.						
	CO3	Construct sample spaces of random experiments and identify the distributions.						
	CO4	Make use of Markov chains to obtain bounds on probability of events.						
	CO5	Apply Stochastic processes and solve Queuing theory problems.						

UNIT-I	**Linear Algebra**	**Periods: 10**
Vector space, subspace, span of a set, linear independence and dependence, Dimension and Bases, inner product space - Gram-Schmidt orthogonalization.		**CO1**
UNIT-II	**Numerical Integration and Solution of ODEs**	**Periods: 10**
Numerical integration in one variable by Trapezoidal and Simpson's 1/3 and 3/8 rules. Single step methods: Taylor series method, Picard's method of successive approximation, Euler, Modified Euler and Improved Euler methods, Runge - Kutta method of fourth order only. Multistep methods: Milne and Adams - Bashforth Predictor –Corrector methods.		**CO2**
UNIT-III	**Discrete Distributions**	**Periods: 10**
Random Variables - Probability mass function, Distribution functions, Special discrete distributions: Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hyper geometric, Discrete Uniform, Constant and Indicator - Probability Generating function-Characteristic function.		**CO3**
UNIT-IV	**Continuous Distributions and Stochastic Processes**	**Periods: 9**
Reliability, Failure density and Hazard function - Some important Continuous distributions: Exponential, Hypo exponential, Erlang, Gamma, Hyper exponential, Weibull, Gaussian, Uniform and Pareto distributions. Stochastic Processes: Definition, Classification of Stochastic Processes - Strictly Stationary Process, Wide Sense Stationary, Bernoulli Process, Poisson process, Markov Process, Markov Chain.		**CO4**
UNIT-V	**Poisson Queueing Models**	**Periods: 9**
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 - Pure Birth and Pure Death Processes.		**CO5**

Lecture Periods: 48	**Tutorial Periods: 12**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. V.Krishna Murthy et al., "An Introduction to Linear Algebra", Affiliated East-West Press, 2012.
2. P. Kandasamy, K. Gunavathy and K. Thilagavathy, "Numerical Methods", S. Chand & Company Ltd, New Delhi, 2014.
3. Kishore S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", John Wiley & Sons Inc. Second Edition, 2012.
4. D.Gross and C.M.Harris, "Fundamentals of Queuing Theory", Wiley Students Edition, Third Edition, 2012.
5. J. Medhi, "Stochastic Processes", New Age International (P) Ltd., Second Edition, 2012.

COURSE ARTICULATION MATRIX

Course: **MAA105 Linear Algebra, Numerical Methods and Random Processes**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	–	–	–	–	–	–	2	2	–
CO2	3	3	3	3	3	–	–	–	–	–	–	2	2	1
CO3	3	3	3	3	3	–	–	–	–	–	–	2	3	–
CO4	3	3	3	3	3	–	–	–	–	–	–	2	3	–
CO5	3	3	3	3	3	–	–	–	–	–	–	2	3	–
MAA105	3	3	3	3	3	–	–	–	–	–	–	2	2.6	1

Note: The correlation level 1, 2 or 3 entered are as defined below:
1. Slight (low) 2. Moderate (Medium) 3. Substantial (High)
If there is no correlation "– " is entered.

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA101	**Circuits and Networks**	3	0	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of circuit theorems.
	CO2 Apply circuit theorems to obtain transient and steady state time response of electric & magnetic circuits.
	CO3 Apply circuit theorems to obtain frequency response of electric & magnetic circuits.
	CO4 Analyze two port networks of different architecture.
	CO5 Evaluate characteristic impedance and propagation constant for different architecture of two port networks.
	CO6 Design the different types of two port filters, attenuators and equalizers.

UNIT-I	**Circuit Analysis and Resonance**	**Periods: 9**
Analysis of DC and AC circuits using Superposition, Thevenin' s, Norton's, Reciprocity and Maximum power transfer theorems. Source and Wye Delta transformation. Resonance-Series resonance - Parallel resonance - Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth – Q factor -Selectivity.		**CO1 CO2 CO3**
UNIT-II	**Transient Analysis**	**Periods: 9**
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.		**CO2**
UNIT-III	**Magnetically Coupled Circuits**	**Periods: 9**
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.		**CO2**
UNIT-IV	**Network Parameters**	**Periods: 9**
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.		**CO4**
UNIT-V	**Filters and Equalizers**	**Periods: 9**
Classification of filters - characteristic impedance in the pass band and stop band, constant K filters - m-derived filters – BPF and BSF. Insertion loss and reflection factor- Attenuators – Equalizer -T section and Pi section filters – Twin T networks, Bridged T and lattice networks.		**CO4 CO5 CO6**

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

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.

COURSE ARTICULATION MATRIX

Course: **ECA101 Circuits and Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	–	–	–	–	–	–	–	–	1	–	–	2	–
CO2	2	3	–	–	1	–	–	–	–	1	–	–	2	2
CO3	2	3	–	–	1	–	–	–	–	1	–	–	3	2
CO4	2	3	1	1	–	–	–	–	–	1	–	–	3	2
CO5	2	2	1	1	2	–	–	–	–	1	–	–	2	1
CO6	2	2	3	3	2	–	–	–	–	1	–	–	2	1
ECA101	2	2.6	1.67	1.67	1.5	–	–	–	–	1	–	–	2.33	1.6

Department : **Electronics and Communication Engineering**		Programme: **B.Tech. (EC)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA102	**Electronic Devices and Circuits**	3	0	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the characteristics and applications of diodes						
	CO2	Demonstrate the understanding of the characteristics of BJT, JFET & MOSFET devices						
	CO3	Design transistor biasing circuits for the given specification						
	CO4	Analyze the small signal, low frequency characteristics of BJT and FET amplifiers						
	CO5	Analyze the small signal, high frequency characteristics of BJT and FET amplifiers						

UNIT-I	**Semiconductor Diodes and Applications**	**Periods: 9**
Introduction to semiconductors - PN junction diode- construction and working –Capacitance effects in diode- current equation –VI characteristics- Breakdown in diodes-Applications : Half Wave Rectifier, Centre tapped and Bridge rectifiers – Ripple factor derivation with and without capacitance filter – Rectifier efficiency and PIV- Zener diode – Regulator – LED – Phototransistor – Varactor Diode		**CO1**
UNIT-II	**BJT and FET Characteristics**	**Periods: 9**
Construction, working and characteristics of CE, CB and CC configurations –Early effect- Thermal runaway– Transistor as an amplifier. Construction, working and characteristics of JFET and MOSFET (enhancement mode and depletion mode).		**CO2**
UNIT-III	**Bias Stabilization and Compensation Circuits**	**Periods: 9**
BJT biasing and Stabilisation: Operating point –DC load line -Bias Stabilisation circuits: Fixed bias, collector to base bias and potential divider bias. Bias compensation circuits: Diode compensation, thermistor compensation and sensistor compensation. Biasing of JFET: Fixed bias, Self bias.		**CO3**
UNIT-IV	**Low Frequency Analysis of Small Signal Amplifiers**	**Periods: 9**
Transistor hybrid model- h-parameters- Analysis of CE, CB and CC amplifiers using h-parameter model. FET small signal model-Low frequency analysis of Common Source and Common drain amplifiers.		**CO4**
UNIT-V	**High Frequency Analysis of Small Signal Amplifiers**	**Periods: 9**
Hybrid pi model- Analysis of CE transistor amplifier using hybrid pi model. Common Source and Common Drain FET amplifiers at high frequencies.		**CO5**

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

Reference Books:

1. J.Millman ,.C.Halkias and Satyabrata ,"Electronic devices and Circuits", Third edition,McGraw Hill, 2010.
2. Robert L. Boylestead and Louis Nasheresky, "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.Theodore F. Bogart, **"**Electronic Devices and Circuits", Pearson Education India ,2011.
5. https://nptel.ac.in/courses/117103063/

COURSE ARTICULATION MATRIX

Course: **ECA102 Electronic Devices and Circuits**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	–	–	–	–	3	2
CO2	3	3	3	3	2	–	–	–	–	–	–	–	3	2
CO3	3	3	3	2	2	–	–	–	–	–	–	–	3	2
CO4	3	3	3	3	2	–	–	–	–	–	–	–	3	2
CO5	3	3	3	3	2	–	–	–	–	–	–	–	3	2
ECA102	3	2.8	2.8	2.6	2	–	–	–	–	–	–	–	3	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA103	**Electromagnetic Waves and Fields**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Demonstrate the understanding of laws and basic terms in electromagnetics
	CO2	Solve static electric potential for the given system of discrete and continuous charge distribution
	CO3	Derive expression for the capacitance of different structures involving perfect dielectricsusing boundary conditions
	CO4	Solve for static magnetic field intensity by applying Biot-Savart law or Ampere's Circuital law
	CO5	Determine induced current due to time varying magnetic fields in simple circuits
	CO6	Demonstrate the understanding of the principle of electromagnetic wave Propagation using analytical expressions and boundary conditions

UNIT-I	**Static Electric Fields**	**Periods: 9**
Coulomb's Law – Electric Field due to a System of Discrete Charges and Continuous Distribution of Charge –Electric Flux density – Energy expended in moving a point charge in electric field- Electric Potential difference– Electric Potential due to discrete and continuous Charge Distributions – Potential gradient- Dipole -Energy density in electrostatic field.		**CO1 CO2**
UNIT-II	**Steady Electric Currents and Capacitance**	**Periods: 9**
Current density—Continuity of current- Metallic conductors-Conductor properties and Boundary Conditions-Method of Images. Dielectric materials- Boundary conditions for perfect dielectric materials.Capacitances- capacitance of parallel plate capacitor, coaxial cable, two-wire line.		**CO1 CO3**
UNIT-III	**Static Magnetic Field and Magnetic Forces**	**Periods: 9**
Biot-Savart Law-Ampere's Circuital law-Stokes' theorem-Magnetic Flux and Magnetic Flux density-Scalar and vector magnetic potentials-Force on moving charge and differential current element, Force between differential current elements- Force and Torque on a closed circuit- Nature of magnetic materials-Magnetization and Permeability- Magnetic Boundary Conditions-Magnetic circuit— Potential energy and forces on magnetic materials-Inductance and Mutual Inductance.		**CO1 CO4**
UNIT-IV	**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 CO5**
UNIT-V	**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-Instantaneous and average power densities;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.		**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. Matthew N O Sadiku , "Principles of Electromagnetic", Oxford University , 2015.
4. Nannapaneni Narayana Rao, "Elements of Engineering Electromagnetics", sixth edition, Prentice Hall of India,2006.
5. Fawwaz T. Ulaby, "Electromagnetics for Engineers", volume 1 ,Pearson/Prentice Hall, 2005.

COURSE ARTICULATION MATRIX

Course: **ECA103 Electromagnetic Waves and Fields**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	--	--	--	--	2	2	1
CO2	3	3	2	2	2	1	1	-	-	-	-	2	2	1
CO3	3	3	2	2	2	1	1	-	-	-	-	2	2	1
CO4	3	3	2	2	2	1	1	-	-	-	-	2	2	1
CO5	3	3	2	2	2	1	1	--	--	--	--	2	2	1
CO6	3	3	2	2	2	1	1	--	--	--	--	2	2	1
ECA103	3	3	2	2	2	1	1	-	-	-	-	2	2	1

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA104	**Digital System Design**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Translate a simple technical challenge to a digital circuit.
	CO2 Demonstrate the understanding of the design of basic combinational circuits and demonstrate the role of PLDs inimplementation of large scale logic functions
	CO3 Analyze the basic synchronous sequential circuits and design simple synchronoussequential circuits based on Mealy and Moore models.
	CO4 Analyze asynchronous sequential circuits and design simple hazard-free digitalcircuits.
	CO5 Analyze and compare the various logic families.
	CO6 Demonstrate the understanding of the organization and operation of semiconductor memory.

UNIT-I	**Number Systems**	**Periods: 9**
Decimal, Binary, Octal, Hexadecimal; Signed binary numbers-Addition and Subtraction; Fixed point numbers, Floating point numbers **Codes**–BCD codes, Biquinary, Gray, ASCII code; Boolean Algebra–Basic theorems-Postulates- Duality – **Boolean Function**- Canonical form-Standard form. Simplification of 3,4 and5- variable Boolean Function: Karnaugh map method – Quine-McCluskey method - Simplification of Incompletely specified functions. Implementation of logic functions using basic gates, NAND gates and NOR gates.		**CO1** **CO2**

UNIT-II	**Combinational Circuits**	**Periods: 9**
Arithmetic circuits-Half Adder and Full Adder; Ripple Carry Adder, Adder/subtractor, Carry Look Ahead Adder; BCD Adder, Binary multiplier, Magnitude Comparator, Encoder, Priority Encoder, Decoder/ Demultiplexers, multiplexers - implementation of combinational circuits using multiplexers, Demultiplexers, Code-converters, ROM, EPROM and EEPROM, PLA and PAL.		**CO1** **CO2**

UNIT-III	**Synchronous Sequential Circuits**	**Periods: 9**
Basic Latch-Gated SR latch, Gated D latch, Master-Slave D Flip-flop, Edge triggered D FF, D FF with clear and preset, FF Timing parameters, JK FF, T FF, Characteristic tables and Characteristic equations of FFs. Analysis of clocked sequential circuits –State equations, State table, State diagram, FF input equations, Mealy and Mooremodels of FSMs, State reduction, State assignment, Design of clocked sequential circuits. **Registers and Counters-**Shift registers, serial adder, Ring Counter, Johnson counter, Universal Shift Register-PN sequence generator. Asynchronous Counters, Synchronous Counters, Counters with parallel load, Timing diagrams– Timing analysis of FF circuits.		**CO1** **CO2** **CO3**

UNIT-IV	**Asynchronous Sequential Circuits**	**Periods: 9**
Transition table, Flow table, Race conditions, Stability considerations Circuits with latches, Primitive flow table, Transition table. Reduction of state and flow tables, Race-free state assignment, Hazards in combinational and sequential circuits, Designing hazard-free circuits, Essential Hazards.		**CO1** **CO2** **CO3** **CO4**

UNIT-V	**Digital IC Technology and Semiconductor Memories**	**Periods: 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.		**CO5** **CO6**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**
Note : Every student should carry out a mini project for this course and submit the report instead of assignment.			
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", 2002, 2006, Tata McGraw-Hill Publishing company Ltd. New Delhi.
3. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic Design with VHDL", (Special Indian Edition) 2006, Tata McGraw-Hill Publishing company Ltd. New Delhi.
4. John F Wakerly, "Digital Design Principles and Practices", Prentice Hall of India, New Delhi, 2005.
5. Floyd T L, "Digital Fundamentals ", Pearson education, NewDelhi, 2009.

COURSE ARTICULATION MATRIX

Course: **ECA104 Digital System Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	–	1	-	–	–	–	–	–	–	–	2	2
CO2	3	2	–	2	3	–	–	–	–	–	–	1	2	2
CO3	3	2	–	3	3	–	–	–	–	–	–	1	2	2
CO4	3	2	–	2	1	–	–	–	–	–	–	1	2	2
CO5	3	2	–	–	–	–	–	–	–	–	–	1	2	2
CO6	–	2	–	–	–	–	–	–	–	–	–	1	2	2
ECA104	3	1.83	–	2	2.33	–	–	–	–	–	–	1	2	2

Department : **Computer Science and Engineering**		Programme : **B.Tech (EC)**						
Semester : **Third/Fourth**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSA134	**Data Structures and Object-Oriented Programming**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Analyze and implement various searching and sorting techniques.
	CO2 Examine linear data structures like stacks, queues and linked list and interpret their difference.
	CO3 Demonstrate the representation of Non-linear data structures like trees and graph.
	CO4 Explore the Object-Oriented Programming Concepts using C++.
	CO5 Develop C++ programs by applying the concepts Inheritance and Polymorphism.

UNIT-I	**Arrays, Searching and Sorting**	**Periods: 9**
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: 9**
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: 9**
Trees: Introduction – Terminology – Binary tree – Representation – Traversals– Graph: Introduction – Terminology – Representation – Traversals – Single Source and All Pairs Shortest path algorithms.		**CO3**
UNIT-IV	**Introduction to Object-Oriented Programming**	**Periods: 9**
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.		**CO4**
UNIT-V	**Concepts of Object-Oriented Programming**	**Periods: 9**
Operators Overloading: Unary and Binary Operators – Type Conversions – Inheritance –Types – Polymorphism – Virtual Functions – Exception Handling: Basics and Mechanism.		**CO5**

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, “Data Structures and Algorithms: Concepts, Techniques and Applications”, McGraw Hill Education (India) Private Limited, 2008.
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, 2017.

COURSE ARTICULATION MATRIX

Course: **CSA 134 Data Structures and Object - Oriented Programming**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	–	–	–	–	–	–	–	–	–	2	-	1
CO2	2	2	2	–	–	2	–	1	1	–	1	2	2	-	1
CO3	2	2	2	1	–	2	–	1	1	–	1	2	1	1	2
CO4	–	1	2	–	–	–	–	–	–	–	–	–	1	2	2
CO5	–	1	2	–	–	1	1	–	1	–	1	–	2	2	2
CSA134	1.67	1.4	2	1	–	1.67	1	1	1	–	1	2	1.6	1.67	1.6

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA105	**Electronic Devices and Networks Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the characteristics of diodes.
	CO2 Construct rectifiers using diodes.
	CO3 Construct and analyze the different biasing circuits of BJT.
	CO4 Demonstrate the characteristics of BJT and JFET.
	CO5 Determine the time and frequency response of RC and RLC circuits.
	CO6 Design and analyze filters, attenuators and equalizers.

List of Experiments

1. VI characteristics of PN junction diode, Zener diode and Point contact diode 2. Input and output characteristics of CB transistor configuration 3. Input and output characteristics of CE transistor configuration 4. Drain and Transfer Characteristics of N-Channel JFET	**CO1** **CO4**
5. Half wave, centre-tapped and bridge rectifier circuits with and without capacitance filter 6. Fixed bias, Collector to base bias and potential divider transistor biasing circuits	**CO2** **CO3**
7. Measurement of (i) frequency response (ii) bandwidth and (iii) Q-factor of (i) series and (ii) parallel resonant RLC circuits using simulation and experiment. 8. Illustrate transient response of RC circuit for DC and sinusoidal excitations using simulation and experiment.	**CO5**
9. Design of m-derived filters. a. Frequency and phase response of the m derived low pass filter. b. Frequency and phase response of the m derived high pass filter. 10. Design of k-type Band pass and Band stop filters. a. Frequency and phase response of the Band pass filter using Lumped elements. b. Frequency and phase response of the Band stop and notch filter using Lumped Elements.	**CO6**
11. Design of switched Twin-T network with its frequency and phase response. 12. Design and analysis of attenuators and equalizers under given load impedance and attenuation parameters.	**CO6**

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.

COURSE ARTICULATION MATRIX

Course: **ECA105 Electronic Devices and Networks Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	2	-	-	3	2
CO2	2	1	2	-	-	-	-	-	2	-	-	-	3	2
CO3	2	2	2	-	-	-	-	-	2	-	-	-	3	2
CO4	3	-	-	-	-	-	-	-	2	2	-	-	3	2
CO5	2	3	-	-	1	-	-	-	2	2	-	-	3	2
CO6	2	3	3	3	2	-	-	-	3	2	-	-	3	2
ECA105	2.33	2.25	2.33	3	1.5	-	-	-	2.17	2	-	-	3	2

Department : **Computer Science and Engineering**		Programme : **B.Tech (EC)**						
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
CSA135	**Data Structures and Object - Oriented Programming Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Select and implement appropriate Searching/sorting algorithms for an application.
	CO2 Implement data structures using C.
	CO3 Apply Non-linear data structures for a given problem.
	CO4 Develop and implement C++ programs using classes and objects, constructors and destructors.
	CO5 Design C++ programs with inheritance and run time polymorphism.

Experiments for Cycle 1	
1. Implementation of Linear search and binary search. 2. Implementation Insertion sort, Selection sort, Bubble sort, Quick sort and Heap Sort.	**CO1**
3. Array implementation of Stacks and Queues. 4. Implementation of Singly and Doubly Linked List.	**CO2**
5. Implementation of Binary Tree Traversals. 6. Implementation of Graph Traversals and shortest path Algorithms.	**CO3**
Experiments for Cycle 2	
7. Programs to implement classes and objects. 8. Programs to implement constructors and destructors.	**CO4**
9. Programs to implement different types of inheritance. 10. Programs to implement virtual functions to demonstrate the use of run time polymorphism.	**CO5**

Lecture Periods: -	**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, Seventh Edition, 2017.

COURSE ARTICULATION MATRIX

Course: **CSA135 Data Structures and Object -Oriented Programming Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	–	2	2	–	2	–	–	–	-	1
CO2	2	2	3	2	–	2	2	–	2	–	–	–	-	1
CO3	1	2	3	1	–	2	1	–	1	–	–	–	1	2
CO4	1	2	2	1	–	2	1	–	2	–	–	–	2	2
CO5	1	2	2	1	–	2	2	–	1	–	–	–	2	2
CSA 135	1.4	2	2.6	1.4	–	2	1.6	–	1.6	–	–	–	1.67	1.6

Department: **Humanities and Social Sciences**		Programme : **B.Tech.**						
Semester : **Third**		Subject Category: MCC			Semester Exam Type: **-**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
SHA102	**Indian Constitution**	3	-	-	-	-	-	-
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Understand the essence and significance of the constitution						
	CO2	Recognize one's fundamental duties and rights						
	CO3	Appreciate the structure and functions of legislature, executive and judiciary						
	CO4	Understand the functioning of state governments and union territories						
	CO5	Understand the centre-state relations and functioning of constitutional bodies						

UNIT-I	**Introduction of Indian Constitution**	**Periods: 09**
The Making of Indian Constitution - The Constituent Assembly - Sources of Indian Constitution - Preamble and the Supreme Court's Judgments on Preamble.		**CO1**
UNIT-II	**State, Rights and Duties**	**Periods: 09**
State and Union Territories – Citizenship - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties.		**CO2**
UNIT-III	**Union Government**	**Periods: 09**
Union Government - The Powers and Functions of the President, Vice–President, Council of Ministers, Prime Minister, Judiciary, Supreme Court - Judicial Review - Judicial Activism- Public Interest Litigation - Power and Functions of the Parliament - Budget Power and Functions of Parliament, Speaker of Lok Sabha.		**CO3**
UNIT-IV	**State Governments**	**Periods: 09**
State Governments – Governor - State Council of Ministers - Chief Minister- Legislative Assembly- High Courts - Union Territories - Panchayati Raj Institutions - 73th and 74th Constitutional Amendment - Gram Panchayats - Block Panchayats - Municipalities.		**CO4**
UNIT-V	**Union- State Relations, Constitutional Bodies**	**Periods: 09**
Centre – State Relations - Public Service - Election Commission - NITI Ayog, Emergency Powers of the President- Constitution Amendment Procedure- Right to Information Act - Right to Education. Major Constitutional Amendments and their impact on Indian Political System.		**CO5**

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

Reference Books:

1. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. Oxford University Press, 1999.
2. Basu, Durga Das, et al. Introduction to the Constitution of India. 20th ed., Thoroughly Rev, Lexis Nexis Butterworths Wadhwa Nagpur, 2008.
3. Choudhry, Sujit, et al., editors. The Oxford Handbook of the Indian Constitution. Oxford University Press, 2016.
4. Bakshi, Parvinrai Mulwantrai, and Subhash C. Kashyap, The Constitution of India (Universal Law Publishing, 2016)
5. Bhargava, Rajeev, 'Politics and Ethics of the Indian Constitution', 2009
6. Rajeev Bhargava - 'The Promise of India's Secular Democracy', 2010
7. Chakrabarty, Bidyut, India's Constitutional Identity: Ideological Beliefs and Preferences (Routledge, 2019)
8. Jayal, Niraja Gopal, and Pratap Bhanu Mehta, The Oxford Companion to Politics in India, Oxford University Press, 2010
9. Kashyap, Subhash C., Our Constitution: An Introduction to India's Constitution and Constitutional Law (NBT India, 1994)
10. Kashyap, Subhash C. Our Parliament: An Introduction to the Parliament of India. Revised edition, National Book Trust, India, 2011.
11. Subhash C. Kashyap Our Constitution Paperback –. (NBT India, 2012).
12. Laxmikanth, M. "INDIAN POLITY". McGraw-Hill Education "Constitution of India". Ministry of Law and Justice, Govt. of India.

COURSE ARTICULATION MATRIX

Course: **SHA102 Indian Constitution**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	–	–	–	–	–	1	–	–	–	–	–	–	–	–
CO2	–	–	–	–	–	1	–	–	–	–	–	–	–	–
CO3	–	–	–	–	–	1	–	–	–	–	–	–	–	–
CO4	–	–	–	–	–	1	–	–	–	–	–	–	–	–
CO5	–	–	–	–	–	1	–	–	–	–	–	–	–	–
SHA102	–	–	–	–	–	1	–	–	–	–	–	–	–	–

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA106	**Transmission Lines and Waveguides**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Analyze the propagation characteristics of transmission lines
	CO2 Design and analyze RF filters
	CO3 Apply Smith Chart for impedance matching of transmission lines
	CO4 Demonstrate the understanding of the fundamentals of transmission line theory and impedance matching in high frequency lines.
	CO5 Analyze the radio propagation in guided systems.

UNIT-I	**Transmission Line Theory**	**Periods: 9**
Types of transmission lines, Primary and secondary constants. General solutions. Characteristic impedance, propagation constant, attenuation and phase constants. Open circuited and short circuited lines. The telephone cable, Reflection of line not terminated in Z0- Reflection coefficient- Distortion in transmission lines- Distortion less line.		**CO1**
UNIT-II	**Filters and Transients Networks**	**Periods: 9**
Filter fundamentals, Constant K – LPF, HPF, BPF and BSF Filter Design, Fundamentals of Attenuators and Equalizers – Lattice type, Concept of reverse-networks Transients in transmission lines.		**CO2**
UNIT-III	**Line at Radio Frequencies**	**Periods: 9**
Standing waves and standing wave ratio on a line – One eighth wave line – The quarter wave line and impedance matching – the half wave line. The circle diagram for the dissipation less line – The Smith Chart – Application of the Smith Chart – Conversion from impedance to reflection coefficient and vice-versa. Impedance to Admittance conversion and vice versa – Input impedance of a lossless line terminated by an impedance – single stub matching and double stub matching.		**CO3**
UNIT-IV	**Characteristics and Modes of Waves**	**Periods: 9**
Waves Between Parallel Planes – characteristic of TE, TM and TEM waves, Velocities of propagation, Solution of wave equation in Rectangular guides, TE and TM modes, Dominant Mode, Attenuation, Excitation Mode, Dielectric slab waveguides.		**CO4**
UNIT-V	**Wave Guides and Cavity Resonators**	**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, Rectangular and Circular cavity Resonators.		**CO5**

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

Reference Books:

1. John D Ryder, "Networks lines and fields", Prentice Hall of India, New Delhi, 2005.
2. E.C. Jordan & K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hallof India 2nd edition 2003. (Unit IV, V). McGraw-Hill, 9th reprint.
3. Umesh Sinha, "Transmission Lines and Network", Satya Prakashan Publishing Company, New Delhi, 2012.
4. William H Hayt and Jr John A Buck, "Engineering Electromagnetics", Tata Mc Graw-Hill Publishing Company Ltd, New Delhi, 2008.
5. David K Cheng, "Field and Wave Electromagnetics", Second Edition, Pearson Education Inc, Delhi, 2004.

COURSE ARTICULATION MATRIX

Course: **ECA106 Transmission Lines and Waveguides**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	–	–	–	–	–	–	1	2	1
CO2	3	3	3	2	2	–	–	–	–	–	–	1	2	1
CO3	3	3	3	2	2	–	2	–	–	2	–	1	2	1
CO4	3	3	3	2	2	–	2	–	–	2	–	1	2	1
CO5	3	3	3	2	2	–	–	–	–	–	–	1	2	1
ECA106	3	3	3	2	2	–	2	–	–	2	–	1	2	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA107	**Electronic Circuit Design**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the effects of negative feedback on the amplifiers.
	CO2 Design oscillators to generate AF and RF frequency.
	CO3 Analyze the characteristics of multistage amplifiers.
	CO4 Compare the operation of different power amplifiers.
	CO5 Demonstrate the understanding of the applications of operational amplifier
	CO6 Demonstrate the understanding of the applications of IC 555 and IC 565.

UNIT-I	**Feedback Amplifiers and Oscillators**	**Periods: 9**	
Feedback concept-transfer gain with feedback-general characteristics of negative feedback amplifiers-Types of negative feedback connections- Input resistance-Output resistance- General methodology of analysis of a feedback amplifier- Analysis of voltage series feedback, current series feedback, current shunt feedback and voltage shunt feedback amplifiers. Barkhausen's criterion for sustained oscillation - Classification of oscillators-LC oscillators: Hartley and Colpitt's oscillator-RC oscillators: RC phase shift oscillator and Wien bridge oscillator – crystal oscillator and frequency stability.			**CO1 CO2**
UNIT-II	**Multistage Amplifiers and Power Amplifiers**	**Periods: 9**	
Need for cascading – Cascade amplifier – cascode amplifier- Darlington pair- Transistorised differential amplifier- differential mode and common mode operation- configurations of a differential amplifier – Analysis of dual input balanced output differential amplifier-Tuned amplifiers : single tuned, double tuned and stagger tuned amplifiers. Classification of power amplifiers –Class A power amplifier : Direct and transformer coupled amplifiers -Class B amplifier: Push pull and complementary symmetry amplifiers – conversion efficiency calculations –cross over distortion – Class AB amplifier – distortion in amplifiers -power transistor –heat sinking –Operation of Class C, Class D and Class S amplifiers.			**CO3 CO4**
UNIT-III	**Operational Amplifier and its Applications**	**Periods: 9**	
Block diagram - dc and ac characteristics of an op-amp-Equivalent circuit- Features of an op-amp – Applications of op-amp: voltage follower- Inverting and non-inverting amplifiers- summing amplifier- difference amplifier- subtractor- adder- zero crossing detector –window detector -comparator- Schmitt trigger- Log and antilog amplifier- integrator – differentiator -active filters- series regulator.			**CO5**
UNIT-IV	**Timer and PLL**	**Periods: 9**	
IC555-Functional diagram-Monostable multivibrator-Linear ramp generator- Frequency divider- Pulse width modulator- Astable operation -FSK generator – PPM modulator. **NE565:** Phase Locked Loop – Basic Block diagram- NE565 -Applications: Frequency multiplication /division- Frequency translation-AM detection – FM detection- FSK demodulator.			**CO6**
UNIT-V	**Wave Generators & Data Converters**	**Periods: 9**	
Wave Generators: Pulse Shaping Circuits – High Pass and Low Pass Filter using R&C for different time constants - RC ramp generator-constant current ramp generator-saw tooth generator –Bootstrap ramp generator – Miller integrator ramp generator –Triangular waveform generator – Pulse generator –Function generator – sinewave converter circuit. **D-A and A-D converters:** DAC specifications –weighted resistor DAC- R-2R ladder DAC- monolithic DAC –ADC specifications- Flash A/D converter-Counter type converter – Servo tracking ADC- successive approximation ADC-Dual slope ADC.			**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", 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, 5th Edition, 2008.
4. Ramakant Gayakwad ,"Opamps and Linear Integrated Circuits," . Prentice Hall, 4th Edition, 2000.
5. Roy Choudhry, "Linear Integrated Circuits", New Age International Publishers,"5th Edition,2017.

COURSE ARTICULATION MATRIX

Course: **ECA107 Electronic Circuit Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	2	-	-	2	-
CO2	2	2	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	1	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	1	-	-	-	-	-	-	-	2	-
CO5	3	1	2	2	2	-	-	-	-	-	-	-	3	2
CO6	2	2	3	3	2	-	-	-	-	-	-	-	3	3
ECA107	2.33	2	2.5	2.67	1.6	-	-	-	-	2	-	-	2.5	2.5

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA108	**Signals and Systems**	3	1	-	4	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Classify continuous/discrete time signals and systems.						
	CO2	Interpret continuous time signals in frequency domain using Fourier and Laplace Techniques						
	CO3	Analyze continuous time LTI systems.						
	CO4	Interpret discrete time signals in frequency domain using Fourier and Z-transform Techniques						
	CO5	Analyze discrete time LTI system						

UNIT-I	**Classification of Signals and Systems**	**Periods: 12**
Continuous time signals - Discrete time signals – Representation of signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Operations on the signals – Classification of continuous time and discrete time signals – Continuous time and discrete time systems – Classification of systems – Properties of systems.		**CO1**
UNIT-II	**Analysis of Continuous Time Signals**	**Periods: 12**
Fourier Series : Properties - Trigonometric and Exponential Fourier Series -Parsavel's relation for periodic signals - Fourier Transform: Properties - Laplace Transformation : Properties, R.O.C - Inverse Laplace transform		**CO2**
UNIT-III	**Analysis of Continuous Time LTI Systems**	**Periods: 12**
LTI continuous time systems- Differential equations – Transfer function and Impulse response – Block diagram representation: Direct Form Structures – Convolution Integral – State Space Representation – State equations.		**CO3**
UNIT-IV	**Analysis of Discrete Time Signals**	**Periods: 12**
Discrete Time Fourier Series: Properties - Discrete Time Fourier Transform : Properties – Z Transformation: Properties – Different methods of finding Inverse Z-Transformation		**CO4**
UNIT-V	**Analysis of Discrete Time LTI Systems**	**Periods: 12**
LTI Discrete time systems – Difference equations – System function and impulse response – Block diagram representation: Direct Form Structures – Convolution Sum – State Space Representation - State equations.		**CO5**

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

Reference Books:

1. J 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 Edition, 2014.

COURSE ARTICULATION MATRIX

Course: **ECA108 Signals and Systems**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	2	-	-	-	-	-	-	-	3	1
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	1	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	2
CO5	3	3	2	2	1	-	-	-	-	-	-	-	3	2
ECA108	3	2.2	2	1.8	1.6	-	-	-	-	-	-	-	3	1.8

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA109	**Analog Communication**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome		
	Upon completion of the course, the students will be able to	
	CO1	Analyze the variants of Amplitude modulation schemes
	CO2	Demonstrate the understanding of the fundamentals of Angle modulation schemes with emphasis on FM modulatorsand demodulators.
	CO3	Compare different transmitter and receiver architectures.
	CO4	Demonstrate the understanding of various pulse modulation schemes.
	CO5	Analyze the performance of various analog communication systems in the presence of noise.

UNIT-I	**Amplitude Modulation Systems**	**Periods: 9**
Introduction –Need for modulation – Amplitude Modulation - Suppressed carrier systems – DSB-SC, SSB-SC -Bandwidth Requirements- Power relations - Generation and detection of AM waves – Generation and detection of DSB-SC waves - Balanced Modulator, Ring Modulator, Coherent detection –Costas Loop - Generation and detection of SSB-SC waves - Phase discrimination method, Coherent detection – Vestigial Sideband Modulation - Comparison of AM systems.		**CO1**
UNIT-II	**Angle Modulation Systems**	**Periods: 9**
Introduction to Angle Modulation – FM and PM - Narrow band FM and Wideband FM –Bandwidth requirements-Pre emphasis, De-emphasis - Generation and demodulation of FM waves –Direct and Indirect FM generation, FM Demodulation- FM to AM Conversion-Balanced Frequency Discriminator and PLL demodulator, FM Stereo Multiplexing-Comparison of frequency modulation and Phase modulation system.		**CO2**
UNIT-III	**Transmitters and Receivers**	**Periods: 9**
Transmitters: Classification of transmitters - Block diagram of AM broadcasting transmitters- Low Level and High Level transmitters -FM transmitters- Direct and Indirect FM systems. **Receivers:** Classifications of receivers - Block diagram – Receiver characteristics - Tuned radio frequency receiver – Super heterodyne receiver –AGC- Merits and demerits of different receivers. Block diagram of FM receiver -Automatic frequency control- Communication Receivers-Delayed AGC.		**CO3**
UNIT-IV	**Pulse Analog Modulation Schemes**	**Periods: 9**
Sampling process – Pulse-amplitude modulation – Pulse-Width modulation – Pulse Position Modulation-Methods of generation and detection- Bandwidth-noise trade off. - FDM and TDM.		**CO4**
UNIT-V	**Noise in Communication Systems**	**Periods: 9**
Shot Noise - Thermal noise - White Noise– Noise Calculations – Equivalent Noise Bandwidth – Noise Figure – Effective Noise Temperature – Narrowband Noise representation- Noise in CW Modulation systems, Noise in Linear Receiver using coherent detection, Noise in AM receivers using envelope Detection – Noise in FM receivers- Threshold effect & Capture effect.		**CO5**

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

Reference Books:

1. Simon Haykin, “Communication Systems”, Wiley Publication, New Delhi, 2011.
2. Kennedy G, “Electronic Communication systems”, Tata McGraw Hill, New Delhi, 2009.
3. Taub and Schilling, "Principles of Communication Systems", McGraw Hill International edition, New Delhi, 1996.
4. Carlson A B, "Communication systems: An Introduction to signals and noise in electrical communication", McGraw Hill, NewDelhi, 2002.
5. Dennis John, Roddy and Coolen, “Electronic Communications”, Prentice Hall of India, New Delhi, 2003.

COURSE ARTICULATION MATRIX

Course: **ECA109 Analog Communication**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	–	–	–	1	2	1
CO2	3	2	2	2	2	–	–	–	–	–	–	1	2	1
CO3	3	2	2	2	2	–	–	–	–	–	–	1	2	1
CO4	3	2	2	2	2	1	1	–	–	–	–	1	2	1
CO5	3	3	3	3	3	2	2	–	–	–	–	1	2	1
ECA109	3	2.2	2.2	2.2	2.2	1.5	1.5	–	–	–	–	1	2	1

Department : **Chemistry**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Subject Category: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
SHA101	**Biology for Engineers**	3	-	-	2	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Recall the classification of living organisms based on morphological, biochemical and ecological aspects.						
	CO2	Apply the concepts of Mendel's laws of inheritance to predict single gene disorder in human.						
	CO3	Choose appropriate dietary biomolecules for healthy life.						
	CO4	Interpret the energy metabolism and energy transfer in biological systems						
	CO5	Prioritize the identification methods and classify microorganisms.						

UNIT-I	**Classification**	**Periods: 9**
Classification outline based on (a) cellularity- Unicellular or multicellular (b) ultrastructure prokaryotes or eukaryotes (c) Energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitats- acquatic or terrestrial (e) Molecular taxonomy three major kingdoms of life.		**CO1**
UNIT-II	**Genetics**	**Periods: 9**
Mendel's laws, Concept of segregation & independent assortment. Concept of allele. Recessiveness, and dominance. Single gene disorders in humans – Sickle cell disease, Phenylketonuria.		**CO2**
UNIT-III	**Biomolecules**	**Periods: 9**
Carbohydrates: Types, Structural & functional importance. Lipids: Classification - Simple, compound, & derived, Importance of lipid soluble vitamins. Amino acids – general structure, essential amino acids. Proteins - Levels of protein structure, structural & functional importance of proteins, Enzymes- Definition, Enzyme Activity & Units, Specific Activity, Specificity, Factors affecting enzyme activity. Nucleic acids: Types and importance.		**CO3**
UNIT-IV	**Metabolism**	**Periods: 9**
Introduction: Food chain & energy flow. Definitions - Anabolism & Catabolism. Photosynthesis: Reaction and importance. Glycolysis & TCA cycle. ATP – the energy currency of cells		**CO4**
UNIT-V	**Microbiology**	**Periods: 9**
Concept of single celled organisms. Concept of species & strains. Identification & classification of microorganisms. Virus – Definition, types, examples.		**CO5**

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

Reference Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed bySatish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers.

COURSE ARTICULATION MATRIX

Course: **SHA101 Biology for Engineers**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	2	-	-	-	-	-	-	-
SHA101	-	-	-	-	-	1	2	-	-	-	-	-	-	-

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA110	**Digital System Design Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Design, implement and experiment the required code converter logic circuit
	CO2	Interpret the data sheets of MSI combinational circuit ICs to apply them for designing higher level logic circuits.
	CO3	Interpret the data sheets of ICs of FFs, counters, shift registers and to design, implement and test any sequential logic circuits using these ICs.
	CO4	Develop behavioural coding in Verilog for combinational and sequential circuits and to test them by simulations.

List of Experiments

1. Design and implementation of the following Code convertors i. BCD to excess-3 code and vice versa ii. Binary to gray code and vice-versa	**CO1**
2. Design and implementation of Adder/Subtractor i. 4 bit binary Adder/ Subtractor using IC7483 ii. BCD adder using IC7483 3. Magnitude comparator i. Study of 4-bit magnitude comparator IC ii. Realization of 8-bit magnitude comparator using 4-bit magnitude comparator ICs 4. Multiplexers and Encoders i. Study of an 8×1 multiplexer IC ii. Realization of 16×1 multiplexer using 8×1 multiplexer ICs iii. Construction and study of a simple Priority Encoder 5. Decoders and Demultiplexers i. Study of a 3 to 8 line decoder as demultiplexer ii. Realization of 4 to 16 line decoder using 3 to 8 line decoder ICs iii. Realization of a combinational circuit using a decoder IC	**CO2**
6. Shift register i. Study 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 the no. of FFs used to construct the counter) iv. BCD counter using mod-10 counter ICs 8. Design and implementation of Synchronous Counters and study of their timingdiagrams i. Binary up counter ii. Non-sequential binary counter iii. 3-bit binary up/down counter 9. Study of a Memory IC i. READ and WRITE operations involving memory chips ii. Expansion of memory size	**CO3**
10. Writing Verilog code for the following circuits: i. Ex-OR Gate ii. Full Adder iii. Multiplexer iv. Binary Up-Counter v. Shift Register	**CO4**

Lecture Periods: -	Tutorial Periods: -	Practical Periods: 45	Total Periods: 45
Reference Books:			
1. Leach Malvino, "Digital Principles and Applications", Tata McGraw Hill, Fifth edition, 2005.			

COURSE ARTICULATION MATRIX

Course: **ECA110 Digital System Design Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	–	–	–	3	2	–	1	1	1
CO2	3	2	2	2	2	-	-	-	3	2	-	2	1	2
CO3	3	3	2	2	3	–	–	–	3	2	–	2	2	3
CO4	3	3	2	2	2	-	–	–	3	2	–	1	3	2
ECA110	3	2.5	1.75	1.75	2.25	-	-	-	3	2	-	1.5	1.75	2

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA111	**Electronic Circuit Design Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Demonstrate the effects of feedback on performance of amplifiers.
	CO2	Compare the operations of different power amplifiers with their characteristics.
	CO3	Design oscillators to generate AF and RF frequency using simulation and hardware model.
	CO4	Determine the characteristics of differential amplifiers.
	CO5	Examine applications of IC 555 and IC 741.
	CO6	Design solution for different real time problems with IC 555 and IC 741 using simulation and hardware model.

List of Experiments

1. To design, construct and measure the frequency response, input impedance and output impedance of a) voltage shunt b) voltage series negative feedback amplifiers with and without feedback. 2. Design and measurement of frequency response, signal handling capacity, input and output impedances of cascade amplifier and cascode amplifier.	**CO1**
a) To obtain the frequency Vs. power and load Vs. power characteristics of Class A power amplifier. b) To obtain the frequency Vs. power and load Vs. power characteristics of Class B complementary symmetry amplifier.	**CO2**
3. To design, construct and study the following oscillator circuits :- a) RC b) Wein Bridge c) Hartley and d) Colpitts Oscillator.	**CO3**
4. To study the applications of op-amp IC741 as a) Inverting amplifier and Non-inverting amplifier b) Summer and subtractor c) Voltage follower d) Integrator and Differentiator 5. To study zero crossing detector, window detector and Schmitt trigger using op-amp 6. To design and test the performance of a 2nd order LPF, HPF, BPF and BSF using Op-amp IC 741. 7.To design and study using OP AMP IC 741, the working of a) Astable Multivibrator b) Monostable Multivibrator 8.To design, construct and study the performance of Miller integrator and Bootstrap ramp generator using op-amp.	**CO4** **CO5** **CO6**
9. To Construct and study the performance of (a) DAC circuits – R-2R and ladder type. (b) Successive approximation type ADC 10. To design and study the working of a) Astable Multivibrator and b) Monostable Multivibrator using IC 555	**CO5** **CO6**
Note: Experimental results are to be validated with simulated results.	

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. Robert.F.Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", PHI Learning Pvt. Ltd, Sixth Edition, 2008.

COURSE ARTICULATION MATRIX

Course: **ECA111 Electronic Circuit Design Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	1	-	-	-	2	2	-	-	2	-
CO2	2	1	1	-	1	-	-	-	2	2	-	-	2	-
CO3	2	2	3	2	2	-	-	-	3	2	-	-	2	1
CO4	3	-	-	-	-	-	-	-	2	2	-	-	2	-
CO5	3	1	2	2	2	-	-	-	3	2	-	-	3	3
CO6	2	2	3	2	2	-	-	-	3	2	-	-	3	3
ECA111	2.33	1.4	2	2	1.6	-	-	-	2.5	2	-	-	2.33	2.33

Department: **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA112	**Analog Communication Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Design and test various analog modulators and demodulators.						
	CO2	Design and test various circuits used in transmitters and receivers						
	CO3	Construct and test various pulse modulator circuits						
	CO4	Analyze the performance of various analog modulation systems through simulation						

List of Experiments

1. Design and testing of Amplitude Modulation and Demodulation circuits. 2. Design and testing of DSB-SC Modulation and Demodulation circuits. 3. Design and testing of Frequency Modulation and Demodulation circuits.	**CO1**
4. Design and testing of Pre emphasis and De-emphasis circuits. 5. Implementation and testing of Simple and Delayed Automatic Gain Control circuits. 6. Design and Testing of Single tuned amplifier. 7. Frequency Response of Mixer Circuit.	**CO2**
8. Implementation and testing of PAM circuit. 9. Implementation and testing of PWM and PPM circuit.	**CO3**
10. Simulation of AM/FM/PM modulation and Demodulation system. 11. Performance analysis of AM and FM systems in presence of noise.	**CO4**

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

Reference Books:

1. Simon Haykin, “Communication Systems”, Wiley Publication, New Delhi, 2011.
2. Kennedy G, “Electronic Communication systems”, Tata McGraw Hill, New Delhi, 2009.

COURSE ARTICULATION MATRIX

Course: **ECA112 Analog Communication Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	–	–	–	1	1	–	1	1	2
CO2	3	2	2	2	2	–	–	–	1	1	–	1	1	2
CO3	3	3	3	3	2	–	–	–	1	1	–	1	1	2
CO4	3	3	3	3	2	2	2	–	1	1	–	1	1	2
ECA112	2.75	2.5	2.5	2.5	2	2	2	–	1	1	–	1	1	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA113	**Digital Signal Processing and DSP Processors**	3	1	-	4	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Interpret the use of DFT to obtain spectrum of discrete time signals and evaluate the DFT using fast algorithms.						
	CO2	Design IIR digital filters from analog filters namely Butterworth and Chebyshev for a given specification and draw the implementation structure of IIR filter using block diagram.						
	CO3	Design Linear phase FIR digital filters using windowing and frequency sampling methods and draw the implementation structure of FIR filter using block diagram.						
	CO4	Describe multi rate sampling techniques and their applications.						
	CO5	Identify the special features of DSP Processors and outline the architecture and addressing modes of a specific DSP processor.						

UNIT-I	**DFT and FFT**	**Periods: 12**
DFT- inverse DFT, properties of DFT. Advantages of FFT - radix 2 FFT - Decimation in Time and Decimation in frequency , Flowgraph for 8 point FFT , Inverse DFT using FFT.		**CO1**
UNIT-II	**IIR Filter Design**	**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 – Realization of IIR filters – Direct form I, II, cascade, parallel and ladder realization.		**CO2**
UNIT-III	**FIR Filter Design**	**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. Realization of FIR filters – Transversal, linear phase and poly phase realization structures.		**CO3**
UNIT-IV	**Multirate Signal Processing**	**Periods: 12**
Principles of multirate DSP – Decimation and Interpolation by integer factors – Structures for FIR decimators and interpolators- Polyphase FIR filter structures - Multistage Decimators and Interpolators. Applications - sub band coding of speech signals, Digital filter bank - 2 channel Quadrature mirror filter bank.		**CO4**
UNIT-V	**Digital Signal 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, PDSPs with RISC and CISC- Architecture of TMS320C6X.		**CO5**

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

Reference Books:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, PHI learning, Fourth edition, New Delhi 2008.
2. B.Venkataramani and M.Bhaskar, “Digital Signal Processors- Architecture, programming and Applications”, Tata McGraw Hill, Fourth Edition, 2005.
3. Sanjit K. Mitra, “Digital Signal Processing: A Computer Based Approach”, Tata McGraw Hill, Third Edition, 2005.
4. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications, Sixth Edition, 2014.

COURSE ARTICULATION MATRIX

Course: **ECA113 Digital Signal Processing and DSP Processors**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	–	–	–	–	–	–	–	1	–
CO2	3	3	3	3	1	–	–	–	–	–	–	–	2	2
CO3	3	3	3	3	1	–	–	–	–	–	–	–	2	2
CO4	3	2	2	2	1	–	–	–	–	–	–	–	1	–
CO5	2	1	1	1	1	–	–	–	–	–	2	–	2	2
ECA113	2.8	2.4	2.2	2.2	1	–	–	–	–	–	2	–	1.6	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA114	**Digital Communication**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the basic building blocks of Baseband communication systems.
	CO2 Compare and contrast suitable Baseband signalling techniques and their impact on digital receivers.
	CO3 Decide upon appropriate source coding and spread spectrum techniques based on the nature of the information sources and application needs.
	CO4 Analyse the BER performance of various bandpass communication systems.

UNIT-I	**Quantization and Encoding**	**Periods: 9**
Sources and Signals – Basic Signal Processing Operations in Digital Communication – PCM generation and recovery using match filter - Analysis of uniform and non uniform quantizers - Delta modulation - Analysis of delta modulators – Delta modulation and adaptive delta modulators - DPCM - Comparison of PCM and DM on the basis of speech signal.		**CO1**
UNIT-II	**Baseband Signalling Techniques**	**Periods: 9**
Need for line shaping of signals, Signaling formats - RZ/NRZ, Duo binary, Split phase (Manchester) and High density bipolar coding - Scrambling and unscrambling - channel equalization-ISI –Eye pattern – Receiving Filters- Matched Filter and Correlation receiver.		**CO2**
UNIT-III	**Source Coding**	**Periods: 9**
Purpose of encoding- Uniquely decipherable codes- Code efficiency and redundancy, Shannon's first and second fundamental theorem, Shannon's encoding algorithm, Shannon Fano code, Huffman code.		**CO3**
UNIT-IV	**Bandpass Transmission & Reception**	**Periods: 9**
BASK, BFSK, and BPSK- Transmitter, Receiver, Signal space diagram, Error probabilities. M-ary PSK, M-ary FSK, QAM, MSK and GMSK- Optimum detector, Signal constellation, error probability-OFDM.		**CO4**
UNIT-V	**Synchronization & Spread Spectrum Techniques**	**Periods: 9**
Synchronization: Need for synchronization - Synchronization methods - Bit, word and frame synchronization – Network synchronization. **Spread Spectrum Technique:** Introduction to Spread Spectrum Techniques - Pseudo noise sequences, Discrete sequence spread spectrum with coherent BPSK, Signal space dimensionality and processing gain, Frequency hop spread spectrum modulation.		**CO3** **CO4**

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

Reference Books:

1. Bernard Sklar, “Digital Communications- Fundamentals and applications”, Pearson Education, New Delhi, 2009.
2. Simon Haykin, "Digital Communications", John Wiley & Sons, Inc. Singapore, 2011.
3. Lathi B P "Modern Digital and Analog communication Systems", Oxford University Press, 2010.
4. Proakis J G, “Digital Communications”, Tata McGraw Hill, New Delhi, 2008.
5. Taub and Schilling D, "Principles of communication systems", McGraw Hill, New Delhi, 2008.

COURSE ARTICULATION MATRIX

Course: **ECA114 Digital Communication**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	1	-	–	–	–	1	2	1
CO2	2	3	3	2	2	1	1	-	–	–	–	1	2	1
CO3	3	2	3	2	2	2	1	-	–	–	–	1	2	1
CO4	3	2	2	2	2	2	1	-	–	–	–	1	2	1
ECA114	2.75	2.5	2.75	2	1.75	1.75	1	-	-	-	-	1	2	1

Department : **Computer Science and Engineering**		Programme : **B.Tech (EC)**						
Semester : **Fifth**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSA136	**Microprocessors and Microcontrollers**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Interpret the basic concepts and programming aspects of 8086 Microprocessors.						
	CO2	Analyze the peripherals and interface them with x86 processors.						
	CO3	Interpret and assess the function of Programmable Interface Controllers (PIC) microcontroller & its Peripherals.						
	CO4	Design and execute programs on Advanced RISC Machine (ARM) microcontroller.						
	CO5	Develop and implement Microcontroller based Systems.						

UNIT-I	**16 bit Microprocessor Architecture and Programming**	**Periods: 9**
Introduction - Evolution of Microprocessors- Intel 8086 Microprocessor Architecture – Pin description – External Memory Addressing – Bus Cycles. – Addressing Modes - Instruction Set – Directives – Assembly Language Programming.		**CO1**
UNIT-II	**Peripheral Interfacing**	**Periods: 9**
Introduction - I/O interfacing - Parallel communication interface and Serial communication interface using 8086 Microprocessor – D/A and A/D Interface - Timer – Printer Interface. BIOS (11H to 14H) and DOS interrupt (21H) functions for console.		**CO2**
UNIT-III	**PIC Microcontroller**	**Periods: 9**
Microchip's PIC Microcontroller - Salient features – Harvard architecture – register file structure – addressing modes – CPU registers – Instruction set – External interrupts – Timers: Compare & Capture modes – PWM outputs – SSP and SPI – I^2C bus – ADC characteristics – UART- serial programming.		**CO3**
UNIT-IV	**Introduction to ARM Microcontroller**	**Periods: 9**
RISC versus CISC – ARM Processor Fundamentals -ARM 7 Architecture – LPC2148 microcontroller introduction – Internal memory map –Thumb/ARM instructions – Assembly Language Programming. Peripheral details – Implementation of GPIO, Timer/Counter, UART, Interrupt architecture – ADC and DAC. SPI, I2C and USB features of LPC2148.		**CO4**
UNIT-V	**Programming and Applications of Microcontrollers**	**Periods: 9**
Firmware development using Embedded C – introduction to data types – conditional statements – loops – simple programs using embedded 'C'. Application of microcontrollers|: Traffic Light control system – DC Motor Speed control – Network Router		**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. A.K. Ray and K.M.Burchandi, and A.K.Ray, "Advanced Microprocessor and Peripherals", McGraw Hill International Edition, Third Edition, 2017.
3. John B. Peatman, "Design with PIC Microcontrollers", Pearson Education, 2013
4. Andrew N. Sloss Dominic Symes and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaughmann/Elsevier Publishers, 2006.
5. Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, and Janice Mazidi, "ARM Assembly Language Programming & Architecture", II Edition, 2016.

COURSE ARTICULATION MATRIX

Course: **CSA136 Microprocessors and Microcontrollers**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	1	1	–	2	1	2	1	2	2
CO2	3	3	2	1	1	2	1	–	2	1	2	1	2	2
CO3	3	3	2	1	1	2	1	–	2	1	2	1	2	2
CO4	3	3	2	1	1	2	1	–	2	1	2	1	2	3
CO5	3	3	3	2	2	2	1	–	2	1	3	1	2	3
CSA136	3	3	2	1.2	1.2	1.8	1	–	2	1	2.2	1	2	2.4

Department : **IEDC**		Programme : **B.Tech.**						
Semester : **Fifth**		Course Category Code: **PAC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EPA101	**Entrepreneurship**	3	-	-	2	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Outline the basics of Entrepreneurship and design thinking.						
	CO2	Extend the knowledgeable to build business model and MVP.						
	CO3	Outline the costing and revenue.						
	CO4	Outline about marketing and sales.						
	CO5	Explain about team and compliance requirements.						

UNIT-I	**Problem and Customer**	**Periods: 9**
Effectuation, Finding the flow. Entrepreneurial style, business opportunity, problems worth solving, methods for finding problems, problem interviews. Design Thinking, Consumer and customer, market types, segmentation and targeting, early adopters, Gains, Pains and "Jobs-To be done, Value Proposition Canvas (VPC), Identifying Unique Value Proposition (UVP).		**CO1**
UNIT-II	**Business Model and Validation**	**Periods: 9**
Types of Business Models, Lean Canvas, Risks. Building solution demo, solution interviews, problem-solution test, competition, Blue Ocean Strategy. MVP- Build-Measure-Learn feedback loop, MVP Interviews, MVP Presentation.		**CO2**
UNIT-III	**Revenue and Cost**	**Periods: 9**
Revenue Streams-Income, costs, gross and net margins - primary and secondary revenue streams- Different pricing strategies - product costs and Operations costs; Basics of unit costing. Financing New Venture- various sources - investor expectation- Pitching to Investors.		**CO3**
UNIT-IV	**Marketing and Sales**	**Periods: 9**
Difference between product and brand - positioning statement. Building Digital Presence, Social media-company profile page – Sales Planning - buying decisions, Listening skills, targets. Unique Sales Proposition (USP), sales pitch, Follow-up and closing a sale.		**CO4**
UNIT-V	**Team and Support**	**Periods: 9**
Team Building - Shared leadership - role of a good team - team fit - defining roles and responsibilities - collaboration tools and techniques- project management, time management, workflow, delegation of tasks. Business regulations - starting and operating a business - compliance requirements.		**CO5**

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

Reference Books:

1. Nandan H, "Fundamentals of Entrepreneurship", Prentice Hall India, 2013.
2. LearnWISE, "Digital learning platform", Wadhwani Foundation, www.learnwise.org
3. Khanka S.S, "Entrepreneurial Development", S Chand & Company, 2007.
4. Sangeetha Sharma, "Entrepreneurship Development", Prentice Hall India, 2017.
5. Anil Kumar.S, "Entrepreneurship Development", New Age Publishers, 2003.

COURSE ARTICULATION MATRIX

Course: **EPA101 Entrepreneurship**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	3	1	2	1	-	–	2	2	-	-	–
CO2	2	3	1	3	1	1	1	-	1	2	2	-	-	–
CO3	1	-	2	2	-	2	1	-	1	2	-	-	-	–
CO4	-	-	2	3	-	2	3	2	1	3	1	-	-	–
CO5	-	2	-	2	-	3	-	-	-	2	2	2	-	–
EPA101	1.33	1.2	1.4	2.6	0.4	2	1.2	0.4	0.6	2.2	1.4	0.4	-	–

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA115	**Digital Signal Processing Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the computation of DFT and FFT and studying its applications in signal analysis Using MATLAB software.
	CO2 Design and test IIR, FIR and multirate filters using software.
	CO3 Relate the various spectral estimation techniques using software. Demonstrate the design and testing of an equalizer for audio signal using software.
	CO4 Develop and apply concepts in writing programs on a floating point DSP processor and studying the effects of sampling and quantization, implement DFT, Convolution and FFT and generating various types of waveforms.
	CO5 Experiment with writing programs on a floating point DSP processor and design and implement IIR and FIR filters.

List of Experiments

1. DFT computation and application to find Circular convolution of two signals. Comparison of linear and circular convolutions. 2. Spectrum analysis of different signals using FFT algorithms.	**CO1**
3. Design of IIR filter for the given specifications using impulse invariant and bilinear transformation technique and study its frequency response characteristics. 4. Design and Implementation of FIR filter for the given specifications using frequency sampling and windowing technique and study its frequency response characteristics. 5. Design and implementation of Multirate LPF filters for the given specifications.	**CO2**
6. Simulation of different non-parametric spectral estimation techniques. 7. Equalization of digital audio signals.	**CO3**
8. Study of sampling, aliasing effects and quantization effects (distortions arising from using under-sampling and less number of bits) using floating point DSP processor kit. 9. Implementation of Linear and Circular convolution and FFT Implementation using floating point DSP processor kit. 10. Generation of different waveforms using floating point DSP processor kit.	**CO4**
11. IIR filter design for the given specifications using floating point DSP processor kit. 12. FIR filter design for the given specifications using floating point DSP processor kit.	**CO5**

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

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.

COURSE ARTICULATION MATRIX

Course: **ECA115 Digital Signal Processing Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	–	3	2	–	1	3	3
CO2	3	3	3	2	3	1	1	–	3	2	–	1	3	3
CO3	3	3	3	2	3	1	1	–	3	2	–	1	3	3
CO4	3	3	3	2	3	1	1	–	3	2	–	1	3	3
CO5	3	3	3	2	3	1	1	–	3	2	–	1	3	3
ECA115	3	3	3	2	3	1	1	–	3	2	–	1	3	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA116	**Digital Communication Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Outline, construct and test the performance of various baseband modulation techniquesusing both experimentally and/or through simulations.
	CO2 Classify the popular coding formats employed in baseband communication systems and inspect its merits and demerits.
	CO3 Analyse the obtained responses of modulation and source coding techniques in a digital communication system.
	CO4 Assess the importance of signal processing techniques employed at the digital receiver through simulations.

List of Experiments

1. Construct a Pulse code modulator and demodulator circuit. Obtain the coded output for the given sine wave. 2. Construct a time division multiplexing circuit to combine two different sampled data/voice streams onto a single channel by assigning time slots to each. Obtain the TDM output. 3. Construct a Delta modulator and demodulator circuit. Obtain the coded output for the given sine wave.	**CO1**
4. To study the different line coding techniques NRZ unipolar format NRZ polar format NRZ bipolar format and Manchester format. Obtain the waveforms of the different formats.	**CO2**
5. Through simulation verify any two source coding techniques. 6. Determination of Power spectral density of different type of Line codes through simulations. 7. Design of Scramblers and descramblers. 8. Design and Implementation of Tapped-Delay equalizer. 9. Design and analyse various pulse shaping filters- Guassian Filters, Cosine filters. Observe the obtained response through simulations.	**CO3** **CO4**
10. Construct an Amplitude Shift Keying (ASK) modulator and demodulator circuit. Obtain the ASK modulated and demodulated waveforms. 11. Construct a Frequency Shift Keying (FSK) modulator and demodulator circuit. Obtain the FSK modulated and demodulated waveforms. 12. Construct a Binary Phase Shift Keying (BPSK) modulator and demodulator circuit. Obtain the BPSK modulated and demodulated waveforms. 13. Simulate BASK, BFSK and BPSK circuits. Obtain the time domain and frequency domain response of the above modulation schemes. Compare its bit error performance.	**CO3**
14. Design and construct a LFSR circuit to generate the required PN-Sequence and observe the nature of PN code generated. Also test its properties through simulation. 15. DS CDMA: To design and construct DS-CDMA circuit and verify its operation. Obtain the DS-CDMA waveform. 16. FH CDMA: Construct a frequency synthesizer circuit using PLL for the given frequency values. Obtain the synthesized waveform.	**CO4**

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

Reference Books:

1. Laboratory Manual Prepared by the Department of ECE, PTU.
2. Simon Haykin, "Digital Communications", John Wiley & Sons, Inc. Singapore, 2011.
3. Bernard Sklar, “Digital Communications– Fundamentals and applications”, Pearson Education, New Delhi, 2009.
3. Dennis Silage, “Digital Communication Systems Using MATLAB and Simulink”, 2009.

COURSE ARTICULATION MATRIX

Course: **ECA116 Digital Communication Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	–	–	–	2	1	–	1	2	1
CO2	3	3	1	3	2	–	–	–	2	1	–	1	2	1
CO3	3	2	2	1	2	–	–	–	2	1	–	1	2	1
CO4	3	3	3	2	2	–	–	–	2	1	–	1	2	1
ECA116	3	2.75	1.75	2	2	–	–	–	2	1	–	1	2	1

Department : **Computer Science and Engineering**		Programme : **B.Tech (EC)**						
Semester : **Fifth**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSA137	**Microprocessors and Microcontrollers Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome		
	Upon completion of the course, the students will be able to	
	CO1	Develop and execute assembly language program of Intel 8086 including arithmetic, searching sorting, string manipulation operations, traffic light control and Stepper motor control.
	CO2	Develop and execute the assembly Language Programs for interfacing Intel 8086 with peripheral devices.
	CO3	Assess microcontroller real time interfaces including RTC, serial ports, Digital- to-Analog converters and Analog-to-Digital converters.
	CO4	Analyse the programming aspects of PIC and ARM microcontroller.

Experiments Using 8086 Microprocessor with MASM	
1. Arithmetic operations: Multi-byte Addition, Subtraction, Multiplication, Division. 2. Searching and Sorting 3. String Operations 4. Traffic light control 5. Stepper motor control 6. Serial and Parallel Interface	**CO1** **CO2**
Experiments Using PIC and ARM Controller	
7. Implementation of Simple Programs 8. Implementation of Interrupts 9. Implementation of UART features. 10. Interfacing SD card and Graphical LCD 11. Implementation of SPI and I2C communication 12. Implementation of USB communication 13. Implementation of Real-Time Clock using timer and interrupt 14. Interfacing with Keyboard matrix 15. Interfacing with Single/Multi channel Analog to Digital Convertor 16. Interfacing with Digital to Analog Convertor 17. Implementation of Watch dog timer 18. Traffic Lights Control 19. Stepper Motor interface 20. Speed control of DC motors 21. Parallel port interface with printer	**CO3** **CO4**

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

COURSE ARTICULATION MATRIX

Course: **CSA 137 Microprocessors and Microcontrollers Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1	1	1	–	2	1	2	1	1	2
CO2	3	3	2	1	1	2	1	–	2	1	2	1	1	2
CO3	3	3	2	1	1	2	1	–	2	1	2	1	2	3
CO4	3	3	2	1	1	2	1	–	2	1	2	1	2	3
CSA 137	3	3	2.25	1	1	1.75	1	–	2	1	2	1	1.5	2.5

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA117	**Microwave and Optical Engineering**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the limitations of conventional vacuum tubes at microwave frequencies and various methods of generating and amplifying microwave signals.
	CO2 Analyze and test microwave components and circuits.
	CO3 Summarize the signal degradation mechanisms in optical fiber and thereby optimize the fiber performance.
	CO4 Design a fiber optic link with appropriate light sources, detectors and amplifiers.
	CO5 Demonstrate the working principles of optical fiber link, WDM and passive 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**
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.		**CO3**
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.		**CO4**
UNIT-V	**Optical Networks**	**Periods: 9**
System design consideration- Point – to –Point link design –Link power budget –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**
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: **ECA117 Microwave and Optical Engineering**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	1	3	–	–	–	–	2	1	–
CO2	3	3	2	3	2	1	2	–	–	–	–	2	2	–
CO3	2	2	2	3	2	1	2	–	–	–	–	2	2	–
CO4	3	2	3	3	3	2	2	–	–	–	–	3	2	–
CO5	2	2	3	3	2	2	3	–	–	–	–	3	2	–
ECA117	2.4	2.4	2.6	3	2.4	1.4	2.4	–	–	–	–	2.4	1.8	–

Department **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA118	**Data Communication Networks**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	List the prime functions of layered architecture models with the protocol suite.						
	CO2	Compare and contrast the various networking technologies and their growth						
	CO3	Select suitable MAC/LLC protocols depending upon the application needs.						
	CO4	Analyse all the critical functional differences and its impact between Non-Mobile and Mobile - IP/TCP Layers.						
	CO5	Recommend appropriate networking technologies and services for emerging applications						

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**
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.		**CO3**
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 2.5/3G wireless networks. Support for mobility: World wide web -Hypertext transfer protocol - Hypertext markup language-System architecture-Wireless application protocol (version 1.x)-Architecture, Wireless telephony application.		**CO4**
UNIT-V	**Advanced Networks and Services**	**Periods: 9**
Differentiated and integrated services, Audio and Video Compression, Real-Time Traffic, Voice Over IP and Multimedia Support—SIP, Real-Time Transport Protocol (RTP). Introduction to Cellular networks Evolution 1G, 2G, 3G, 4G standards, Satellite networks, Ad hoc and Sensor networks. Enterprise Network Concepts: VPNs, MPLS networks, Next Generation Multiservice ATM, Beyond IP, 5G hetnets, IoT – Issues and challenges.		**CO5**

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

Note : Every student should carry out a mini project for this course and submit the report instead of assignment.

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. Aftab Ahmad, “Data Communication Principles -For Fixed and Wireless Networks”, Kluwer Academic Publishers, 2003.
4. Gurudeep S. Hura, Mukesh Singhal , “Data and Computer Communication - Networking and Internetworking”, CRC Press, 2001.
5. William Stallings, “Data and Computer Communication”, Pearson Education, Eighth edition, 2007.

COURSE ARTICULATION MATRIX

Course: **ECA118 Data Communication Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2	–	–	–	–	2	2	1
CO2	3	2	3	2	1	2	2	–	–	–	–	1	1	1
CO3	3	3	3	3	2	2	2	–	–	–	–	1	1	1
CO4	3	3	3	2	2	2	3	–	–	–	–	1	1	1
CO5	3	2	2	2	2	3	3	–	–	–	–	1	1	1
ECA118	3	2.6	2.8	2.4	1.8	2.2	2.4	–	–	–	–	1.2	1.2	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA119	**VLSI Design**	3	-	-	3	25	75	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	Design the combinational logic circuits using static CMOS logic.
	CO3	Design the combinational and sequential logic circuits using Pass transistor, Transmission Gate and Dynamic CMOS logic.
	CO4	Design the basic arithmetic functional blocks using CMOS and analyze the hardware complexity.
	CO5	Determine the test vectors of a faulty circuit.
	CO6	Discuss the steps in physical design flow.

UNIT-I	**MOS Technology**	**Periods: 9**
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, MOS Active Resistor, Current Sinks and Sources, CurrentMirrors - Current mirror with Beta Helper, Degeneration, Cascode current Mirror, Widlar and Wilson CurrentMirror, Current and Voltage References, Band gap Reference, Design of Opamp using CMOS.		**CO1**
UNIT-II	**CMOS Circuit Characterization**	**Periods: 9**
Moore's Law - CMOS Inverter – DC and Switching Characteristics of CMOS Inverter – Propagation Delay – Sheet Resistance – Inverter Pair Delay – NMOS, CMOS – Power Dissipation – Realization of Combinational Logic Functions using static CMOS – CMOS Layers – Stick Diagram –Design Rules - CMOS Layout.		**CO2**
UNIT-III	**Design of Logic Circuits and Array Subsystem**	**Periods: 9**
Pass Transistor - Transmission Gate - Realization of Combinational Logic Using Pass Transistor and Transmission 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 – Charge Sharing. Inverter, NAND and NOR using BiCMOS. Realization of Sequential Circuits using Transmission Gate – Registers - D-Latch – D-Flip-Flop – Memory elements – DRAM – SRAM.		**CO3**
UNIT-IV	**Datapath Subsystem Design**	**Periods: 9**
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 Shifter.		**CO4**
UNIT-V	**Fault Models and Physical Design Automation**	**Periods: 9**
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 – Partitioning – K –L Partitioning – Placement – Cluster Growth – Floor Planning – Hierarchical Tree based and slicing plan - Global Routing – Lee's algorithm – Allocation – Scheduling – ASAP and ALAP.		**CO5** **CO6**

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

Reference Books:

1. Philip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Neil H. E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI design - A circuits and Systems Perspective", Dorling Kindersley (India) Pvt Ltd, 2009.
3. Naveed A. Sherwani, "Algorithms for VLSI Physical Design Automation", Springer, Third Edition, 1999.
4. Paul. R. Gray, Paul. J. Hurst, S. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International, Fifth Edition, 2010.
5. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective",Prentice Hall of India, 2012.

COURSE ARTICULATION MATRIX

Course: **ECA119 VLSI Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	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	2	2	2	2	2	-	-	-	-	-	-	2	3	1
CO6	2	2	2	2	2	-	-	-	-	-	-	2	3	1
ECA119	2.66	2.66	2.66	2.66	2	-	-	-	-	-	-	2	3	1

Department : **Humanities and Social Sciences**		Programme : **B.Tech**						
Semester : **ODD/EVEN**		Subject Category: **PE**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HSA102	**Industrial Economics & Management**	3	-	-	3	40	60	100
Prerequisite:	-							
Outcome:	The course will enable the students:							
	CO1	Demonstrate economic theories, revenue and cost concepts and set of analytical techniques applied to a variety of economic, non-economic and financial management issues.						
	CO2	**A**nalyse the overall performance of an economy through an understanding of functional relationships between macroeconomic aggregates						
	CO3	Demonstrate knowledge on business management concepts to relate theory with practice.						
	CO4	Interpret company's income statements and balance sheets to ascertain the financial position of a company.						
	CO5	Apply financial planning, project scheduling and financial analysis to economic investment and project management problems.						
UNIT-I	**MICRO AND MACRO ECONOMICS AND ITS APPLICATIONS**				**Periods: 09**			
Nature and Scope of Economic science: Micro – Macro Economics, Economic decisions and Technical decisions. Demand and Supply concepts: Types of Demand, Determinants of Demand and Supply, concept of Equilibrium, Elasticity of Demand, cost components, Concepts of ISO-Quant – Break Even Analysis – Market structure – Price of Product Nature of pricing in different types of competition Small Scale Industries – Role of SSI in Indian Economy. Macro Economics: Nature and functions of Money – National Income – GNP and Savings – Inflation and Deflation concept – Business Cycle – Foreign Trade and Balance of payment.								**CO1**
UNIT-II	**MANAGEMENT TECHNIQUES**				**Periods: 09**			
Types and Principles of Management – Elements of Management – Planning, Organising, Staffing, Directing, Coordinating Controlling - Scope of Management – Types of Organization Merits and Demerits – Types of (Ownership) of a firm Merits and Demerits.								**CO2**
UNIT-III	**INDUSTRIAL FINANCE**				**Periods: 09**			
Need for Finance – Types of finance – Sources of finance – Types of Investment – Evaluation of Investment – Preparation of Trading, Profit and loss Account and Balance Sheet – types of accounting and significance of each types.								**CO5**
UNIT-IV	**PRODUCTION MANAGEMENT**				**Periods: 09**			
Theory of Production Function – Types of Production Merits and Demerits – Process Planning – Routing – Scheduling – Material Control Concepts of Productivity – Measurement of Productivity – Inspection and Dispatches.								**CO4**
UNIT-V	**MARKETING MANAGEMENT**				**Periods: 09**			
Core Concepts of Marketing -0 Needs – Wants – Demand, Marketing Vs Selling – Products and Markets – Pricing and related factors – Channels of Distribution – Promotion Advertising – Market Research Vs Marketing Research								**CO5**
Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**			**Total Periods: 45**			

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, DhanpatRai and Sons, 2009.
6. Philip B Kotler, “Marketing Management, MacMillan, New York 2011.

COURSE ARTICULATION MATRIX

Course: **HSA 102 Industrial Economics and Management**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	-	-	-	-	-	1	-	-	-	-	1	1		
CO2	-	-	-	2	-	-	-	-	-	-	1	1		
CO3	-	-	-	-	-	1	-	-	3	-	3	2		
CO4	-	-	-	-	-	-	-	-	-	-	3	1		
CO5	-	-	-	-	-	1	-	-	2	-	3	2		
HSA102														

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA120	**Microwave and Optical Engineering Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Demonstrate the characteristics of microwave sources.
	CO2	Analyse the performance of microwave components and antennas.
	CO3	Experimentally evaluate VSWR, impedance and dielectric constant using Microwave test bench.
	CO4	Experimentally measure the light propagation characteristics
	CO5	Demonstrate the design and testing of microwave link.

List of Experiments

1. Mode characteristics of Reflex Klystron Mode characteristics measurement of Reflex Klystron Oscillator and estimation of ETS and ETR 2. Gunn diode characteristics and standing wave pattern a) V-I and V-P characteristics of Gunn diode. b) Measurement of standing wave pattern, wavelength and operating frequency of Gunn diode using slotted waveguide.	**CO1** **CO5**
3. Determination of VSWR and impedance of unknown load a) To measure VSWR of a matched load. b) To measure impedances of load such as capacitive iris, horn antenna, etc 4. Measurement of VSWR and return loss using reflectometer method.	**CO2** **CO3**
5. Radiation pattern of antenna Estimation of FNBW, HPBW and side lobe level of the given antenna	**CO2**
6. Determination of gain of an antenna a) To determine gain of identical horn antenna. b) To determine gain of unknown parabolic reflector 7. Characteristics of microwave components Characteristics of given passive microwave components such as directional coupler, magic tee, circulator and isolator.	**CO2** **CO5**
8. Determination of dielectric constant of given material Measurement of relative and absolute dielectric constant of given dielectric materials such as wood, Teflon, Nylon, rubber, ebonite, etc., using basic microwave setup	**CO2** **CO3**
9. Study of optical fiber characteristics a) Frequency response of fiber b) Attenuation c) Coupling loss and bending loss d) Numerical aperture and acceptance angle	**CO4** **CO5**
10. Characteristics of digital link using optical fiber a) To establish a digital fiber optic link and obtain its frequency response. b) To obtain BER of the digital fiber optic link. c) To set up a TDM link using fiber optics and transmit the multiplexed audio and data and receive the same.	**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.

COURSE ARTICULATION MATRIX

Course: **ECA120 Microwave and Optical Engineering Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	3	2	-	-	3	2	-	-	1	-
CO2	2	2	3	2	3	1	-	-	1	1	-	-	1	-
CO3	3	3	3	2	2	1	-	-	2	2	-	-	2	-
CO4	3	3	3	3	3	1	-	-	3	2	-	-	2	-
CO5	2	2	3	3	3	2	-	-	3	2	-	-	1	-
ECA120	2.4	2.4	3	2.6	2.8	1.4	-	-	2.4	1.8	-	-	1.4	-

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA121	**Data Communication Networks Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the functioning of various mechanism employed at lower / upper layers.						
	CO2	Analyze the various mechanisms involved in communication networks involved using NS.						
	CO3	Compare the different routing protocols.						
	CO4	Develop and examine unicast / multicasting communication for various types of networks.						

List of Experiments

1. Communication between PC's
   a) Serial communication using RS 232C.
   b) Parallel Communication using 8- bit parallel cable.
2. Demonstration of error detection codes using simulation software.
   a) Parity Check
   b) Cyclic Redundancy Check
3. To verify the performance of error correction codes.
   a) Hamming code
4. To evaluate the performance of flow control mechanisms in a data network
   a) Stop and Wait ARQ
   b) Go back N
   c) Selective Reject
5. Demonstrate the operation of the Ethernet.
6. To demonstrate LAN Trainer Experiments
   a) MAC Protocol Analysis
   b) Routing Algorithms
   c) Token passing
   d) File transfer using FTP
7. Design and verify congestion control algorithm
   a) token bucket
   b) leaky bucket
8. Performance Analysis and modelling of
   a) Voice traffic
   b) Data traffic
9. Implementation of Data encryption and decryption
   a) Caesar cipher
   b) Vignere cipher
   c) RSA
10. Using TCP/IP sockets, write a client server program to make client sending the file name and server to send back the contents of the requested file if present.

CO1
CO2

11. To implement and analyse wired network topology and wireless network topology using network simulator. 12. Implementation of distance vector routing algorithm and Link state routing algorithm using any Simulator. 13. Simulate a Layer2 VPN through fibre Optical Link. 14. Installation, configuration, classification and performance analysis of a) TCP/IP b) UDP 15. Simulation of ICMP pings for a network management.	**CO3**
16. Perform multicast communications using appropriate simulator tools (NS2/QUALNET etc.). 17. Examine the effect of ATM adaptation layers and service classes on the performance of the network using appropriate simulator tools (NS2/QUALNET etc.). 18. Sharing of processed image from one host to another using Scan IP imaging software.	**CO4**

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

Reference Books:

1. Azhar Sayeed, Monique Morrow, "MPLS and Next-Generation Networks: Foundations for NGN and Enterprise Virtualization", Cisco Press, 2006.
2. Jyh-Cheng Chen, Tao Zhang, "MPLS and IP-Based Next-Generation Wireless Networks", John Wiley & Sons, Inc., Publication, 2002.
3. Robert Wood, "Next-Generation Network Services", Cisco press, Nov 2000.

COURSE ARTICULATION MATRIX

Course: **ECA121 Data Communication Networks Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	-	-	3	2	-	1	1	1
CO2	3	3	2	2	3	1	-	-	1	1	-	1	1	1
CO3	3	3	2	2	2	1	-	-	2	2	-	1	2	1
CO4	3	3	2	3	3	1	-	-	3	2	-	1	2	1
ECA121	3	3	2	2.5	2.75	1.25	-	-	2.25	1.75	-	1	1.5	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA122	**VLSI Design Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Examine the functionality of the combinational and sequential logic circuits using Xilinx ISE synthesis tool.
	CO2 Analyze static timing analysis using Xilinx ISE tool.
	CO3 Develop Verilog HDL programs and emulate using FPGA.
	CO4 Build the layout of the given schematic using Micro wind and Design Schematic Tool.
	CO5 Develop the Spice code and evaluate the performance of the given circuit through S-Edit using Tanner EDA Tool.

Part – I VLSI Front End Design	
Using HDL based design entry, perform the synthesis/simulation of following combinational/sequential circuits using Xilinx ISE Tool and generate Technology schematic and Synthesis Report. 1. a) Design and verify the functionality of a 1-Bit Adder and Subtractor. b) Design and verify the functionality of an 8-Bit Serial and Parallel adder/Subtractor. 2. a) Design and verify the functionality of a 4-bit unsigned array multiplier. b) Design and verify the functionality of a 4-bit signed multiplier. 3. a) Design and verify the functionality of a Frequency Divider Circuit. b) Design and verify the functionality of a Serial Data Transfer System. c) Design and verify the functionality of a 4-bit ripple counter. d) Design and test a Switch Debounce System. 4. Design a Camera Scanner and SPST Keypad Encoder system. 5. Design a Mux/Demux based Security System. 6. Design of Code Converters. 7. a) Finite State Machine Implementation – Vending Machine System b) Sequence Detector (Mealy and Moore) 8. Realization of ROM / RAM	**CO1**
9. Using Xilinx ISE Synthesis tool, perform place and route back annotation of 4-bit counter and observe the static timing analysis.	**CO2**
Part – II Implementation using Spartan6 FPGA Board	
10. Seven Segment Display 11. LCD 12. Traffic Light Controller 13. 4x4 Matrix Keypad 14. UART implementation	**CO3**
Part – III VLSI Back End Design	
15. Using Microwind and Dsch Tool, generate the layout of the following circuits: a) 4-Bit Carry Look-Ahead Adder b) 4x4 Bit Multiplier	**CO4**
16. Using TannerEDA Tool, perform the static timing analysis using L-Edit and extract the SPICE code andverify the design rules. a) CMOS Inverter, CMOS NAND and CMOS NOR gates b) CMOS Differential Amplifier	**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 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", 2006, Tata McGraw-Hill Publishing company Ltd. New Delhi.

COURSE ARTICULATION MATRIX

Course: **ECA122 VLSI Design Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	–	–	1	2	-	2	3	2
CO2	3	3	3	3	3	2	–	–	1	2	–	2	3	2
CO3	3	3	3	3	3	2	–	–	1	2	–	2	3	2
CO4	3	3	3	3	3	2	–	–	1	2	–	2	3	2
CO5	3	3	3	3	3	2	–	–	1	2	–	2	3	2
ECA122	3	3	3	3	3	2	–	–	1	2	–	2	3	2

Department : **Humanities and Social Sciences**			Programme : **B.Tech. (EC)**						
Semester : **Sixth**			Subject Category: **MCC**			Semester Exam Type: -			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
SHA103	**Essence of Indian Traditional Knowledge**		3	-	-	-	-	-	-
Prerequisite	-								
Course Outcome	Upon completion of the course, the students will be able to								
	CO1	Explain and connect to the basics of Indian traditional knowledge from a modern scientific perspective							
UNIT-I						**Periods: 23**			
Basic structure of Indian knowledge system, Modern science and Indian knowledge system, Yoga and holistic health care.									**CO1**
UNIT-II						**Periods: 22**			
Philosophical tradition, Indian linguistic tradition, Indian artistic tradition.									
Lecture Periods: 45	**Tutorial Periods:**		**Practical Periods:**			**Total Periods: 45**			
Reference Books:									

1. N. Sivaramakrishnan (Ed.) Culteral Heritage of India – Course Materal, Bharatiya Vidya Bhavan, Mumbai 5th edition, 2014.
2. Swami Jitatmanand, Modern Physics and Vedanta, Bharatiya Vidya Bhavan.
3. Fritzof Capra, Tao of Physics.
4. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
5. R.N. Jha, Science of Conciousness Psychotherapy and yoga Practices, Vidyanidhi Prakashan, Delhi 2016.
6. S.C Chaterjee and D.M Datta, An Introduction to Indian Philosophy, University of Calcutta, 1984.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987

COURSE ARTICULATION MATRIX

Course: **SHA103 Essence of Indian Traditional Knowledge**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SHA103	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA123	**Wireless Communication**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of different types of wireless technologies**.**						
	CO2	Analyse the different multipath fading models.						
	CO3	Analyse the BER and capacity performance under different fading channels.						
	CO4	Summarise the different diversity and equalization techniques of multipath environment.						

UNIT-I	**Wireless services**	**Periods: 9**
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		**CO1**
UNIT-II	**Large Scale Multipath Propagation**	**Periods: 9**
Large scale Path loss and shadowing: Wireless communication Environment, Radio Wave Propagation, Transmit and Receive Signal Models, Free-Space Path Loss, Ray Tracing, Empirical Path Loss Models, Simplified Path Loss Model, Shadow Fading, Combined Path Loss and Shadowing.		**CO2**
UNIT-III	**Small Scale Multipath Propagation**	**Periods: 9**
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 Channel Models:** Rayleigh and Rician distribution.		**CO2**
UNIT-IV	**Performance and Capacity Analysis**	**Periods: 9**
Block diagram of wireless Communication system. **Demodulation:** Demodulator structure, error probability in AWGN channels, Error Probability in flat fading channels, Error Probability in Delay and Frequency Dispersive fading Channels. **Capacity Analysis:** Capacity of Flat fading Channels, Channel and system model, Channel State Information at transmitter and receiver, Capacity of frequency selective fading Channels.		**CO3**
UNIT-V	**Performance Enhancement Techniques (Qualitative Treatment only)**	**Periods: 9**
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, SVD of MIMO, MIMO Capacity Analysis for static and fading channels. Introduction to Multiuser MIMO.		**CO4**

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

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, 2006.
4. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communications", Cambridge University Press, 2006.
5. Aditya.K.Jegannathan, "Principles of Modern Wireless Communication Systems",Tata McGraw Hill, 2016.

COURSE ARTICULATION MATRIX

Course: **ECA123 Wireless Communication**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	1	1	-	-	-	-	1	1	2
CO2	3	3	3	2	2	1	1	-	-	-	-	1	3	2
CO3	3	3	3	2	1	1	1	-	-	-	-	1	2	2
CO4	3	1	1	1	1	-	-	-	-	-	-	1	1	1
ECA123	3	2	2.5	1.75	1.25	1	1	-	-	-	-	1	1.75	1.75

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA124	**Information Theory and Coding**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Apply the concept of entropy and different channel models to solve numerical problems.						
	CO2	Construct block codes, BCH ,RS codes and convolutional codes						
	CO3	Develop an in-depth understanding of concatenated codes and exhibit proficiency in the design of Turbocodes.						
	CO4	Interpret the concepts involved in the detection of signals corrupted with noise.						

UNIT-I	**Introduction to Information Theory**	**Periods: 9**
Measure of information- Entropy of symbols –Continuous and discrete cases, Conditional entropies- Mutual information and Trans information. Discrete memoryless channels-Channel representations-noiseless channel, lossless channel, deterministic, Binary Symmetric channel, Binary Erasure channel and their capacities. Continuous and discrete channels with noise- Shannon Hartley theorem and its implications.		**CO1**
UNIT-II	**Error Control Coding: Block Codes, BCH and RS Codes**	**Periods: 9**
Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding. Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes. Syndrome calculation, Encoder and decoder. Basic principle of BCH and RS codes		**CO2**
UNIT-III	**Error Control Coding: Convolutional Codes**	**Periods: 9**
Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft–output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding.		**CO2**
UNIT-IV	**Error Control Coding: Concatenated Codes & Turbo Codes**	**Periods: 9**
Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.		**CO3**
UNIT-V	**Detection of Signals and Channels With Noise**	**Periods: 9**
Hypothesis testing- Baye's criterion Minimum error probability criterion, Neyman Pearson criterion, Min-max criterion Maximum likelihood detector- Wiener filter.		**CO4**

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

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.

COURSE ARTICULATION MATRIX

Course: **ECA124 Information Theory and Coding**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO2	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO3	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO4	3	2	1	–	1	–	1	–	–	–	–	1	2	1
ECA124	3	2	1	–	1	–	1	–	–	–	–	1	2	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA125	**Embedded System**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	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.						

UNIT-I	**Introduction**	**Periods: 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**
UNIT-II	**Programming for Embedded Systems**	**Periods: 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 – Program Models- DFG Models – FSM Models – Modeling of Multiprocessor Systems.		**CO2**
UNIT-III	**Real-time Operating Systems**	**Periods: 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**
UNIT-IV	**Reliability Evaluation Techniques**	**Periods: 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**	**Periods: 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 – Requirements, Characteristics and Applications – Smart Lighting – Smart Traffic Light Control – Smart Parking and Smart Irrigation.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 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, Second reprint, 2008.
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, 2013.
5. David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint, 2000.

COURSE ARTICULATION MATRIX

Course: **ECA125 Embedded Systems**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	1	1	–	–	–	–	1	1	3
CO2	3	3	3	3	3	1	1	–	2	2	–	1	3	3
CO3	3	2	3	2	2	1	1	–	–	–	–	1	1	3
CO4	3	2	3	3	2	1	1	–	–	–	–	1	1	3
CO5	3	3	3	2	3	1	1	–	2	2	–	1	3	3
ECA125	3	2.4	3	2.4	2.4	1	1	–	2	2	–	1	1.8	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA126	**Wireless Communication Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Practically analyze the components of transmitter and receiver of a wireless communication link
	CO2 Examine the error performance of mobile radio links for digital modulation schemes and error correction codes.
	CO3 Examine the working of GSM, CDMA, WLAN and Wireless sensor networks.
	CO4 Analyse the parameters of a RF network using Vector Network Analyser.
	CO5 Build the algorithms of speech and images processing related to wireless communication.

List of Experiments

1. Establishment and study of Wireless Communication Link at X band to transmit voice. 2. Design and testing of GMSK Modulator and study its spectrum using Spectrum analyser.	**CO1**
3. 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 using MATLAB SIMULINK. 4. Simulate and study the performance of error detection and correction codes: a) Cyclic redundancy check and b) Hamming codes using MATLAB SIMULINK for a Binary symmetry channel with varying error probabilities.	**CO2**
5. Performance analysis of Wireless Networks using QualNet: a) GSM Network. b) WLAN Network. c) Heterogeneous network of GSM and WLAN. 6. a) Simulation of Hand off mechanisms in Cellular Mobile Communications using NETSIM. 7. b) Design and implementation of PAN Networks using NETSIM. 8. Establish and study a Prototype Wireless Sensor Network using NI LabVIEW.	**CO3**
9. Design and testing of Yagi antenna using Vector Network Analyzer. 10. Study the characteristics of MIC components using Vector Network Analyser.	**CO4**
11. Simulate and study algorithms for Speech signal processing. 12. Simulate and study algorithms for Image processing.	**CO5**

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

Reference Books:

1. Laboratory Manual Prepared by the Department of ECE, PTU.
2. Andrea Goldsmith, “Wireless Communications”,Cambridge University Press (2005)
3. Frank Gustrau, “RF and Microwave Engineering– Fundamentals of Wireless Communications”, Wiley (2012).pdf

COURSE ARTICULATION MATRIX

Course: **ECA126 Wireless Communication Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	2	–	–	–	2	1	–	1	1	1
CO2	1	2	1	2	2	–	–	–	2	1	–	1	1	1
CO3	1	2	1	2	2	–	–	–	2	1	–	1	1	1
CO4	1	2	1	2	2	–	–	–	2	1	–	1	1	1
CO5	1	2	1	2	2	–	–	–	2	1	–	1	1	1
ECA126	1	2	1	2	2	–	–	–	2	1	–	1	1	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA127	**Embedded System Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Examine the issues involved in embedded system design.
	CO2 Apply microcontroller programming and interfacing skills.
	CO3 Design, develop and test the embedded systems.
	CO4 Develop the program and analyse codes using an IDE.
	CO5 Implement and test small scale embedded systems.

List of Experiments

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. Irrigation controller using Moisture Sensor 7. Temperature Measurement and Display 8. Hot Chamber Temperature Controller 9. Obstacle Detector 10. Password based Security Lock	**CO1** **CO2** **CO3** **CO4** **CO5**

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

Reference Books:

1. Laboratory Manual Prepared by the Department of ECE, PTU.
2. Jonathan. W. Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition, Cengage Learning, 2012.

COURSE ARTICULATION MATRIX

Course: **ECA127 Embedded Systems Laboratory**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1	1	–	2	–	–	1	1	3
CO2	3	3	3	3	3	1	1	–	2	2	–	1	3	3
CO3	3	3	3	3	3	1	1	–	2	–	–	1	1	3
CO4	3	3	3	3	3	1	1	–	2	–	–	1	1	3
CO5	3	3	3	3	3	1	1	–	2	2	–	1	3	3
ECA127	3	3	3	2.8	2.8	1	1	–	2	2	–	1	1.8	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PAC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA128	**Mini Project**	-	-	2	1	100	-	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of state of art technology and objective of the project.
	CO2 Analyze problems / create a new product process.
	CO3 Apply knowledge and skills acquired to identify a solution for specific problem or an issue.
	CO4 Implement and evaluate the proposed solution/ developed projects.
	CO5 Document the findings of the report and make effective presentation.

Mini Project

The students will carry out a project in one of the following Electronics and communication engineering areas but with substantial multidisciplinary component involving Electrical Engineering, Computer Science Engineering, Information Technology, Mechanical Engineering and Bio-Medical Engineering. i) Communication ii) Signal Processing iii) Image Processing iv) Bio-Medical Electronics v) Data Communication vi) VLSI vii) Embedded Systems viii) Robotics ix) Internet of Things x) Artificial Intelligence xi) Cryptography and Security In the course of the degree programme each group of not more than three students has to identify a mini project work in the area of their specialization and the mini project will be implemented under the supervision of a faculty. The progress of the work will be monitored and assessed internally. A project report has to be submitted at the end of the semester after completion of the project work.	**CO1** **CO2** **CO3** **CO4** **CO5**

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

COURSE ARTICULATION MATRIX

Course: **ECA128 Mini Project**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	1	1	3	3	2	2	3	2
CO2	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO3	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO4	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO5	-	-	-	-	-	-	-	-	3	3	3	3	3	3
ECA128	3	3	2.75	2.75	2.5	1	1	1.75	3	3	2.2	2.2	3	2.2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **MCC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA129	**Professional Ethics**	2	-	-	Non-Credit	-	-	-
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the ethical and moral principles.
	CO2 Identify the ethical problems and analyze them.
	CO3 Interpret and confront moral issues and dilemmas.
	CO4 Demonstrate the understanding of the major ethical theories.
	CO5 Apply ethical theories to resolve moral issues.

UNIT-I	**Ethics and Moral Principles**	**Periods: 6**
Profession – Morals – Ethics and Moral – Professional Ethics – Ethics and Science. Types of Ethics – Normative Ethics, Meta-Ethics and Applied Ethics.		**CO1**
UNIT-II	**Analysis of Ethical Problems**	**Periods: 6**
Ethical problems and analysis – Engineering Ethics – Micro-Ethics, Macro-Ethics. Ethical analysis – Normative Inquiry, Conceptual Inquiry and Factual Inquiry – Case Study.		**CO2**
UNIT-III	**Moral Dilemmas**	**Periods: 6**
Moral Dilemmas – definition – examples of moral dilemmas – methodology for resolving moral dilemmas. Kohlberg's theory of moral development – Heinz's dilemma – Gilligan's theory – Case study. Consensus and Controversy – Authority and Autonomy – Multiple Motives – Safety in Engineering.		**CO3**
UNIT-IV	**Ethical Theories**	**Periods: 6**
Ethical Theories – Virtue Ethics: Aristotle and MacIntyre, Utilitarian Ethics: Act Utilitarian and Rule Utilitarian, Duty Ethics and Rights Ethics - Case Study.		**CO4**
UNIT-V	**Application of Ethical Theories**	**Periods: 6**
Engineering as Social Experimentation.		**CO5**

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

Reference Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
5. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

COURSE ARTICULATION MATRIX

Course: **ECA129 Professional Ethics**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	–	–	–	–	2	2	3	3	3	3	3	–	–
CO2	1	–	–	–	–	2	2	3	3	3	3	3	–	–
CO3	1	–	–	–	–	2	2	3	3	3	3	3	–	–
CO4	1	–	–	–	–	2	2	3	3	3	3	3	–	–
CO5	1	–	–	–	–	2	2	3	3	3	3	3	–	–
ECA129	1	–	–	–	–	2	2	3	3	3	3	3	–	–

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Eighth**		Course Category Code: **PAC**				Semester Exam Type: -		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA130	**Comprehensive Test**	-	-	2	1	100	-	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1 Evaluate the technical strength in the core area.							
	CO2 Choose answers for questions in precise manner within a specified time limit.							
	CO3 Build the technical skill to find the criteria to crack the competitive examinations.							
	CO4 Develop confidence to appear for placement interviews.							
Comprehensive Test								
The comprehensive viva-voce is intended to test the domain knowledge of the undergraduate students, pertaining to the subjects covered in the previous semesters falling under broad areas of electronic circuits, communication systems, electromagnetic waves and signal processing. This viva-voce also prepares the students for their competitive examinations like GATE, IES and also enables them to self-assess their domain knowledge.								**CO1 – CO4**
Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**				**Total Periods: 30**		

COURSE ARTICULATION MATRIX

Course: **ECA130 Comprehensive Test**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	–	–	–	1	–	–	–	1	3	3
CO2	3	3	3	2	–	–	–	1	–	–	–	1	3	3
CO3	3	3	3	2	–	–	–	1	–	–	–	1	3	3
CO4	3	3	3	2	–	–	–	1	–	3	–	1	3	3
ECA130	3	3	3	2	–	–	–	1	–	3	–	1	3	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Eighth**		Course Category Code: **PAC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA131	**Internship**	-	-	-	2	100	-	100
Prerequisite	-							
Course Outcome	Upon completion of the Internship, the students will be able to							
	CO1	Develop expertise on one or more applications of the core courses						
	CO2	Build expertise in the field for a career transition.						
	CO3	Build professional networking.						
	CO4	Develop valuable skills and knowledge.						
	CO5	Perceive an idea of industrial and organizational/company setup						

Internship

• 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 is required to undergo '*internship*' in industry / research laboratory / higher learning institution for a minimum period of 6 weeks in a maximum of 3 spells during vacations. Each spell of internship shall be for a period of not less than 2 weeks. • The student will make the presentation for a duration of 20 to 25 minutes and also submit a detailed report after completion for the purpose of assessment.	**CO1 - CO5**

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

COURSE ARTICULATION MATRIX

Course: **ECA131 Internship**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	1	1	1	2	2	2	2	3	2
CO2	3	2	2	1	3	1	1	1	2	2	2	2	3	2
CO3	3	2	2	1	3	1	1	1	2	2	2	2	3	2
CO4	3	2	2	1	3	1	1	1	2	2	2	2	3	2
CO5	3	2	2	1	3	1	1	1	2	2	2	2	3	2
ECA131	3	2	2	1	3	1	1	1	2	2	2	2	3	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Eighth**		Course Category Code: **PAC**				Semester Exam Type: **PR**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA132	**Project Work**	-	-	8	8	60	40	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of state-of-the-art technology, objective and different phases of the project work.						
	CO2	Analyze problems / create a new product process.						
	CO3	Apply knowledge and skills acquired to identify a solution for specific problem or an issue.						
	CO4	Implement the project using hardware / software.						
	CO5	Evaluate the solution against bench mark standards.						
	CO6	Document the findings of the report and make effective presentation.						

Project Work

Each batch of 2 or more students will be assigned an experimental or a simulation project to be carried out under the supervision of a guide. The student is given an option to carry out this project work either in the college or in an industry / research laboratory / higher learning institution. The project work will be carried out under the supervision of a project guide from the department. In the case of student carrying out the project work outside the college, an external guide from the relevant organization shall be assigned in addition to the internal guide from the department. Students will be continuously monitored and assessed regarding the progress of their work and will be advised suitably through a panel of review committee.	**CO1** **CO2** **CO3** **CO4** **CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 120**	**Total Periods: 120**

COURSE ARTICULATION MATRIX

Course: **ECA132 Project Work**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	1	1	3	3	2	2	3	2
CO2	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO3	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO4	3	3	3	3	3	1	1	2	3	3	2	2	3	2
CO5	2	2	3	3	2	1	1	2	3	3	2	2	3	2
CO6	-	-	-	-	-	-	-	-	3	3	3	3	3	3
ECA132	2.8	2.8	2.8	2.8	2.4	1	1	1.8	3	3	2.17	2.17	3	2.17

Professional Elective Courses

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA201	**Random Variable and Random Processes**	3	-	-	3	25	75	100
Prerequisite	Basic knowledge on communication theory.							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the basic probability theory and random variables.						
	CO2	Extend the random variable knowledge to random process.						
	CO3	Evaluate the response of random signals to linear systems.						
	CO4	Demonstrate the understanding of the basics of Markov process.						
	CO5	Apply Random Variable and Random Processes theory for practical systems.						

UNIT-I	**Introduction to Probability theory and random variables**	**Periods: 9**
Mathematical, deterministic, probability models Sample space- discrete and continuous. Baye's Law, Probability law- Binomial, Multinomial, Geometric laws. Random variable – Discrete random variables and continuous random variables- cumulative distribution function, probability density function, expectation, variance.		**CO1**
UNIT-II	**Random process**	**Periods: 9**
Gaussian- Random variable, joint Gaussian random variable, Transformation of Gaussian random variable. random vector, random process, discrete time random process, continuous time random process, stationary random process. Deterministic and Non-deterministic processes. Central limit theorem.		**CO2**
UNIT-III	**Spectral characteristics of random process**	**Periods: 9**
Power spectral density – continuous time and discrete time random process. Response of linear systems to random signals – continuous time and discrete time systems. Power spectrum density properties. Ergodic theorems.		**CO3**
UNIT-IV	**Introduction to Markov process**	**Periods: 9**
Discrete time Markov chains –n-step transitional probabilities, state probabilities and steady state probabilities. Continuous time Markov chains –state occupancy times, transition rates and steady state probabilities. Elements of queueing systems, Little's formula.		**CO4**
UNIT-V	**Practical Applications**	**Periods: 9**
Probability model of a voice transmission system. Kalman filter, Bandpass , Band limited and Narrowband random process with example. Characterization of white and colored noise by power spectrum with relevant example.		**CO5**

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

Reference Books:

1. Alberto Leon-Garcia, "Probability and Random process for Electrical Engineering", Second edition, Pearson Education, 1994.
2. Peyton Z.Peebles, "Probability Random Variables and Random Signal Principles", Mc-Graw-Hill International editions, Electrical Engineering series, 1987.
3. John A. Gubner, "Probability and Random Processes for Electrical and Computer Engineers", Cambridge University Press, 2006.
4. Charles Therrien, Murali Tummala, "Probability and Random Processes for Electrical and Computer Engineers",Second edition, CRC press,2018.
5. Venkatarama Krishnan, "Probabiity and Random Process", Wiley Interscience, 2006.

COURSE ARTICULATION MATRIX

Course: **ECA201 Random Variable and Random Processes**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	–	–	–	–	–	–	1	2	–
CO2	2	3	2	2	2	–	–	–	–	–	–	1	2	–
CO3	3	3	1	3	2	–	–	–	–	–	–	1	2	–
CO4	3	3	1	3	2	–	–	–	–	–	–	1	2	–
CO5	3	3	1	3	2	–	–	–	–	–	–	1	2	–
ECA201	2.8	3	1.2	2.6	2	–	–	–	–	–	–	1	2	–

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fourth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA202	**Computer Architecture and Organization**	3	-	-	3	25	75	100
Prerequisite								

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Describe 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 the understanding of the concepts of Cache memory, Virtual memory and DMA transfer
	CO6 Demonstrate the understanding of the concepts of inter processor arbitration, communication and synchronization

UNIT-I	**Structure of Computers and Register Transfer and Micro-Operations**	**Periods: 9**	
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: 9**	
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 Set Computer (RISC).			**CO1 CO3**
UNIT-III	**Micro-programmed Control and Computer Arithmetic**	**Periods: 9**	
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: 9**	
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: 9**	
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: -**	**Practical Periods: -**	**Total Periods: 45**

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.

COURSE ARTICULATION MATRIX

Course: **ECA202 Computer Architecture and Organization**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	-	-	-	-	2	2	2
CO2	3	3	2	2	2	1	1	-	-	-	-	2	2	2
CO3	3	3	2	2	2	2	1	-	-	-	-	2	2	2
CO4	3	3	2	2	2	1	1	-	-	-	-	2	2	2
CO5	3	3	2	2	2	2	2	-	-	-	-	2	2	2
CO6	3	3	2	2	2	1	1	-	-	-	-	2	2	2
ECA202	3	3	2	2	2	1.5	1.33	-	-	-	-	2	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA203	**Antennas and Wave Propagation**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of antenna radiation and reception and to know about the various antenna parameters.
	CO2 Illustrate the concept of antenna arrays and its radiation pattern.
	CO3 Analyze the given aperture, slot and horn antennas and its radiation characteristics.
	CO4 Identify the best suitable antennas for a given communication systems
	CO5 Compare the different signal propagation modes and identify the mechanism of the atmospheric effects on radio wave propagation.

UNIT-I	**Electromagnetic Radiation and Fundamentals of Antenna**	**Periods: 9**
Radiation mechanism-single wire, two wire, dipole and current distribution on thin wire. Radiated field components -Hertizan dipole, half wave dipole, monopole antenna. Basic Antenna Parameters: Gain, Directivity, Effective aperture, Radiation Resistance, Radiation Intensity, Beam width, Beam Efficiency, Input Impedance, Antenna Apertures and Effective Height. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi antenna.		**CO1**
UNIT-II	**Point Sources and Antenna Arrays**	**Periods: 9**
Point Sources - Definition, Pattern, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication. Linear arrays of point sources – Direction of Maxima, Direction of Minima and Beam Width – Types of arrays – Broad side, End fire, Colinear, Parasitic arrays. Method of excitation of antennas – Impedance matching techniques.		**CO2**
UNIT-III	**Aperture, Slot and Horn Antennas**	**Periods: 9**
Aperture Antennas: Magnetic Current and its fields, Uniqueness theorem, Field equivalence principle, Duality principle, Method of Images, Pattern properties, Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes.		**CO3**
UNIT-IV	**Special Antennas**	**Periods: 9**
Loop antennas, Travelling Wave antennas – V and rhombic antennas, Parabolic Antenna, Lens Antenna and Wide band antennas – Log-periodic antennas – Micro strip antenna – Ultra wideband antenna – Smart antennas for mobile communications – Antennas for Bio-Medical Applications –Antenna for infrared detectors, Diversity/MIMO.		**CO4**
UNIT-V	**Propagation of Radio Waves**	**Periods: 9**
Modes of propagation , Structure of atmosphere , Ground wave propagation, Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept. Space Wave Propagation - Introduction, Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super retraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation. Sky Wave Propagation - Introduction, 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, Multi-hop Propagation.		**CO5**

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

Reference Books:

1. Krauss.J.D, “Antennas”, II edition, John Wiley and sons, New York, 1997.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, “Antennas and Wave Propagation”, Tata McGraw HillPublication, 4th Edition, 2012.
3. E.C. Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, 2nd Edition, PHI, 2003.
4. I.J.Bahl and P.Bhartia, “Microstrip Antennas”, Artech house, Inc.,1980.
5. Simon R Saunders, “Antennas and Propagation for wireless communication system”, John Wiley Publications,3rd Edition, 2001.

COURSE ARTICULATION MATRIX

Course: **ECA203 Antennas and Wave Propagation**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	-	2	-	-	-	-	1	1	1
CO2	3	3	1	1	1	-	2	-	-	-	-	1	1	1
CO3	3	3	1	1	1	-	2	-	-	-	-	1	1	1
CO4	3	3	1	1	1	-	2	-	-	-	-	1	1	1
CO5	3	3	1	1	1	-	2	-	-	-	-	1	1	1
ECA203	3	3	1	1	1	-	2	-	-	-	-	1	1	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA204	**Deep Learning**	3	-	-	3	25	75	100
Prerequisite	Knowledge in programming and Machine Learning							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Interpret various ML approaches with merits and demerits.						
	CO2	Summarize various ML/DL algorithms with technical upgradations employed in them.						
	CO3	Analyse the challenges associated with dimensionality reduction and optimization.						
	CO4	Formulate appropriate DL approach suitable for specific application.						

UNIT-I	**Machine Learning and its Basic Concepts**	**Periods: 9**
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 stochasticgradient descent- Neural networks as universal function approximates.		**CO1**
UNIT-II	**Overview of Deep Learning**	**Periods: 9**
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.		**CO2**
UNIT-III	**Dimensionality Reduction Techniques**	**Periods: 9**
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.		**CO2 CO3**
UNIT-IV	**Optimization Methodologies**	**Periods: 9**
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: 9**
ImageNet- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection- Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions.		**CO4**

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

Reference Books:

1. Cosma Rohilla Shalizi, “Advanced Data Analysis from an Elementary Point of View”, 2015.
2. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
4. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015.
5. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

COURSE ARTICULATION MATRIX

Course: **ECA204 Deep Learning**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	3	3	1	-	1	-	-	-	-	1	2	2
CO2	1	1	3	3	1	-	1	-	-	-	-	1	2	2
CO3	1	1	3	3	1	-	1	-	-	-	-	1	2	2
CO4	1	1	3	3	1	-	1	-	-	-	-	1	2	2
ECA204	1	1	3	3	1	-	1	-	-	-	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA205	**Control Systems Engineering**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of mathematical modelling of electrical/mechanical systems.						
	CO2	Analyse the time domain behaviour of control systems.						
	CO3	Analyse the frequency domain behaviour of control systems.						
	CO4	Investigate the stability of control systems.						
	CO5	Determine control systems using state space approach.						

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**
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 response analysis-steady state error-generalized error co-efficient–Response with P, PI, PD and PID controllers.		**CO2**
UNIT-III	**Frequency Domain Analysis**	**Periods: 9**
Frequency response-Frequency domain specifications-Correlation between time domain and frequency domain specifications-Bode plot-Stability analysis using Bode plot- transfer function from Bode plot-Polar plot.		**CO3**
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.		**CO4**
UNIT-V	**State Space Analysis**	**Periods: 9**
Concepts of state, state variables and state model - state space models for continuous time LTI systems using physical, phase and canonical variables - Transfer function from state space representation – solutions of state space equations – concepts of controllability and observability.		**CO5**

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

Reference Books:

1. I.J.Nagrath, M. Gopal, “Control Systems Engineering”, New Age International, Fifth Edition, New Delhi, 2011.
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”, Sixth Edition, Wiley, 2010.

COURSE ARTICULATION MATRIX

Course: **ECA205 Control Systems Engineering**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	–	–	–	–	1	–	1	2	3
CO2	3	3	2	2	2	–	–	–	–	1	–	1	2	3
CO3	3	3	2	2	2	–	–	–	–	1	–	1	2	3
CO4	3	3	2	2	2	–	–	–	–	1	–	1	2	3
CO5	3	3	2	2	2	–	–	–	–	1	–	1	2	3
ECA205	3	3	2	2	2	–	–	–	–	1	–	1	2	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA206	**Digital Image and Video Processing**	3	-	-	3	25	75	100
Prerequisite	Digital Signal Processing & DSP Processors							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Outline the fundamentals of images processing and transform techniques						
	CO2	Apply the principles of image filtering techniques and image segmentation						
	CO3	Analyze the image compression models						
	CO4	Compare the differences between analog and digital video and basic principles of video signal processing.						
	CO5	Analyse motion detection, Estimation and video coding.						

UNIT-I	**Fundamentals of Image processing and Image Transforms**	**Periods: 9**
Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels. Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.		**CO1**
UNIT-II	**Image Processing Techniques**	**Periods: 9**
Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering. Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.		**CO2**
UNIT-III	**Image Compression**	**Periods: 9**
Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.		**CO3**
UNIT-IV	**Basic Steps of Video Processing**	**Periods: 9**
Analog and digital video -Principles of colour video processing -Video display -Composite versus component video-Progressive and interlaced scan -Sampling of video signals.		**CO4**
UNIT-V	**2-D Motion Estimation and Video coding basics**	**Periods: 9**
Optical flow, general methodologies, pixel based motion estimation, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding.		**CO5**

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

Reference Books:

1. R.C.Gonzalez and R.E. Woods,"Digital Image Processing ", 4th edition, Pearson,2018.
2. Yao Wang, Jorm Ostermann and Ya – Qin Zhang, "Video processing and communication ",1st edition , Pearson,2001.
3. M. Tekalp,"Digital video Processing", 2nd edition , Prentice Hall International, 2015.
4. Chris Solomon, Toby Breckon,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons,2011.

COURSE ARTICULATION MATRIX

Course: **ECA206 Digital Image and Video Processing**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	1	-	1	2	2
CO2	3	3	3	3	2	-	-	-	-	1	-	1	2	2
CO3	3	3	3	3	2	-	-	-	-	1	-	1	2	2
CO4	3	3	3	3	2	-	-	-	-	1	-	1	2	2
CO5	3	3	3	3	2	-	-	-	-	1	-	1	2	2
ECA206	3	3	3	3	2	-	-	-	-	1	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA207	**Wavelet Transforms and Applications**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Describe wavelet functions and their properties.
	CO2 Interpret multi-resolution analysis and wavelet basis for multi-resolution analysis.
	CO3 Describe continuous wavelet transform, its features and inverse computation.
	CO4 Demonstrate the understanding of the use of filter banks and computation of discrete wavelet transform and its inverse.
	CO5 Apply wavelets for various image processing applications.

UNIT-I	**Wavelet Transforms and Properties**	**Periods: 9**
Vector spaces- Basis- Dimension- Orthogonality and Orthonormality-Definition of wavelet- Properties- Representation of wavelet function- Examples of wavelet function: Haar, Daubachies, Shannon, Morlet, Mexican, Hat, Sinc, Gaussian, Bi-orthogonal wavelets.		**CO1**
UNIT-II	**Multi-Resolution Analysis (MRA)**	**Periods: 9**
Definition of MRA- Construction of a general orthonormal MRA- Wavelet basis for MRA- Digital filtering interpretation- PRQMF filters banks.		**CO2**
UNIT-III	**Continuous Wavelet Transform**	**Periods: 9**
Definition of CWT- CWT as a correlator- Constant Q factor filtering interpretation and time frequency resolution- Inverse CWT.		**CO3**
UNIT-IV	**Filter Banks and Discrete Wavelet Transform**	**Periods: 9**
Filter banks and Sub-band coding principles- Inverse DWT computation- Multiband wavelet transform lifting scheme- Wavelet transform using poly phase matrix factorization.		**CO4**
UNIT-V	**Wavelet Applications**	**Periods: 9**
DTWT for image compression- Wavelet denoising- Speckle removal- Edge detection and Object isolation- Image fusion.		**CO5**

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

Reference Books:

1. Raguveer M.Rao, S.Ajit Bopardikar, "Wavelet Transforms: Introduction to theory and applications", Pearson Education, 2005.
2. Jaideva C Goswami and Andrew K Chan, "Fundamentals of Wavelets – Theory, Algorithms and Applications", John Wiley & Sons, Inc. , Singapore, 2011.
3. Stephane G. Mallat, "A Wavelet tour to signal processing", Academic Press, Third Edition, 2009.
4. Soman K P and Ramachandran K I, "Insight into wavelets: From Theory to Practice", Prentice Hall, New Delhi, Third Edition, 2010.
5. Sidney Burrus C, "Introduction to Wavelets and Wavelets Transforms: A Primer", Prentice Hall, New Delhi, 2002.

COURSE ARTICULATION MATRIX

Course: **ECA207 Wavelet Transforms and Applications**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	–	–	–	–	–	1	–	–	1
CO2	3	1	1	1	1	–	–	–	–	–	1	–	–	1
CO3	3	1	1	1	1	–	–	–	–	–	1	–	–	1
CO4	3	1	1	1	1	–	–	–	–	–	1	–	–	1
CO5	3	1	1	1	1	–	–	–	–	–	1	–	–	1
ECA207	3	1	1	1	1	–	–	–	–	–	1	–	–	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA208	**Satellite Communication Systems**	3	-	-	3	25	75	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	Demonstrate the understanding of optical satellites and microsatellites.						
	CO5	Analyze the recent trends and technologies of satellite communication.						

UNIT-I	**Basic Concepts of Satellite Communication**	**Periods: 9**
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: 9**
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**
UNIT-III	**Multiple Access Schemes**	**Periods: 9**
Satellite Access – Types - concepts - FDMA – pre assigned and demand assigned - inter modulation and back off-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**
UNIT-IV	**Optical Communication**	**Periods: 9**
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.		**CO4**
UNIT-V	**Future Trends and its Applications**	**Periods: 9**
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 in future network.		**CO5**

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

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: **ECA208 Satellite Communication Systems**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	1	1	–	–	–	–	1	2	2
CO2	3	3	2	2	3	1	1	–	–	–	–	1	2	2
CO3	3	3	3	2	3	1	1	–	–	–	–	1	2	2
CO4	3	3	2	2	3	1	1	–	–	–	–	1	2	2
CO5	3	3	2	2	3	1	1	–	–	–	–	1	2	2
ECA208	3	3	2.2	2	3	1	1	-	-	-	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA209	**Microwave Integrated Circuit Design**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the operation and working of the various sources for the transmission ofmicrowave frequencies.						
	CO2	Outline various Microwaves Integrated Circuits Components.						
	CO3	Analyze Active and Passive Microwave Devices.						
	CO4	Summarize the various Microwave Semiconductor Sources and Amplifiers.						
	CO5	Demonstrate the understanding of the various Fabrication techniques of MMC's/ MMIC's.						

UNIT-I	**Transmission Lines**	**Periods: 9**
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**
UNIT-II	**Microwaves Integrated Circuits Components**	**Periods: 9**
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 using aperture coupled lines.		**CO2**
UNIT-III	**Active and Passive Microwave Devices**	**Periods: 9**
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: 9**
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, biasing networks, and linear amplifier design.		**CO4**
UNIT-V	**Fabrication of MMC's/MMIC's**	**Periods: 9**
Introduction, materials, mask layouts and mask fabrication, hybrid MIC, Mimics- design considerations, design procedures and MMIC fabrication. Hybrid versus Mimics.		**CO5**

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

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: **ECA209 Microwave Integrated Circuit Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	1	-	-	-	-	1	3	2
CO2	3	2	2	2	1	-	1	-	-	-	-	1	3	2
CO3	3	2	3	2	1	-	1	-	-	-	-	1	3	2
CO4	3	2	2	2	1	-	1	-	-	-	-	1	3	2
CO5	3	2	2	2	1	-	1	-	-	-	-	1	3	2
ECA209	3	2	2.2	2	1	-	1	-	-	-	-	1	3	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA210	**Intelligent Networks**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the fundamentals of Intelligent Networks and service switching function.						
	CO2	Illustrate the impact of Intelligence in Signalling.						
	CO3	Summarize the International Standards for IN						
	CO4	Analyze the effects of intelligence in call party handling and advantages of Distributed Intelligence.						
	CO5	Analyze the IN services used in practice.						
UNIT-I	**Introduction**				**Periods: 9**			
Basics of Intelligent Networks-Service Switching function-Triggering to remote service logic-Hosting and creating IN Services-Intelligent peripheral-INAP-IN CS1 implementation issues.								**CO1**
UNIT-II	**Signalling Intelligence**				**Periods: 9**			
Introduction – CCS-Layered signaling model-Message transfer part-Telephony user part intelligence-SS7 signalling for IN.								**CO2**
UNIT-III	**International Standards for Intelligent Networking**				**Periods: 9**			
Introduction-US Standards for IN-ITU-T IN CS-1-ETSI Core INAP and CS-1R- IN and mobile systems-ITU-T IN CS-2-ITU-T IN CS-3-ITU-T IN CS-4.								**CO3**
UNIT-IV	**Call Party Handling and Distributed Intelligence**				**Periods: 9**			
Introduction-CS-2 call model-Call party Handling-Distributed Intelligence-Parlay API-TINA.								**CO4**
UNIT-V	**Service Examples**				**Periods: 9**			
Simple Number Translation-Personal Numbering-Incoming call screening-Least cost routing-VPN Service Example-Directory enquiry call completion service-Call gapping-Activate Service filtering-Simple CTI-CAMEL calls-IN control for Internet dial up access.								**CO5**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 45**			
Reference Books:								
1. John Anderson, “Intelligent Networks: Principles and Applications”, IET, 2002. 2. Syed V. Ahamed, “Intelligent Networks”, ELSEVIER, 2013.								

COURSE ARTICULATION MATRIX

Course: **ECA210 Intelligent Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	–	2	2	–	–	–	–	–	–	1	2	2
CO2	3	2	–	2	2	–	–	–	–	–	–	1	2	2
CO3	3	2	1	2	2	–	–	–	–	–	–	1	2	2
CO4	3	2	1	2	2	–	–	–	–	–	–	1	2	2
CO5	3	2	1	2	2	–	–	–	–	–	–	1	2	2
ECA210	3	2	1	2	2	–	–	–	–	–	–	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA211	**Cellular Mobile Communication**	3	-	-	3	25	75	100
Prerequisite	Analog and Digital Communication							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the Cellular Concepts						
	CO2	Analyze the operations of Cellular Communications with Mobility Management Protocols.						
	CO3	Demonstrate the understanding of various wireless standards.						
	CO4	Analyze different type of applications for smart phones and mobile devices with latest network strategies.						
	CO5	Analyze the performance of Cognitive radio and VANETs .						

UNIT – I	**Cellular Concept**	**Periods: 8**
Cellular Concept – Frequency Reuse – Channel Assignment Strategies – Interference – Co channel Interference and System Capacity – Adjacent Channel Interference – Handover – Call Splitting – Cell Sectoring – Coverage Zone Concept – Multiple Antennas		**CO1**
UNIT – II	**Mobility Management and GSM**	**Periods: 12**
Handoff and Roaming concept - concept and its types- Handoff detection – channel Assignment techniques - Radio link transfer– hard handoff and soft handoff- IS-41 signalling, IS-41 Intersystem handoff and Authentication - cellular digital packet data GSM system overview –GSM Network signaling. - GSM Mobility management - GSM short message service.		**CO2**
UNIT – III	**GPRS , VoIP and WAP**	**Periods: 8**
International roaming for GSM – Introduction to GSM operation, Administration and maintenance - Mobile number portability's, VoIP service for mobile networks – GPRS network architecture. WAP: WAP model - WAP Gateway - WAP Protocol, WAP UAProf and caching - WAP developer tool kits – Mobile station application execution environment.		**CO3**
UNIT – IV	**3G,4G & Beyond**	**Periods: 9**
UMTS: WCDMA air interface- UMTS architecture- UMTS packet data- Establishment of a UMTS speech call- UMTS core network evolution Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO, Introduction to 5G features, challenges and Technologies.		**CO4**
UNIT – V	**Software Defined Radios and VANET**	**Periods: 8**
Software defined radio architecture and challenges- Core cognitive radio and MAC functions- MAC layer Evaluation - **Vehicular networks**- Introduction, Application, Enabling protocols, Study on Mobi MESH and GLS.		**CO5**

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

Reference Books:

1. Yi-Bing Lin and Imrich Chlante, "Wireless and Mobile Network Architecture ", John Wiley 2006.
2. T.S. Rappaport, " Wireless and Mobile Communication", Pearson Education, 2008
3. Vijay Garg, " Wireless Communications and Networking", First Edition, Elsevier, 2007.
4. Dipankar Raychaudhuri, Mario Gerla, "Emerging Wireless Technologies and the Future Mobile Internet", ISBN: 978-0-521-11646-6, Cambridge University Press, 2011.
5. Clint Smith and Daniel Collins, 3G Wireless Networks, Tata McGraw Hill, second edition.

COURSE ARTICULATION MATRIX

Course: **ECA211 Cellular Mobile Communication**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	1	-	-	-	-	1	2	2
CO2	3	2	1	1	1	-	1	-	-	-	-	1	2	2
CO3	3	2	1	1	1	-	1	-	-	-	-	1	2	2
CO4	3	2	1	1	1	-	1	-	-	-	-	1	2	2
CO5	3	2	1	1	1	-	1	-	-	-	-	1	2	2
ECA211	3	2	1	1	1	-	1	-	-	-	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA212	**Mobile Adhoc and Wireless Sensor Networks**	3	-	-	3	25	75	100
Prerequisite	Knowledge in communication Engineering							

Course Outcome	Upon completion of the course, the students will be able to	
	CO1	Demonstrate the understanding of the basic concepts of Ad hoc and Sensor network and their related issues.
	CO2	Outline the various layers of Ad hoc Network, challenges, classification and design of MAC protocols.
	CO3	Demonstrate the understanding of the design issues and requirements of routing protocols with energy efficiency.
	CO4	Analyze the importance of Data dissemination with security and integrity with the use of cost effective and compact design architectures
	CO5	Demonstrate the understanding of advanced technology and its applications.

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**
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**
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).		**CO3**
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.		**CO4**
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.		**CO5**

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.

COURSE ARTICULATION MATRIX

Course: **ECA212 Mobile Adhoc and Wireless Sensor Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	1	-	-	-	-	1	3	3
CO2	3	3	3	2	2	-	1	-	-	-	-	1	3	3
CO3	3	3	3	2	2	-	1	-	-	-	-	1	3	3
CO4	3	3	3	2	2	-	1	-	-	-	-	1	3	3
CO5	3	3	3	2	2	-	1	-	-	-	-	1	3	3
ECA212	3	3	3	2	2	-	1	-	-	-	-	1	3	3

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA213	**Optical Networks**	3	-	-	3	25	75	100
Prerequisite	Optical Communication							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the operation and applications of various components used in opticalnetworks.
	CO2 Analyze the optical network architectures and the protocol stack.
	CO3 Outline the issues in wavelength routed optical networks.
	CO4 Apply the principle of optical packet and burst switching in developing next generation networks.
	CO5 Demonstrate the understanding of the differences in the design, management and protection methodsfor optical networks.

UNIT-I	**Optical System Components**	**Periods: 9**
Light propagation in optical Fibers-System limitations-loss, dispersion and Non-Linear effects. Optical Network Components – Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Switches and Wavelength Converters.		**CO1**
UNIT-II	**Optical Network Architectures**	**Periods: 9**
Introduction to SONET / SDH- multiplexing –elements of SONET/SDH infrastructure –SONET/SDH layers. Concepts of WDM and DWDM. Broadcast and Select Networks – Topologies for Broadcast and select networks. Wavelength Routing Architecture –WDM network elements- Introduction to linear light wave networks.		**CO2**
UNIT-III	**Wavelength Routing Network**	**Periods: 9**
Issues in wavelength routed networks. RWA algorithms - Needs for wavelength conversion-wavelength convertible node architectures. Optical multicasting node architectures and source based multicast tree generation.		**CO3**
UNIT-IV	**Packet Switching and Access Networks**	**Periods: 9**
Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Contention Resolution, OBS node architecture-burst switching protocols. Access Networks – FTTC and PON architectures.		**CO4**
UNIT-V	**Network Design and Management**	**Periods: 9**
Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations. Control and Management – Network management functions, Configuration management, Performance management, Fault management.		**CO5**

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

Reference Books:

1. Rajiv Ramaswami, Kumar N. Sivarajan and G.H. Sasaki, “Optical Networks – A Practical perspective”, Elsevier, Third Edition, 2010.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Designand Algorithms”, Prentice Hall of India, 2002.
3. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.
4. Gerd Keiser, “Optical Fiber Communications”, Tata McGraw Hill , Fifth Edition, 2013.
5. Govind P. Agrawal, “Fiber-Optic Communication Systems”, Wiley, Third Edition, 2015.

COURSE ARTICULATION MATRIX

Course: **ECA213 Optical Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	–	1	–	–	–	–	1	3	1
CO2	2	3	2	2	2	–	1	–	–	–	–	1	3	1
CO3	2	2	2	2	2	–	1	–	–	–	–	1	3	1
CO4	2	2	2	2	2	–	1	–	–	–	–	1	3	1
CO5	2	2	2	2	2	–	1	–	–	–	–	1	3	1
ECA213	2	2.2	1.8	1.8	2	–	1	–	–	–	–	1	3	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA214	**Cryptography and Network Security**	3	-	-	3	25	75	100
Prerequisite	Wireless Communication							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Analyse the design of Symmetric Key cryptography algorithms						
	CO2	Analyse the PKC algorithms for secured communication.						
	CO3	Develop Network Security Protocols.						
	CO4	Determine the threats and notable attacks to provide security solutions.						
	CO5	Evaluate the vulnerabilities across any Wireless Systems.						

UNIT-I	**Basics of Cryptography and Finite Fields**	**Periods: 9**
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 Cipher Modes and its Operation-Basics of hardware design for Security algorithms		**CO1**
UNIT-II	**Number Theory, PKC, Data Integrity and Authentication**	**Periods: 9**
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.		**CO2**
UNIT-III	**Network Security**	**Periods: 9**
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-Basics of Cloud security.		**CO3**
UNIT-IV	**Security of Mobile Communications-Part I**	**Periods: 9**
WLAN Vulnerabilities and Threats-IEEE 802.11i Wireless LAN security, Wireless Transport Layer Security, WAP End- to-End Security-Vulnerabilities, Threats and Attacks in Cellular Systems-Mobile Malware-Prevention Techniques in Cellular Systems-Intrusion Detection in Wireless Communications-GSM, UMTS and LTE-Security Architecture, Attacks and Security Model, LTE- AKA (Authentication and Key Agreement) Protocols.		**CO4**
UNIT-V	**Security of Mobile Communications-Part II**	**Periods: 9**
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-Heterogeneous architecture- Authentication and Cryptography in heterogeneous networks		**CO5**

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

Reference Books:

1. William Stallings, "Cryptography and Network Security-Principles and Practice", Pearson, 7th Edition, 2017.
2. Noureddine Boudriga, "Security of Mobile Communications", CRC Press, Taylor& Francis Group, 2010.
3. T. S. Rappaport, "Wireless and Mobile Communication", Pearson Education, 2008.
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, Third Edition, 2006.

COURSE ARTICULATION MATRIX

Course: **ECA214 Cryptography and Network Security**

Regulation: 2022-23

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
ECA214	3	2.4	1.6	3	2.6	2	1	2	–	–	–	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA215	**LTE Technology and Network Design**	3	-	-	3	25	75	100
Prerequisite	Cellular Mobile Communication							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Interpret the LTE Technologies and Network Architectures.						
	CO2	Compare LTE Protocols and procedures used in uplink and downlink.						
	CO3	Illustrate OFDM and MIMO techniques.						
	CO4	Examine the signal structure and detection mechanisms used in downlink and uplink design.						

UNIT-I	**Introduction**	**Periods: 9**	
Motivation to LTE - Evolution of Architecture – Standardization process in 3GPP –Technologies for LTE, Network Architecture - Core Network – Access Network – Roaming Architecture – Protocol Architecture – Quality of service and EPS Bearers - S1 and X2 E-UTRAN Network Interfaces.			**CO1**
UNIT-II	**Control Plane and User Plane Protocols**	**Periods: 9**	
Radio Resource Control – PLMN and Cell Selection – Paging, User Plane Protocol Stack – Packet Data Convergence Protocol – Radio Link Control – Medium Access Control.			**CO2**
UNIT-III	**Orthogonal Frequency Division Multiple Access & MIMO Techniques**	**Periods: 9**	
History of OFDM Development – OFDMOFDMA– Parameter Dimensioning. Fundamentals of Multiple antenna theory – MIMO Signal Model – Single User MIMO, MultiUser MIMO – MIMO Schemes in LTE.			**CO3**
UNIT-IV	**Downlink Design**	**Periods: 9**	
Transmission Resource Structure – Signal Structure – Downlink operation. Synchronization and Cell Search – Synchronization sequences and cell search in LTE – Coherent Vs Non-Coherent Detection.			**CO4**
UNIT-V	**Uplink Design**	**Periods: 9**	
Uplink Physical Layer Design - SC- FDMA Principle –SC-FDMA Design in LTE. Uplink Physical channel structure – Physical uplink shared Data channel Structure – Uplink control channel Design – Multiplexing of control signaling – ACK/NACK Reception, Uplink transmission procedures- Timing Control – Power control.			**CO4**

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

Reference Books:

1. Stefania Sesia, Issam Toufik and Matthew Baker, “LTE – The UMTS Long Term Evolution: From Theory to Practice”, John Wiley & Sons, 2011.
2. Christopher Cox, “An introduction to LTE – LTE, LTE-Advanced, SAE and 4G Mobile Communications”, John Wiley & Sons, 2012.
3. Moray Rumney, “LTE and Evolution to 4G Wireless: Design and Measurement Challenges”, Agilent Technologies, 2013.

COURSE ARTICULATION MATRIX

Course: **ECA215 LTE Technology and Network Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	2	-	1	-	-	-	-	1	3	2
CO2	3	1	1	3	2	-	1	-	-	-	-	1	2	1
CO3	3	2	1	3	2	-	1	-	-	-	-	1	1	1
CO4	3	2	-	3	2	-	1	-	-	-	-	1	2	2
ECA215	3	1.75	1	3	2	-	1	-	-	-	-	1	2	1.5

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA216	**Cognitive Radio Networks**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of different cognitive radio network (CRN) paradigms.						
	CO2	Compare different methods of spectrum sensing and their applications in CRN.						
	CO3	Summarize the fundamental constraints and properties of a cognitive radio network.						
	CO4	Implement cognitive radio network (CRN) architectures.						
	CO5	Analyze the security threats to CR networks.						

UNIT-I	**Cognitive Radio Technology**	**Periods: 9**
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**
UNIT-II	**Propagation Issues for Cognitive Radio**	**Periods: 9**
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**
UNIT-III	**Spectrum Management**	**Periods: 9**
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.		**CO2**
UNIT-IV	**Cognitive Radio Communication Techniques**	**Periods: 9**
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.		**CO3**
UNIT-V	**Cognitive Radio Network Architectures and Security**	**Periods: 9**
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.		**CO4** **CO5**

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

Reference Books:

1. Ezio Biglieri Andrea j .Goldsmith LarryJ .Greenstein Narayan B .Mandayam & H. Vincent, “Poor Principles of Cognitive Radio”, Cambridge University Press.
2. Alexander M. Wyglinski, Maziar Nekovee, Y. Thomas Hou, “Cognitive Radio Communications and Networks Principles and Practice”, Academic Press.
3. Bruce A. Fette, “Cognitive Radio Technology”, Newnes publications.
4. Yan Zhang, Jun Zheng& Hsiao-Hwa Chen, “Cognitive Radio Networks Architectures, Protocols, and Standards”, CRC Press.

COURSE ARTICULATION MATRIX

Course: **ECA216 Cognitive Radio Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	1	–	–	–	–	1	1	1
CO2	3	2	2	2	2	–	1	–	–	–	–	1	1	1
CO3	2	2	2	2	2	–	1	–	–	–	–	1	1	1
CO4	3	3	3	2	2	–	1	–	–	–	–	1	1	1
CO5	3	2	2	2	2	–	1	–	–	–	–	1	1	1
ECA216	2.8	2.2	2.2	2	2	–	1	–	–	–	–	1	1	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA217	**Multimedia Compression**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Determine the performance of different coding Schemes for digital multimedia.						
	CO2	Identify the performance of dictionary techniques for file compression.						
	CO3	Demonstrate the understanding of various Vocoder.						
	CO4	Compare the various lossless compression links.						
	CO5	Compare the various lossy compression links.						

UNIT-I	**Text Data**	**Periods: 9**	
Individual Samples - Huffman Coding: Basic Huffman - Adaptive Huffman- Golomb code- Tunstall code - Applications; Arithmetic Coding: Basic Arithmetic Coding - Adaptive arithmetic coding- Applications;			**CO1**
UNIT-II	**Dictionary coding**	**Periods: 9**	
Static dictionary-Diagram coding - Adaptive Dictionary- LZ77-LZ78 - LZW. Block of Samples- Vector Quantization- Basic Algorithm-			**CO2**
UNIT-III	**Audio Data**	**Periods: 9**	
Speech production: Expressing source- Vocoders- LPC – CELP - Sinusoidal Coders - Wide band Compression; Exploiting Correlation- Basic DPCM- Adaptive DPCM- Delta Modulation – Applications			**CO3**
UNIT-IV	**Lossless Compression**	**Periods: 9**	
Hearing perception: Masking-MPEG Audio coding- Advanced Audio Coding. Image data: Lossless compression: Calic - JPEG LS - Progressive Transmission- Facsimile Encoding			**CO4**
UNIT-V	**Lossy Compression**	**Periods: 9**	
DCT - Walsh Hadamard - Wavelet - JPEG 2000, **Video data** - H.261- MPEG 1 - MPEG 2 - MPEG 4.			**CO5**

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

Reference Books:

1. Khalid Sayood, "Introduction to Data Compression" Third Edition, Morgan Kauffmann Publishers, Inc. California, 2010.
2. Mark Nelson, Jean Louf Goilly, "The Data Compression Book", BPB Publications, 1996.
3. Rafel C.Gonzalez, "Digital Image Processing", Addison Wesley, 1998.
4. Darrel Hankerson, Greg A Harris, Peter D Johnson, „Introduction to Information Theory and Data Compression" Second Edition, Chapman and Hall ,CRC press company, 2007.

COURSE ARTICULATION MATRIX

Course: **ECA217 Multimedia Compression**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	3	–	–	–	–	–	–	1	2	2
CO2	3	3	2	1	3	–	–	–	–	–	–	1	2	2
CO3	3	3	2	1	3	–	–	–	–	–	–	1	2	2
CO4	3	2	1	1	2	–	–	–	–	–	–	1	2	2
CO5	3	1	1	1	2	–	–	–	–	–	–	1	2	2
ECA217	3	2.4	1.6	1	2.6	–	–	–	–	–	–	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech. (EC)**						
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
ECA218	**Radar and Navigational Aids**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of the fundamental concepts of Radar.						
	CO2	Illustrate the mathematical model and performance of Radar.						
	CO3	Demonstrate the understanding of the Doppler frequency shift and the design of Digital MTI Doppler signal processor.						
	CO4	Summarize the different types of Radar tracking.						
	CO5	Demonstrate the understanding of the functions of Radar antenna.						

UNIT-I	**Basics of Radar**	**Periods: 9**
Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse waveform - PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems.		**CO1**
UNIT-II	**Radar Equation**	**Periods: 9**
Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector — False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets – sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.		**CO1**
UNIT-III	**MTI and Pulse Doppler Radar**	**Periods: 9**
Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with – Power Amplifier Transmitter, Delay Line Cancelers — Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler. Digital MTI Processing – Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD.		**CO2**
UNIT-IV	**Tracking Radar**	**Periods: 9**
Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse (one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers.		**CO3**
UNIT-V	**Radar Antenna**	**Periods: 9**
Functions of the Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased array Antennas. Radar Receiver - Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays.		**CO5**

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

Reference Books:

1. M.I. Skolnik, “Introduction to Radar System”, McGraw Hill, Third Edition, 2001.
2. N. S. Nagaraja, “Elements of Electronic Navigation Systems”, Tata McGraw-Hill, Second Edition, 2001.
3. Sen & Bhattacharya, “Radar Systems and Radio Aids to Navigation”, Khanna publishers, Sixth Edition, 1987.
4. Peyton Z. Peebles, “Radar Principles”, John Wiley, 2004.
5. J.C Toomay, “Principles of Radar”, Second Edition, PHI, 2004.

COURSE ARTICULATION MATRIX

Course: **ECA218 Radar and Navigational Aids**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO2	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO3	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO4	3	2	1	–	1	–	1	–	–	–	–	1	2	1
CO5	3	2	1	–	1	–	1	–	–	–	–	1	2	1
ECA218	3	2	1	–	1	–	1	–	–	–	–	1	2	1

Department: **Electronics and Communication Engineering**		Programme: **B.Tech.**						
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
ECA219	**Internet of Everything**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of IOE layered architecture.
	CO2 Develop models/protocols for different layers of IOE.
	CO3 Examine the protocols of different layers in IOE.
	CO4 Evaluate the protocols of different layers used in IOE.
	CO5 Demonstrate the understanding of the applications of IOE
	CO6 Design solution for real time problems using IOE.

UNIT-I	**IoE Introduction and Fundamentals**	**Periods:9**
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 analysis. IoE Architectures: IoT - A, IoT - RA, IEEEP 2413, Cisco Reference Model and Reference IoT Layered Architecture – IoE and AI- Fog, Edge and Cloud in IoE – Functional blocks of an IoE Ecosystem		**CO1**

UNIT-II	**Signals, Sensors, Actuators and Interfaces**	**Periods:9**
Introduction to sensors and transducers, Introduction to electrodes and biosensors, Different types of sensors, Selection criteria's 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 CO3 CO4**

UNIT-III	**IoE Protocols**	**Periods:9**
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 – Application Layer Protocols: CoAP and MQTT.		**CO2 CO3 CO4**

UNIT-IV	**IoE Data analytics and Security:**	**Periods:9**
IoE Data Analytics. Cryptographic algorithms, Analysis of Light weight Cryptographic solutions, IoE security, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoE.		**CO2 CO3 CO4**

UNIT-V	**IoE Applications**	**Periods:9**
Smart Lighting-Smart Parking – Smart Traffic Control- Home Intrusion Detection-Smart Grids-Smart Payments-Smart Irrigation-Health and Fitness monitoring-Industry 5.0.		**CO5 CO6**

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

ReferenceBooks:

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.
4. Arshdeep Bahga, Vijay Madisetti,"Internet of Things–Ahands - on approach", Universities Press,2015.

COURSE ARTICULATION MATRIX

Course: **ECA219 Internet of Everything**

Regulation: 2022-23

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
ECA219	2.17	2.2	1.6	1.6	2	-	2	1	2.5	2.33	-	-	1.67	2.2

Department: **Electronics and Communication Engineering**		Programme: **B.Tech.**						
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
ECA220	**Advanced Mobile Communications**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Summarize the evolution of mobile communication standards developed over the years.
	CO2 Demonstrate the understanding of 5G architecture, its components and functional criteria.
	CO3 Outline the in-depth functioning of 5G radio access technologies.
	CO4 Demonstrate the understanding of device to device (D2D) communication and standardization.
	CO5 Evaluate the use of advanced techniques in cellular communications.

UNIT I	**Mobile Communications Overview**	**Periods:9**

Evolution from 1G to 5G, Analog voice systems in 1G, digital radio systems in 2G, 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 — **CO1**

UNIT II	**Introduction to 5G Communication**	**Periods:9**

Building Blocks of 5G, 5G Architecture, 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. — **CO2**

UNIT III	**5G Network**	**Periods:9**

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 — **CO3**

UNIT IV	**5G Evaluation & Applications**	**Periods:9**

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 – Calibration – New challenges in the 5G modeling. — **CO4**

UNIT V	**Current state and Challenges ahead**	**Periods:9**

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 (Bharat Net, TVWS Long range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV. — **CO5**

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

Reference Books:

1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson
2. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGraw Hill Education
3. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.

4. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson
5. Harri Holma, Antti Toskala, LTE for UMTS: Evolution to LTE-Advanced, John Wiley and Sons, 2011
6. 5G Technology Evolution Recommendations, 4G Americas, 2015
7. 5G Mobile and Wireless Communications Technology, Afif Osseiran, Jose F. Monserrat, Patrick Marsch Cambridge University Press , Second Edition , 2011
8. 5G NR: The Next Generation Wireless Access Technology,Erik Dahlman, Stefan Parkvall, Johan Sko Ï d Elsevier, First Edition,2016
9. Fundamentals of 5G Mobile Networks Jonathan Rodriguez Wiley First Edition ,2010

COURSE ARTICULATION MATRIX

Course: **ECA220 Advanced Mobile Communication**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	1	-	1	-	-	-	-	1	3	2
CO2	3	1	1	3	1	-	1	-	-	-	-	1	3	2
CO3	3	1	1	3	1	-	1	-	-	-	-	1	3	2
CO4	3	1	1	3	1	-	1	-	-	-	-	1	3	2
CO5	3	1	1	3	1	-	1	-	-	-	-	1	3	2
ECA220	3	1	1	3	1	-	1	-	-	-	-	1	3	2

Open Elective Courses

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4 /5/6/7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA301	**Consumer Electronics**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Classify various faults in Home electronic devices.						
	CO2	Demonstrate the understanding of washing machine and air conditioner operation.						
	CO3	Interpret various components of the digital devices for home applications.						
	CO4	Demonstrate the understanding of various digital set boxes.						
UNIT-I	**Microwave Ovens**				**Periods: 9**			
Microwaves (Range used in Microwave ovens), Microwave oven block diagram, LCD timer with alarm, Single chip controller, Types of Microwave oven, wiring and safety instructions, Care and Cleaning.								**CO1**
UNIT-II	**Washing Machines**				**Periods: 9**			
Electronic controller for washing machines, washing machine hardware and software, Types of washing machines - Fuzzy logic washing machines, Features of washing machines.								**CO2**
UNIT-III	**Air Conditioners and Refrigerators**				**Periods: 9**			
Air Conditioning, Components of air conditioning systems, All water air conditioning systems, All air conditioning systems, Unitary and central air conditioning systems, Split air conditioners.								**CO2**
UNIT-IV	**Home/Office Digital Devices**				**Periods: 9**			
Facsimile machine, Xerographic copier, calculators, Structure of a calculator, Internal organization of a calculator, Servicing electronic calculators, Digital clocks, Block diagram of a digital clock.								**CO3**
UNIT-V	**Digital Access Devices**				**Periods: 9**			
Digital computer, Internet access, online ticket reservation, functions and networks, barcode scanner and decoder, Electronic Fund Transfer, Automated Teller Machines (ATMs), Set-Top boxes, Digital cable-TV, Video on demand.								**CO4**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 45**			

Reference Books:

1. S.P.Bali, "Consumer Electronics", Pearson Education, 2005.
2. M. L. Anand, "Consumer Electronics", Khanna Publications, 2011.
3. Phillip Hoff, Phillip Herbert Hoff, "Consumer Electronics for Engineering", Cambridge Press,1998.
4. R. G. Gupta, " Audio and Video systems", Tata McGraw Hill, 2004.

COURSE ARTICULATION MATRIX

Course: **ECA301 Consumer Electronics**

Regulation: 2022-23

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	1	-	1	1	-	-	1	2
CO2	3	2	2	-	1	-	2	-	-	1	1	-	1	2
CO3	3	2	2	1	1	-	1	-	-	1	1	1	1	1
CO4	3	2	2	-	1	1	2	-	-	1	-	1	1	2
ECA301	3	2	2	1	1	1	1.5	-	1	1	1	1	1	1.75

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4/ 5/ 6/ 7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA302	**Communication Engineering**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Demonstrate the understanding of Amplitude Modulation Systems.						
	CO2	Analyse Angle Modulation System						
	CO3	Summarize the Baseband Modulation Systems						
	CO4	Analyse Digital Modulation Systems and Synchronization Techniques.						
	CO5	Compare various Wireless technologies.						

UNIT-I	**Amplitude Modulation Systems**	**Periods: 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**	**Periods: 9**	
Frequency and Phase Modulation - Narrow band and Wideband FM- Transmission Bandwidth - Generation and Demodulation of FM Signal-Operation of FM receivers.			**CO2**
UNIT-III	**Baseband Modulation Systems**	**Periods: 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-Correlation Receiver-Multilevel Base Band PAM System-Inter Symbol Interference - Eye Pattern.			**CO3**
UNIT-IV	**Digital Modulation Systems and Synchronization**	**Periods: 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**
UNIT-V	**Wireless Communication Systems**	**Periods: 9**	
Wireless Communication Systems: Cellular Mobile Communication-System Mode-Frequency Reuse-Handoff-Interference and Capacity-GPRS-EDGE-UMTS-HSPA-Bluetooth and PAN- Introduction to IoT.			**CO5**

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

Reference Books:

1. George Kennedy, Bernard Davis and S.R.M. Prasanna, "Electronic Communication systems", Mc. Graw Hill Education (India) Private Limited, Fifth edition, 2011.
2. Simon Haykin, "Communication Systems", John Wiley & sons, New York, Fourth Edition, 2001.
3. Theodore S. Rappaport, "Wireless communication-Principle and practices", PHI, second edition, New Delhi, 2003.
4. Bernard Sklar and Pabitra Kumar Ray, "Digital Communication", Pearson, Second Edition, 2009.
5. Wayne Tomasi, "Electronic Communication Systems", Pearson Education, Fifth edition.

COURSE ARTICULATION MATRIX

Course: **ECA302 Communication Engineering**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO4	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO5	3	2	2	2	1	-	-	-	-	-	-	1	2	2
ECA302	3	2	2	2	1	-	-	-	-	-	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4/ 5/ 6/ 7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA303	**CMOS VLSI Design**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of MOS Fabrication Process.
	CO2 Design the combinational logic circuits using standard CMOS, Pass transistor, transmission gate and BiCMOS
	CO3 Design the sequential logic circuits and memory elements using CMOS.
	CO4 Demonstrate the understanding of low power dissipation using various techniques.
	CO5 Design of logic circuits using VHDL.

UNIT-I	**Technology Introduction**	**Periods: 9**
Introduction to IC Technology –Fabrication Process Flow, CMOS n-well Process – Layout Design Rules – Full Custom Mask Layout Design – MOS Transistor Structure and Operation – MOSFET Current Voltage Characteristics – MOSFET Scaling – MOSFET Capacitances – MOS Inverters – Static Characteristics – Resistive Load – Inverters with n-Type MOSFET Load – CMOS Inverter.		**CO1**
UNIT-II	**Switching Characteristics and Interconnect Effects of CMOS Combinational Logic Circuits**	**Periods: 9**
Introduction – Delay Time Definitions – Calculation of Delay Times – Inverter Design with Delay Constraints – Estimation of Interconnect Parasitic – Calculation of Interconnect Delay – Switching Power Dissipation of CMOS Inverters - MOS Logic Circuits with Depletion nMOS Load – CMOS Logic Circuits – Complex LogicCircuits – CMOS Transmission gates and Pass Transistor.		**CO2 CO4**
UNIT-III	**Sequential MOS Logic Circuits and Array Subsystem Using CMOS**	**Periods: 9**
Introduction – Behavior of Bistable Elements – SR Latch Circuits – Clocked Latch and Flip Flop Circuits – CMOS D-Latch and Edge Triggered Flip-flop – Dynamic Logic Circuits – Voltage Bootstrapping – Synchronous Dynamic Circuit Techniques – Dynamic CMOS Circuit Techniques – High Performance Dynamic CMOS Circuits - DRAM – SRAM – Non-Volatile Memory – Flash memory – Ferroelectric Random Access Memory (FRAM)		**CO3**
UNIT-IV	**Low Power Techniques and Design of BiCMOS Logic Circuits**	**Periods: 9**
Overview of Power Consumption – Low Power Design Through Voltage Scaling – Estimation and Optimization of Switching Activity – Reduction of Switched Capacitance – Adiabatic Logic Circuits – Basic BiCMOS Circuits – NOT, NAND and NOR – Static and Switching Delay Characteristics.		**CO4**
UNIT-V	**Design of Logic Circuits using VHDL**	**Periods: 9**
RTL Design – simulation and synthesis - Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: adders, counters, flipflops, FSM, Multiplexers / Demultiplexers).		**CO5**

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

Reference Books:

1. Sung-Mo (Steve) Kang and Yusuf Leblebici ,"CMOS Digital Integrated Circuits Analysis and Design" , Tata McGraw Hill, Third Edition, 2003.
2. Neil H. E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI design - A circuits and Systems Perspective", Dorling Kindersley (India) Pvt Ltd, 2009.
3. Volnei.A.Pedroni, " Circuit Design with VHDL", Prentice Hall of India, Third Edition, 2005.

COURSE ARTICULATION MATRIX

Course: **ECA303 CMOS VLSI Design**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	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	2	2	2	2	2	-	-	-	-	-	-	2	3	1
ECA303	2.8	2.8	2.8	2.8	2	-	-	-	-	-	-	2	3	1

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4/ 5/ 6/ 7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA304	**Internet of Things**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of IoT layered architecture.
	CO2 Develop models/protocols for different layers of IoT.
	CO3 Design and development of IoT protocols.
	CO4 Evaluate the security issues in IoT.
	CO5 Demonstrate the understanding of the applications of IoT.
	CO6 Design solution for real time problems using IoT.

UNIT-I	**Fundamentals of IoT**	**Periods: 9**
Evolution of Internet of Things - Enabling Technologies – IoT Architectures: IoT – A, IoT – RA, IEEE P2413, Cisco Reference Model and Reference IoT Layered Architecture -–IoT and AI- Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.		**CO1** **CO2**
UNIT-II	**IoT Protocols**	**Periods: 9**
IoT Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah 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 – Application Layer Protocols: CoAP and MQTT.		**CO2** **CO3** **CO4**
UNIT-III	**Design and Development**	**Periods: 9**
Naming Service, Objective Naming Service, Efficient Naming, Addressing, and Profile Services in IoT Sensory Environments - Standardization and Optimization of IoT Protocol – Green IoT- Internet of Things Forensics - Internet of Nano-Things - Internet of Nano-Things Forensics - IoNTF Investigation Model- Social IoT.		**CO2** **CO3** **CO4**
UNIT-IV	**Securing Internet of Things**	**Periods: 9**
Internet of Things as Interconnections of Threats -Cryptographic primitives and its role in IoT – Common IoT Attack types- Encryption and Decryption – Hashes – Digital Signatures – Random Number Generation – Cipher Suites – Key Management Fundamentals – Cryptographic Controls for IoT Messaging and Communication protocols – IoT Node Authentication- Lightweight and Robust Schemes for Privacy Protection-Cloud IoT Security Controls – Issues in SIoT.		**CO2** **CO3** **CO4**
UNIT-V	**Applications in IoT**	**Periods: 9**
Smart Lighting- Smart Parking –Smart Traffic Control - Home Intrusion Detection- Smart Grids- Smart Payments- Green House Control- Smart Irrigation- Health and Fitness monitoring- Wearable electronics- IoT Printer.		**CO5** **CO6**

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

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, 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 Rehman Khan, Sajjad A. Madani, “Internet of Things - Challenges, Advances, and Applications”, Taylor & Francis, CRC Press, 2017.
4. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.

COURSE ARTICULATION MATRIX

Course: **ECA304 Internet of Things**

Regulation: 2022-23

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
ECA304	2.17	2.2	1.6	1.6	2	-	2	1	2.5	2.33	-	-	1.67	2.2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4/ 5/ 6/ 7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA305	**Wireless Communication Networks**	3	-	-	3	25	75	100
Prerequisite	-							
Course Outcome	Upon completion of the course, the students will be able to							
	CO1	Outline the evolution of technological trends in wireless communication.						
	CO2	Demonstrate the understanding of the concepts in wireless communication technology.						
	CO3	Demonstrate the seamless improvement in the various generations of cellular networks.						
	CO4	Identify suitable architecture for upcoming application.						
	CO5	Apply new communication concepts in diverse application domains.						

UNIT-I	**Introduction**	**Periods: 9**
Transmission fundamentals – signals, analog and digital data transmission, channel capacity, Transmission Media. Communication Networks – switching Techniques, ATM. Protocols and TCP/IP suite.		**CO1**
UNIT-II	**Wireless Communication Technology**	**Periods: 9**
Antennas and propagation – antennas, propagation modes, LOS transmission, Fading. Spread spectrum – Frequency hopping, Direct sequence, CDMA, spreading sequences. Coding and Error control – Error detection, Error correction codes, ARQ mechanisms.		**CO2**
UNIT-III	**Cellular Wireless Networks**	**Periods: 9**
Principles of cellular network, First generation, second generation, third generation wireless systems and protocols. Mobile IP and Wireless access Protocol.		**CO3**
UNIT-IV	**Short Range Radio Access Networks**	**Periods: 9**
Architecture of WiFi, Bluetooth, ZigBee. Ultra wideband, Cordless systems – DECT, Infra-Red transmission, Wireless Sensor networks, 6Lowpan, Adhoc Networks.		**CO4**
UNIT-V	**Latest Developments and Applications**	**Periods: 9**
Technology and features of 4G LTE, IEEE802.16, Evolution of 5GTechnology, wireless Body Area Network. Software Defined Radio, IoT and IoE, Telemedicine, Smart Grid technology.		**CO5**

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

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, Second Edition, 2005.
2. Theodre Rappaport, "Wireless communication: Principles and Practice", Pearson Education, 2009.
3. T.L.Singal, "Wireless Communications", Tata McGraw-Hill education, 2010.
4. Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 08-Aug-2005.
5. P.Muthu chidambaranathan, "Wireless Communication", PHI Learning, 2008.

COURSE ARTICULATION MATRIX

Course: **ECA305 Wireless Communication Networks**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	2	-	1	-	-	-	-	1	2	2
CO2	3	1	1	2	2	-	1	-	-	-	-	1	2	2
CO3	3	1	1	2	2	-	1	-	-	-	-	1	2	2
CO4	3	1	1	2	2	-	1	-	-	-	-	1	2	2
CO5	3	1	1	2	2	-	1	-	-	-	-	1	2	2
ECA305	3	1	1	2	2	-	1	-	-	-	-	1	2	2

Department : **Electronics and Communication Engineering**		Programme : **B.Tech.**						
Semester : **4/ 5/ 6/ 7**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECA306	**Cyber Security**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Upon completion of the course, the students will be able to
	CO1 Demonstrate the understanding of the basics of cyber security
	CO2 Analyze vulnerabilities in cyber security.
	CO3 Analyse the security in servers and web applications.
	CO4 Implement operational methodologies to conduct cyberspace operations.
	CO5 Outline the concepts of cyber forensics and its techniques for investigations.

UNIT-I	**Cyber Security**	**Periods: 9**
Overview of Cyber Security– Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime, Cyber terrorism, Cyber Espionage, Cyber Operations, Cyber Weaponry, Cyber world, Advanced Persistent Threat-Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.		**CO1**
UNIT-II	**Cyber Security Vulnerabilities and Cyber Security Safeguards**	**Periods: 9**
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration and Open Access to Organizational Data, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Security Services and Mechanism, Audit, Denial of Service Filter, Ethical Hacking.		**CO2**
UNIT-III	**Securing Web Application, Services and Servers**	**Periods: 9**
Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security- Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Security Information Management, Network Session Analysis, System Integrity Validation.		**CO3**
UNIT-IV	**Cyberspace and the Law**	**Periods: 9**
Introduction to Cyberspace environment and its characteristics, Cyberspace Operations –Network Operations (NETOPS), Defensive Cyberspace Operations (DCO), Offensive Cyberspace Operations (OCO), Operational methodologies to conduct cyberspace operations, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.		**CO4**
UNIT-V	**Cyber Forensics**	**Periods: 9**
Introduction to Cyber Forensics, Spyware and Adware, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time, Biometric security System.		**CO5**

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

Reference Books:

1. Jeffery carr et al, "Inside Cyber Warfare: Mapping the Cyber Underworld," O'Reilly Publication December 2012.
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland, 2015.
4. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, "Security in Computing", 5th Edition, Pearson Education, 2015.
5. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

COURSE ARTICULATION MATRIX

Course: **ECA306 Cyber Security**

Regulation: 2022-23

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	2	-	-	-	1	2	2
CO2	3	3	3	3	2	2	-	2	-	-	-	1	2	2
CO3	3	3	3	3	2	2	-	2	-	-	-	1	2	2
CO4	3	3	3	3	2	2	-	2	-	-	-	1	2	2
CO5	3	3	3	3	2	2	-	2	-	-	-	1	2	2
ECA306	3	3	3	3	2	2	-	2	-	-	-	1	2	2