



SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution | Accredited with 'A++' Grade by NAAC)



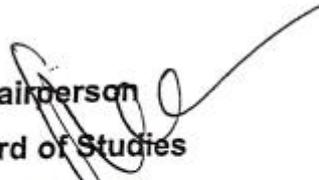
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
B.E. ECE accredited by NBA, New Delhi under Washington Accord (Tier-I)

REGULATION – R2021

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM & SYLLABUS

Batch (2023-2027 & 2024-2028)


Chairperson
Board of Studies
CHAIRPERSON
BOARD OF STUDIES
ELECTRONICS & COMMUNICATION ENGINEERING
SETHU INSTITUTE OF TECHNOLOGY
KARIAPATI-626 115


Chairman
Academic Council
CHAIRMAN
ACADEMIC COUNCIL
Sethu Institute of Technology
Pulloor, Kariapatti - 626 115



SETHU INSTITUTE OF TECHNOLOGY

An Autonomous Institution | Accredited By NAAC with A++ Grade Pulloor,
Kariapatti –Taulk. Virudhunagar Dist-626115.

Re-Accredited By NBA

ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION- R2021[Batch 2023 Onwards] OVERALL COURSE STRUCTURE

Code	Category	Total No. of Courses	Credits	Percentage
BS	Basic Sciences	8	24	14.6%
ES	Engineering Sciences	9	24	14.6%
HSS	Humanities and Social Sciences	6	9.5	5%
PC	Professional Core (Including Lab Courses)	23	57.5	35%
PE	Professional Elective	6	18	10.9%
OE	Open Elective	4	12	7.3%
PW	Project Work, Seminar & Internship	3	13	7.9%
MC	Mandatory Courses	10	5	3.6%
	TOTAL	69	164	100%

COURSE CREDITS – SEMESTERWISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
ECE	19	18	22	24	25	25	17	14	164

SEMESTER I

Course Code	Course Title	L	T	P	C	Type of Course
THEORY						
R21UEN101	English for Technical Communication (Common to ALL Branches– Except CSBS)	2	0	0	2	HSS
R21UMA102	Matrix and Calculus (Common to ALL Branches – Except CSBS)	3	1	0	4	BS
R21UCY107	Chemistry for Engineers (Mech, Chemical, ECE, EEE, BME, BT, Agri, Civil)	3	0	0	3	BS
R21UCS107	Problem Solving and C Programming– (Except CSBS)	3	0	0	3	ES
R21UEC204	Basic Electrical and Instrumentation Engineering	3	0	0	3	ES
PRACTICAL						
R21UCS111	Problem Solving and C Programming Laboratory (Except CSBS)	0	0	2	1	ES
R21UEC112	Engineering Fundamentals Laboratory (Common to ECE, CSE, IT, BME & BT)	0	0	2	1	ES
R21UCY113	Chemistry Laboratory (Common to ALL Branches)	0	0	2	1	BS
MANDATORY						
R21UGT140	Heritage of Tamils	1	0	0	1	MC
R21UGM131	Induction Programme (Common to ALL Branches)	0	3	0	P/F	MC
TOTAL		15	4	6	19	
Total No of Credits – 19						

SEMESTER II

Course Code	Course Title	L	T	P	C	Type of Course
THEORY						
R21UEN201	Communication Skills for Professionals (Integrated course) (Common to ALL Branches, Except CSBS)	1	0	1	1.5	HSS
R21UMA204	Calculus, Complex Analysis and Numerical Methods (Only for ECE)	3	1	0	4	BS
R21UPH205	Physics for Electronics Engineering (Only for ECE)	3	0	0	3	BS
R21UME209	Engineering Drawing	1	3	0	4	ES
R21UEC205	Electronic Devices (Integrated course)	2	0	3	3.5	PC
PRACTICAL						
R21UPH210	Applied Physics Laboratory (Common to ALL Branches – Except CSBS)	0	0	2	1	BS
MANDATORY						
R21UGT241	Tamils and Technology	1	0	0	1	MC
R21UAC231	Biology for Engineers (Common to all branches except BME, BT)	2	0	0	P/F	MC
TOTAL		13	4	6	18	
Total No of Credits - 18						

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UMA323	Numerical Analysis and Linear Algebra (Only for ECE)	3	1	0	4	BS
2.	R21UEC302	Digital Electronics and Design	3	0	0	3	PC
3.	R21UEC303	Circuit Theory	3	0	0	3	PC
4.	R21UEC305	Electronic Circuits	3	0	0	3	PC
5.	R21UEC308	Electromagnetic Theory and Transmission Lines	3	0	0	3	PC
6.	R21UEC309	Principles of Python Programming (Integrated course)	2	0	2	3	ES
PRACTICAL							
7.	R21UEC306	Digital Electronics Laboratory	0	0	3	1.5	PC
8.	R21UEC307	Electronic Circuits Laboratory	0	0	3	1.5	PC
MANDATORY							
9.	R21UGM331	Environmental Science (Common to all branches)	2	0	0	P/F	MC
TOTAL			19	1	8	22	
Total No of Credits - 22							

SEMESTER IV

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UMA422	Probability, Statistics and Mathematical Structures (Only for ECE)	3	1	0	4	BS
3.	R21UEC411	Data Communication and Networking Protocols	3	0	0	3	PC
5.	R21UEC405	Analog and Digital Communication	3	0	0	3	PC
4.	R21UEC408	Principles of Linear Integrated Circuits	3	0	0	3	PC
5.	R21UEC409	Signals and Linear Systems	3	1	0	4	PC
6.	R21UEC410	Data structures and Programming Techniques (Integrated Course)	2	0	2	3	ES
PRACTICAL							
7.	R21UGS433	Interpersonal Skills & Team building Laboratory (Only for ECE)	0	0	2	1	HSS
8.	R21UEC406	Analog and Digital Communication Laboratory	0	0	3	1.5	PC
9.	R21UEC407	Linear Integrated Circuits Laboratory	0	0	3	1.5	PC
MANDATORY							
10.	R21UGM431	Gender Equality (Common to ALL Branches)	1	0	0	P/F	MC
TOTAL			18	2	10	24	
Total No of Credits - 24							

SEMESTER V

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UEC501	Digital Signal Processing	3	1	0	4	PC
2.	R21UEC502	Microprocessors, Microcontrollers and Applications	3	0	0	3	PC
3.	R21UEC503	Internet of Things and Applications (Integrated Course)	2	0	2	3	ES
4.	R21UEC504	Antenna and Wave Propagation	3	0	0	3	PC
5.	PE – I	Professional Elective – I	3	0	0	3	PE
6.	OE – I	Open Elective – I	3	0	0	3	OE
PRACTICAL							
7.	R21UEC505	Microprocessors, Microcontrollers and Applications Laboratory	0	0	2	1	PC
8.	R21UEC506	Digital Signal Processing Laboratory	0	0	2	1	PC
9.	R21UEC507	Creative Thinking and Innovation	0	0	2	1	PW
MANDATORY							
10.	R21UGS535	Universal Human Values II	2	1	0	3	MC
TOTAL			19	2	8	25	
Total No of Credits – 25							

SEMESTER VI

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UEC601	Wireless Communication	3	0	0	3	PC
2.	R21UEC602	VLSI Design	3	0	0	3	PC
3.	R21UEC603	Image Processing and Analysis	3	0	0	3	ES
4.	PE – II	Professional Elective – II (Swayam Course)	3	0	0	3	PE
5.	PE – III	Professional Elective – III	3	0	0	3	PE
6.	OE – II	Open Elective – II	3	0	0	3	OE
7.	R21UGS631	Logical Reasoning and Aptitude (Common to ECE, CIVIL, BME and BT)	1	0	0	1	HSS
PRACTICAL							
8.	R21UEC607	Product Development Project	0	0	8	4	PW
9.	R21UEC608	VLSI Design Laboratory	0	0	2	1	PC
10.	R21UGS632	Soft skills and Communication Laboratory (Common to MECH, ECE, CIVIL, BME, BT, IoT, Cyb.Sec., and CHEMICAL)	0	0	2	1	HSS
MANDATORY							
11.	R21UGM631	Indian Constitution (Common to ALL Branches)	1	0	0	P/F	MC
TOTAL			20	0	12	25	
Total No of Credits - 25							

SEMESTER VII

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UME701	Project Management and Finance	3	0	0	3	HSS
2.	R21UEC702	Optical and Microwave Communication	3	0	0	3	PC
3.	PE – IV	Professional Elective – IV	3	0	0	3	PE
4.	PE – V	Professional Elective – V	3	0	0	3	PE
5.	OE – III	Open Elective – III *	3	0	0	3	OE
PRACTICAL							
6.	R21UEC708	Optical and Microwave Communication Laboratory	0	0	2	1	PC
7.	R21UGE710	Multi-Disciplinary Project - Phase I	0	0	6	3	PW
MANDATORY							
8.	R21UGM731	Sports and Social Development	-	-	-	P/F	MC
9.	R21UGM732	Skill Development	-	-	-	P/F	MC
10	R21UEC735	Internship	-	-	-	1	MC
TOTAL			15	0	8	17	
Total No of Credits - 17							

*The students those who opt for MDP Phase I are exempted from taking Open Elective III

SEMESTER VIII

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	PE - VI	Professional Elective – VI	3	0	0	3	PE
2.	OE - IV	Open Elective – IV	3	0	0	3	OE
PRACTICAL							
3.	R21UEC801	Project work	0	0	16	8	PW
4.	R21UGE810	Multi-Disciplinary Project - Phase II *	0	0	16	8	PW
MANDATORY							
5.	R21UGM831	Professional Ethics and Human Values (Common to ALL Branches)	2	0	0	P/F	MC
TOTAL			8	0	16	14	
Total No of Credits - 14							

* The students those who opt for MDP Phase I are allowed to take Multi-Disciplinary Project - Phase II

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
Vertical I – 21ECV100-Signal Processing						
1.	R21ECV101	Adaptive Signal processing and Applications	3	0	0	3
2.	R21ECV102	Speech and Audio Signal Processing	3	0	0	3
3.	R21ECV103	Video Processing and Analysis	3	0	0	3
4.	R21ECV104	Bio Medical Signal & Image Processing	3	0	0	3
5.	R21ECV105	DSP Processor Architecture	3	0	0	3
6.	R21ECV106	Software Defined and Cognitive Radio	3	0	0	3
7.	R21ECV107	Machine Vision	3	0	0	3
8.	R21ECV1N01	Machine Learning	3	0	0	3
Vertical II – 21ECV200-High Speed Communications						
1.	R21ECV201	Advanced wireless Techniques	3	0	0	3
2.	R21ECV202	Advanced Communication Network Security	3	0	0	3
3.	R21ECV203	High Performance Networks	3	0	0	3
4.	R21ECV204	MIMO System Modeling	3	0	0	3
5.	R21ECV205	Fiber optic Communication & networks	3	0	0	3
6.	R21ECV206	Ultra-wide band Communication Networks	3	0	0	3
7.	R21ECV207	5G Technology	3	0	0	3
Vertical III – 21ECV300-Sensor Technologies and IoT						
1.	R21ECV306	Principles of Wireless Sensor Networks	3	0	0	3
2.	R21ECV302	MEMS and NEMS	3	0	0	3
3.	R21ECV303	Nano Electronics	3	0	0	3
4.	R21ECV304	IoT Ecosystem	3	0	0	3
5.	R21ECV305	IoT Networks and Protocols	3	0	0	3

6.	R21ECV3N03	Industrial IoT	3	0	0	3
7.	R21ECV307	Smart Sensor Networks	3	0	0	3
8.	R21ECV308	Block Chain Technology	3	0	0	3
9.	R21ECV309	AI-ML IN IOT	3	0	0	3
Vertical IV – 21ECV400-Space Technologies						
1.	R21ECV401	Global Positioning and Navigation System	3	0	0	3
2.	R21ECV402	Remote Sensing and Information Systems	3	0	0	3
3.	R21ECV403	Navigation and Communication System	3	0	0	3
4.	R21ECV404	Satellite Communication and services	3	0	0	3
5.	R21ECV405	Avionics Systems	3	0	0	3
6.	R21ECV406	Radar Signal Processing Technology	3	0	0	3
7.	R21ECV4N04	Rocketry and Space Mechanics	3	0	0	3
8.	R21ECV407	Design of UAV systems	3	0	0	3
Vertical V – 21ECV500 - Semiconductor Chip Design and Testing						
1.	R21ECV501	Device Modeling	3	0	0	3
2.	R21ECV502	Validation and Testing Technology	3	0	0	3
3.	R21ECV503	Low Power VLSI Systems	3	0	0	3
4.	R21ECV504	VLSI Design and Testing	3	0	0	3
5.	R21ECV505	Mixed Signal Integrated Circuits	3	0	0	3
6.	R21ECV506	Analog CMOS Circuit Design	3	0	0	3
7.	R21ECV507	Microelectronics and VLSI Design Technology	3	0	0	3
8.	R21ECV5N05	ASIC & FPGA based Design	3	0	0	3
9.	R21ECV508	AI in Semiconductor Chip Design	3	0	0	3

10.	R21ECV509	CMOS Advanced Micro Fabrication Using Simulator 3D	3	0	0	3
Vertical VI – 21ECV600 - Bio Medical Technologies						
1.	R21ECV601	Wearable Electronics	3	0	0	3
2.	R21BMV702	Human Assist Devices	3	0	0	3
3.	R21BMV704	Therapeutic Equipment	3	0	0	3
4.	R21ECV6N06	Healthcare Engineering	3	0	0	3
5.	R21ECV605	Biomedical Measurements and Instrumentation	3	0	0	3
6.	R21ECV606	Body Area Networks	3	0	0	3
7.	R21ECV607	Embedded Systems in Medical Devices	3	0	0	3
8.	R21ECV608	Tele Medicine	3	0	0	3
Other Electives						
1.	R21UEC901	Linear Control Engineering	3	0	0	3
2.	R21UEC902	Robotics and Applications	3	0	0	3
3.	R21UEC903	Principles of Artificial Intelligence	3	0	0	3
4.	R21UEC904	Multimedia Compression and Communication	3	0	0	3
5.	R21UEC905	ARM System Development	3	0	0	3
6.	R21UEC906	AR & VR	3	0	0	3
7.	R21UEC907	Cyber security systems	3	0	0	3
8.	R21UEC908	Essentials of Big Data Analytics	3	0	0	3
9.	R21UEC909	Fundamentals of Ubiquitous Computing	3	0	0	3

GENERAL VERTICALS FOR MINOR DEGREE

S.No.	Course Code	Course Title	L	T	P	C
Vertical – 21CBVG00-Fintech and Block Chain						
1.	R21CBVG01	Financial Management	3	0	0	3
2.	R21CBVG02	Fundamentals of Investment	3	0	0	3
3.	R21CBVG03	Banking, Financial Services and Insurance	3	0	0	3
4.	R21CBVG04	Introduction to Blockchain and its Applications	3	0	0	3
5.	R21CBVG05	Fintech Personal Finance and Payments	3	0	0	3
6.	R21CBVG06	Introduction to Fintech	3	0	0	3
Vertical – 21MEVG00- Entrepreneurship						
1.	R21MEVG01	Foundations of Entrepreneurship	3	0	0	3
2.	R21MEVG02	Team Building & Leadership Management for Business	3	0	0	3
3.	R21MEVG03	Creativity & Innovation in Entrepreneurship	3	0	0	3
4.	R21MEVG04	Principles of Marketing Management for Business	3	0	0	3
5.	R21MEVG05	Human Resource Management for Entrepreneurship	3	0	0	3
6.	R21MEVG06	Financing New Business Ventures	3	0	0	3
Vertical – 21EEVG00- Public Administration						
1.	R21EEVG01	Principles of Public Administration	3	0	0	3
2.	R21EEVG02	Indian Economics	3	0	0	3
3.	R21EEVG03	Public Personnel Administration	3	0	0	3
4.	R21EEVG04	Administrative Theories	3	0	0	3
5.	R21EEVG05	Indian Administrative System	3	0	0	3
6.	R21EEVG06	Public Policy Administration	3	0	0	3
Vertical – 21CSVG00- Business Data Analytics						
1.	R21CSVG01	Statistics for Management	3	0	0	3
2.	R21CSVG02	Data mining for Business Intelligence	3	0	0	3
3.	R21CSVG03	Human Resource Analytics	3	0	0	3
4.	R21CSVG04	Web and Social Media Analytics for Marketing	3	0	0	3

5.	R21CSVG05	Operation and Supply Chain Analytics	3	0	0	3
6.	R21CSVG06	Financial Analytics	3	0	0	3
Vertical – 21CEVG00- Environment and Sustainability						
1.	R21CEVG01	Sustainable infrastructure Development	3	0	0	3
2.	R21CEVG02	Sustainable Agriculture and Environmental Management	3	0	0	3
3.	R21CEVG03	Sustainable Bio Materials	3	0	0	3
4.	R21CEVG04	Materials for Energy Sustainability	3	0	0	3
5.	R21CEVG05	Green Technology	3	0	0	3
6.	R21CEVG06	Environmental Quality Monitoring and Analysis	3	0	0	3
7.	R21CEVG07	Integrated Energy Planning for Sustainable Development	3	0	0	3
8.	R21CEVG08	Energy Efficiency for Sustainable Development	3	0	0	3

OPEN ELECTIVE COURSES OFFERED TO ECE STUDENTS

S.No	Course Code	Course Name	Dept Offered
1.	R21UME971	Introduction to Industry 4.0	MECH
2.	R21UME972	Product Life Cycle Management	MECH
3.	R21UEE971	Drone Technologies	EEE
4.	R21UEE972	Renewable Energy Technology	EEE
5.	R21UCE971	Developments of Smart Cities	CIVIL
6.	R21UCE972	Remote Sensing and GIS Application	CIVIL
7.	R21UAG971	ICT in Agriculture	AGRI
8.	R21UAG972	Integrated Farming System	AGRI
9.	R21UCH971	Fire safety Engineering	Chemical
10.	R21UBT971	Bio nanotechnology	BTECH
11.	R21UBT972	Herbal Medicines	BTECH
12.	R21UFR973	French For Engineers	ENGLISH
13.	R21UJN975	Japanese For Engineers	ENGLISH
14.	R21UEN972	Speak Better, Write Better	ENGLISH

OPEN ELECTIVE COURSES OFFERED TO OTHER PROGRAMMES

S. No.	Course Code	Course Title	L	T	P	C
1.	R21UEC971	Design thinking for Innovations	3	0	0	3
2.	R21UEC972	IoT Concepts and Applications	3	0	0	3
3.	R21UEC973	Sensors	3	0	0	3
4.	R21UEC974	Fundamentals of VLSI Design	3	0	0	3
5.	R21UEC975	Wearable Devices	3	0	0	3
6.	R21UEC976	Basics of Communication Systems	3	0	0	3
7.	R21UEC977	Automotive Electronics	3	0	0	3
8.	R21UEC978	CMOS Fabrication Using Simulator 3D	3	0	0	3

LIST OF INDUSTRY DESIGNED / VALUE ADDED COURSES

S.No.	Course Code	Course Title	Course Designers	L	T	P	C
1.	R21UEC861	PIC Embedded Programming	White Pixel Technologies	0	0	2	1
2.	R21UEC862	PCB Design	SMJ Smart Products Limited	0	0	2	1
3.	R21UEC863	Python Programming	Suresh Academy	0	0	2	1
4.	R21UEC864	Data Science for ECE	Suresh Academy	0	0	2	1
5.	R21UEC865	Trouble Shooting in Smart phones	SMJ Smart Products Limited	0	0	2	1
6.	R21UEC866	Arduino Programming	Smart makers Private limited	0	0	2	1
7.	R21UEC869	Programming in C++	Smart makers Private. limited	0	0	2	1
8.	R21UEC868	Introduction to Java Programming	Suresh Academy	0	0	2	1
9.	R21VEC01	CCNA Networking	Amogaa Private Limited	Value added Course			
10.	R21VEC02	Programming in C	Suresh Academy	Value added Course			
11.	R21VEC03	Java Programming for ECE	Suresh Academy	Value added Course			

COURSES OFFERED TO OTHER PROGRAMMES

S. No.	Course Code	Course Title	Dept	L	T	P	C
1.	R21UEC225	Principles of Electronics Engineering	CSBS	3	0	0	3
2.	R21UEC226	Electronics Engineering Laboratory	CSBS	0	0	2	1
3.	R21UEC425	Microprocessor and Microcontrollers	CSE	3	0	0	3
4.	R21UEC426	Microprocessors and Microcontrollers Laboratory	CSE	0	0	2	1
5.	R21ECV102	Speech and Audio Signal Processing	BME	3	0	0	3
6.	R21ECV107	Machine Vision	BME	3	0	0	3

SEMESTER I

SEMESTER I

Course Code	Course Title	L	T	P	C	Type of Course
THEORY						
R21UEN101	English for Technical Communication (Common to ALL Branches– Except CSBS)	2	0	0	2	HSS
R21UMA102	Matrix and Calculus (Common to ALL Branches – Except CSBS)	3	1	0	4	BS
R21UCY107	Chemistry for Engineers (Mech, Chemical, ECE, EEE, BME, BT, Agri, Civil)	3	0	0	3	BS
R21UCS107	Problem Solving and C Programming– (Except CSBS)	3	0	0	3	ES
R21UEC204	Basic Electrical and Instrumentation Engineering	3	0	0	3	ES
PRACTICAL						
R21UCS111	Problem Solving and C Programming Laboratory (Except CSBS)	0	0	2	1	ES
R21UEC112	Engineering Fundamentals Laboratory (Common to ECE, CSE, IT, BME & BT)	0	0	2	1	ES
R21UCY113	Chemistry Laboratory (Common to ALL Branches – Except CSBS)	0	0	2	1	BS
MANDATORY						
R21UGT140	Heritage of Tamils	1	0	0	1	MC
R21UGM131	Induction Programme (Common to ALL Branches)	0	3	0	P/F	MC
TOTAL		15	4	6	19	
Total No of Credits - 19						

R21UEN101	ENGLISH FOR TECHNICAL COMMUNICATION (Common to All Branches except CSBS)	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To enhance the vocabulary of students
- To strengthen the application of functional grammar and basic skills
- To improve the language proficiency of students

Unit – 1	PRESENTING ESSENTIALS OF CORRESPONDENCE	8
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Listening –Formal and informal conversations and comprehension. Speaking- introducing one-self – exchanging personal and social information-Reading – Skimming and Scanning. Writing–Sentence Formation, Formal Letters (Permission/Requisition) - Grammar - Parts of Speech - Tense - Vocabulary Development – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms-Phrases and Clauses.

Unit – 2	COMMUNICATION SKILLS	8
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Listening– Telephonic Conversations. Speaking– Pronunciation rules with Stress pattern. Reading – comprehension-pre-reading, post-reading- comprehension questions Writing – Punctuation rules, paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions, Precise writing, Developing Hints - Report Writing (Industrial, Accident)- Grammar – Voice Vocabulary Development- Words from other languages in English.

Unit – 3	CORRESPONDENCE AND VOCATION IMPROVEMENT	7
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Listening – Motivational speech by Great Speakers Speaking–Narrating daily events - retelling short stories. Reading – Newspaper reading. Writing – Job application letter - Transformation of Information (Transcoding)– Grammar Subject-Verb Agreement (Concord),— Vocabulary Development –Same word in different parts of speech

Unit – 4	PORTRAYAL AND SUMMATION	7
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Listening – Understating the instruction. Speaking-Intonation and preparing dialogue on various formal and informal situation Reading –Note Making from given text - Writing– Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) -Grammar–Spot the Errors in English, Vocabulary Development– One word substitution.

Unit – 5	CRITICAL THINKING	7
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Listening –Listening important messages based on news report. Speaking-retelling short stories. Reading- Organization Profile, news report. Writing –Precise writing, Developing Hints - Report Writing (Industrial, Accident).Grammar – Spot the Errors in English

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply grammar effectively in writing meaningful sentences and paragraphs.	Apply
CO2	Exhibit reading skills and comprehension to express the ideas in the given text.	Understand
CO3	Develop writing skills to present the ideas in various formal situations.	Apply

CO4	Develop oral fluency to express the ideas in various formal situations.	Apply
CO5	Prepare Reports for various purposes by analyzing the situations.	Analyze
TEXT BOOKS:		
1. KN Shoba, Lourdes Joavani Rayen, Communicative English, New Delhi, Cambridge University Press, 2017		
REFERENCES:		
1. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press, 2014.		
2. Lakshminarayanan. K.R, English for Technical Communication, Chennai, Scitech Publications (India) Pvt. Ltd, 2004.		
3. Rizvi. Asraf M, Effective Technical Communication, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2007.		
COURSE DESIGNER: English Department		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1									2	3		2		
CO 2									2	3		2		
CO 3									2	3		2		
CO 4									2	3		2		
CO 5									2	3		2		
CAM (Avg)									2	3		2		
3- Strong 2- Medium 1- Weak														

R21UMA102	MATRIX AND CALCULUS	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"> • To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases. • To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals. • Able to integrating various types of functions using various integration methods. • To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions • To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field. 					
UNIT 1	MATRICES				8+3
Eigen value and eigenvector of a real matrix – Characteristic equation – Properties – CayleyHamilton theorem (excluding Proof) – Orthogonal reduction – (transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation					
UNIT 2	DIFFERENTIAL CALCULUS				8+3
Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (nth derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling– Heat flow problems, Rate of decay of radioactive materials – Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems)					
UNIT 3	FUNCTIONS OF SEVERAL VARIABLES				8+3
Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylors expansion – Maxima and Minima – Method of Lagrangian Multipliers					
UNIT 4	INTEGRAL CALCULUS				8+3
Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.					
UNIT 5	MULTIPLE INTEGRALS				8+3
Doubleintegration–CartesianandPolarcoordinates–Changeoforderofintegration–Areas as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates–Volume as triple integral.					

SUPPLEMENT TOPIC (for internal evaluation only) 3 Evocation
 /Application of Mathematics, Quick Mathematics – Speed Multiplication and Division Applications of Matrices.

TOTAL : 45 (L) + 15 (T) = 60

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the knowledge of Matrices to solve Engineering problems	Apply
CO2	Analyze Engineering problems using limits, continuity and derivatives	Analyze
CO3	Apply the knowledge of differentiation techniques to predict the extreme values of the Engineering problems with constraints	Apply
CO4	Apply the knowledge of Beta and Gamma function and their relation to evaluate the Engineering problems involving definite integrals	Apply
CO5	Apply the concept of Multiple integrals in telecommunications in Engineering problems	Apply
CO6	Explain the basic concepts of Matrix, Differentiation and Integration	Understand

TEXT BOOKS:

1. Bali n. P and manishgoyal, a text book of engineering mathematicsII, laxmi publications (p) ltd, new Delhi, 8th edition,(2011).
2. Veerarajan.t—engineeringmathematicsIItatamcgrawhillpublishingcompany,newDelhi, 2008.
3. Grewal. B.s, —higher engineering mathematicsII, khanna publications, new Delhi, 42nd edition,(2012).

REFERENCES:

1. Ramanab.v, —higher engineering mathematicsII, Tata mcgraw hill publishing company, new Delhi, 11th reprint,(2010).
2. Glynjames,—advanced engineering mathematicsII,Pearson education,new Delhi, 7th edition,(2007).
3. Jainr.kandiyengars.r.k,advanced engineering mathematicsII,narosa publishing house, new delhi, 3rd edition, (2007).
4. Bharati krishnatirthaji, —vedic mathematics - mental calculationII, motilal banarsi dass publications, new delhi, 1st edition,(1965).
5. Kreyszig. E, —advanced engineering mathematicsII, john wiley& sons, New York, 10th edition,(2011).
6. P.sivaramakrishnadas,e.rukmangada chari—engineering mathematicsII,volume1, Pearson Edison new Delhi, 2nd edition,(2013).

COURSE DESIGNER : Mathematics Department**CO/PO/PSO MAPPING**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3											1	2	
CO 2	3											1	2	
CO 3	3	3		1								1	2	
CO 4	3											1	2	
CO 5	3											1	2	
CO 6	2											1	2	
CAM (Avg)	2.7	3		1								1	2	

3- Strong**2- Medium****1- Weak**

R21UCY107	Chemistry for Engineers (Common to Mech, Chemical, ECE, EEE, BME, BT, Agri, Civil)	L	T	P	C	
		3	0	0	3	
OBJECTIVES: <ul style="list-style-type: none"> To impart the knowledge on Chemical bonding and types. To make the students conversant with boiler feed water requirements, related problems and water treatment techniques. To explain the importance of smart material, green chemistry and energy storage devices 						
UNIT 1	WATER TECHNOLOGY					9
Characteristics of water – Specification of water for Industries and domestic purposes –Physical and Chemical impurities, Hardness – Types of hardness (problems on hardness)–Estimation by EDTA–Boiler feed water – Boiler Trouble -Requirements – Priming and foaming, Scales and sludges Caustic embrittlementand Boiler corrosion – External conditioning (Ion-exchange) – Internal conditioning – Domestic water treatment –Disinfection methods – Break point chlorination – Desalination by reverse osmosis.						
UNIT 2	ELECTROCHEMISTRY AND CORROSION					9
Introduction – Cell terminologies (Current, Electrode, Anode, Cathode, Electrolyte, Half-cell, Cell) – Electrode potential – Nernst equation (Problems)– Electrochemical series. Corrosion – Chemical corrosion – Electrochemical corrosion – Factors influencing corrosion – Different types of Corrosion – Corrosion control – Cathodic protection -Sacrificial anode and Impressed current cathodic protection method – Pretreatment of surface – Fundamentals of Copper electroplating and Applications for Next generation - Electroless plating of Nickel.						
UNIT 3	ENERGY SOURCES & STORAGE DEVICES					9
Introduction – Classification of Fuels – Comparison of Fuels – Knocking – Improvement of Anti-knock characteristics and agents, Octane number, Cetane number. Nuclear energy –Light water nuclear power plant, breeder reactor –Batteries: Types of batteries, Primary battery – Alkaline battery, Secondary battery - lead acid battery and lithium-ion-LiTiS ₂ battery; Principle and Working of Super capacitors: types and examples, working principles of Electric-vehicles.						
UNIT 4	SMART MATERIALS AND GREEN CHEMISTRY					9
Introduction, Quantum dots-Electroluminescence -OLED types, principle and applications. Liquid crystals; Classification, chemical constitution, stability and applications. Introduction and applications of Electro-active polymers (conducting polymers-Poly acetylene). Green chemistry; Principles of green chemistry, Applications of green chemistry in day today life, Environmental related issues. Green processes and sustainability (3R concept).						
UNIT 5	MODERN ANALYTICAL TECHNIQUES					9
Introduction, basic principle, instrumentation (block diagram) and applications of UV-Visible spectroscopy, FT-IR spectroscopy, Raman spectroscopy, Thermo gravimetric analysis (TGA), Atomic Absorption Spectroscopy (AAS), Scanning Electron Microscope (SEM), Field emission scanning electron microscopy (FE-SEM) and Transmission Electron Microscope (TEM)						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course the student will be able to:						

CO1	Describe the basic concepts of chemistry involved in water technology, electrochemistry, genery sources and its storage devices and nano materials, (Understand-K2)	Understand
CO2	Explain the principles and applications of various analytical techniques, organic light emitting diodes, liquid crystals and green chemistry	Understand
CO3	Apply the electrochemical concepts towards corrosion and its protection strategies	Apply
CO4	Apply the knowledge of electrodynamics to identify the types of energy storage devices	Apply
CO5	Analyze the impurities of water to find its hardness and remove the hardness causing substances	Analyze
CO6	Write a report on chemical application for Industries	Respond

TEXT BOOKS:

1. Engineer Chemistry, G.V.Subba Reddy et al., Mc Graw Hill Education (India Private
2. Chemistry for Engineers, K.Uma Maheswari et al., Mc Graw Hill Education (India Private Limited
3. Private Limited

REFERENCES:

1. Engineer Chemistry, O. G. Palanna., Mc Graw Hill Education (India Private Limited)
2. Engineer Chemistry, P. B. Joshi, S. Deep, Oxford University Press.

COURSE DESIGNER : Chemistry Department

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3													
CO 2	3											1		
CO 3	3													
CO 4	3					2	1					1		
CO 5		3				1	1					1		
CO 6						2				3				
CAM (Avg)	2.5	3				1.6	1			3		1		
3- Strong 2- Medium 1- Weak														

R21UCS107	PROBLEM SOLVING AND C PROGRAMMING (Except CSBS)	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To impart the concepts in basic organization of computers and problem solving techniques. • To familiarize the programming constructs of C. • To explain the concepts of arrays, strings, functions, pointers, structures and unions in C 					
UNIT I	INTRODUCTION TO C PROGRAMMING				11
Basic Organization of a Computer – Problem formulation – Problem Solving - Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart- Introduction to __C' programming – fundamentals – structure of a __C' program – Compilation and Linking processes – Constants, Variables – Data Types – Expressions using operators in __C' – Managing Input and Output operations.					
UNIT II	DECISION MAKING AND LOOPING STATEMENTS				9
if - if-else - nested if-else – else-if ladder statement – switch – goto – for- while – do-while – break – continue statements .					
UNIT III	ARRAYS AND STRINGS				9
Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays - String - String operations – string arrays.					
UNIT IV	FUNCTIONS				8
Function – Definition of function – Declaration of function – Parameter passing methods – Recursion.					
UNIT V	POINTERS, STRUCTURES AND UNIONS				8
Pointers - Dynamic Memory allocation – Structure – Union.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the basic problem-solving techniques and concepts of the C programming language.				Understand
CO2	Apply problem-solving techniques and basic concepts of the C programming language to find solutions to real-world problems.				Apply
CO3	Apply the concepts of looping, branching, and decision-making statements for a given problem.				Apply
CO4	Apply the advanced concepts of C language like, pointers, structures, unions and arrays to solve real-world problems.				Apply

CO5	Analyze the appropriateness of C language constructs to provide solutions to computer applied complex engineering problems.	Analyze
CO6	Work individually or in teams and demonstrate the solutions to the given exercises through presentation	Affective Domain

TEXT BOOKS:

- Balagurusamy, E, —Programming in Ansi C++, Eighth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2019.
- Deitel and Deitel, —C How to Program, Pearson Education, New Delhi, 2011.

REFERENCES:

- Yashavant P. Kanetkar. —Let Us C++, BPB Publications, 2011.
- Kernighan.B.W, Ritchie.D.M, —The C Programming language, Pearson Education, Second Edition, 2006.
- Stephen G.Kochan, —Programming in C++, Pearson Education India, Third Edition, 2005.
- Anita Goel, Ajay Mittal, —Computer Fundamentals and Programming in C++, Dorling Kindersley (India) Pvt. Ltd, Pearson Education in South Asia, 2011.
- Byron S Gottfried, —Programming with C++, Schaum's Outlines, Tata McGraw-Hill, Second Edition, 2006.
- PradipDey, ManasGhosh, —Fundamentals of Computing and Programming in C++, Oxford University Press, First Edition, 2009.

COURSE DESIGNER : CSE Department

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1													3	
CO 2	3												3	
CO 3	3												3	
CO 4	3												3	
CO 5		2											3	
CO 6									2	2				
CAM (Avg)	3.00	2.00							2.00	2.00			3.00	
3- Strong 2- Medium 1- Weak														

R21UEC204	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the types of AC and DC Machines. To familiarize the students about the Electromechanical Indicating Instruments. To summarize the methods of Signal generators and Oscilloscopes. 					
UNIT 1	A.C CIRCUITS AND TRANSFORMERS				9
Introduction to AC circuits – waveforms and RMS value – power and power factor – Pure R,L and C alone-series RL, RC and RLC circuits. Transformers-Introduction – working principle-Types of transformers-Losses in a Transformer.					
UNIT 2	AC AND DC MACHINES				9
Single phase Induction motors -Construction–Synchronous motors- working principle Stepper Motors. Introduction – Constructional Features.					
UNIT 3	ELECTRO MECHANICAL INDICATING INSTRUMENTS				9
Galvanometer, Permanent magnet moving coil mechanism, DC Ammeter, DC Voltmeter, Series type Ohm meter, Shunt type Ohmmeter, Multimeter or VOM					
UNIT 4	SIGNAL GENERATORS				9
Signal generators - sine wave generators, Signal generator modulation, pulse and square wave generators, Function generator, Audio frequency signal generator.					
UNIT 5	OSCILLOSCOPES				9
Cathode ray oscilloscopes - block diagram, Cathode ray tube, CRT circuits, Vertical Deflection system, Horizontal Deflection system, Analog and Digital Storage oscilloscope.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the working principles of electrical circuits and machines.				Understand
CO2	Describe the fundamental concepts of EMI instruments, Signal generators and Oscilloscopes.				Understand
CO3	Apply the fundamental concepts of Electrical engineering to solve simple AC circuits.				Apply
CO4	Apply the constructional features of AC and DC machines for specific applications				Apply
CO5	Apply the principles of different Electromechanical indicating instruments to measure the physical quantities				Apply
CO6	Apply the principles of measuring instruments for real world problems				Apply

R21UCS111	PROBLEM SOLVING AND C PROGRAMMING LABORATORY (Except CSBS)	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Familiarize with programming environment
- Familiarize the implementation of programs in C
- **Familiarization with Integrated Development Environment (IDE)**(Compile, Debug)

LIST OF EXPERIMENTS

Problems involve arithmetic computations and sequential logic

1. Write a C program to display the Bio data using printf statement.
2. Write a c program to find simple interest.
3. Writing a C program for a landscaping company. The company needs a tool to calculate the amount of material required to create circular garden beds and the length of edging required for each bed.

Problems involve decision making

- 1 Write a C program for an event management company that organizes seating arrangements for events such as concerts, conferences, or sports matches. The company needs a tool to efficiently assign seats to attendees based on whether their ticket numbers are even or odd.
- 2 Write a C program for developing software for a payroll management system used by a company with employees working on projects spanning multiple years. The system needs to calculate salaries and benefits, taking into account leap years for accurate time calculations. Your task is to write a program that determines whether a given year is a leap year or not.
- 3 Write a C program to read the age of a candidate and determine whether he is eligible to cast his/her own vote.
- 4 Write a C program to find Largest from Three Numbers given by user using Else-if Statement
- 5 Design a calculator to perform the arithmetic operations.

Problems involve iterations

- 1 You are developing a program for a financial institution that offers investment plans based on the Fibonacci sequence. The institution wants to provide a tool that visualizes the growth of investments over time using the Fibonacci series.
- 2 Developing a program for an online security system that requires checking whether a user's chosen PIN is a prime number. The security system wants to ensure that users have unique and secure PINs.

A supermarket manager wishes to keep some toys and puzzle games to enable the customers to manage their kids during the purchase time. He kept a machine called —Fortune Teller machinell, it replies the kid with some fortune message if he enters the palindrome number. It replies 3

with —try again

4 laterll if the kid failed to input a valid palindrome number.

5 Write a C program to print Triangle Pattern Using Nested for Loop.

Problems involve arrays

1 You are developing a program for a gradebook application used by teachers to manage student scores. The application needs a tool that allows teachers to input the scores of five different assignments for each student and then display the scores entered. Your task is to write a C program that takes 5 values from the user representing the scores of five different assignments and stores them in an array. After storing the values, the program should print the elements stored in the array. 2 You are developing a program for a scientific research project where data from multiple experiments need to be analyzed. The research team wants a tool that can calculate the average of a set of data points collected from various experiments. Your task is to write a C program that finds the average of n numbers using arrays.

3 You are developing a program for a financial analysis tool used by an investment firm. The tool requires performing matrix addition to analyze the performance of various investment portfolios over multiple periods. Your task is to write a C program that prints the elements of two 2D arrays representing the returns of two investment portfolios over a specific time period and then performs matrix addition to calculate the combined returns.

4 Write a C program to print the elements of 2D-array Matrix addition using 2D-Array.

Problem involve strings

1. Developing a program for a language learning platform that helps students practice reading and understanding words and sentences in a foreign language. As part of the exercises, the platform needs a tool to display the reverse of the words or sentences entered by the students.

Problems involve in functions, recursion

1. Write a C program to swap two values using call by value and call by reference.
2. You are developing a program for a manufacturing company that produces various components. One of the critical processes involves calculating the number of possible combinations of components that can be assembled. Your task is to write a C program that calculates the factorial of a given number representing the number of components available, using recursion.

Problems involve structures, Unions

1. Create a C programming using Union called Employee which stores the name, id, basic pay, HRA and DA as members. Find the total pay of the employee.
2. Create a C programming using an Structure called Student with name, class, rollnum, total marks as members. Find and display the grade of each student.

>80 – Grade A

>60 – Grade B ● > 50 – Grade C ● <50 – Fail		
TOTAL: 30 PERIODS		
COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Write programs to solve problems involving computations	Apply
CO2	Develop computer applications using suitable control structures	Apply
CO3	Apply different programming constructs to solve a variety of computational problems efficiently	Apply
CO4	Provide solutions for Computer applied complex engineering problems that meet specified needs	Apply
CO5	Design solutions for solving real world problems using C programming techniques	Create
CO6	Work individually or in teams and demonstrate the solutions to the given exercises through presentation	Value-Affective Domain
COURSE DESIGNER : CSE Department		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3												3	
CO 2	3												3	
CO 3	3												3	
CO 4	3												3	
CO 5		2	2										3	
CO 6								2	2					
CAM (Avg)	3.00		2.00						2.00	2.00		2.00	2.00	2.00
3- Strong 2- Medium 1- Weak														

R21UEC112	ENGINEERING FUNDAMENTALS LABORATORY (Common to CSE, ECE, IT)	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To familiarize with word, excel and power point using AI concepts.
- To familiarize with the function of electronic components, logic gates and electronic devices.
- To study various electronic measurements using Arduino Processor

LIST OF EXPERIMENTS:

- 1.Word Processing using AI concepts
- 2.MS –Excel using AI concepts
- 3.Power point Presentation using AI concepts
- 4.Study of electronic components and equipment-
 - a. Resistor color coding
 - b. Measurement of AC signal parameter (peak to peak, rms, period, frequency) using CRO/DSO
5. Study of logic gates
6. Soldering practice – components devices and circuits - using general purpose PCB
7. Study of Diodes, Transistors and Special Diodes
8. Study Experiments using Arduino Processor
 - a. Interfacing of PIR sensor
 - b. Switch control
 - c. Temperature measurement
9. Assembling and disassembling of Desktop

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Implement the process of Microsoft windows, PowerPoint and Excel using AI concepts.	Apply
CO2	Demonstrate the function of various electronic components and devices.	Apply
CO3	Apply the knowledge of basic concepts of Arduino to demonstrate various real time applications.	Apply
CO4	Apply appropriate software tools to make measurements of physical quantities.	Apply
CO5	Demonstrate proficiency in using discipline specific tools.	Apply
CO6	Function effectively as an individual for efficiently executing the given task	Organize

EQUIPMENTS

SI No.	Name of the Equipment / Software	Quantity
1.	Logic Trainer Kit	2
2.	CRO And AFO	2
3.	Small Multipurpose PCBS	5
4.	Soldering Guns	5
5.	Multimeters	5
6.	DC Ammeter	10
7.	DC Voltmeter	10
8.	Variable DC Power Supply	5
9.	Node MCU Development Board	10
10.	PIR Sensor (HC-SR501)	5
11.	Temperature Sensor (IM35 or DHT11)	5
12.	PC With Windows 7	3

COURSE DESIGNER : Mrs.A.JANSI RANI, AP/ECE

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	-	-	-	-	-	-	3	-	-	1	1	-
CO 2	3	2	-	-	-	-	-	-	3	-	-	1	1	-
CO 3	3	2	-	-	3	-	-	-	3	-	-	1	1	-
CO 4	3	2	-	-	3	-	-	-	3	-	-	1	1	-
CO 5	3	2	-	-	3	-	-	-	3	-	-	1	1	-
CO 6	3	2	-	-	3	-	-	-	3	-	-	1	1	-
CAM (Avg)	3	2	-	-	3	-	-	-	3	-	-	1	1	-

3- Strong 2- Medium 1- Weak

R21UCY113	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge on basic concepts in applications chemical analysis To explain the knowledge of various instruments and analysis of various metal ions To explain the water quality parameters for the analysis of industrial effluents. 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> 1. Preparation of molar and normal solutions of the following substances – Oxalic acid , Sodium Carbonate , Sodium Hydroxide and Hydrochloric acid 2. Conductometric Titration of strong acid with strong base 3. Conductometric Titration of Mixture of Acids 4. Estimation of Iron by Potentiometry 5. Determination of Strength of given acid using PH metry 6. Estimation of copper in brass by EDTA method 7. Estimation of hardness of water by EDTA method. 8. Estimation of alkalinity of water sample. 9. Estimation of Chloride in water sample (Argentometric method) 10. Determination of DO in water 11. Estimation of iron by Spectrophotometry. 12. Determination of acidity of industrial effluents. 					
TOTAL: 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis.	Apply			
CO2	Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents.	Apply			
CO3	Analyze the given solution quantitatively using titration.	Analyze			
CO4	Apply the basic knowledge of testing methods of water to identify the water quality for environmental sustainability.	Apply			
CO5	Estimate the quality of water parameters that suits for domestic application	Apply			
CO6	Analyze the industrial effluents to identify the quality parameters and impurities to prevent water pollution.	Analyze			
COURSE DESIGNER : Chemistry Department					

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3								1					
CO 2	3					1	1		1			1		
CO 3		3							1					
CO 4	3					1	1		1			1		
CO 5	3					1	1		1			1		
CO 6		3				1	1		1			1		
CAM (Avg)	3	2				1	1		1			1		

3- Strong 2- Medium 1- Weak

R21UGT140	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1
UNIT I	LANGUAGE AND LITERATURE				3
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan					
UNIT II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART –SCULPTURE				3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils					
UNIT III	FOLK AND MARTIAL ARTS				3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.					
UNIT IV	THINAI CONCEPT OF TAMILS				3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam LiteratureAram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports ofSangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas					
UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE				3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.					
TOTAL : 15 PERIODS					

TEXTBOOKS CUM REFERENCES:

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference

R21UGM131	INDUCTION PROGRAMME	L	T	P	C	
		0	3	0	P/F	
OBJECTIVES:						
<ul style="list-style-type: none"> To rejuvenate the Body and Mind To strengthen Attitude and soft skills To practice Moral values of life 						
UNIT 1	PHYSICAL ACTIVITY					10
Zumba- Bokwa Fitness – Yoga – Mediation – Fine Arts						
UNIT 2	CREATIVE ARTS					5
Painting – Class Painting – Wall Painting – Art from waste						
UNIT 3	UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS					5
Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence– Belief – Morality of life – Guest Lecture by Eminent personality						
UNIT 4	LITERARY					
Elocution - Essay writing Competition - Impromptu Session - Dance and singing competition						
UNIT 5	PROFICIENCY MODULES					15
Elocution - Essay writing Competition - Impromptu Session - Dance and singing competition						
UNIT 6	INDUSTRIAL & LOCAL VISIT					8
VaigaiDam–Theni-VOC-Port-Tuticorin-MaduraiRadioCity-Madurai-AavinMilk –Madurai-NSS Activities						
UNIT 7	FAMILIARIZATION OF THE DEPARTMENT AND INNOVATION					2
Department Introduction and Purpose of Course-Eminent speakers– Scope and Feature of the Course - Latest Innovation						
TOTAL : 45 PERIODS						
COURSE OUTCOMES:						
At the end of the course the student will be able to:						
CO1	Practice physical activities regularly.					
CO2	Implement creativity in drawing and waste material					
CO3	Communicate their ideas effectively.					
CO4	Identify inputs and outputs of different industry process					
CO5	Describe the scope and features of their programme of study					
TEXT BOOKS: Student Induction Programme: A Detailed Guide by AICTE, New Delhi.						

SEMESTER II

SEMESTER II

Course Code	Course Title	L	T	P	C	Type of Course
THEORY						
R21UEN201	Communication Skills for Professionals (Integrated course) (Common to ALL Branches, Except CSBS)	1	0	1	1.5	HSS
R21UMA204	Calculus, Complex Analysis and Numerical Methods (Only for ECE)	3	1	0	4	BS
R21UPH205	Physics for Electronics Engineering (Only for ECE)	3	0	0	3	BS
R21UME209	Engineering Drawing	1	3	0	4	ES
R21UEC205	Electronic Devices (Integrated course)	2	0	3	3.5	PC
PRACTICAL						
R21UPH210	Applied Physics Laboratory (Common to ALL Branches – Except CSBS)	0	0	2	1	BS
MANDATORY						
R21UGT241	Tamils and Technology	1	0	0	1	MC
R21UAC231	Biology for Engineers (Common to all branches except BME, BT)	2	0	0	P/F	MC
TOTAL		13	4	6	18	
Total No of Credits - 18						

R21UEN201	COMMUNICATION SKILLS FOR PROFESSIONALS (IC) (Common to all branches except CSBS)	L	T	P	C
		1	0	1	1.5
OBJECTIVES:					
<ul style="list-style-type: none"> To improve the communication skills To develop the public speaking skills To develop their confidence and ability to speak in public To develop the leadership capacity 					
UNIT - I	ERROR FREE LANGUAGE	3 HOURS			
Parliamentary English words, Pronounce the words with stress, Words often confused. Finding Common Errors.					
UNIT -II	LUCID WRITING	3 HOURS			
Principles of Communicative English, Business Letters, Writing Technical Proposal.					
UNIT -III	INDIVIDUAL AND TEAM WORK	3 HOURS			
Creative Writing- Writing Paragraph, Dialogue Writing (Various situations), Rearrange the jumbled sentences.					
UNIT -IV	LIFE SKILLS	3 HOURS			
Professional Ethics, Code of Conduct, Relative Clause					
UNIT -V	INTERPERSONAL SKILLS	3 HOURS			
Swot Analysis& Life Position					
5 Oral Projects					
Project 1	SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE	5 to 7 minutes			
<ul style="list-style-type: none"> To Speak in front of an audience with courage. Make your message clear, with supporting material. Create a strong opening and conclusion. 					
Project 2	SPEAK ON THE CHOSEN CONTENT	5 to 7 minutes			
<ul style="list-style-type: none"> Select a general topic and bring out specific purposes. Avoid using notes. Use symbolic ideas to develop your ideas. 					
Project 3	USE EFFECTIVE BODY LANGUAGE& INTONATION	5 to 7 minutes			
<ul style="list-style-type: none"> Use appropriate posture, gestures, facial expressions and Eye contact to express your ideas. Use proper intonation and adequate speech module. 					
Project 4	PRESENT YOUR TOPIC WITH VISUAL AIDS	5 to 7 minutes			
Persuade your points with suitable illustration, specific facts, examples Use suitable visual aids to present your topic with confidence.					

Project 5	GRASP THE ATTENTION OF THE AUDIENCE	5 to 7 minutes
	<ul style="list-style-type: none"> Influence your listeners by adopting holistic viewpoint. Use emotions, stories, and positive quotes in your speech 	
TOTAL: 15+15 PERIODS		
COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Communicate orally with fluency and clarity in a given contextual situation	Responding A2
CO2	Adapt them to work in a group as a member or leader for effectively executing the task.	Organizing A4
CO3	Write language appropriately without error in any given circumstances	Responding A2
CO4	Communicate information ideas and opinions in any given situations	Responding A2
CO5	Present the ideas creatively with coherence for given topic	Organizing A4
REFERENCES:		
Competent Communication- A Practical Guide to becoming a better speaker, Toastmasters International, USA.		
Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.		
COURSE DESIGNER: English Department		

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1									2	3		2		
CO 2									2	3		2		
CO 3									2	3		2		
CO 4									2	3		2		
CO 5									2	3		2		
CAM (Avg)									2	3		2		
3- Strong					2- Medium					1- Weak				

R21UMA204	CALCULUS, COMPLEX ANALYSIS AND NUMERICAL METHODS (Only ECE)	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"> To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them. To acquaint the student with the concepts of analytic functions and their interesting properties which could be exploited in a few engineering areas, and be introduced to the host of conformal mappings with a few standard examples that have direct application 					
UNIT 1	SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS	8+3			
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE (Bacterial growth, Population growth, Decayed problems).					
UNIT 2	VECTOR CALCULUS	8+3			
Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallel piped.					
UNIT 3	COMPLEX ANALYSIS	8+3			
Functions of a complex variable – Analytic function – Necessary and Sufficient Conditions (excluding Proofs) – Harmonic function - Properties of an analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping-Simple Transformation: $w = z+c$, cz , $1/z$, and Bilinear transformation.					
UNIT 4	COMPLEX INTEGRATION	8+3			
Statement and applications of Cauchy's integral theorem, Cauchy's integral formula and Cauchy Residue Theorem – Taylor's and Laurent's expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).					
UNIT 5	SOLUTION OF ALGEBRAIC, TRANSCENDENTAL EQUATIONS AND EIGENVALUE PROBLEMS	8+3			
Iteration method – Newton-Raphson method – Gauss Elimination method – Pivoting – Gauss Jordan methods –iterative methods: Gauss Jacobi method, Gauss Seidel method - Eigen values of a matrix by Power method– Jacobi's method for a real symmetric matrix					
SUPPLEMENT TOPIC (for internal evaluation only)					
Evocation / Application of Mathematics, Applications of Matrices.					
TOTAL: 45 (L) + 15 (T) = 60 Periods					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the knowledge of higher order ordinary differential equations in real life engineering problems	Apply			
CO2	Apply the knowledge of vector calculus to solve Engineering problems	Apply			
CO3	Apply the knowledge of complex derivatives and transformation to solve engineering problems.	Apply			
CO4	Apply the knowledge of complex integration to solve engineering problems	Apply			

CO5	Apply the Numerical techniques to solve the Engineering problems involving system of equations and Eigen values of a matrix	Apply
CO6	Explain the concepts of ordinary differential equations, vector identities, complex analysis and Eigen values.	Understand
TEXT BOOKS:		
1. Veerarajan.T —Engineering Mathematics for First year Tata McGraw Hill Publishing Company, New Delhi,2008. 2. Iyengar S.R.K, JAIN R.K. , MAHIDEN KUMAR JAIN — Numerical Methods for Scientific and Engineering Computations New Age International Publishers 7th Edition2019. 3. Grewal. B.S, —Higher Engineering Mathematics , Khanna Publications, New Delhi, 43rd Edition, (2014).		
REFERENCES:		
1. Ramana B.V, —Higher Engineering Mathematics , Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010). 2. Brown J.W. and Churchill R.V. Complex Variable and Applications 7th Edition McGraw Hill Publishing Company2004. 3. Jain R.K and IYENGAR S.R.K, —Advanced Engineering Mathematics , Narosa Publishing House Pvt. Ltd., New Delhi, 3rd Edition,(2007). 4. InceE.L—OrdinaryDifferentialEquations—DoverPublications1958.		
COURSE DESIGNER : Mathematics Department		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3											1	2	
CO 2	3											1	2	
CO 3	3											1	2	
CO 4	3											1	2	
CO 5	3											1	2	
CO 6	2											1	2	
CAM (Avg)	3.0											1	2	
3- Strong 2- Medium 1- Weak														

R21UPH205	PHYSICS FOR ELECTRONICS ENGINEERING (Common to ECE & EEE)	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the essential principles of physics for electronic engineering and related applications. To demonstrate the concepts of electron theories of solids. To enable the students to understand the dielectric and magnetic materials. To apply fundamental knowledge in the nanodevices. 					
UNIT – I	ELECTRON THEORY OF SOLIDS				9
Introduction – Conduction in metals – mobility and conductivity – classical free electron theory of metals–merits and demerits – Electrical and thermal conductivity (derivation) – Wiedemann–Franz law – Lorentz number – Quantum free electron theory – Band theory of solids – Fermi distribution function–Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.					
UNIT – II	MAGNETOSTATICS AND ELECTRODYNAMICS				9
Introduction – Magnetic field & magnetic flux density – Biot-Savart law – Ampere’s and Gauss’s laws of magnetism, Magnetic scalar and vector potential – Faraday’s law of induction and its integral form – Lenz’s law – Equation of continuity – Displacement current – Maxwell’s equations: differential and integral form.					
UNIT – III	MAGNETIC AND DIELECTRICS MATERIALS				9
Introduction–Classification of magnetic materials – Domain theory – Hysteresis – Soft and hard magnetic material - Ferrites - Magnetic storage devices-hard disc - compact disc – RAM - ROMApplications – Introduction to dielectrics- Types of polarization – Dielectric loss - Dielectric breakdown – Capacitor and its types-Applications.					
UNIT – IV	OPTICAL PROPERTIES				9
Introduction – Absorption, emission and scattering of light – Carrier generation and recombination processes – Classification of optical materials – scattering of light in metals, insulators and semiconductors (qualitative) – Optical data storage devices – Optical characterization techniques (UV-Visible, RAMAN and FTIR Spectroscopy, etc).					
UNIT – V	NANOELECTRONIC DEVICES				9
Introduction – Quantum confinement – Quantum structures – Quantum dot, wires and wells – ZenerBloch oscillations – Resonant tunneling – Quantum interference effects – Single electron phenomena – Single electron transistor – Semiconductor photonic structures – 1D, 2D and 3D photonic crystals – Optoelectronic devices – Spintronics – Carbon nanotubes: properties and applications.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the basic concepts of Conducting, Magnetic, Optical and Nanomaterials				Understand
CO2	Describe the behavior of elastic and magnetic dipoles to study the energy storage properties of engineering materials.				Understand

CO3	Apply the concepts of spin and orbital motion of electrons in determining the magnetic properties of materials having specific engineering applications.	Apply
CO4	Apply free electron theory, to calculate energy density and carrier concentration in metals.	Apply
CO5	Apply the principles of electrostatics and magnetostatics to solve engineering problems in communication field.	Apply
CO6	Analyze the electrical, magnetic and optical properties of the materials for industrial application.	Analyze

TEXTBOOKS:

1. Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, —A Textbook of Engineering PhysicsII, revised Edition 2014, S. Chand Company and Private limited, New Delhi.
2. Dr. Mani. P, —Engineering Physics III, Dhanam Publications, Edition, 2018, Chennai
3. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
4. Electromagnetic Theory and Applications: A.K. Saxena: Second Edition, Alpha science

REFERENCES:

1. Nano-electronics & Nano-systems: From Transistor to Molecular & Quantum Devices: Karl Goser, Jan Dienstuhl, Springer 2004 or new Edition
2. Aruldoss G., —Engineering PhysicsII, New Delhi, Revised Edition 2013.
3. Ghatak & Thyagarajan, —Introduction to fiber optics, II Cambridge Univ. Press. 1998 (reprinted 2000)

COURSE DESIGNER: Physics Department

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2										2		
CO 2	3	2										2		
CO 3	3	2										2		
CO 4	3	2										2	2	
CO 5	2	2										2		
CO 6	3	2										2		
CAM (Avg)	3.00	2.00										2.00	2.00	
3- Strong					2- Medium					1- Weak				

R21UME209	ENGINEERING DRAWING			L	T	P	C
	(Common to ECE, EEE, Civil, Agri, BME and BT)			1	3	0	4
OBJECTIVES:							
<ul style="list-style-type: none"> To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings. To impart knowledge in development of surfaces, isometric and perspective projections. 							
UNIT 1	PLANE CURVES, PROJECTION OF POINTS AND LINES						12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves. First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.							
UNIT 2	PROJECTION OF SOLIDS						12
Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.							
UNIT 3	SECTION OF SOLIDS						12
Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one of the plane.							
UNIT 4	DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS						12
Development of lateral surfaces of simple and truncated solids - Prisms, pyramids, cylinders and cones - Development of lateral surfaces of sectioned solids. Principles of isometric projection – isometric scale – isometric view - isometric projections of simple solids and cut solids.							
UNIT 5	ORTHOGRAPHIC AND PERSPECTIVE PROJECTIONS						12
Representation of Three Dimensional objects – General principles of orthographic projectionNeed for importance of multiple views and their placement – First angle projection – layout views. Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.							
TOTAL: 60 Periods							
COURSE OUTCOMES:							
At the end of the course the student will be able to:							
CO1	Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings						Understand
CO2	Apply the principles of orthographic projections to draw projections of solids and sections of solids						Apply
CO3	Develop lateral surfaces of regular and sectioned solids						Apply
CO4	Prepare isometric drawings of simple solids from orthographic views						Apply

CO5	Construct orthographic projection from the given pictorial view	Apply
CO6	Analyze the projections of various solid models using different resting conditions	Analyze
TEXT BOOKS:		
1. Natarajan K.V—A Textbook of Engineering Graphics II, Dhanalakshmi Publishers, (2006). Bhatt N.D—Engineering DrawingII, 46 th Edition, Charotar Publishing House, (2003).		
REFERENCE BOOKS:		
1. Venugopal K., and Prabhu Raja V., —Engineering GraphicsII, New Age International (P) Limited, (2008).		
2. Gopalakrishnan K.R., —Engineering DrawingII (Vol.I&II), 23 rd edition, Subhas Publications. (2014).		
3. Dhananjay A. Jolhe, —Engineering Drawing with an introduction to Auto CADII, Tata McGraw Hill Publishing Company Limited, (2012). Saravanan M, Bensan Raj J, Ganesh Kumar S, —Engineering GraphicsII, JBR Trisea Publishers, Nagarcoil,2020.		
COURSE DESIGNER: Mechanical Department		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1														2
CO 2	3									3				2
CO 3	3									3			3	2
CO 4	3									3			3	2
CO 5	3									3			3	2
CO 6	3	2			3					3			3	2
CAM (Avg)	3	2			3					3			3	2
3- Strong 2- Medium 1- Weak														

R21UEC205	ELECTRONIC DEVICES (Integrated Course)	L	T	P	C
		2	0	3	3.5
OBJECTIVES:					
<ul style="list-style-type: none"> ● To explain the basic physical structure, principles of operation & electrical characteristics of diodes. ● To make the students understand the construction, operation and characteristics of BJT, FET and MOSFET. ● To give an idea about the characteristics and behavior of special semiconductor devices. 					
UNIT 1	SEMICONDUCTORS				30
<p>Classification of solids based on energy band theory - Classification of semiconductors- Diffusion current, drift current, mobility and resistivity - Theory of PN junction diode – Zener diode and its characteristics.</p> <p>Applications: Rectifiers - Half-wave, Full-wave and Bridge - Zener diode as Voltage regulator, PIN diode, SCR characteristics, DIAC, TRIAC, UJT, Laser, LED, LCD.</p> <p>Lab Support:</p> <ol style="list-style-type: none"> 1. Characteristics of PN diode 2. Characteristics of Zener diode and voltage regulator using Zener diode. 3. Half wave rectifier and full wave rectifier with capacitor filter 4. Bridge rectifier with capacitor filter. 5. Characteristics of phototransistor 6. Characteristics of SCR 					
UNIT 2	BIPOLAR JUNCTION TRANSISTORS				15
<p>Formation of PNP / NPN junctions - Transistor mechanism and principle of transistors - CE, CB, CC configuration - Transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency - Current amplification factors for CB and CE modes.</p> <p>Lab Support :</p> <ol style="list-style-type: none"> 1. Characteristics of CE configuration 2. Characteristics of CB configuration. 					
UNIT 3	FIELD EFFECT TRANSISTORS				15
<p>JFET – Construction and Operation of N-Channel, P-channel – Characteristic parameters -Drain characteristics – Transfer characteristics– Comparison of JFET and BJT – Applications of JFET, MOSFET : Enhancement MOSFET – Depletion MOSFET– Comparison of N and P-Channel MOSFETs</p> <p>Lab Support :</p> <ol style="list-style-type: none"> 1. Characteristics of JFET and MOSFET 					
TOTAL: 60 Periods					

COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Describe the fundamental concept of various electronic Devices.	Understand
CO2	Apply the knowledge of PN Junctions in semiconductor devices for various applications.	Apply
CO3	Design voltage regulators and simple rectifiers using Diodes.	Apply
CO4	Design simple BJT circuits for real time applications.	Apply
CO5	Analyze the various parameters of transistors for suitable application.	Analyze
CO6	Analyze the parameters of FET for suitable applications	Analyze
TEXT BOOKS:		
1. Salivahanan S., Suresh kumar N. and Vallavanraj A., — Electronic Devices and CircuitsII, Tata McGraw Hill., 4th Edition, 2017.		
2. David A. Bell, —Electronic Circuits and Electron DevicesII, Oxford University Press, Anna Edition, 2010.		
REFERENCES:		
1. Robert T. Paynter, —Introducing Electronics Devices and CircuitsII, Pearson Education, Seventh Edition, 2010.		
2. Millman J. &Halkins and Satyebranta Jit, —Electronic Devices &CircuitsII, Tata Mc- Graw Hill, Second Edition, 2008.		
COURSE DESIGNER : Mr. P.Selvaprasanth, AP/ECE		

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2												2	2
CO 2	2												2	2
CO 3	3												2	2
CO 4	3	3	3										2	2
CO 5	3												2	2
CO 6	3	3	3										2	2
CAM (Avg)	2.8	3.0	3.0										2.0	2.0
3 – Strong 2- Medium 1- Weak														

R21UPH210	APPLIED PHYSICS LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> ● To create scientific temper among the students. ● To know how to execute experiments properly, presentation of observations and arrival of conclusions. ● To view and realize the theoretical knowledge acquired by the students through experiments 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> 1. Laser – (a) Determination of particle size (b) wave length of Laser source. 2. Determination of numerical aperture and acceptance angle of an optical fiber using diode laser. 3. Poiseuille’s method- Determination of coefficient of viscosity of liquid. 4. Spectrometer-Determination of wavelength of mercury spectrum using grating. 5. Determination of Energy band gap of a semiconductor. 6. Uniform bending method–Determination of Young’s modulus of the given rectangular beam. 7. Lee’s Disc – Determination of thermal conductivity of a bad conductor. 8. Air Wedge method-Determination of thickness of a thin wire. 9. Newton’s rings – Determination of radius of curvature of a convex lens 10. Torsion pendulum-Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire. 11. Determination of Solar cell characteristics using optical transducers kit. 12. Magnetic field along the axis of current carrying coil–Stewart and Gee 					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the principles of Optics, Laser physics and Mechanics to determine the Engineering properties of materials.	Apply			
CO2	Analyze the given liquid sample to determine the viscosity and compressibility of the liquid.	Analyze			
CO3	Apply the principles of spectroscopy to determine the properties using prism.	Apply			
COURSE DESIGNER : Physics Department					

CO/PO/PSO MAPPING

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3								2				2	
CO 2	3								2					
CO 3	3								2					
CO 4	3								2					
CO 5	2								2					
CO 6	3								2					
CAM (Avg)	3								2				2	

3 – Strong 2- Medium 1- Weak

R21UGT241	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1
UNIT I	WEAVING AND CERAMIC TECHNOLOGY				3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.					
UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY				3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period					
UNIT III	MANUFACTURING TECHNOLOGY				3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads Glass beads - Terracotta beads -Shell beads/ bone beats – Archeological evidences - Gem stone types described in Silappathikaram					
UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY				3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompou of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.					
UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING				3
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project..					
TOTAL: 15 PERIODS					

TEXTBOOK CUM REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference

R21UAC231	BIOLOGY FOR ENGINEERS	L	T	P	C
		2	0	0	P/F
OBJECTIVES:					
<ul style="list-style-type: none"> To provide a basic understanding of biological mechanisms of living organisms and the human biology from the perspective of engineers. To encourage engineering students to think about solving biological problems with engineering principles and tools. 					
UNIT I	INTRODUCTION AND CLASSIFICATION				5
Introduction to Biology – Comparison of Biology and Engineering – Eye and Camera – Bird flying and Aircraft – Brownian motion and Thermodynamics – Classification – Unicellular or multicellular – Unicellular: Bacteria, Protozoa, Yeast – Multi Cellular: Animals, Humans, Plants, fungi, etc.–Ultra structure: prokaryotes or eukaryotes – Habitat: aquatic or terrestrial.					
UNIT II	DIGESTIVE & RESPIRATORY SYSTEMS – ENZYME				6
Study of digestive – Respiratory systems and their functions –Enzyme – Classification of Enzyme – Mechanism of Enzyme activity–Enzymes for Industrial Applications: Waste management – Food processing industry – Beverages – Pharmaceutical – Paper Industry etc.					
UNIT III	GENETICS AND BIO MOLECULES (Basics only)				7
Basics of Genes – DNA structure – Genes and hereditary – Genetic Code – Coding and decoding Genetic information – Gene Mapping – Gene Interactions – Mutations – Genetic disorders – Gene therapy – Biomolecules: Carbohydrates, lipids, nucleic acids, proteins. Biological Applications in Engineering: Genetic Algorithm – Computer Application in Genetic Engineering – Genetic Programming–Genetic Computers.					
UNIT IV	NERVOUS SYSTEM AND CELL SIGNALING				7
Central Nervous System: Brain and Spinal Cord – Peripheral Nervous System – Sensory Division – Motor Division – Neurons – sensory, motor, and inter neurons–Signals–Transfer of Information – Bio Signals – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electrooculography (EOG) – X-ray – CT Scan – MRI scan – Biological Applications in Engineering– Neurons and Neural Network.					
UNIT V	BIOLOGY AND ITS INDUSTRIAL APPLICATION				5
Bioreactors – Biopharming – Recombinant vaccines – Cloning – Drug discovery –Bioremediation – Biofertilizer – Biocontrol – Biofilters –Biosensors – Biopolymers – Bioenergy – Biomaterials – Biochips					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the fundamentals of living things, their classification, cell structure and biochemical constituents.				Understand
CO2	Apply the concept of plant, animal and microbial systems and growth in real life situations				Apply

CO3	Analyze biological engineering principles and procedures needed to solve societal issues.	Analyze
TEXT BOOKS		
1. R.C.Dubey, A Textbook of Biotechnology, S.Chand Higher Academic Publications,2013. 2. R.Khandpur, Biomedical instrumentation-Technology and applications, McGraw Hill Professional, 2004.		
REFERENCES		
1. ArthurT.Johnson, —Biology for Engineers, CRC Press, Taylor and Francis, 2nd Edition,2019. 2. Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, —Cell Biology and Genetics (Biology: The unity and diversity of life Volume I) ,Cengage Learning, 12 th Edition,2008. 3. Gerard J.Tortora and Bryan H.Derrickson, —Principles of Anatomy and PhysiologyII, 15 th Edition, Wiley publications, 2016.		
COURSE DESIGNER: BME Department		

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	2	2					3							
CO 3	2	2				3	3							
CAM (Avg)	2	2				3	3							
3 – Strong 2- Medium 1- Weak														

SEMESTER III

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UMA323	Numerical Analysis and Linear Algebra (Only for ECE)	3	1	0	4	BS
2.	R21UEC302	Digital Electronics and Design	3	0	0	3	PC
3.	R21UEC303	Circuit Theory	3	0	0	3	PC
4.	R21UEC305	Electronic Circuits	3	0	0	3	PC
5.	R21UEC308	Electromagnetic Theory and Transmission Lines	3	0	0	3	PC
6.	R21UEC309	Principles of Python Programming (Integrated course)	2	0	2	3	ES
PRACTICAL							
7.	R21UEC306	Digital Electronics Laboratory	0	0	3	1.5	PC
8.	R21UEC307	Electronic Circuits Laboratory	0	0	3	1.5	PC
MANDATORY							
9.	R21UGM331	Environmental Science (Common to all branches)	2	0	0	P/F	MC
TOTAL			19	1	8	22	
Total No of Credits - 22							

R21UMA323	NUMERICAL ANALYSIS AND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"> To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines To make the student acquire sound knowledge in applications of numerical methods in various fields, solving practical technical problems using scientific and mathematical tools when available in Engineering. To apply the concept of Inner product space in orthogonalization. 					
UNIT I	NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9 + 3			
Derivatives from difference tables – Divided differences and finite differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two point and Three-point Gaussian quadrature formulae					
UNIT II	NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS	9 + 3			
Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.					
UNIT III	NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS	9 + 3			
Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.					
UNIT IV	VECTOR SPACES	9 + 3			
Linear dependence of vectors, basis, dimension, linear transformations (maps), range and kernel of a linear map, rank and nullity inverse of a linear transformation rank nullity theorem, composition of linear maps, matrix associated with a linear map					
UNIT V	INNER PRODUCT SPACE	9 + 3			
Inner product space, Norm of a vector matrix vector, Cauchy Schwarz inequality Triangle inequality, orthogonal space					
TOTAL: 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the Numerical techniques of Differentiation and Integration for Engineering Problems.	Apply			
CO2	Apply the Numerical techniques of Ordinary Differential Equation to solve Engineering Problems.	Apply			
CO3	Apply the Numerical techniques of Partial Differential Equations to solve engineering application	Apply			

CO4	Apply the knowledge of structures and principles of vector space to solve engineering problems	Apply
CO5	Apply the knowledge of inner product space to solve engineering problems	Apply
CO6	Explain the concepts of parabolic, elliptic, eigenvalues and ordinary differential equation	Understand

TEXT BOOKS:

1. Grewal.S, —Higher Engineering Mathematics II, Khanna Publishers, New Delhi, 42nd Edition, (2012).
2. Kandasamy.P, Thilagavathy.K, And Gunavathy.K, Numerical Methods, S.Chand & Company Ltd., New Delhi, 2rd Edition, (2012).
3. David, C., Lay, —Linear Algebra and Its Applications 4th Edition Published By Addison Wesley / Pearson, 2011.

REFERENCES:

1. BALI N.P., MANISH GOYAL and WATAINS, —Advanced Engineering MathematicsII, Firewall Media (An imprint of Laxmi Publication Private limited) New Delhi, 7thEdition, (2009).
2. David C. Lay, —Linear Algebra and its applicationsII 3rd Edition updated Pearson Education, (2005).
3. RAMANA.B.V,— Higher Engineering Mathematics II Tata Mc Graw Hill, NewDelhi,11thReprint (2010).
4. Peter, D. Lax, —Linear Algebra and its applicationsII 2nd Edition Wiley- Inter science Publication, (2007).

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3			1								2	2	2
CO 2	3													2
CO 3	3													2
CO 4	3													2
CO 5	3													2
CO 6	2													2
CAM (Avg)	2.83													2
3 – Strong 2- Medium 1- Weak														

R21UEC302	DIGITAL ELECTRONICS AND DESIGN	L	T	P	C	
		3	0	0	3	
OBJECTIVES: <ul style="list-style-type: none"> • To Introduce basic postulates of Boolean algebra • To outline the formal procedures for the analysis and design of combinational and sequential circuits • To introduce the concept of memories, programmable logic devices, synchronous and asynchronous circuits 						
UNIT 1	NUMBER SYSTEM, LOGIC GATES AND MINIMIZATION TECHNIQUES					9
Number Systems- Binary Arithmetic - Addition, Subtraction, Complementary numbering systems: 1s and 2s Complements, Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive– OR and Exclusive–NOR- NAND–NOR implementations Minimization -Boolean postulates and laws – DeMorgan,,s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions- Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don,,t care conditions - Quine-McCluskey method of minimization						
UNIT 2	COMBINATIONAL CIRCUITS					9
Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor -Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator						
UNIT 3	SEQUENTIAL CIRCUITS					9
Latches, Flip-flops -Characteristic table and equation–Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops –Asynchronous counter Synchronous counters –Design of Synchronous counters: - Modulo–n counter, Registers – shift registers - Universal shift registers– Shift register counters -Sequence generators						
UNIT 4	SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS					9
Synchronous Sequential Circuits: General Model – Classification – Design –Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits.						
UNIT 5	MEMORY DEVICES					9
Classification of memories – ROM organization -Types of ROM - RAM organization - Types of RAM –Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL						
TOTAL : 45 PERIODS						

COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Describe the functions of the various building blocks of digital circuits	Understand
CO2	Apply the fundamental concepts of digital electronics to design digital circuits	Apply
CO3	Analyze the digital circuits to verify their functionalities	Analyze
CO4	Evaluate the function of digital circuits using the fundamental concepts	Evaluate
CO5	Design digital circuits for real time applications	Create
CO6	Simulate logic circuits using a software that is used to design and simulate logic circuits	Apply
TEXT BOOKS:		
1. M. Morris Mano, Digital Design with an introduction to the VHDL, Pearson Education, 2013.		
2. S.Salivahanan, S. Arivazhagan „Digital Circuits and Design,, Oxford university press, 2018		
REFERENCES:		
1. Comer —Digital Logic & State Machine Design, Oxford, 2012.		
2. Mandal, —Digital Electronics Principles & Application, McGraw Hill Edu, 2013. 3. D.P.Kothari, J.S.Dhillon, Digital circuits and Design, Pearson Education, 2016.		
COURSE DESIGNER : Mrs.P.Deepa, AP/ECE		

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													3
CO 2	3	2										2	2	3
CO 3	3	1										2	2	3
CO 4	3	2										2	2	3
CO 5	3	2	2									2	2	3
CO 6	3	2	2	3								2	2	3
CAM (Avg)	2.83	1.8	2	3								2	2	3
3 – Strong 2- Medium 1- Weak														

R21UEC303	CIRCUIT THEORY	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To learn an engineering circuit analysis technique such as nodal analysis, and mesh analysis. To explain Network theorems and their applications to electric circuits. To familiarize resonant, coupled, transient circuits, and two port networks. 					
UNIT I	CIRCUIT ANALYSIS (BOTH DC & AC CIRCUIT ANALYSIS)	9			
Circuit Elements-Network graphs- Concept of branch, link, tree and co-tree- dual networks- Ohm's Law-Kirchoff's voltage law – Kirchoff's current law – Mesh analysis – Super mesh analysis – Nodal analysis – Super node analysis – Source transformation technique – Voltage and current source transformations- Star delta transformation.					
UNIT II	NETWORK THEOREMS (ONLY DC CIRCUITS)	9			
Superposition theorem – Thevenin's theorem – Norton's theorem – Reciprocity theorem – Compensation theorem – Maximum power transfer theorem – Tellegen's theorem – Millman theorem					
UNIT III	RESONANT CIRCUITS AND COUPLED CIRCUITS	9			
Series and parallel resonance –frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.					
UNIT IV	TRANSIENT CIRCUITS	9			
Transient response of RL, RC and RLC series and parallel circuits – frequency response – step and sinusoidal responses – natural frequency, damped frequency, damping factor and logarithmic decrement.					
UNIT V	TWO PORT NETWORKS	9			
Driving point and transfer impedances/admittances – voltage and current ratios of two port networks – admittance, impedance, hybrid, transmission and image parameters for two- port networks Interconnection of two port networks.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic properties of circuit elements.	Understand			
CO2	Apply the basic laws to compute voltage and current in AC and DC circuits	Apply			

CO3	Apply the various network theorems to compute power in DC circuits.	Apply
CO4	Analyze the characteristics of resonant and coupled circuits.	Analyze
CO5	Analyze the frequency response of transient circuits.	Analyze
CO6	Evaluate the various parameters of two port networks.	Evaluate

TEXT BOOKS:

1. A.Sudhakar, Shyam Mohan S P —Circuits and Networks: Analysis & SynthesisII, Tata McGraw - Hill, 5th edition, 2015.
2. William H.Hyte, J.E.Kemmerly, Steven M.Durban —Engineering Circuit AnalysisII, Tata McGraw – Hill, 8th edition.

REFERENCES:

1. Joseph Edminister, —Electric circuitsII, Schaums Outline Series, McGraw-Hill, 6th edition, 2013.
2. M.Arumugam, N.Premkumar —Electric circuit TheoryII, Khanna Publishers, New Delhi 2006.
3. M.L.Soni, J.C Gupta —Electrical Circuit AnalysisII, DhanpatRai and Sons, New Delhi 2006.
4. Charles K. Alexander, Mathew N.O.Sadiku, —Fundamentals of Electric CircuitII, McGrawHill's New York, 2003.

COURSE DESIGNER: Mr. D.John Pragasam, AP/ECE

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	3	1											2	
CO 3	3	1											2	
CO 4	3	3	1	1									2	
CO 5	3	3	1	1									2	
CO 6	3	3	2	2	2								2	
CAM (Avg)	2.8 3	2.2	1.33	1.33	2								2	
3 – Strong 2- Medium 1- Weak														

R21UEC305	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To familiarize the students about the mid band analysis of amplifier circuits using smallsignal equivalent circuits. To summarize the method of analyzing large signal and feedback amplifiers. To impart knowledge on design of sinusoidal and non-sinusoidal oscillators. 					
UNIT I	MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS				9
Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis					
UNIT II	FREQUENCY RESPONSE OF SINGLE STAGE AND MULTISTAGE AMPLIFIERS				9
General shape of frequency response of amplifiers - Definition of cutoff frequencies and bandwidth Low frequency analysis of amplifiers to obtain lower cutoff frequency, High frequency analysis of amplifiers to obtain upper cutoff frequency, High frequency transistor models for BJT and FET amplifiers, Unity Gain-Bandwidth product, General expression for frequency response of multistage amplifiers – Amplifier rise time , sag time and their relation to cut off frequencies, design procedure for given parameters.					
UNIT III	POWERAMPLIFIERS				9
Classification of amplifiers, Class A large signal amplifiers and Direct- coupled Class A audio power amplifier - transformer-coupled Class A audio power amplifier – efficiency and linearity issues, ClassB amplifier–push-pull amplifier-distortion in amplifiers- complementary-symmetry (Class B) push-pull amplifier - efficiency, class AB-Class C,MOSFET power amplifier, Thermal stability and heat sink.					
UNIT IV	FEEDBACKAMPLIFIERS				9
Block Diagram of Feedback amplifiers, Voltage series , current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., concept of stability, gain margin and phase margin, design of feedback amplifiers					
UNIT V	OSCILLATORS				9
Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge), LC oscillators (Hartley, Colpitt, Clapp), non- sinusoidal oscillators, Frequency range of RC and LC Oscillators, crystal oscillator, non-sinusoidal oscillators- UJT relaxation oscillator, negative resistance oscillator					
TOTAL: 45 PERIODS					
COURSEOUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the characteristics of amplifiers and oscillators.				Understand
CO2	Apply the knowledge of stabilization technique for analyzing the operation of amplifier in mid band region.				Apply

CO3	Analyze the amplifier and oscillator circuits to verify their functionalities.	Analyze
CO4	Evaluate the function of amplifier and oscillator circuits using the suitable electronic devices.	Evaluate
CO5	Design the amplifier Circuit for real time applications	Create
CO6	Design amplifier and oscillator using PSPICE	Modern Tool Usage

TEXTBOOKS:

1. Salivahanan.S, SureshKumar.N, Vallavaraj.A Electronic Devices and Circuits, TMH, 4th Edition, 2017.
2. Robert L.Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education/PHI,11th Edition, 2013.
3. R.S.Sedha, A textbook of Electronic Circuits, S.Chand,4th edition,2014.

REFERENCES:

1. Millman.J, Halkias.C, Integrated Electronics, TMH, 2nd edition, 2010.
2. David A. Bell, Electronic Devices & Circuits, PHI, 4th Edition, 2007.
3. Floyd, Electronic Devices, Pearson Education, 6th Edition, 2002.
4. Nagrath.I.J, Electronic Devices and Circuits, PHI, 2007.

COURSE DESIGNER : Mrs.G.Ramu Priya, AP/ECE

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	3	2				2								2
CO 3	3	2				2								2
CO 4	3	2	2			2								2
CO 5	3	2	2			2								2
CO 6	3	2	2	2	2	2	3		3			3		2
CAM (Avg)	3	2	2	2	2	2	3		3			3		2

3 – Strong 2- Medium 1- Weak

R21UEC308	ELECTROMAGNETIC THEORY AND TRANSMISSION LINES	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the relation between the fields under Static and Time varying situations To give an idea about symmetrical networks and various transmission line parameters To explain about EM propagation in guided systems. 					
UNIT 1	STATIC AND TIME VARYING ELECTRIC AND MAGNETIC FIELDS				9+3
Review of Electromagnetic fields and its formulas – Poisson’s and Laplace’s equation- Capacitance of various geometries using Laplace’s equation- Faraday’s law –Maxwell’s Equation in integral form from Faraday’s Law, Ampere’s circuital law, Gauss law – Equation expressed in point form - Maxwell’s four equations in integral form and differential form.					
UNIT II	ELECTROMAGNETIC WAVES				9+3
Derivation of Wave Equation – Uniform Plane Waves – Plane waves in free space and in a homogenous material-Wave equation for a conducting medium – Plane waves in lossy dielectrics – Propagation in good conductors – Skin effect – Reflection of Uniform Plane Waves – normal and oblique incidence, Brewster angle.					
UNIT III	FILTERS AND TRANSMISSION LINE PARAMETERS				9+3
Characteristic impedance of Symmetrical Networks – Filter fundamentals – Constant K Filters - Low pass, High pass, band pass, band elimination filters - Transmission lines - General Solution- Line Distortion, Distortion less line, Reflection, Reflection Coefficient					
UNIT IV	THE LINE AT RADIO FREQUENCY				9+3
Introduction- standing wave ratio -standing wave ratio on a line- input impedance of open and short circuited lines - $\lambda/4$ line, $\lambda/2$ line, $3\lambda/4$ line- Impedance matching –smith chart and its applications – Problem solving using Smith chart. Reflection on a line not terminated in Z_0 , Reflection Coefficient, Open and short circuited lines, Insertion loss.					
UNIT V	GUIDED WAVES BETWEEN PARALLEL PLANES				9+3
Transmission of TM waves between Parallel planes – Transmission of TE waves between Parallel planes. Transmission of TEM waves between Parallel planes – TE, TM waves in Rectangular waveguide.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the fundamental concepts of Electromagnetic Fields and Transmission Lines				Understand
CO2	Apply Maxwell’s equations to solutions of problems relating to uniform plane wave propagation and transmission lines				Apply
CO3	Design filters for various cut-off frequencies				Apply
CO4	Analyze the wave propagation parameters indifferent mediums				Analyze

CO5	Analyze the transmission lines and their parameters using the Smith Chart	Analyze
CO6	Analyze the field components of different waveguides and planar transmission lines based on various modes of E and H field.	Analyze
TEXTBOOKS:		
1. Hayt.W.H.,BuckJ.A, —Engineering ElectromagneticsII , TATA McGraw-Hill, 7 th Edition , 2007		
2. E.C.Jordan, K.G. Balmain, —E.M. Waves & Radiating SystemsII, Pearson Education, 2006		
3. John D.Ryder, —Networks, lines and fieldsII, Prentice Hall of India, 2 nd Edition, 2015.		
REFERENCE BOOKS:		
1. Joseph Edminister, —Schaum"s Series, ElectromagneticsII , Tata Mc-graw Hill,2007		
2. G S N Raju, —Electromagnetic Field Theory and Transmission LinesII, Pearson Education, 2006.		
3. Matthew, Sadiku.N.O. —Elements of Engineering ElectromagneticsII , Oxford University Press, 6 th edition, 2015.		
4. Philip C. Magnusson, Andreas Weisshaar, Vijai K. Tripathi, Gerald C. Alexander, —Transmission Lines and Wave PropagationII , CRC Press, Fourth Edition, 2006		
5. Ramo, Whineery and Van Duzer, —Fields and Waves in Communication ElectronicsII, John Wiley, 2003.		
COURSE DESIGNER : Mr. B.Michael Vinoline Rinoj , AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	3	2											2	
CO 3	3	2											2	
CO 4	3	3											2	
CO 5	3	3	1	1	1								2	
CO 6	3	3	2	2	1								2	
CAM (Avg)	2.83	2.6	1.5	1.5	1								2.00	
3– Strong 2- Medium 1- Weak														

R21UEC309	PRINCIPLES OF PYTHON PROGRAMMING (Integrated Course)	L	T	P	C
		2	0	2	3
OBJECTIVES: <ul style="list-style-type: none"> To impart the concepts in Python Programming To familiarize the logical constructs of programming To illustrate programming in Python 					
UNIT I	INTRODUCTION TO PYTHON				10+10
<p>Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function- conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve. Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Simple python programs Programs on operators Programs to Implement selection statements Programs to Implement iterative statements 					
UNIT II	LISTS, TUPLES, DICTIONARIES, STRINGS AND SET				10+10
<p>Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension - Strings: string slices; immutability, string functions and methods, string module- Python Set: Creating a set- Adding items to the set- Set Operations Experiments:</p> <ol style="list-style-type: none"> Programs on list operations Programs on set operations Programs on string operations Programs to Implement tuple and dictionaries 					
UNIT III	FUNCTIONS, MODULES AND I/O FILES				10+10
<p>Functions - function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition-Anonymous or Lambda Function, recursion - Python Modules- Python File Handling.</p> <p>Experiments:</p> <ol style="list-style-type: none"> Program to implement Functions Program to implement Lambda and Recursive functions Program to implement Modules and Packages 					

COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Demonstrate the basic functionalities of python syntax and semantics using Data types, variables, Operators and identifiers	Understand
CO2	Apply the knowledge of Arithmetic & Sequential logic to solve problems related to mathematical expressions	Apply
CO3	Apply the Concept of Python to solve computer applied complex engineering problems that meet specified needs	Apply
CO4	Analyse various problems and implement python applications using function	Analyze
CO5	Formulate the problem to provide solution to computer applied complex engineering problem using modularity	Analyze
CO6	Work individually or in teams and demonstrate the solutions to the given exercises through presentation	Affective Domain

TEXT BOOKS

1. Reema Thareja, —Python Programming using Problem Solving Approachll, Oxford University Press, 2018.
2. Ashok Namdev Kamthane & Amit Ashok Kamthane, —Problem solving and python programmingll, McGraw Hill Education, 2018 (copyright)

REFERENCE BOOKS

1. John V Guttag, — Introduction to Computation and Programming Using Python___, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Pythonll, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programsll, CENGAGE Learning, 2012.
5. Charles Dierbach, — Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3ll, Second edition, Pragmatic

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	3	2											2	
CO 3	3	2											2	
CO 4	3	3	2	2									2	
CO 5	3	3	2	2	2	3			3				2	
CO 6	3	3	3	3	3	3			3	3		3	2	
CAM (Avg)	2.8	2.6	2.3	2.3	2.5	3			3	3		3	2	
3 – Strong 2- Medium 1- Weak														

R21UEC306	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5
<p>OBJECTIVES: To construct digital circuits using standard ICs. • To expose the students to the aspect of designing and implementing combinational</p> <p>• and sequential circuits.</p>					
<p>LIST OF EXPERIMENTS:</p>					
<ol style="list-style-type: none"> 1. Design and implementation of Adder and Subtractor using logic gates. 2. Design and implementation of code converters using logic gates <ol style="list-style-type: none"> a. BCD to excess-3 code and vice versa b. Binary to gray and vice-versa 3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using MSI devices 4. Design and implementation of 2 bit Magnitude Comparator using logic gates, 8 Bit Magnitude Comparator using MSI devices. 5. Design and implementation of 16 bit odd/even parity checker generator using MSI devices 6. Design and implementation of Multiplexer and Demultiplexer using logic gates. 7. Design and implementation of encoder and decoder using logic gates. 8. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops. 9. Design and verification of 4 bit, Mod-10 / Mod-12 Ripple counters. 10. Design and implementation of 3-bit synchronous up/down counter. 					
TOTAL: 45 PERIODS					
<p>COURSE OUTCOMES:</p> <p>At the end of the course the student will be able to:</p>					
CO1	Design and Implement Combinational circuits using Logic Gates.				Apply
CO2	Implement Combinational circuits using MSI Devices.				Apply
CO3	Design and Construct Sequential circuits using Flip - Flops.				Apply
CO4	Apply appropriate software tools to make measurements of physical quantities.				Apply
CO5	Demonstrate proficiency in using discipline-specific tools				Apply
CO6	Function effectively as an individual for efficiently executing the given task				Organize
COURSE DESIGNER : MrS. P.Deepa, AP/ECE					

CO/PO/PSO MAPPING

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	2	2	1	2	2		2	2	2	1		3
CO 2	3	2	2	2	2	2	2		2	2	2	2		3
CO 3	3	3	2	2	2	2	2		2	2	2	1		3
CO 4	3				3									2
CO 5	3				3									2
CO 6	3								2					2
CAM (Avg)	3	2.3	2	2	2.2	2	2		2	2	2	1.3		2.5

3 – Strong 2- Medium 1- Weak

R21UEC307	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5
OBJECTIVES:					
<p>To familiarize the students about the mid band analysis of amplifier circuits using small signal equivalent circuits. To summarize the method of analyzing large signal and feedback amplifiers.</p> <ul style="list-style-type: none"> To impart knowledge on design of sinusoidal and non-sinusoidal oscillators. 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> Verification of KVL and KCL Verification of Thevenin and Norton Theorems. Verification of Superposition Theorem. Verification of Maximum power transfer Theorem Design of DC biasing circuit using potential divider arrangement. Power Amplifiers – Class A Amplifier – measurement of gain. Power Amplifiers – Complementary Symmetry class B Amplifier – measurement of gain. Design of RC phase shift oscillator - Estimation of frequency of oscillation – compare with theoretical value. Design of Hartley oscillator - Estimation of frequency of oscillation – compare with theoretical value. Design of Colpitts oscillator - Estimation of frequency of oscillation – compare with theoretical value. 					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Impart skills and apply knowledge to analyze feedback in amplifiers	Apply			
CO2	Design and analyze various signal and power amplifier circuits using BJTs and FETs	Analyze			
CO3	Design oscillator and amplifier circuits with frequency capability in BJT and FET.	Analyze			
CO4	Apply appropriate instrumentation tools to make measurements of physical quantities	Apply			
CO5	Use appropriate procedure to conduct experiments and collect data	Apply			
CO6	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organize			
COURSE DESIGNER : Mrs.G.Ramu Priya, AP/ECE					

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	2	2	3				1	2		1		2
CO 2	3	2	2	2	3				1	2		1		2
CO 3	3	3	2	2	3				1	2		1		2
CO 4	3				3									2
CO 5	3				3									2
CO 6	3				3				3					2
CAM (Avg)	3	2	2	2	3				1	2		1		2

3 – Strong 2- Medium 1- Weak

R21UGM231	ENVIRONMENTAL SCIENCE	L	T	P	C
		1	0	0	P/F
OBJECTIVES:					
<ul style="list-style-type: none"> • To explain the concepts of Environment and ecosystem. • To describe the knowledge about the impact of environmental pollution. • To impart the environmental issues in the society. • To explain the knowledge about the impact of environment related to human health. • To describe the knowledge in alternative energies. 					
UNIT 1	ENVIRONMENT AND ECOSYSTEMS	9			
Definition, scope and importance of environment – Need for public awareness – Concept of ecosystem– Structure and function of ecosystem– Producers, consumers and decomposers- Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grassland ecosystem.					
UNIT 2	ENVIRONMENTAL POLLUTION	9			
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution - pollution case studies - Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides..					
UNIT 3	SOCIAL ISSUES AND THE ENVIRONMENT	9			
Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).					
UNIT 4	HUMAN POPULATION AND THE ENVIRONMENT	9			
Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights -Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health.					
UNIT 5	FUTURE POLICY AND ALTERNATIVES	9			
Introduction to future policy and alternatives-fossil fuels-nuclear energy-solar energy-wind energy hydroelectric energy-geothermal energy - tidal energy – sustainability - green power-nanotechnology.					
TOTAL : 45 PERIODS					

COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Understand the basic concept of structure and function of ecosystem.	Understand
CO2	Apply the knowledge of various pollution types to prevent the ecosystem and Environment	Apply
CO3	Analyze the environmental problem to report the social issues and the environment	Analyze
CO4	Compare the suitable methods for conservation and sustainable development of natural resources	Analyze
CO5	Apply the principles of value education with respect to human population to preserve environment	Apply
CO6	Analyze the current energy crisis and suggest a suitable sustainable alternatives that promotes social health and environmental prospects	Analyze

TEXT BOOKS:

1. Anubha Kaushik, kaushik C.P., Environmental Science and Engineeringll ,Third Edition, New Age International, New Delhi, 2009.
2. Benny Joseph — Environmental Science and Engineeringll , Tata Mc-Graw Hill, New Delhi, 2006.

REFERENCES:

1. Gilbert M.Masters, _ Introduction to Environmental Engineering and Science ,Pearson Education, Upper saddle River, New Jersey, 2008
2. Miller T.G. Jr., Environmental Sciencell , Wadsworth Publishing Company, Belmont, California, 2005
3. De A.K., — Environmental Chemistryll , Wiley Eastern Ltd., New Delhi,2001
4. Trivedi R.K., Goel P.K., — Introduction to Air Pollutionll , Techno-Science Publication, Jaipur 2005

COURSE DESIGNER : Civil Department

SEMESTER IV

SEMESTER IV

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UMA422	Probability, Statistics and Mathematical Structures (Only for ECE)	3	1	0	4	BS
3.	R21UEC411	Data Communication and Networking Protocols	3	0	0	3	PC
5.	R21UEC405	Analog and Digital Communication	3	0	0	3	PC
4.	R21UEC408	Principles of Linear Integrated Circuits	3	0	0	3	PC
5.	R21UEC409	Signals and Linear Systems	3	1	0	4	PC
6.	R21UEC410	Data structures and Programming Techniques (Integrated Course)	2	0	2	3	ES
PRACTICAL							
7.	R21UGS433	Interpersonal Skills & Team building Laboratory (Only for ECE)	0	0	2	1	HSS
8.	R21UEC406	Analog and Digital Communication Laboratory	0	0	3	1.5	PC
9.	R21UEC407	Linear Integrated Circuits Laboratory	0	0	3	1.5	PC
MANDATORY							
10.	R21UGM431	Gender Equality (Common to ALL Branches)	1	0	0	P/F	MC
TOTAL			18	2	10	24	
Total No of Credits - 24							

R21UMA422	PROBABILITY, STATISTICS AND MATHEMATICAL STRUCTURES	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<p>To provide necessary basic probability concepts and standard distributions that can</p> <ul style="list-style-type: none"> describe real life phenomena. To make the student acquire sound knowledge of fundamentals and applications of statistics which will greatly help at the data analysis stage of comparative experiments. To familiarize the student to analyze the response of random inputs to linear time invariant systems. 					
UNIT I	PROBABILITY & RANDOM VARIABLES				9 + 3
Axioms of probability - Conditional probability - Total probability - Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Normal and Exponential- Joint probability distributions - Marginal and Conditional distributions – Covariance - Correlation and Regression					
UNIT II	TESTING OF HYPOTHESIS				9 + 3
Sampling distributions - Normal, t, Chi-square and F distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes					
UNIT III	DESIGN OF EXPERIMENTS				9 + 3
Completely Randomized Design – Randomized Block Design – Latin Square Design					
UNIT IV	CORRELATION AND SPECTRAL DENSITIES				9 + 3
Auto Correlation Functions - Cross Correlation Functions – Properties - Power Spectral density - Cross spectral density - Applications of correlations and Spectral Densities.					
UNIT V	LOGIC AND PROOF METHODS				9 + 3
Propositional Logic – Propositional equivalences - Predicates and quantifiers – Nested Quantifiers - Rules of inference - Introduction to Proofs - Proof Methods and Strategy					
TOTAL : 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions.				Apply
CO2	Apply the concept of testing of hypothesis for small and large samples in Real life Problems				Analyze
CO3	Analyze a process, to find its significance using design of experiments				Analyze

CO4	Apply the knowledge on random process to analyze the linear system with random inputs in the areas of communication and signal processing	Apply
CO5	Apply basic probability techniques and models in linear systems	Apply
CO6	Understand the basic concept of probability , Random Variable and statistics	Understand

TEXT BOOKS:

1. Grewal B.S, —Higher Engineering MathematicsII, Khanna Publishers, New Delhi,42nd Edition,(2012).
2. Guptas.C, Kapoor v.K.—Fundamental of Mathematical Statistics II 10th Edition , Sultan Chand and Sons, New Delhi,2002.
3. VEERARAJAN.T—ProbabilityandRandomProcessesII4thEditionTataMcGraw-Hill, New Delhi,(2015).

REFERENCE BOOKS:

1. SHARMA J.N , GOEL J.K — Mathematical statistics — 7th Edition Krishna Prakasham Mandis, Mearut1998.
2. Venkatarama Krishnan, —Probability and Random Processes—, Wiley-Interscience Publication, 2006.
3. John A. Gubner., —Probability and Random Processes For Electrical and Computer EngineersII, Cambridge University Press,(2006).
4. Alberto Leon-Garcia., —Probability, Statistics and Random Processes For Electrical EngineeringII, 3rd Edition, Prentice Hall publisher,(2008).

COURSE DESIGNER : Maths Department

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3			1								1	2	2
CO 2	3	3		1								1	2	2
CO 3	3			1								1	2	2
CO 4	3			1								1	2	2
CO 5	3			1								1	2	2
CO 6	2			1								1	2	2
CAM (Avg)	2.83	3.00		1.00								2	2.00	2.00

3 – Strong 2- Medium 1- Weak

R21UEC411	DATA COMMUNICATION AND NETWORKING PROTOCOLS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To give an overview of the functions of different layers To impart knowledge on IEEE standards employed in computer networking To familiarize the students with different protocols and network components 					
UNIT 1	INTRODUCTION TO DATA COMMUNICATION NETWORKING AND MODELS				9
Data communication Components – Data representation and Data flow- Types of Connections – Topologies- Protocols and Standards – OSI model, TCP/IP model- Transmission Media-Switching					
UNIT II	DATA LINK LAYER				9
Framing -Flow Control and Error control – Stop and Wait – Go back – N ARQ – Selective Repeat ARQ – Sliding Window – Piggybacking – Random Access – controlled access. – LAN –Wired LANs: Ethernet, Wireless LANs-IEEE 802.11, Virtual LANs.					
UNIT III	NETWORK LAYER				9
Logical addressing – IPV4, IPV6, Addresses–IPV4, IPV6, Address mapping–ARP, RARP, BOOTP, ICMP, IGMP and DHCP–Routing–Unicast Routing protocols.					
UNIT IV	TRANSPORT LAYER				9
Process to Process Delivery – User Datagram Protocol – Transmission Control Protocol – Congestion Control with Examples. QoS and techniques to improve QoS.					
UNIT V	APPLICATION LAYER				9
Domain Name System (DNS) - Basics of EMAIL - FTP, FTP Connections – WWW – HTTP- Cryptography- Basic Concepts, symmetric key and public key cryptography					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the concepts of data communication and networks				Understand
CO2	Apply the knowledge of network models to compute the network parameters				Apply
CO3	Analyze the parameters of the network protocols used in different layers				Analyze
CO4	Analyze the performance parameter of computer network using any network simulation software				Analyze
CO5	Select the most appropriate networking architecture; analyze the requirements for a Given organizational structure.				Evaluate

CO6	Design and simulate the given network using network simulation software	Apply
TEXT BOOKS:		
1. Behrouz A. Forouzan, —Data communication and NetworkingII, Tata McGraw– Hill, Fourth Edition,2011.		
2. Andrew S. Tanenbaum , David J. Wetherall, Computer Networks, 5th Edition, 2010.		
REFERENCES:		
1. William Stallings, —Data and Computer CommunicationII, Eighth Edition, Pearson Education, 2007.		
2. Larry L.Peterson, Peter S. Davie, —Computer NetworksII, Elsevier, Fifth Edition, 2012 3. James F. Kurose, Keith W. Ross, —Computer Networking: A Top–Down Approach Featuring the InternetII, Pearson Education, 2005.		
COURSE DESIGNER : Ms.Judith, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2												3	
CO 2	3	1											3	
CO 3	3	2		2	1				2	3	2	2	3	
CO 4	3	2	1	1									3	
CO 5	3	2	1	2	1				2	3	2	2	3	
CO 6	3	2	2	3	2	2							3	
CAM (Avg)	3	1.8	1.3	2	1.3	2			2	3	3	2.3	3	
3 – Strong 2- Medium 1- Weak														

R21UEC405	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of information and Digital Communication in baseband and pass band domains
- To illustrate the signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission analog signals
- To impart the knowledge on spread source and error control coding techniques

UNIT I	AMPLITUDE MODULATION SYSTEMS	9
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Baseband and Carrier Communication, Amplitude Modulation, Generation and Demodulation of Amplitude Modulations, Double Side Band Suppressed Carrier, Single Side Band, Vestigial Side Band, AM Transmitter and Receiver

UNIT II	ANGLE MODULATION SYSTEMS	9
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Angle Modulation: Generalized concept of Angle Modulation, Narrow- Band and Wide-band FM, Phase Modulation, Generation and Demodulation of Angle Modulations, FM Transmitter and Receiver

UNIT III	DIGITAL DATA TRANSMISSION	9
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Pulse Modulation: Sampling Theorem, Quantization, Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation Digital Data Transmission: Line coding, Power spectral density of various line codes, Inter Symbol Interference, Nyquist Criterion for Zero ISI, Regenerative Repeater, Eye Diagram.

UNIT IV	DIGITAL MODULATION TECHNIQUES	9
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Carrier Systems: Amplitude Shift Keying, Phase Shift Keying, Frequency Shift Keying, Differential Phase Shift Keying, Coherent Detection and Non-Coherent Detection, BER Analysis, M-Ary Communication

UNIT V	INFORMATION THEORY AND CODING	9
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Measure of Information, Entropy, Source Coding, Compact (Huffman) Code, Discrete Memoryless Channels, Channel Coding Theorem, Information Capacity Theorem. Error Correcting Codes: Linear Block Code, Cyclic Code, Convolutional Codes, Viterbi Algorithm

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the basic concepts of different modulation techniques in baseband and pass band communication systems	Understand
CO2	Apply the knowledge of mathematical theory to characterize and construct analog and digital transmission schemes in time and frequency domain	Apply

CO3	Apply the knowledge of line coding techniques and information theory for efficient baseband signaling	Apply
CO4	Compare the performance of different types of analog modulation and analog to digital conversion techniques	Analyze
CO5	Analyze the performance of efficient source and error control coding techniques	Analyze
CO6	Evaluate the performance of different digital modulation techniques in terms of bandwidth, signal to noise ratio and probability of error	Evaluate

TEXT BOOKS:

1. Simon Haykin and Michael Moher, —Communication Systemsll John Wiley & Sons, Fifth Edition, 2016.
2. B.P. Lathi and Zhi Ding, —Modern Digital and Analog Communicationll Oxford University Press, Fifth Edition, 2018.

REFERENCES:

1. John G Proakis, and Masoud Salehi, —Fundamentals of Communication Systemsll Pearson, 2nd Edition, 2014.
2. Sam Shanmugam, —Digital and Analog Communication systemsll John Wiley, 2nd edition, 1992. 3. Herbert Taub, Donald L Schilling, and Goutam Saha, —Principles of Communication Systemsll McGraw-Hill, Third Edition, 2008.

COURSE DESIGNER: Dr.K.A.Sahul Hameed, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2												2	
CO 2	3	2										2	2	
CO 3	3	2										2	2	
CO 4	3	3	2									2	2	
CO 5	3	3	2									2	2	
CO 6	3	3	3	2								3	2	
CAM (Avg)	2.83	2.6	2.3	2.00								2.2	2	

3 – Strong 2- Medium 1- Weak

R21UEC408	PRINCIPLES OF LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge in basic building blocks of linear integrated circuits To make the students to learn the linear and non-linear applications of operational amplifiers To familiarize some special function ICs To prepare the students to learn the types of ADC and DAC 					
Unit-1	IC FABRICATION AND CIRCUIT CONFIGURATION FOR LINEAR IC				9
Advantages of ICs over discrete components – Manufacturing process of monolithic ICs – Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors – Monolithic Capacitors – Inductors.					
Unit-2	BASICS OF OPERATIONAL AMPLIFIERS				9
Current sources, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations with different input configurations. Applications of op-amps.					
Unit-3	OPERATIONAL AMPLIFIERS APPLICATIONS				9
Sign Changer, Scale Changer, Phase Shift Circuits, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, peak detector, clipper and clamper.					
Unit - 4	WAVEFORM GENERATORS AND REGULATORS				9
Filters, Sine-wave generators, Saw-tooth wave generator, Multivibrators using Timer IC 555, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator. Applications of Voltage regulators - Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565.					
Unit - 5	DATA CONVERTERS				9
Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type. Applications of data convertors.					
TOTAL:45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the concepts of linear integrated circuits				Understand

CO2	Design the linear and nonlinear applications of an Op- Amp	Apply
CO3	Design amplifiers, oscillators, D-A converters using operational amplifiers.	Apply
CO4	Design filters, regulators and PLL using op-amp for a given Specification	Apply
CO5	Analyze the various types of waveform generators and timers	Analyze
CO6	Analyze the performance of filters, multivibrators and A/D converter	Analyze
TEXTBOOKS:		
1. D.Roy Choudhry, Shail Jain, —Linear Integrated CircuitsII, New Age International Pvt. Ltd., 2018, Fifth Edition.		
2. Sergio Franco, —Design with Operational Amplifiers and Analog Integrated Circuits, 4 th Edition, Tata Mc Graw-Hill, 2016		
REFERENCES:		
1. Ramakant A. Gayakwad, —OP-AMP and Linear ICs, 4th Edition, Prentice Hall / Pearson Education, 2015.		
2. S.Salivahanan & V.S. Kanchana Bhaskaran, —Linear Integrated Circuits, TMH,2 nd Edition, 4 th Reprint, 2016.		
3. Gray and Meyer, —Analysis and Design of Analog Integrated Circuits, Wiley International,5th Edition 2009		
COURSE DESIGNER : Mr.R.Abdul Sikkandhar, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2												2	
CO 2	3	2										2	2	
CO 3	3	2										2	2	
CO 4	3	2										2	2	
CO 5	3	3	2									2	3	
CO 6	3	3	2									2	3	
CAM (Avg)	2.8	2.4	2									2	2.3	
3 – Strong 2- Medium 1- Weak														

R21UEC409	SIGNALS AND LINEAR SYSTEMS	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"> ➤ To introduce the concept of continuous and discrete signals and systems ➤ To introduce various transformation techniques to analysis CT and DT signals and systems ➤ To explain the conversion of Continuous time to discrete time signal. 					
UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS				9+3
Classification of signals: Continuous time (CT) and Discrete Time (DT) signals - Standard signals - Basic operations on signals - properties of signals - Periodic & Aperiodic signals, Deterministic & Random signals, Even and Odd signals, Energy & Power signals, Classification of systems: CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, static and Dynamic, Causal & Non-causal, Stable & Unstable. - Linear Time invariant Systems and properties.					
UNIT II	FOURIER SERIES AND FOURIER TRANSFORM				9+3
Fourier Series Signal Analysis: Introduction – Trigonometric Fourier Series for Periodic Signals – Exponential Fourier Series – Symmetry Properties – Properties of Fourier Series – Parseval’s Theorem. Fourier Transform: Introduction – Fourier Integral – Energy Spectral Density – Fourier Transform Properties – System Analysis – Impulse response					
UNIT III	CONTINUOUS TIME SIGNALS AND SYSTEM ANALYSIS USING LAPLACE TRANSFORM				9+3
Laplace Transform - Inverse Laplace Transform- Laplace transform properties-LTI CT System Analysis – Frequency Domain solution – Frequency, Impulse and steady state response– Analysis of Electrical Circuits - Convolution Integral-Block Diagram realization -					
UNIT IV	DISCRETE TIME SIGNALS AND SYSTEM ANALYSIS USING DTFT				5+3
Sampling and aliasing - DTFT - Properties of DTFT-LTI DT System Analysis – Frequency Domain solution - Frequency, Impulse response– Convolution sum.					
UNIT V	DISCRETE-TIME SIGNALS AND SYSTEMS ANALYSIS USING Z TRANSFORM				9+3
Z-Transform — Inverse Z-Transform -Properties– LTI DT System Analysis – Frequency Domain solution – Frequency, Impulse response– Convolution Sum – Block Diagram realization.					
TOTAL: 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concepts of continuous time and Discrete time (CT/DT) signals and systems				Understand
CO2	Determine the classifications of the CT/DT signals and systems according to their properties				Apply

CO3	Apply various transformation techniques to derive Continuous time and Discrete time signals and linear time invariant systems.	Apply
CO4	Analyze the time-domain and frequency domain approaches of continuous and discrete systems.	Analyze
CO5	Comment on various kinds of canonical block diagram realization for any given systems.	Analyze
CO6	Evaluate the characteristics of CT/DT systems using properties of convolution.	Evaluate

TEXT BOOKS:

1. Simon Haykins, Barry Van Veen, — Signals and Systems II, John Wiley & sons Inc, 2004
2. Allan V.Oppenheim, S.Wilsky, S.H.Nawab ,—Signals and Systems II, Pearson Education ,2nd Edition, 2007.

REFERENCES

1. Hwei Hsu, Schaum"s Outline of Signals and Systems, McGraw Hill, 2011.
2. H P Hsu, RakeshRanjan, —Signals and SystemsII, Schaum"s Outlines, Tata McGraw Hill, Indian Reprint, 2007.
3. M J Roberts, —Signals and Systems – Analysis using Transform Methods and MATLABII, TataMcGraw-Hill, 2003.
4. Steven T. Karris, —Signals and Systems: With Matlab ApplicationsII, Orchard Publications, 2003.

COURSE DESIGNER : Dr.M.Parisa Beham, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2											2		
CO 2	3	2		1								2	2	
CO 3	3	2		1								2	2	
CO 4	3	3	2	1								2	2	
CO 5	3	3	2	1								2	2	
CO 6	3	3	3	1								2	2	
CAM (Avg)	2.8 3	2.1	2.3	1								2	2	

3 – Strong 2- Medium 1- Weak

R21UEC410	DATA STRUCTURES AND PROGRAMMING TECHNIQUES (Integrated Course)		L	T	P	C
			2	0	2	3
OBJECTIVES:						
<ul style="list-style-type: none"> ● To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms. ● To impart a thorough understanding of linear non-linear data structures such as list, stacks, queues, trees, graphs and their applications. ● To impart familiarity with various sorting, searching techniques and their performance comparison 						
Unit-1	OBJECT ORIENTED PROGRAMMING				10+10	
<p>Introduction – Tokens – Expressions-Control Structures-Functions in C++, Classes and Objects, Constructors and Destructors, Operator overloading Inheritance-Extending classes, pointers, Polymorphism, File Handling, Exception handling.</p> <p>Experiments:</p> <ol style="list-style-type: none"> 1. Implementation of console I/O operations. 2. Implement Classes with constructor, destructor. 3. Implementation of Operator overloading. 4. Implementation of Inheritance concepts. 						
Unit-2	LINEAR DATA STRUCTURE – ARRAY, LIST, STACK, QUEUE				10+10	
<p>Basic Terminologies: Abstract Data Types (ADTs)– Arrays– List ADT– Singly linked lists (Insertion, Deletion) – Circularly linked lists – Doubly-linked lists– Application of List - Stack ADT: Array & Linked Representation – Applications of Stack–Queue ADT: Array & Linked Representation–Application of Queue.</p> <p>Experiments:</p> <ol style="list-style-type: none"> 1.Implementation of Linked list 2.Implementation of Balancing Parenthesis using stack 3.Program to implement stack and use it to Evaluate postfix expression 4.Implementation of Queue ADT 						
Unit-3	NON-LINEAR DATA STRUCTURE – TREE, GRAPH				10+10	
<p>Tree – Basic Terminology –Traversal – Operations: Binary trees – Expression Tree – Binary Search tree – AVL Tree – Graph Terminology – Representation of Graphs – Graph Traversal – Minimum Spanning Tree – Shortest path algorithm– Sorting – Bubble Sort, Insertion sort, Selection Sort.</p> <p>Experiments:</p> <ol style="list-style-type: none"> 1. Implementation of Minimum Spanning Tree. 2. Implementation of Insertion sort and Bubble sort. 						
Total : 60 PERIODS						
COURSE OUTCOMES:						
At the end of the course the student will be able to:						
	Understand the basic concepts of data structures and					

CO1	algorithm like linear and non-linear	Understand
CO2	Apply appropriate data structure and algorithm design method for a specified application	Apply
CO3	Analyze the different Program to implement various data structure algorithms.	Analyze
CO4	Design and develop efficient linear, non-linear, data structure algorithms to solve problems	Apply
CO5	Evaluate the problems and find solutions using linear, nonlinear applications	Evaluate
CO6	Work individually or in teams and demonstrate the solutions to the given exercises through presentation	Affective Domain

TEXT BOOKS:

1. Reema Thareja, Data Structures Using C++, Oxford University Press, Second Edition, 2014.
2. Weiss. M.A, —Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, 2012

REFERENCE BOOKS:

1. Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, Data Structures using C, Pearson Education Asia,2004
2. Aho.V,Hopcroft.J.E, Ullman.J.D, "Data Structures and Algorithms", Pearson Education, 1st Edition Reprint, 2006.
3. Gilberg.R.F, Forouzan.B.A, "Data Structures", Thomson India Education, 2nd Edition 2005.
4. Sara Baase and A.Van Gelder, "Computer Algorithms", Pearson Education, 3rd Edition, 2005.
5. Cormen.T.H, C.A.Leiserson. B.A, R.L.Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2009.

CO/PO/PSO MAPPING														
COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2													
CO 2	3	2											2	
CO 3	3	2											2	
CO 4	3	3	1	1									2	
CO 5	3	3	2	2	2	3			3				2	
CO 6	3	3	3	3	2	3			3	3		3	2	
CAM (Avg)	2.8	2.6	2	2	2	3			3	3		3	2	
3 – Strong 2- Medium 1- Weak														

R21UGS433	INTERPERSONAL SKILLS & TEAM BUILDING LABORATORY	L	T	P	C
		0	0	3	1

LIST OF EXPERIMENTS:

List of Exercises Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

C01	Communicate orally with fluency and clarity in a given contextual situation (Responding - Affective Domain)	Responding - Affective Domain
C02	Evaluate a speech and offer constructive evaluation of the speech (Evaluate)	Evaluate
C03	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task (Organizing – Affective Domain)	Organizing - Affective Domain
C04	Analyze a problem and find appropriate solution	Analyze
C05	Take decision by organizing relevant information and defining alternatives (Organizing – Affective Domain)	Organizing - Affective Domain

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3								3	2	2	3	3	
CO 2	3	2							3	2	2	3	3	
CO 3	3	2							3	2	2	3	3	
CO 4	3	2							3	2	2	3		
CO 5	3	2							3	2	2	3		
CO 6									3	2	2	3		
CAM (Avg)	3	2							3	2	2	3	3	

3- Strong 2- Medium 1- Weak

R21UEC406	ANALOG AND DIGITAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1.5
OBJECTIVES: To provide an overview of discrete time signals using simulation software <ul style="list-style-type: none"> To implement the various modulation and demodulation techniques. To demonstrate line coding 					
LIST OF EXPERIMENTS:					
1. Generation of standard signals in continuous and discrete time domain 2. Amplitude Modulation Generation and Detection. 3. Frequency Modulation Generation and Detection 4. Verification of sampling theorem. 5. Pulse Code Modulation. 6. Digital modulation and Demodulation techniques – ASK, PSK and FSK (Hardware and Software simulation) and Bit Error Rate analysis. 7. Line coding techniques 8. Pulse Modulation Techniques-PAM, PPM and PWM 9. Simulation of Linear block codes and cyclic codes 10. Simulation of convolutional codes and decoding algorithm					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course the student will be able to:					
CO1	Choose and implement suitable digital modulation technique for given constraints on data rate, bandwidth, power, fidelity, and complexity	Apply			
CO2	Analyze the performance of a digital communication link when additive noise is present in terms of the signal to noise ratio and bit error rate	Analyze			
CO3	Calculate the power and bandwidth requirements of modern communication systems, including those employing ASK, PSK, FSK modulation formats	Apply			
CO4	Apply appropriate instrumentation tools to make measurements of physical quantities	Apply			
CO5	Use appropriate procedure to conduct experiments and collect data	Apply			
CO6	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organize			
COURSE DESIGNER: Mrs. P.Murugeswari, AP/ECE					

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	2		2					2			2	
CO 2	3	2	2		2					2			2	
CO 3	3	3	3		2					2			2	
CO 4	3				3								2	
CO 5	3				3								2	
CO 6	3								3				2	
CAM (Avg)	3	2.3	2		2.4				3	2			2	

3 – Strong 2- Medium 1- Weak

R21UEC407	LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5
OBJECTIVES:					
<p>To make the students to learn the linear and non-linear applications of operational amplifiers</p> <ul style="list-style-type: none"> To prepare the students to learn the types of ADC and DAC To use SPICE software for circuit design 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> Inverting, Non inverting and differential amplifiers. Integrator and Differentiator. Instrumentation amplifier Active low-pass and high-pass filters. Schmitt Trigger using op-amp. Phase shift and Wien bridge oscillators using Op-amp. Astable and Monostable multivibrators using NE555 Timer. R-2R Ladder Type D-A Converter using Op-amp. Study of simulation using SPICE: Filters using Op-amp Multivibrators using NE555 Timer. 					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Design the linear and nonlinear applications using Op- Amp	Apply			
CO2	Design the amplifiers, oscillators, D-A converters using operational amplifiers	Apply			
CO3	Analyze the performance of filters, multivibrators and A/D converter using SPICE.	Analyze			
CO4	Apply appropriate software tools to make measurements of physical quantities.	Apply			
CO5	Demonstrate proficiency in using discipline-specific tools	Apply			
CO6	Function effectively as an individual for efficiently executing the given task.	Organize			
COURSE DESIGNER: Mr.R.Abdul Sikkandhar, AP/ECE					

CO/PO/PSO MAPPING

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	3	2	1	2	2	2	2		2	2	2	2	2	
CO2	3	2	1	2	2	2	2		2	2	2	2	2	
CO3	3	3	3	2	2	2			2	2	2	2	2	
CO4	3				3								2	
CO5	3				3								2	
CO6	3								2				2	
CAM (Avg)	3	2.3	1.67	2	2.4	2	2		2	2	2	2	2	
<p align="center">3-Strong 2- Medium 1-Weak</p>														

R21UGM431	GENDER EQUALITY	L	T	P	C
		1	0	0	P/F
OBJECTIVES:					
<ul style="list-style-type: none"> ▪ To introduce basic concepts relating to gender and to provide logical understanding of gender roles. 					
UNIT I	GENDER SENSITIZATION				5
	Definition of gender, Perspectives-Gender sensitive approach- Gender and sex- Social construction of gender and gender roles- Socialization- institutions of socialization- changing content and context of gender-need for re-socialization. Gender Stereotyping and Gender Discrimination				
UNIT II	GENDER EQUALITY AND CONSTITUTION				5
	Indian constitution related to equality - Fundamental rights - Directive principles of state policy - right to equality - rights against exploitation - cultural and educational rights - the right to constitutional remedy - University Declaration of Human Rights - Enforcement of Human Rights for Women and Children - Role of Cells and Counseling Centers- Internal Complaints Committee - Legal AID cells, Help line, State and National Level Commission				
UNIT III	GENDER ROLES & EQUALITY				5
	Gender & Morality – Structural and functionalist views of Gender- Gender in the Classroom-Beyond access for girls and boys- Gender equality in schools- Gender equality and adult basic education- Developing capacity to achieve gender equality in education- Individuality and removal of gender stereotypes- Respect for each others-Promote equal Opportunity				
TOTAL : 15 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the social construction of gender and sexuality and their influence in social context.			Understand	
CO2	Analyze how the concepts of gender equality are created, maintained, and/or challenged			Analyze	
CO3	Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project			Apply	
REFERENCE BOOKS:					
1. Sheila Aikman and Elaine Unterhalter, —Practicing Gender Equality in Education, Oxfam GB, 2007.					
2. Pasadena and Hackensack, —Gender roles and Equality, Salem Press, 2011.					

SEMESTER V

SEMESTER V

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UEC501	Digital Signal Processing	3	1	0	4	PC
2.	R21UEC502	Microprocessors, Microcontrollers and Applications	3	0	0	3	PC
3.	R21UEC503	Internet of Things and Applications (Integrated Course)	2	0	2	3	ES
4.	R21UEC504	Antenna and Wave Propagation	3	0	0	3	PC
5.	PE – I	Professional Elective – I	3	0	0	3	PE
6.	OE – I	Open Elective – I	3	0	0	3	OE
PRACTICAL							
7.	R21UEC505	Microprocessors, Microcontrollers and Applications Laboratory	0	0	2	1	PC
8.	R21UEC506	Digital Signal Processing Laboratory	0	0	2	1	PC
9.	R21UEC507	Creative Thinking and Innovation	0	0	2	1	PW
MANDATORY							
10.	R21UGS535	Universal Human Values II	2	1	0	3	MC
TOTAL			19	2	8	25	
Total No of Credits - 25							

R21UEC501	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce about DFT and its computation techniques To impart knowledge on design techniques of digital filters To outline the concept of finite word length effects and digital signal processor 					
Unit – 1	DISCRETE FOURIER TRANSFORM	9+3			
Introduction to DFT – Properties of DFT - Circular Convolution – Filtering methods based on DFT- Linear Filtering of long data sequences - Overlap-add and save methods- FFT Algorithms - Decimation in time and Decimation in frequency algorithms- Use of FFT in linear filtering					
Unit – 2	INFINITE IMPULSE RESPONSE DIGITAL FILTERS	9+3			
Design of analogue Butterworth and Chebyshev Filters – Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance and bilinear transform techniques – pre warping – Structures of IIR					
Unit – 3	FINITE IMPULSE RESPONSE DIGITAL FILTERS	9+3			
Symmetric and Anti symmetric FIR filters - Linear phase FIR filter -Fourier Series -Filter design using windowing Techniques (Rectangular Window, Hamming Window, Hanning Window)- Frequency sampling techniques-Structures of FIR					
Unit – 4	FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS	9+3			
Binary fixed point and floating point number representations – Comparison Quantization noise – truncation and rounding -Quantization noise power- input quantization error, coefficient quantization error -limit cycle oscillations -Overflow error- signal scaling					
Unit – 5	ADVANCE DSP TECHNIQUES AND DSP PROCESSOR	9+3			
Multirate Signal Processing: Decimation, Interpolation -Sampling rate conversion by rational factor - Architecture of DSP Processors & applications: Introduction to Programmable DSPs -Architecture of TMS320C5x -TMS320C6xx DSP processors - Assembly language Instructions - Addressing Modes – Applications					
TOTAL: 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the functions and fundamental concepts of various DSP algorithms and processor.	Understand			
CO2	Apply the knowledge of digital signal processing to design and simulate digital filters using various transformation techniques.	Apply			
CO3	Analyze various digital signal processing algorithms and multirate signal processing systems.	Analyze			
CO4	Compare and evaluate various signal transformation techniques and the impact of finite word length effects	Evaluate			

CO5	Design DSP / Multirate signal processing applications using DSP processor with appropriate software.	Create
CO6	Develop various DSP algorithms for real time applications using open source/freeware software	Apply

TEXT BOOKS:

1. John G Proakis and, Dimitris G Manolakis, Digital Signal Processing- Principles, Algorithms and Applications, Prentice Hall India, New Delhi, 2010.
2. S.Salivahanan, A.Vallavaraj, C.Gnanapriya —Digital Signal Processing II, Tata McGraw Hill, 2007.

REFERENCES

1. Oppenheim A V, Discrete Time Signal Processing, Prentice Hall India, New Delhi, 2010.
2. Mitra S K, Digital Signal Processing – A Computer based Approach, Tata McGraw Hill, New Delhi, 2010.
3. David J. Defatta, Joseph G. Lucas, William S. Hodgkiss, Digital signal processing: a system design approach, John Wiley, 1995.
4. B.Venkataramani, M.Bhaskar, Digital Signal Processor, Architecture, Programming and Applications, Tata McGraw Hill, 2011

COURSE DESIGNER : Mr.A.Nagaraj , AP/ECE

CO/PO/POS MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2			3								3	
CO4	3	3	2	2	2								2	
CO5	3	3	2	2	2							1	2	
CO6	3	3	3	3	3							1	3	
CAM (Avg)	2.83	2.1							2	3	2	1	2	
3 – Strong 2- Medium 1- Weak														

R21UEC502	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To develop an in-depth understanding of the operation of microprocessors and Microcontrollers, assembly language programming & interfacing techniques To introduce the hardware architecture, instruction set, programming and interfacing of 8051 microcontrollers. To introduce the modern tool usage for microprocessor and microcontroller-based Applications. 					
UNIT 1	INTEL 8086 ARCHITECTURE				9
Introduction to Microprocessor-Architectural advancement of microprocessors-Evolution of Microprocessors-Introduction to Intel 8085-Architecture of INTEL 8086 (Bus Interface Unit, Execution unit)-Pin Description-Bus cycles -8086 System configuration and Memory –Interfacing- Minimum mode -Maximum mode configurations-Interrupt processing-Direct Memory Access - Comparison between 8086 and 8088					
UNIT 2	INTEL 8086 MICROPROCESSOR – INSTRUCTION SET AND PROGRAMMING				9
Programmer Model of Intel 8086, Operand types -Operand Addressing -Intel 8086 Assembler Directives -Instruction Set -Data transfer group-Arithmetic group -Logical group-Control transfer group -Miscellaneous Instruction group(string, processor control group)					
UNIT 3	MICROCONTROLLERS				9
INTEL 8-bit and 16 bit Microcontrollers : INTEL 8051 Internal Architecture- addressing modes Programming 8051 and Interrupts, -Instruction set -Introduction to 16 Microcontrollers INTEL 8096 Architecture, instruction set and addressing modes of 8096.					
UNIT 4	PERIPHERAL INTERFACING WITH MICROPROCESSOR AND MICROCONTROLLER				9
Programmable peripheral interface (8255)-Keyboard display controller (8279)- Programmable interval timers /Counter, (8253and 8254)-Digital to analog converter, analog to Digital Converter Traffic light control,-Washing machine control -Stepper motor control					
UNIT 5	PROGRAMMING WITH ARDUINO AND MASM				9
The Arduino uno hardware and software development environment –programming various sensors using Arduino Uno IDE and MASM- Introduction to Atmel's AVR, the Microchip PIC processors, ARM processors					
TOTAL:45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the architecture of 8086 microprocessors and 8051, 8096 Microcontrollers and RISC processors	Understand			
CO2	Develop an ALP for general purpose programming using 8086 and 8051	Apply			

CO3	Develop an ALP to interface peripheral devices with 8086 and 8051	Apply
CO4	Apply the modern tools for various microprocessor and microcontroller-based application development	Apply
CO5	Analyze the functioning of microprocessor and microcontroller for the given condition	Analyze
CO6	Develop an application using ALP programming software and IDEs	Create

TEXT BOOKS:

1. Krishna Kant, —Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096II, PHI, 2011
2. The 8051 Microcontroller architecture, Programming and Applications Ayala J.K Penram International (2005) 3rd Edition
3. Massimo Banzi, Getting Started with Arduino , First Edition, pub. O'Reilly, 2008.

REFERENCES:

1. Ramesh S Gaonkar, —Microprocessor Architecture, Programming and Application with 8085II, Penram International Publishing, 4th Edition, New Delhi, 2005 3rd edition.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi,—The 8051 Microcontroller and Embedded SystemsII ,Pearson Education Asia, New Delhi, 2006.
3. A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, third Edition, Tata McGraw Hill, 2012

COURSE DESIGNER : Ms.S.Ramya, AP/ECE

		CO/PO/PSO MAPPING													
COs	PO s												PSO s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	2													2	
CO2	3													2	
CO3	3													2	
CO4	3													2	
CO5	3	3	3	2	3									3	
CO6	3	3	3	2	3									3	
CAM (Avg)	2.83	3	3	2	3									2.3	
			3 – Strong			2- Medium			1- Weak						

R21UEC503	INTERNET OF THINGS AND APPLICATIONS (Integrated course)	L	T	P	C
		2	0	2	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain about Internet of Things. To explain about IoT concepts such as sensing, actuation and communication. To impart the knowledge of Raspberry Pi in Internet of Things. 					
Unit – 1	Introduction to Internet of Things				10
Characteristics of IoT - Design Principles of IoT - IoT Architecture and Protocols -Enabling Technologies for IoT-IoT Levels - IoT vs M2M - Challenges in IoT Design- Sensors - IoT Servers: Sensor Cloud, Open Remote, Thing speak, IBM IoT, Blynk					
Unit-2	IoT protocols and Communication Technologies				10
Wired Technology-Wireless Technology-IoT Protocols: CoRE , CoAP, MQTT, SOAP, REST, WEBSOCKET, Cloud Computing: Data Collection, Storage and computing.					
Unit – 3	Applications of IoT				10
Smart Environment Monitoring –Smart Agriculture – Smart City: Street Light control and Monitoring - IoT Applications In Business: Premises, Supply-Chain and Customer Monitoring.					
Lab Support:					
<ol style="list-style-type: none"> Design a Basic communication Networks Connecting IoT devices Smart Home Smart City Smart Agriculture Smart Health Project Development 					
TOTAL : 60 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concepts of IoT	Understand			
CO2	Apply the knowledge of IoT to develop commercial applications	Apply			
CO3	Analyze the performance of various communication protocols for IoT.	Analyze			
CO4	Apply the concept of IoT to identify the Suitable cloud service for various IoT Application	Apply			
CO5	Design an IoT application system using Network Simulation tool	Apply			
CO6	Design an IoT application system using Network Simulation tool	Apply			

TEXT BOOKS:

1. Dr. Raj Kamal, —Internet of things Architecture and Design PrinciplesII, by McGraw Hill Education (India) Private Limited,2017.
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh and Mahend rawain, —Internet of things with Raspberry pi and Arduinoll, 2020 by CRC Press Taylor & Francis Group, 2020.
3. Vijay Madiseti, Arshdeep Bahga,IIInternet of Things A Hands-On-ApproachII, 2014
4. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press,2017.

REFERENCES:

1. Parikshit N. Mahalle & Poonam N. Railkar, —Identity Management for Internet of ThingsII, River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatias Karnouskos, Stefan Avesand,David Boyle, —From Machine-to-Machine to the Internet of ThingsII, ISBN 9780124076846, Academic Press 2014.
3. Daniel Minoli,—Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M CommunicationsII, ISBN:978-1-118-47347-4, Willy Publications.

COURSE DESIGNER : Dr.M.Sheik Dawood, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2	3	2											2	2
CO3	3	2											2	2
CO4	3	2											2	2
CO5	3	2	1	1	2							2	2	2
CO6	3	3	3	3	2		2		3	3		3	3	3
CAM (AVG)	3	2	2	2	2		2		3	3		3	2	2
3 – Strong 2- Medium 1- Weak														

R21UEC504	ANTENNA AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the various parameters of an antenna. To impart knowledge on aperture antennas and frequency independent antennas. To gain knowledge on Radio Wave Propagation. 					
UNIT 1	ANTENNA FUNDAMENTALS	9			
Antenna Parameters: Radiation pattern, Beam solid angle, Return loss, VSWR- Directivity, Gain, Input impedance -Polarization, Bandwidth Reciprocity -Equivalence Radiation Pattern, Equivalence of Impedances -Effective aperture -Vector effective length - Antenna temperature - Friss transmission equation					
UNIT 2	WIRE ANTENNAS AND ANTENNA ARRAYS	9			
Wire antennas: Hertzian dipole -Half wave Dipole, Radiation resistance and Directivity - Monopole -Radiation resistance and Directivity -Small loop antennas -Antenna Arrays: Linear Array -Pattern Multiplication -Two element array -Uniform Array with non- uniform Excitation-. Binomial Array					
UNIT 3	APERTURE ANTENNAS	9			
Magnetic current and its fields -Uniqueness theorem -Field equivalence principle -Slot antenna Horn Antenna, Pyramidal Horn Antenna -Reflector Antenna-Flat reflector - Corner Reflector - Common curved reflector shapes -, Lens Antenna					
UNIT 4	SPECIAL ANTENNAS AND ANTENNA MEASUREMENTS	9			
Special Antennas: Yagi-Uda Antenna, Helical Antenna – Axial mode helix, Normal mode helix - Log -periodic dipole array -Spiral antenna, Microstrip patch antenna - Wearable antennas, Mobile phone antenna -Introduction to software related to antennas-Antenna Measurements : Radiation Pattern measurement -Gain and Directivity Measurements- Anechoic Chamber measurement- RF Safety Precautions.					
UNIT 5	RADIO WAVE PROPAGATION	9			
Ground Wave Propagation -Free-space Propagation, Ground Reflection-Surface waves, Diffraction-Wave propagation in complex Environments.-Tropospheric Propagation, Tropospheric Scatter -Ionospheric propagation, Structure of Ionosphere - Sky waves, Skip distance, Virtual height, Critical frequency, MUF-Electrical properties of ionosphere, Effects of earth's magnetic fields -Faraday rotation, Whistlers					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the fundamental characteristics of antenna and wave propagation	Understand			
CO2	Apply the knowledge of antennas to calculate the basic antenna parameters	Apply			
CO3	Apply the knowledge of wave propagation to determine the radiation characteristics	Apply			
CO4	Analyze the parameters of various antennas for the given specification	Analyze			

CO5	Evaluate the performance of the given antenna for different substrates using simulation software.	Evaluate
CO6	Design antennas for the given specification using simulation software.	Apply
TEXT BOOKS:		
1. K.D Prasad, —Antennas and Wave PropagationII, Sathya Prakasan Publications, 4 th Edition, 2009.		
2. Constantine A. Balanis, —Antenna Theory Analysis and Design, John Wiley Indiall, 4thEdition, 2016.		
3. E.C.Jordan and Balmain, — Electromagnetic waves and Radiating systems II, Pearson Education, 2015.		
REFERENCES:		
1. John D.Kraus, Ronald J.Marhefka and Ahmad S.Khan — Antennas and wave propagationII Tata MC Graw-Hill Book company,4 th Edition,2010		
2. G.S.N.Raju, —Antenna Wave PropagationII, Pearson Education, 2004.		
3. A .R.Harish, M.Sachidanada, —Antennas and wave propagation —Oxford University Press, 1 st Edition,2007		
4. Wearableantenna https://www.researchgate.net/publication/224089551_A_review_of_wearableantenna		
COURSE DESIGNER :Dr. T.Venkatesh Kanna, ASP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	2	
CO2	3	2										2	2	
CO3	3	2										2	2	
CO4	3	2										2	2	
CO5	3	3		2	2							2	2	
CO6	3	3	2		2							2	2	
CAM (Avg)	3	3	3	2	2							2	2	
3- Strong 2- Medium 1- Weak														

R21UEC505	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop knowledge in assembly language programming with microprocessor and microcontrollers.
- To give knowledge in various peripheral interfacing with microprocessor and microcontrollers.
- To introduce modern tools for programming the microprocessor and microcontroller.

LIST OF EXPERIMENTS:

Programming with 8086 and 8051

1. Arithmetic operations (in 8086 and 8051)
2. Logical Operations (in 8086 and 8051).
3. Array processing And Matrix operations (in 8086 kit and MASM).
4. String Manipulations (in 8086 kit and MASM).
5. Interfacing with 8255 PPI.
6. 8279 Keyboard & display using 8086.
7. ADC and DAC using 8086.
8. Stepper Motor Control using 8051 **Programming with Arduino uno**

1. To make a switch to control LED
2. Interfacing with various sensors (Motion, Smoke, humidity, color, distance)
3. Serial Communication between Node MCU and Arduino
4. Transferring Data from One Arduino to Another
5. Add WiFi to Arduino UNO
6. Stepper motor Control

Project based Learning

Mini project: Any application using Node MCU, Arduino uno and MASM, EMU 8086.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the programming knowledge of microprocessor and microcontroller to perform various functions	Apply
CO2	Interface peripheral devices with microprocessor and microcontroller to develop applications	Apply
CO3	Develop applications using modern tools like Arduino uno IDE and MASM	Create
CO4	Apply appropriate software tools to make measurements of physical quantities	Apply
CO5	Demonstrate proficiency in using discipline-specific tools	Apply

CO6	Function effectively as an individual for efficiently executing the given task	Organize
COURSE DESIGNER : Ms.S.Ramya, AP/ECE		

CO/PO/PSO MAPPING														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			-		-	-	-					-	2
CO2	3			-		-	-	-					-	2
CO3	3	3	2	-		-	-	-					-	2
CO4	3			-	3	-	-	-					-	2
CO5	3	3	3	-	3	-	-	-					3	2
CO6	3		3	-		-	-	-					3	2
CAM (Avg)	3	3	2.7	-	3	-	-	-					3	2
3- Strong 2- Medium 1- Weak														

R21UEC506	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> To demonstrate signal processing techniques using DSP processor To demonstrate signal processing functions using Simulation Software. 					
LIST OF EXPERIMENTS:					
Using Simulation Software:					
1. Linear convolution between two sequences.					
2. Circular convolution between two sequences.					
3. Linear convolution using circular convolution.					
4. Program to perform N-point DFT. Also to perform the IDFT on the result obtained to verify the result.					
5. Linear convolution using (a) overlap save method (b) overlap add method.					
6. Perform FFT on a sequence using the following methods. (a) Decimation in time (b) Decimation in frequency.					
7. Design an IIR filter using transformation method.					
8. Design an FIR filter using windowing techniques.					
Using Digital Signal Processor:					
9. Study of various addressing modes of DSP using simple programming examples					
10. Implementation of Linear Convolution using Digital Signal Processor					
11. Implementation of Circular Convolution using Digital Signal Processor					
12. Waveform generation using Digital Signal Processor					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Develop various DSP Algorithms using Simulation Software.	Apply			
CO2	Analyze the frequency response characteristics of digital FIR and IIR filters.	Analyze			
CO3	Implement the DSP algorithms in digital signal processor.	Apply			
CO4	Apply appropriate software tools to make measurements of physical quantities.	Apply			
CO5	Demonstrate proficiency in using discipline-specific tools	Apply			
CO6	Function effectively as an individual for efficiently executing the given task	Organize			
COURSE DESIGNER : Mr.A.Nagaraj , AP/ECE					

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	3	2	2	2	3				1			1	3	
CO2	3	2	2	2	3				1			1	3	
CO3	3	3	2	2	3				1			1	3	
CO4	3				3								2	
CO5	3				3								2	
CO6	3				3				3				2	
CAM (Avg)	3	2.3	2	2	3				- 1.5			1	2.1	
3- Strong 2- Medium 1- Weak														

R21UEC507	CREATIVE THINKING AND INNOVATION	L	T	P	C
		0	0	2	1

PREAMBLE:

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

COURSE OBJECTIVES:

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

Course Content

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

List of Activities

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and Innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation)	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques
Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 6	Evaluates the presentation	Presentation on the Innovative
Week 7	Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation

Week 8	Facilitates the students work	Preparation of InnovationDevelopment Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

Total Hours: 30 PERIODS

Assessment Pattern

1. Internal Assessment: Presentation on the Innovative Idea
2. End Semester Assessment:
 - Submission of Business Plan
 - Presentation on My Startup Idea (Evaluator: From Industry)

Course Outcomes:

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

CO1	Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice	Valuing – Affective Domain
CO2	Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development	Organization – Affective Domain
CO3	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organization – Affective Domain

R21UGM535	UNIVERSAL HUMAN VALUES II	L	T	P	C
		2	1	0	3
COURSE OBJECTIVES: <ul style="list-style-type: none"> To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature. 					
Module 1	Introduction to Value Education	9			
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Exploring Human Consciousness, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations, Exploring Natural Acceptance					
Module 2	Harmony in the Human Being	9			
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, Exploring the difference of Needs of Self and body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Exploring Sources of Imagination in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health, Exploring Harmony of Self with the Body					
Module 3	Harmony in the Family and Society	9			
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, Exploring the Feeling of Trust, 'Respect' – as the Right Evaluation, Exploring the Feeling of Respect, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order, Exploring Systems to fulfil Human Goal					
Module 4	Harmony in the Nature/Existence	9			
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Exploring the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence, Exploring Co-existence in Existence					
Module 5	Implications of the Holistic Understanding – a Look at Professional Ethics	9			
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, Exploring Ethical Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Exploring Humanistic Models in Education, Holistic Technologies, Production Systems and Management Models Typical Case Studies, Strategies for Transition towards Value-based Life and Profession, Exploring Steps of Transition towards Universal Human Order					

Total: 45 Periods

COURSE OUTCOMES:

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

CO1	Understand the need, basic guidelines, content and process for value education and develop the right understanding of happiness and prosperity in life.	Understand
CO2	Apply the concepts of harmony in the human being to ensure self-regulation and holistic well-being.	Apply
CO3	Apply the principles of trust, respect, and other feelings to foster harmony in family and society.	Apply
CO4	Analyze the interconnectedness and mutual fulfillment among the four orders of nature to understand harmony in existence.	Analyze
CO5	Analyze the implications of a holistic understanding in professional and social contexts to identify ethical conduct.	Analyze
CO6	Evaluate different humanistic models and strategies to transition towards a value-based life and universal human order.	Evaluate

Text Book

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

References

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

SEMESTER VI

SEMESTER VI

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UEC601	Wireless Communication	3	0	0	3	PC
2.	R21UEC602	VLSI Design	3	0	0	3	PC
3.	R21UEC603	Image Processing and Analysis	3	0	0	3	ES
4.	PE – II	Professional Elective – II (Swayam Course)	3	0	0	3	PE
5.	PE – III	Professional Elective – III	3	0	0	3	PE
6.	OE – II	Open Elective – II	3	0	0	3	OE
7.	R21UGS631	Logical Reasoning and Aptitude (Common to ECE, CIVIL, BME and BT)	1	0	0	1	HSS
PRACTICAL							
8.	R21UEC607	Product Development Project	0	0	8	4	PW
9.	R21UEC608	VLSI Design Laboratory	0	0	2	1	PC
10.	R21UGS632	Soft skills and Communication Laboratory (Common to MECH, ECE, CIVIL, BME, BT, IoT, Cyb.Sec., and CHEMICAL)	0	0	2	1	HSS
MANDATORY							
11.	R21UGM631	Indian Constitution (Common to ALL Branches)	1	0	0	P/F	MC
TOTAL			20	0	12	25	
Total No of Credits - 25							

R21UEC601	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge on the characteristics of wireless channels and various cellular architectures. To introduce the concepts behind various digital signaling schemes for fading channels To familiarize the various multipath mitigation techniques and wireless system standards 					
Unit – 1	INTRODUCTION TO WIRELESS COMMUNICATION & CELLULAR CONCEPT				8
Introduction to Wireless Communication - Cellular concept- Frequency reuse- Channel assignment Strategies-Hand off Strategies- Interference & system capacity- Trunking and Grade of Service- Improving Coverage and Capacity in Cellular Systems					
Unit – 2	MOBILE RADIO PROPAGATION				10
Introduction to Radio Wave Propagation, Free Space Propagation model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Ground Reflection (Two- Ray) Model, Diffraction, Scattering, Practical Link Budget Design Using Path Loss Models, Indoor and Outdoor Propagation models, Small-Scale Multipath Propagation- Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels-Types of Small-Scale Fading					
Unit – 3	DIGITAL SIGNALING FOR FADING CHANNELS				9
Linear Modulation Techniques – Constant Envelope Modulation- Combined Linear and Constant Envelope Modulation Techniques- Spread Spectrum Modulation Techniques- Modulation Performance in Fading and Multipath Channels					
Unit – 4	MULTIPATH MITIGATION TECHNIQUES				9
Introduction, Fundamentals of Equalization-Training A Generic Adaptive Equalizer – Equalizers in a Communications Receiver- Survey of Equalization Techniques-Linear Equalizers-Nonlinear Equalization-Algorithms for Adaptive Equalization- Diversity Techniques-RAKE Receiver- Interleaving					
Unit – 5	ADVANCEMENTS IN WIRELESS COMMUNICATION				9
Bluetooth and IEEE 802.15.376– Cellular Wireless Networks- Fourth Generation Systems and LTE-Advanced- Requirements of 5G-5G standards-Impact of radiations in 4G & 5G- Millimeter Wave Technology- Cognitive Radio- Long Range Communications-WiMAX- Smart Grid- NB-IoT- LoraWAN					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concepts of wireless communication systems				Understand
CO2	Apply the knowledge of cellular concept to compute the parameters of cellular services				Apply

CO3	Apply the knowledge of channel characteristics to compute the different parameters of multipath channels	Apply
CO4	Apply the knowledge of digital filter to design Equalizers for the given specifications	Apply
CO5	Apply the knowledge of 4G and 5G in real time applications.	Apply
CO6	Analyze the error performance of various signaling schemes for fading channels	Analyze

TEXT BOOKS:

1. Rappaport, T.S., —Wireless communications II, Second Edition, Pearson Education, 2014.
2. Cory Beard, William Stallings, —Wireless Communication Network and Systems II, Pearson Education, 2016.

REFERENCES:

1. Andrea Goldsmith, —Wireless communications: principles and practice II, second edition, PHI, 2006.
2. William C.Y. Lee, —Wireless and Cellular communications, Third Edition, Tata Mc- Graw Hill, 2006.
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication II, Cambridge University Press, 2005.
4. Upena Dalal, —Wireless Communication II, Oxford University Press, 2009.
5. Jonathan Rodriguez, —Fundamentals of 5G Mobile Networks II Wiley Publications, 2015.

COURSE DESIGNER : Mrs. R.Devika, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	1											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2	1			2						2	2	
CO6	3	3	2	2		2						2	2	
CAM (Avg)	2.83	2	1.5	2		2						2	2	
3- Strong 2- Medium 1- Weak														

R21UEC602	VLSI DESIGN	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the basic concepts of CMOS Technologies and testing To outline the formal procedures for the design of combinational and sequential circuits 					
UNIT1	INTRODUCTION TO VERILOG HDL				9
VLSI Circuit Design Flow- Hierarchical modeling concepts-Basic concepts-Gate level modeling-Dataflow modeling- Behavioral modeling-Design examples of Combinational and Sequential circuits.					
UNIT2	CMOS TECHNOLOGY				9
MOS Transistor theory I-V Characteristics-C-V Characteristics-Non -Ideal I-V Characteristics-DC Transfer characteristics-CMOS Technology-Layout design rule					
UNIT3	CIRCUITS CHARACTERIZATION				9
Delay estimation-Logical effort and Transistor sizing-Power dissipation-Interconnect- Design Margin-Reliability-Scaling					
UNIT4	CMOS LOGIC STRUCTURES AND SUBSYSTEM DESIGN				9
Static CMOS logic Design-Dynamic CMOS logic Design-Circuit families-Circuit design Of latches and flip-flop –Adder circuits-Ripple carry adder-Carry look ahead adder- High speed adder-Multiplier					
UNIT5	LOW-POWER CMOS LOGIC CIRCUITS				9
Overview of Power Consumption, Low-Power Design Through Voltage Scaling, Estimation and Optimization of Switching Activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits					
TOTAL:45PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the Fundamentals of CMOS circuits and it's Characteristics				Understand
CO2	Design and Implement Digital Circuits using HDL				Apply
CO3	Design the CMOS inverter with optimized power, area and timing				Apply
CO4	Analyze the various Characteristics of MOS Transistor				Analyze
CO5	Analyze various Low power design principles in Digital Integrated circuit				Analyze
CO6	Evaluate the Performance of CMOS circuits				Evaluate

TEXTBOOKS:

1. Samir Palnitkar —Verilog HDL a guide to digital design and Synthesis II, Prentice Hall, 2nd edition, 2003
2. Weste and Harris: CMOS VLSI DESIGN (fourth edition) Pearson Education, 2013.
3. John P. Uyemura,— Introduction to VLSI Circuits and systems II, John Wiley & Sons, Reprint 2009

REFERENCES:

1. Neil H.E Weste & Kamaran Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Pearson Education, 2010
2. Jan Rabaey. M, Digital Integrated Circuits: A design Perspective, second Edition fifth reprint Prentice Hall 2002..
3. Pucknell. D.A & K. Eshraghian Basic VLSI Design, Third edition, PHI, 2003.
4. David A. Johns and Ken Martin, —Analog Integrated Circuit Design II John Wiley and Sons Inc., 1997.

COURSE DESIGNER : Mr.D.John Pragasam, AP/ECE

CO/PO/PSO MAPPING														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3	2												2
CO3	3	2												2
CO4	3	3	2	1										3
CO5	3	3	2	1										3
CO6	3	3	3	2	2									3
CAM (Avg)	2.83	2.6	2.33	1.33	2									2.5
3- Strong 2- Medium 1- Weak														

R21UEC603	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the basic concepts of digital image processing. To impart knowledge on image enhancement and segmentation techniques. To get exposed to the fundamentals of machine learning concepts and its application in computer vision. 					
Unit – 1	IMAGE FORMATION AND IMAGE PROCESSING				9
Introduction and Goals of Computer Vision, Fundamentals of Image Processing, Image Formation and Radiometry, Geometric Transformation, Geometric Camera Model, Image Reconstruction from a series of Projections					
Unit – 2	IMAGE PROCESSING CONCEPTS				9
Image Enhancement techniques: Point, Geometric, and Spatial Operations, Image Transforms: DFT, DCT, KL, Wavelet, Ridgelet, Contourlet Transform, Image Filtering: Spatial domain filtering, Frequency domain filtering, Homomorphic filtering and Wiener Filtering for image restoration					
Unit – 3	IMAGE SEGMENTATION AND FEATURES				10
Morphological operations: Binary, Grayscale, and Distance Transform, Image Segmentation: Thresholding, Region-based segmentation, Edge detection- based segmentation; Deformable models form image segmentation, Image Descriptors and Features: Texture Descriptors, Color Features, Edge detection, Object boundary and shape representation, Scale Invariant Feature Transform.					
Unit – 4	FUNDAMENTALS OF MACHINE LEARNING CONCEPTS: PATTERN RECOGNITION				9
Introduction to Pattern Recognition, Linear Regression and Decision theory, Parameter Estimation and Dimension Reduction, Artificial Neural Network for Pattern Classification, Convolutional Neural Networks.					
Unit – 5	APPLICATIONS OF COMPUTER VISION				8
Machine Learning Algorithms and Their Applications in Medical Image Segmentation, Face and Facial Expression Recognition, Gesture Recognition, Simulation Examples.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	State the fundamental concepts and transform domain operations associated with digital image processing.				Understand
CO2	Apply the mathematical concepts to enhance and compress to improve the quality of images.				Apply
CO3	Simulate machine learning based pattern recognition algorithms using modern engineering tools.				Apply
CO4	Analyze and utilize different image segmentation techniques.				Analyze

CO5	Analyze different machine learning techniques used for pattern recognition.	Analyze
CO6	Evaluate the performance of various machine learning algorithms used in computer vision applications.	Evaluate

Text Books:

1. Manas Kamal Bhuyan, —Computer Vision and Image Processing: Fundamentals and Applications, CRC Press, Taylor & Francis Group, 2020
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis and Machine Vision, Cengage Learning, Fourth Edition, 2015

References:

1. Rafael C. Gonzalez, Richard. E. Woods, Digital Image Processing, Pearson Education, 2003.
2. Anil K.Jain, Fundamentals of Digital Image Processing, Pearson Education, 2003.
3. Kenneth R. Castleman, —Digital Image Processing, Pearson, 2006.
4. William K. Pratt, —Digital Image Processing, John Wiley, New York, 2002

COURSE DESIGNER : Dr. K.A.SHAHUL HAMEED, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	3		2	2								2	
CO5	3	3		2	2								2	
CO6	3	3	3	2	2								2	
CAM (Avg)	2.83	2.6	2	2	2								2	
3- Strong 2- Medium 1- Weak														

R21UGS631	LOGICAL REASONING AND APTITUDE (common to ECE, Civil, BME,BT)	L	T	P	C
		1	0	0	1
OBJECTIVES:					
<ul style="list-style-type: none"> To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude. To familiarize the student with various principles involved in solving mathematical problems. To develop an understanding of the basic concepts of reasoning skills 					
Unit – I	QUANTITATIVE APTITUDE	8			
Ratio and Proportion - Averages –Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest -- Time – Speed –Distance -Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.					
Unit – II	VERBAL AND NON VERBAL REASONING	7			
Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out– Venn Diagrams- Data Sufficiency – Data interpretation — Syllogism - Coding –Decoding.					
TOTAL : 15 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Select an appropriate technique to solve the quantitative problems within the stipulated time	Apply			
CO2	Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning	Apply			
CO3	Analyze the direction to solve equations involving one are more unknowns	Analyze			
TEXT BOOKS:					
1. Dr. R.S.AGARWAL, —Quantitative Aptitude, S. Chand Publications, New Delhi, 20 th Edition , (2013).					
2. ABIJITGUHA,—QuantitativeAptitudeforCompetitiveExaminations, TataMcGrawHill Publication, New Delhi, 4th Edition,(2011).					
3. R.V.Praveen,—QuantitativeAptitudeandReasoning, PHI Learning Pvt.Ltd., Delhi, 2 nd Edition, (2013).					
REFERENCES:					
1. Ashish aggarwal,—Quick Arithmetic II, S.Chand Publications, New Delhi ,6 th Revised Edition, (2014).					
2. Dr.V.A.Sathgurunath,,S —A Guide for Campus Recruitment, Sagarikka Publications, Thiruchirapalli, 3 rd Edition, (2011).					
WEBSITES:					
www.m4maths.com , www.indiabix.com , www.fresherworld.com , www.campusgate.co.in , www.indianstudyhub.in , www.tcyonline.com					

R21UEC607	PRODUCT DEVELOPMENT PROJECT	L	T	P	C
		0	0	8	4
OBJECTIVES:					
<ul style="list-style-type: none"> To develop competency with a set of tools and methods for product design, manufacturing and marketing functions in creating a new product. 					
Project Description:					
<p>Product development is the process of delivering a new product or improving and existing product for customers. This course helps students to convert an idea into a product. Eight periods per week will be allotted in the time table and this time shall be utilized by the students to receive directions from the guide, for library reading, laboratory work, computer analysis and field work as assigned by the guide. There shall be periodical seminar presentations about the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews.</p>					
TOTAL : 120 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Design and develop sustainable innovative solutions for societal issues with consideration for public health, safety and environment.	Create – Cognitive Domain			
CO2	Analyze the market potential and evolve the product strategy	Analyze -Cognitive Domain			
CO3	Apply modern engineering and IT tools, algorithms, techniques to provide valid conclusion following the norms of engineering Practice	Apply - Cognitive Domain			
CO4	Test and evaluate the performance of the developed innovative product using appropriate techniques and tools	Evaluate-Cognitive Domain			
CO5	Organize effectively as a team for executing the project	Organize -Affective Domain			
CO6	Write effective reports and make clear presentations	Respond -Affective Domain			

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	3	2	2									2	2	
CO2	3	3	2									2	3	
CO3	3	3	2									2	3	
CO4	3	3	2									2	3	
CO5	3	3	2									2	3	
CO6	3	3	2									2	3	
CAM (Avg)	3.00	2.83	2.00									2.00	2.83	
3- Strong 2- Medium 1- Weak														

R21UEC608	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES: <ul style="list-style-type: none"> To implement Verilog coding for combinational and sequential circuits To provide the knowledge of synthesis, simulation and generation of configuration file for combinational and sequential circuits 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> Design and simulation of adder (min8bit). Design and simulation of Multiplexer and Demultiplexer. Design and simulation of multiplier (min4bit). Design and simulation of ALU. Design and simulation of flip-flop. Design and simulation of Universal shift register. Design and simulation of finite state machine. Design and simulation of counter. Simulate minimum dimension of CMOS inverter, NAND, NOR and XOR circuits Design and simulation of Static CMOS and Dynamic CMOS circuits. Design and simulation of differential amplifier. 					
TOTAL: 30 PERIODS					
COURSE OUTCOMES: At the end of the course the student will be able to:					
CO1	Design and Simulate digital circuits using VLSI Software	Apply			
CO2	Design and implement combinational and sequential circuit using FPGA.	Apply			
CO3	Analyze the functional behavior and performance characteristics of digital circuits	Analyze			
CO4	Apply appropriate software tools to make measurements of physical quantities	Apply			
CO5	Demonstrate proficiency in using discipline-specific tools	Apply			
CO6	Function effectively as an individual for efficiently executing the given task	Organize			
COURSE DESIGNER : Mr.D.John Pragasam, AP/ECE					

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	3	2			2									2
CO2	3	2			2									2
CO3	3	3	3	2	2									3
CO4	3				3									2
CO5	3				3									2
CO6	3													2
CAM (Avg)	3	2.33			2									2.16
<p align="center">3- Strong 2- Medium 1- Weak</p>														

R21UGS632	SOFT SKILLS AND COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> To develop a requisite knowledge in Communication skills and Soft skills. To enhance the students, acumen in honing the skills to meet the Global changes and Industrial needs. 					
Unit – 1	SPEAKING SKILLS				6
Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills					
Unit – 2	WRITING SKILLS				6
Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation					
Unit – 3	READING AND LISTENING SKILLS				6
Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking					
Unit – 4	SOFTSKILLS				6
Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution					
Unit – 5	INTERVIEW SKILLS				6
Types of Interview – Body Language – Professional Grooming – Basic Etiquette					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Answer the queries precisely after carefully listening to the conversation or speech.(Affective domain - Responding)	Responding			
CO2	Communicate orally with fluency and clarity in a given contextual situation (Affective domain - Responding)	Responding			
CO3	Debate with clarity of thought and expression to convey their ideas politely to others (Affective domain - Valuing)	Valuing			
CO4	Apply correct usage of English grammar in writing, fluent speaking and comprehending. (Cognitive Domain - Apply)	Apply			
REFERENCES:					
1. Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011Edition.					
2. Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014Edition.					
3. Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – Pearson Education Publishers.					

R21UGM631	INDIAN CONSTITUTION	L	T	P	C
		1	-	-	P/F
OBJECTIVES:					
<ul style="list-style-type: none"> The students will be exposed to fundamental rights & duties in Indian Constitution. The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development. The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB The student will know about the functions of judiciary and electoral process followed in the country. 					
UNIT 1	INTRODUCTION ON INDIAN CONSTITUTION				4
Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.					
UNIT 2	PARLIAMENTARY SYSTEM				4
Parliamentary System – parliamentary system of other countries - Indian parliamentary system- Federal System – LS and RS, Centre-State Relations-Election of member of parliaments- Union Executive - President, Prime Minister, Union Cabinet. State Legislature -State Executives –election of MLA- Governor, Chief Minister, State Cabinet.					
UNIT 3	JUDICIARY AND ELECTION COMMISSION				4
Supreme Court of India: Structure, Power and Functions of Supreme Court-Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lokadhalats. Elections- Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.					
UNIT 4	LOCAL ADMINISTRATION				3
Local Administration: Powers and functions of Municipalities and Panchayats System- Panchayat Raj- Co-operative Societies and Constitutional and Non-constitutional Bodies.					
TOTAL : 15 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.				
CO2	Manage complex societal issues in society with the knowledge of judiciary and local administration.				
CO3	Interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.				
CO4	Understand the ethical responsibilities of Municipalities, Panchayats and co- operative societies.				

CO5	Understand and distinguish the functioning of the parliamentary system followed in various countries.
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TEXT BOOKS:

1. Shubham Singles, Charles E.Haries, et al., — Constitution of India and Professional EthicsII by Cengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap, —Our Constitution: An Introduction to India's Constitution and constitutional LawII, NBT, 2018.
3. BrijKishore Sharma, —Introduction to the Constitution of IndiaII, PHI Learning Pvt. Ltd. New Delhi, 2011.
4. M.V.Pylee, —An Introduction to Constitution of India II, Vikas Publishing, 2002.
5. Durga Das Basu, —Introduction to the Constitution on India II Prentice Hall, 2001.

SEMESTER VII

SEMESTER VII

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	R21UME701	Project Management and Finance	3	0	0	3	HSS
2.	R21UEC702	Optical and Microwave Communication	3	0	0	3	PC
3.	PE – IV	Professional Elective – IV	3	0	0	3	PE
4.	PE – V	Professional Elective – V	3	0	0	3	PE
5.	OE – III	Open Elective – III *	3	0	0	3	OE
PRACTICAL							
6.	R21UEC708	Optical and Microwave Communication Laboratory	0	0	2	1	PC
7.	R21UGE710	Multi-Disciplinary Project - Phase I	0	0	6	3	PW
MANDATORY							
8.	R21UGM731	Sports and Social Development	-	-	-	P/F	MC
9.	R21UGM732	Skill Development	-	-	-	P/F	MC
10	R21UEC735	Internship	-	-	-	1	MC
TOTAL			15	0	8	17	
Total No of Credits - 17							

R21UME701	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge to find solutions and approaches for various projects. To familiarize the utilization of project within time, resource and financial constraints 					
Unit – 1	PROJECT MANAGEMENT CONCEPTS				9
Concept and characteristics of a project, importance of project management, types of project, project organizational structure, project life cycle, Statement of Work, Work Breakdown Structure.					
Unit – 2	PROJECT PLANNING				9
Project Planning and Scheduling techniques - developing the project network using CPM/PERT, Limitations of CPM/PERT, Precedence Diagramming Method, constructing diagram and computations using precedence diagramming method, PERT/CPM simulation, reducing project duration					
Unit – 3	RESOURCE SCHEDULING & CRITICAL CHAIN SCHEDULING				9
Resource Scheduling - Resource allocation method, splitting and multitasking, Multi project resources scheduling - Critical Chain Scheduling -Concept of critical chain scheduling - critical chain scheduling method, application of Critical chain scheduling and Limitations					
Unit – 4	PROJECT QUALITY MANAGEMENT				9
Concept of project quality, responsibility for quality in projects, quality management at different stages of project, tools and techniques, Quality Management Systems, TQM in projects - Project Performance Measurement and Control - Monitor and assess project performance, schedule, and cost.Earned Value Management, performance measurement methods to monitor, evaluate and control planned cost and schedule performance - Project Closure/ Termination - Meaning of closure/ termination, project audit process, termination steps, final closure.					
Unit – 5	FINANCIAL ACCOUNTING				9
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements. Investments- Average rate of return - Payback Period - Net Present Value - Internal rate of return.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Analyze different types of projects and identify the suitable project for the given constraints				Analyze
CO2	Analyze and identify Critical Path using PERT/CPM for the given project				Analyze
CO3	Analyze Theory of Constraints, Multi project scheduling and heuristic methods for allocating resources to a project				Analyze

CO4	Apply the knowledge of Quality Management and TQM Concepts to different stages of project and design a suitable Quality Management System	Apply
CO5	Investigate the financial data such as balance sheet, income expenditure statement, cash flow statement and budget to interpret, synthesize to provide valid solution for a variety of business problems	Analyze

TEXT BOOKS:

1. Prasanna Chandra — 'Fundamentals of Financial Management 'II, Tata Mc graw-Hill Publishing Ltd, 2005.
2. Jack Meredith, Samuel J. Mantel, — Project Management – A Managerial Approach II, John Wiley and Sons

REFERENCES:

1. Clifford F Gray, Erik W Larson, —Project Management-The Managerial ProcessII, Tata Mcgraw - Hill Publishing Co. Ltd.
2. John M Nicholas, —Project Management for Business and TechnologyII, Prentice Hall of India Pvt Ltd.
3. Paresh Shah, —Basic Financial Accounting for ManagementII, Oxford University Press, 2007.

CO /PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1											3			
CO2											3			
CO3											3			
CO4											3	2		
CO5											3			
CO6												2		
CAM Avg											3	2		
3- Strong 2- Medium 1-Weak														

R21UEC702	OPTICAL AND MICROWAVE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To learn the basic elements of optical fiber communication.
- To learn the principles and characteristics of various optical sources and receivers and performance
- To study the characteristics of microwave tube Generators and Amplifiers.
- To understand MMICs and microwave measurements.

UNIT I	OPTICAL RAY THEORY AND OPTO ELECTRONIC DEVICES	10
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Introduction, Ray theory transmission- Total Internal Reflection Acceptance angle, Numerical Aperture, Types of fibers - Step index, graded index, single mode & multimode, Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications and simulation software of fiber optics in communication.

UNIT II	CHARACTERISTICS OF OPTICAL TRANSMITTER AND RECEIVER	9
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Attenuation – Material absorption losses in silica glass fibers – Linear and Nonlinear Scattering losses - Fiber Bend Losses -Intra and inter Modal Dispersion Fundamental receiver operation, Pre amplifiers, Receiver Configuration – Probability of Error – Quantum limit. Recent trends in optical communication.

UNIT III	MICROWAVE DEVICES AND MICROWAVE TUBES	10
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Microwave frequencies (IEEE Standards), Properties of S-parameters, S-matrix calculations of E- plane, H-plane and Magic Tee, Directional Couplers, Microwave Circulators and Isolators, Gunn Diodes-GaAs Diode- Reflex klystron- Traveling-Wave Tubes (TWTs)- Magnetron Oscillators.

UNIT IV	MONOLITHIC MICROWAVE INTEGRATED CIRCUITS	8
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Introduction, Definition, characteristics, comparison with conventional circuits, fields of application and limitations and criteria for the choice of substrate material; Conductor Materials, Dielectric Materials, Resistive Materials, Monolithic Microwave Integrated Circuit Growth, MMIC Fabrication Techniques- Fabrication of microwave circuit.

UNIT V	MICROWAVE MEASUREMENTS AND APPLICATIONS	8
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Microwave measurements - guide wavelength VSWR, frequency and impedance, practical perspective of microwaves: Microwave oven, Radar, wireless applications, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC).

TOTAL : 45 Periods

COURSE OUTCOMES

After completion, the student will be able to

CO 1	Illustrate the concept of optical and microwave communication system.	Understand
CO 2	Apply the fundamental principles of optics and light wave to design optical fiber communication systems.	Apply
CO 3	Apply the knowledge of optical characteristics to compute the losses and error probability.	Apply
CO 4	Apply the knowledge of microwave devices for various microwave applications.	Apply

CO 5	Analyze the performance of microwave circuits in terms of its properties.	Analyze
CO 6	Design an optical and microwave communication system for the given specification.	Create

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communications, Tata McGraw-Hill India, 5th edition, 2017.
2. Senior John M., Optical Fiber Communications, Pearson Education India, 4th edition, 2014.
3. Samuel Y Liao, Microwave devices and circuits, Pearson Education India, 3rd edition 2015

REFERENCE BOOKS:

1. Govind P. Agrawal, —Fiber-optic communication systems, John Wiley & sons, 5th Edition, 2021.
2. David M. Pozar, Microwave Engineering, John Wiley & Sons, 4th edition, 2011.
3. Valeria Teppati, Andrea Ferrero, Mohamed Sayed, —Modern RF and Microwave Measurement Techniques, Cambridge University Press, 2013.
4. Annapurna Das, Sisir K. DAS, —Microwave Engineering, Tata McGraw-Hill, 4th edition, 2020.

COURSE DESIGNER: Dr. M. Pandimadevi, ASP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	3	2			2			2				2	
CO6	3	3	2	2	2		2		2	2		2	2	
CAM Avg	2.8	2.5	2	2	2	2	2		2	2		2	2	
3- Strong 2- Medium 1-Weak														

R21UEC708	OPTICAL AND MICROWAVE COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> ● To demonstrate the characteristics of Microwave sources ● To study the characteristics of Microwave Components ● To train the students about fiber optic components used in optical communication. 					
LIST OF EXPERIMENTS:					
MICROWAVE EXPERIMENTS					
<ol style="list-style-type: none"> 1. Reflex Klystron–Mode characteristics 2. V-I characteristics of Gunn Diode 3. VSWR, Frequency and Wave Length Measurement 4. Directional Coupler – Directivity and Coupling Coefficient–S–parameter measurement 5. S-matrix Characterization of E-Plane Tee, H-Plane Tee 6. Radiation Pattern of Antennas. 7. Antenna Gain Measurement 					
OPTICAL EXPERIMENTS:					
<ol style="list-style-type: none"> 1. DC characteristics of LED 2. DC characteristics of Laser diode 3. Fiber Optic Analog and Digital Link 4. Determination of Numerical Aperture of optical fiber. 5. Losses in Fiber optic communication systems 					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Analyze the DC characteristic of Optical Sources.	Analyze			
CO2	Estimate the scattering parameters of Microwave components.	Analyze			
CO3	Analyze various losses in fiber optic communication system	Analyze			
CO4	Apply appropriate instrumentation tools to make measurements of physical quantities	Apply			
CO5	Use appropriate procedure to conduct experiments and collect data	Apply			

CO6	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organize
COURSE DESIGNER: Dr. M. Pandimadevi, ASP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	3				2	2		2	3	
CO2	3	3	2	2	3				2	2		2	3	
CO3	3	3	2	2	3				2	2		2	3	
CO4	3				3								2	
CO5	3				3								2	
CO6	3								3				2	
CAM Avg	3	3	2	2	3				1.5	2		2	2.5	
3- Strong 2- Medium 1-Weak														

SEMESTER VIII

SEMESTER VIII

S.No.	Course Code	Course Title	L	T	P	C	Type of Course
THEORY							
1.	PE - VI	Professional Elective – VI	3	0	0	3	PE
2.	OE - IV	Open Elective – IV	3	0	0	3	OE
PRACTICAL							
3.	R21UEC801	Project work	0	0	16	8	PW
4.	R21UGE810	Multi-Disciplinary Project - Phase II *	0	0	16	8	PW
MANDATORY							
5.	R21UGM831	Professional Ethics and Human Values (Common to ALL Branches)	2	0	0	P/F	MC
TOTAL			8	0	16	14	
Total No of Credits - 14							

R21UEC801	PROJECT WORK	L	T	P	C
		0	0	16	8
OBJECTIVES:					
<ul style="list-style-type: none"> To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer-based project or management project. 					
PROJECT DESCRIPTION:					
Sixteen periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews.					
TOTAL: 240 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge				Create
CO2	Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion				Analyze
CO3	Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice				Apply
CO4	Test and Evaluate the performance of the developed solution using appropriate techniques and tools				Evaluate
CO5	Apply management principles to function effectively in the project team for project execution				Affective Domain
CO6	Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs.				Affective Domain
CO7	Write effective reports and make clear presentation to the engineering community and society				Psycho motor Domain

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3				3							
CO2		3		3										
CO3					3			3						
CO4		3			3									
CO5									3		3		3	
CO6						3	3			3		3		3
CAM Avg	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3- Strong 2- Medium 1-Weak														

R21UGM831	PROFESSIONAL ETHICS & HUMAN VALUES	L	T	P	C
		2	0	0	P/F
OBJECTIVES:					
<ul style="list-style-type: none"> To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others 					
UNIT 1	HUMAN VALUES				7
Morals- Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage - Valuing Time - Co-operation – Commitment – Empathy- self-Confidence –Character					
UNIT 2	ENGINEERING ETHICS				7
Senses of „Engineering Ethics” – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues –Uses of Ethical Theories.					
UNIT 3	UNIVERSAL HARMONY				4
Engineering Harmony in the family – Harmony in the society – Trust and Respect – Universal harmonious order					
UNIT 4	SAFETY, RESPONSIBILITIES AND RIGHTS				6
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest - Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination.					
UNIT 5	GLOBAL ISSUES				6
Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.	Apply			

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, —Engineering Ethics, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, —Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. Charles B. Fleddermann, —Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, —Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, —Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, Oxford, 2001.
4. John R Boatright, —Ethics and the Conduct of Business, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, —Business Ethics: Decision Making for Personal Integrity and Social Responsibility, McGraw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, „ Value Education“, Vethathiri publications, Erode, 2011.

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3				3							
CO2		3		3										
CO3					3			3						
CO4		3			3				3		3		3	
CO5						3	3			3		3		3
CO6														
CAM Avg	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3- Strong 2- Medium 1-Weak														

VERTICALS

S.No	Course Code	Course Title	L	T	P	C
Vertical I – 21ECV100 - Signal Processing						
1.	R21ECV101	Adaptive Signal processing and Applications	3	0	0	3
2.	R21ECV102	Speech and Audio Signal Processing	3	0	0	3
3.	R21ECV103	Video Processing and Analysis	3	0	0	3
4.	R21ECV104	Bio Medical Signal & Image Processing	3	0	0	3
5.	R21ECV105	DSP Processor Architecture	3	0	0	3
6.	R21ECV106	Software Defined and Cognitive Radio	3	0	0	3
7.	R21ECV107	Machine Vision	3	0	0	3
8.	R21ECV1N01	Machine Learning	3	0	0	3

R21ECV101	ADAPTIVE SIGNAL PROCESSING AND APPLICATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce practical aspects of adaptive signal processing in particular adaptive systems. To know the current applications for adaptive systems To know the basic principles of adaptation, will cover various adaptive signal processing algorithms and many applications, such as adaptive noise cancellation, interference canceling, system identification, etc. 					
UNIT I	Introduction to Adaptive Systems				9
Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response, Performance function - Gradient					
UNIT II	Theory of Adaption with stationary signals and Gradient search methods				9
Normal form of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, geometrical significance of Eigen vectors, Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent.					
UNIT III	Linear Prediction And Adaptive Filters				9
Linear prediction – forward & backward filters -solution of normal equations -AR Lattice and ARMA Lattice -Ladder Filters, Wiener Filters for Filtering and Prediction -Adaptive Filters - Gradient Adaptive Lattice -Minimum mean square criterion					
UNIT IV	Adaptive Modeling				9
Adaptive Modeling of a multipath communication channel- Adaptive modeling in geophysical exploration- General description of Inverse Modeling, Adaptive equalization of telephone channels, Adaptive Interference canceller as a notch filter and high pass filter					
UNIT V	Adaptive arrays and adaptive beam forming				9
Side lobe cancellation, beam forming with a pilot signal, spatial configurations, adaptive algorithms, performance characteristics of receiving arrays, the Griffiths LMS beam former, The frost adaptive beam former , signal cancellation and distortion					
TOTAL :					45 PERIODS
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamentals of adaptive signals and systems				Understand
CO2	Design a linear adaptive filters using efficient algorithms				Apply

CO3	Apply mathematical models for error performance and stability.	Apply
CO4	Apply adaptive modeling techniques for real time applications	Apply
CO5	Analyze signals and develop their statistical models for efficient processing	Analyze
CO6	Analyze various parameters of signals with different constraints	Analyze

TEXT BOOKS:

1. J.G.Proakis and D.G.Manolakis —Digital signal processing: Principles, Algorithm and ApplicationsII, 4th Edition, Prentice Hall, 2014.
2. M. H. Hayes, —Statistical Digital Signal Processing and ModelingII, John Wiley & Sons Inc., 2017.

REFERENCES:

1. Optimum signal processing: An introduction - Sophocles.J.Orfamadis, 5th Ed., McGrawHill, New York, 2010.
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, Springer, Verlag.2018
3. S.Haykin, —Adaptive Filter TheoryII, 4th Edition, Prentice Hall, 2015.
4. D.G.Manolakis, V.K. Ingle and S.M.Kogon, —Statistical and Adaptive Signal ProcessingII, McGraw Hill, 2018.

COURSE DESIGNER: Dr. M.Fathu Nisha, ASP\ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	2	2	-	-	-	-	-	2	-	3	-
CO6	3	3	3	2	-	-	-	-	-	-	2	-	3	-
CAM (Avg)	2.8	1	1	0.6	0.3	-	-	-	-	-	0.6	-	2.3	-
3- Strong 2- Medium 1- Weak														

R21ECV102	SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3
OBJECTIVE:					
<ul style="list-style-type: none"> • To introduce the basic concepts of speech. • To discuss the analysis features of speech. • To familiarize Speech quantization and coding. • To explain the speech processing applications. 					
MODULE 1	Introduction				9
Basics of speech production- LTI model, LTV model, voiced and unvoiced decision making, speech parameters, pitch and formants, pitch frequency measurement using AMDF and autocorrelation, Parallel processing approach, pitch period measurement using spectral domain, cepstral domain, relation between formants and LPC, evaluation of formants using cepstrum, log spectrum and Power spectral density estimate.					
MODULE 2	Time Domain models for Speech Processing				9
Time Domain models for Speech Processing: Introduction – Window considerations, Short time energy, average magnitude, average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, pitch period estimation using a parallel processing approach, the short time autocorrelation function, average magnitude difference function, pitch period estimation using the autocorrelation function.					
MODULE 3	Linear Predictive Coding (LPC) Analysis				9
Linear Predictive Coding (LPC) Analysis : Basic principles of Linear Predictive Analysis : The Autocorrelation Method, The Covariance method, Solution of LPC Equation :Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, comparison between the methods of solution of the LPC Analysis Equations, Applications of LPC Parameters : Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.					
MODULE 4	Homomorphic & Automatic Speech Recognition				9
Homomorphic speech analysis: Definition of the cepstrum and complex cepstrum, short time cepstrum, homomorphic filtering of speech, Application: pitch detection-pattern recognition. Automatic Speech Recognition: problem of automatic speech recognizer, building a speech recognition system, decision recognition system, decision process in ASR, representation recognition performance, challenges in ASR technology.					
MODULE 5	Audio Coding				9
Audio Coding : Lossless Audio Coding, Lossy Audio coding, Psychoacoustics , ISO-MPEG-1 Audio coding , MPEG- 2 Audio coding, MPEG - 2 Advanced Audio Coding, MPEG - 4 Audio Coding.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
After successful completion of this course the students will be able to :					

CO1	Understand the basic concept of speech signals ,speech production, speech analysis, speech coding and parameter representation of speech	Understand
CO2	Develop linear predictive coding algorithm for speech signal and extract the LPC coefficient used to synthesis or compress the speech.	Apply
CO3	Apply speech coding and enhancement algorithms on speech signals.	Apply
CO4	Develop MATLAB code for processing audio and speech signals.	Apply
CO5	Analyze the speech in time domain and various coding technique to extract various parameters	Analyze
CO6	Design basic audio coding methods using existing code	Create

Text Books:

1. —Digital Processing of Speech Signals|| L.R. Rabiner and S. W. Schafer. Pearson Education. 2003 (Module 2 and 3))
2. —Introduction to Digital speech processing|| Lawrence R.Rabiner and Ronald W.Schafer. Foundation and Trends in signal processing, 2007 (Module 4)
3. —Digital Audio Signal Processing|| Udo Zolzer, 2nd Edition, Wiley, 2008 (Module 5)
4. Dr.Shaila D Apte- —Speech and audio processing||, Wiley India Publication, 2019 (Module1)

Reference Books:

1. —Discrete Time Speech Signal Processing|| Principles and Practice - Thomas F. Quateri, 1st Ed., Pearson Education, 2002.
2. —Speech & Audio Signal Processing|| Ben Gold & Nelson Morgan, Wiley -Indian Edition, 2006.

COURSE DESIGNER: Mr.N.Sathiyathan, AP / ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	
CO4	2	2	2	-	2	-	-	-	-	-	-	-	2	
CO5	2	3	-	-	-	-	-	-	-	-	-	-	2	
CO6	3	3	3	-	3	-	-	-	-	-	-	-	2	
CAM (Avg)	2.5	2.4	2.3	-	2.5	-	-	-	-	-	-	-	2	

3- Strong 2- Medium 1- Weak

R21ECV103	VIDEO PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To have a better knowledge about videos representation and its formats • To know the fundamental concepts of data science and analytics • To expose the student to emerging applications in video analytics • 					
UNIT 1	VIDEO FUNDAMENTALS				9
Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog- to Digital Conversion – Color Representation and Chroma SubSampling – Video Sampling Rate and Standards Conversion – Digital Video Formats –Video Features – Color, Shape and Textural Features					
UNIT II	MOTION ESTIMATION AND VIDEO SEGMENTATION				9
Fundamentals of Motion Estimation – Optical Flow – 2D and 3D Motion Estimation – Block Based Point Correspondences – Gradient Based Intensity Matching – Feature Matching – Frequency Domain Motion Estimation – Video Segmentation.					
UNIT III	FUNDAMENTAL DATA ANALYSIS				9
Exploratory Data Analysis – Collection of Data – Graphical Presentation of Data – Classification of Data – Storage and Retrieval of Data – Big Data – Challenges of Conventional Systems – Web Data – Evolution of Analytic Scalability – Analytic Processes and Tools – Analysis vs. Reporting.					
UNIT IV	MINING DATA STREAMS AND VIDEO ANALYTICS				9
Introduction To Streams Concepts – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Analytic Processes and Tools – Video shot boundary detection – Model Based Annotation and Video Mining – Video21ECV103 Database – Video Categorization – Video Query Categorization.					
UNIT V	EMERGING APPLICATIONS				9
Affective Video Content Analysis – Parsing a Video Into Semantic Segments – Video Indexing and Abstraction for Retrievals – Automatic Video Trailer Generation – Video In painting – Forensic Video Analysis					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the fundamental concepts and algorithms for performing video nalysis				Understand
CO2	Apply different motion estimation and data analytics techniques to address the challenges in video processing				Apply
CO3	Apply the mathematical model for solving motion estimation and data analytic problems.				Apply

CO4	Apply the role of video analytics in emerging applications with case studies	Apply
CO5	Analyze different approaches of motion estimation and data analytics for solving real world problems.	Analyze
CO6	Analyze and apply algorithms for developing solutions for real world problems	Analyze
TEXT BOOKS:		
1. A. Murat Tekalp, —Digital Video ProcessingII, Second Edition, Prentice Hall, 2015. 2. Oges Marques, —Practical Image and Video Processing Using MATLABII, Wiley and Sons (IEEE Press), 2011.		
REFERENCES:		
1. Anand Rajaraman, Jeffrey David Ullman, —Mining of Massive DatasetsII, Cambridge University Press, 2012. 2. Alan C. Bovik, —Handbook of Image and Video processingII, Second Edition, Academic Press, 2005.		
COURSE DESIGNER: Mrs.T. Ruba, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	2	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	3	2										2	
CO6	3	3	2										2	
CAM (Avg)	2.7	2.4	2										2	
3- Strong 2- Medium 1- Weak														

R21ECV104	BIOMEDICAL SIGNAL AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the basic signal in the field of biomedical. To describe the techniques for analyzing bio signals. To help students in learning the principles and various biomedical image processing techniques. 					
UNIT I	ELEMENTS OF BIO-SIGNALS				9
Nature of bio-signals, characteristics of various bio-signals: ECG, EMG, EEG, ERG, ERP, EGG, PCG, ENG, EOG, Speech signal and VAG-Interference associated with bio-signal - Objective and difficulties in biomedical signal analysis - Computer aided diagnosis.					
UNIT II	FILTERING FOR REMOVAL OF ARTIFACTS				9
Fundamental Concepts of Filtering - Time domain: synchronous averaging, moving average filters, Derivative-based operators to remove low frequency artifacts - Frequency domain: Removal of highfrequency noise: Butterworth low pass filters- Removal of low-frequency noise: Butterworth high pass filters- Removal of periodic artifacts: Notch and comb filters - Optimal filtering - Adaptive Filters for Removal of Interference: adaptive noise canceler- LMS adaptive filter- RLS adaptive filter					
UNIT III	BIOMEDICAL SIGNAL PROCESSING				9
Electric Activities of the Cell - Electrocardiogram: Signal of Cardiovascular System - Cardiovascular Diseases and ECG - Processing and Feature Extraction of ECG - Electroencephalogram: Signal of the Brain -Evoked Potentials- Diseases of Central Nervous System and EEG - Processing and Feature Extraction of EEG - Electromyogram: Signal of Muscles - Processing and Feature Extraction of EMG					
UNIT IV	BIOMEDICAL IMAGE PROCESSING				9
Principles of Computed Tomography - X-Ray Imaging and Computed Tomography - Magnetic Resonance Imaging - Ultrasound Imaging					
UNIT V	MODELING BIOMEDICAL SYSTEMS				9
Parametric System Modeling - Autoregressive or All-pole Modeling - Pole-zero Modeling - Electromechanical Models of Signal Generation - Application:Heart-rate Variability - Spectral Modeling and Analysis of PCG Signal.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamentals of Bio medical signal and Image processing techniques.				Understand
CO2	Apply filtering to remove physiological interferences and artifacts from bio signals.				Apply

CO3	Apply different methods of signal processing techniques to analyze the ECG, EEG & EMG signals.	Apply
CO4	Design and Implement various algorithm to process medical images using MATLAB.	Apply
CO5	Analyze various Biomedical Signal Characteristics using appropriate signal processing technique.	Analyze
CO6	Develop a mathematical model of various image processing techniques to analyze their performance.	Analyze

TEXT BOOKS:

1. Rangaraj M. Rangayyan, —Biomedical Signal Analysis—A case study approachII, 2nd Edition, Wiley Inter science /IEEE Press, 2012.
2. Kayvan Najarian, Robert Splinter, Biomedical Signal and Image Processing , 2nd Edition, CRC Press, 2014

REFERENCES:

1. D.C.Reddy, —Biomedical Signal Processing: Principles and TechniquesII, Tata McGraw Hill, New Delhi, 2005.
2. Willis J. Tompkins, —Biomedical Digital Signal ProcessingII, Prentice Hall of India, New Delhi, 2003.
3. Leif Sornmo, Pablo Laguna, —Bioelectrical Signal Processing in Cardiac & Neurological ApplicationsII, Elsevier, 2005.
4. Arnon Cohen, —Bio–Medical Signal ProcessingII, Vol I and Vol II, CRC Press Inc., 1999.

COURSE DESIGNER: Mr. A.Nagaraj, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	3	-	-	-	-	-	-	-	2	-
CO5	3	3	2	-	2	-	-	-	-	-	-	-	3	-
CO6	3	3	2	-	2	-	-	-	-	-	-	-	3	-
CAM (Avg)	2.8	2.5	2.6	-	2.3								2.3	
3- Strong 2- Medium 1- Weak														

R21ECV105	DSP PROCESSOR ARCHITECTURE	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> Basics on Digital Signal Processors Programmable DSP_s Architecture, On-chip Peripherals and Instruction set Programming for signal processing applications Advanced Programmable DSP Processors 					
UNIT I	FUNDAMENTALS OF PROGRAMMABLE DSPs				9
Introduction to Programmable DSPs, Architectural Features of PDSPs - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Applications of Programmable DSPs.					
UNIT II	TMS320C5X PROCESSOR				9
Architecture of C5X Processor – Addressing modes – Assembly language Instructions - Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK onboard peripherals, Application Programs for processing real time signals					
UNIT III	TMS320C6X PROCESSOR				9
Architecture of the C6x Processor - Instruction Set – Addressing modes, Assembler directives, On-chip peripherals, DSP Development System: DSP Starter Kit - Code Composer Studio - Support Files – Introduction to AIC23 codec and other on-board peripherals, Real-Time Programming Examples for Signals and Noise generation, Frequency analysis, Filter design.					
UNIT IV	ADVANCED PROCESSORS				9
Study of TI_s advanced processors - TMS320C674x and TMS320C55x DSPs, ADSP_s Blackfin and Sigma DSP Processors, NXP_s DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors.					
UNIT V	RECENT TRENDS IN DSP SYSTEM DESIGN				9
An Overview of the Application Notes on DSP Systems-Evolution of FPGA Based DSP System Design-Design Flow for an FPGA Based System Design-Softcore Processors - Comparison of the Performances of the Systems Designed Using FPGAs and Digital Signal Processors.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the architecture details and instruction sets of various DSP processors.				Understand
CO2	Apply the knowledge of programming skills to develop code for processing real time signals.				Apply
CO3	Design and implement DSP algorithm using code composer studio.				Apply
CO4	Analyze various DSP algorithms for real time application.				Analyze
CO5	Compare and evaluate various DSP algorithms.				Evaluate
CO6	Design DSP based system for real time applications.				Create

TEXT BOOKS:

1. B.Venkataramani and M.Bhaskar, Digital Signal Processors – Architecture, Programming and Applications– Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing Thomson Publications, 1st Edition, 2004

REFERENCES:

1. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
2. K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, A Practical Approach to Digital Signal Processing, New Age International, 1st Edition, 2006.

COURSE DESIGNER: Mr.A.Manoj Prabaharan AP\ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	3											2	2	
CO3	3												2	
CO4	3	3											3	
CO5	3	3	3	2								2	3	
CO6	3	3	3	3	2								3	
CAM (Avg)	3	3	3	2.5	2								2.5	
3- Strong 2- Medium 1- Weak														

R21ECV106	SOFTWARE DEFINED AND COGNITIVE RADIO	L	T	P	C
		3	0	0	3
OBJECTIVES: <ul style="list-style-type: none"> To introduce the basic concept of Software defined and Cognitive Radio To impart the knowledge of Cognitive Radio and Networks To introduce the different Dynamic Spectrum Access of Cognitive radi 					
Unit I	INTRODUCTION TO SOFTWARE DEFINED AND COGNITIVE RADIO				9
Software Radio Aspects, The Software Communications Architecture (SCA), The Operating Environment, The SCA Specification Structure - General Requirements and Services. Cognitive Radio: Introduction to cognitive radios, Economics of cognitive Radio- spectrum awareness, spectrum subleasing, spectrum sharing					
Unit II	COGNITIVE RADIO NETWORKS(CRN)				9
Cognitive radio features and capabilities - Research challenges in cognitive radio - Cognitive radio architectures for NeXt Generation (XG) networks - Cognitive radio standardization - Limitations with Cognitive Radio Network Applications - Architectural Descriptions of Cognitive Radio Networks - Cognitive Radio Networks as Heterogeneous Systems - Technologies to Drive Cognitive Radio Network.					
Unit III	SPECTRUM SENSING IN COGNITIVE RADIO				9
Energy Detection Techniques - Matched Filter Detection Techniques - Cyclo-stationary Feature Detection Techniques - Waveform-Based Sensing Techniques - Radio Identification Sensing Techniques - Techniques that Employ Multiple Antennas - Determining Sensing Accuracy- Cooperative Spectrum Sensing in Cognitive Radio Networks - Spectrum Sensing for Cognitive Multi-Radio Networks.					
Unit IV	DYNAMIC SPECTRUM ACCESS OF COGNITIVE RADIO				9
Spectrum access models - Dynamic spectrum access architecture - Medium access control for dynamic spectrum access - Open issues in dynamic spectrum access - Centralized dynamic spectrum access - Distributed dynamic spectrum access: cooperative and non- cooperative approaches.					
Unit V	COGNITIVE RADIO APPLICATIONS				9
Location Estimation & Sensing, Mobility management, UWB Cognitive Radio, Cognitive radios in wireless communication, Cognitive Application Challenges.					
TOTAL:45 PERIODS					
COURSE OUTCOMES: At the end of the course the student will be able to:					
CO1	Describe the concept of Software defined and Cognitive Radio	Understand			
CO2	Apply various techniques in Cognitive Radio Networks for the Spectrum Sensing.	Apply			
CO3	Apply the Cognitive Radio design methodologies for developing the wireless applications.	Apply			

CO4	Analyze the performance of various Spectrum Access technique in Cognitive Radio networks	Analyze
CO5	Analyze the different cognitive radio techniques for spectrum holes detection	Analyze
CO6	Analyze the performance of spectrum availability in cognitive radio networks using various simulation tools.	Analyze

TEXTBOOKS:

1. Bodhaswar TJ Maharaj, Babatunde Seun Awoyemi, —Developments in Cognitive Radio Networks: Future Directions for Beyond 5Gll, Springer, 2022.
2. Ekram Hossain, Dusit Niyato, Zhu Han, —Dynamic Spectrum Access and Management in Cognitive Radio Networksll, Cambridge University Press 2009.

REFERENCES:

1. Kwang-Cheng Chen, Ramjee Prasad, —Cognitive Radio Networksll, John Wiley & Sons Ltd., 2009.
2. John Bard, Vincent J, Kovarik Jr, —Software Defined Radio: The Software Communications Architectureell Wiley 2007.
3. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, —Cognitive Radio Communications and Networks - Principles and Practicell, Elsevier Inc., 2010.
4. Bruce Fette, Cognitive Radio Technology - Second Edition, Elsevier, 2009.
5. Huseyin Arslan, —Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systemsll, Springer, 2007.

COURSE DESIGNER : Mr.R.Abdul Sikkandhar, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	2										3	
CO5	3	2											3	
CO6	3	3			3	2	2					2	3	
CAM (Avg)	2.8	1.8	2		3	2	2					2	2.5	
3- Strong 2- Medium 1- Weak														

R21ECV107	MACHINE VISION	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To review image processing techniques for computer vision. To understand Camera model and feature detecting techniques. To study segmentation, object recognition and its applications. 					
UNIT I	Introduction to Computer Vision and Projective Geometry				9
Introduction to Computer Vision, Applications, Camera Model- Pinhole camera, Camera parameters, intrinsic and extrinsic parameters, Projective Geometry- Perspective Projection, Orthographic Projection, Affine Projection, camera parameters for perspective projection					
UNIT II	Face Detection, Matching and Alignment				9
Interest point detection, corner detection, SIFT, Feature matching- RANSAC, matching strategy and error rates, 2D Feature based Alignment- Least squares method					
UNIT III	Segmentation and Clustering				9
Segmentation-Thresholding and Connected component algorithm, Contour Detection, Region Segmentation, Motion Segmentation- Grouping- K- means clustering, Graph cut ^[SEP]					
UNIT IV	Object Recognition				9
Object detection, Object Modeling, Model based object recognition, Scene and Object based recognition, Shape based recognition.					
UNIT V	Applications				9
Face Recognition, Emotion Recognition Scene Understanding, Action Recognition, Augmented Reality ^[SEP]					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Able to comprehend and describe basic concepts of image processing.				Understand
CO2	Apply various feature extraction methods and matching algorithms to find the similarities of two regions				Apply
CO3	Apply numerous segmentation techniques and grouping the regions into meaningful segments				Apply
CO4	Analyze object recognition techniques to understand the shape and scene of an image.				Analyze
CO5	Analyze various segmentation and object recognition techniques.				Analyze

CO6	Simulate and analyze different computer vision algorithms using modern tools.	Analyze
TEXT BOOKS:		
1. R Szeliski, —Computer vision: algorithms and applicationsII, Springer Science & Business Media, 2010.		
REFERENCES:		
1. David A. Forsyth, Jean Ponce, —Computer Vision – A Modern ApproachII, Prentice Hall, 2003, ISBN: 0130851981. [L] [SEP]		
2. Richard Hartley and Andrew Zisserman, —Multiple View Geometry in Computer VisionII, Second Edition, Cambridge University Press, March 2004.		
3. Al Bovik, —Handbook of Image & Video ProcessingII, Academic Press, 2000, ISBN: 0121197905. [L] [SEP]		
4. Chris Stauffer and W.E.L Grimson, —Adaptive background mixture models for real-time trackingII. In IEEE Computer Vision and Pattern Recognition, 2242–2252, June 1999.		
5. http://www.ius.cs.cmu.edu/demos/facedemo.html		
COURSE DESIGNER: Dr. K.A.Shahul Hameed., PROF/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	3	2										3	
CO5	3	3	2										3	
CO6	3	3	3										3	
CAM (Avg)	2.6	2.6	2.3										2.5	
3- Strong 2- Medium 1- Weak														

R21ECV1N01	MACHINE LEARNING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To understand the basic concepts of machine learning. • To understand and build supervised learning models. • To understand and build unsupervised learning models. 					
Unit I	INTRODUCTION TO MACHINE LEARNING				9
Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik - Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.					
Unit II	SUPERVISED LEARNING				9
Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests					
Unit III	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING				9
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.					
Unit IV	NEURAL NETWORKS				9
Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.					
Unit V	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS				9
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K- fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concepts of machine learning				Understand
CO2	Apply regression methods to Construct supervised learning models.				Apply

CO3	Apply the algorithms to a real problem, optimize the models on the expected accuracy that can be achieved by applying the models	Apply
CO4	Analyze and compare different models	Analyze
CO5	Analyze machine and deep learning algorithms.	Analyze
CO6	Construct and create unsupervised learning algorithms	Create

TEXT BOOKS:

1. Ethem Alpaydin, —Introduction to Machine LearningII, MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, —Second EditionII, CRC Press, 2014.

REFERENCES:

1. Christopher M. Bishop, —Pattern Recognition and Machine LearningII, Springer, 2006.
2. Tom Mitchell, —Machine LearningII, McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, —Foundations of Machine LearningII, Second Edition, MIT Press, 2012, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, —Deep LearningII, MIT Press, 2016
5. Sebastain Raschka, Vahid Mirjalili, —Python Machine LearningII, Packet publishing 3rd Edition,2019.

CO/PO/PSO MAPPING														
CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO.4	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CO.5	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CO.6	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CAM	3	3	2	2	-	-	2	-	3	-	-	2	-	2
<p style="text-align: center;">3- Strong 2- Medium 1- Weak</p>														

S.No	Course Code	Course Title	L	T	P	C
Vertical II – 21ECV200-High Speed Communications						
1.	R21ECV201	Advanced wireless Techniques	3	0	0	3
2.	R21ECV202	Advanced Communication Network Security	3	0	0	3
3.	R21ECV203	High Performance Networks	3	0	0	3
4.	R21ECV204	MIMO System Modeling	3	0	0	3
5.	R21ECV205	Fiber optic Communication & networks	3	0	0	3
6.	R21ECV206	Ultra-wide band Communication Networks	3	0	0	3
7.	R21ECV207	5G Technology	3	0	0	3

R21ECV201	ADVANCED WIRELESS TECHNIQUES	L	T	P	C
		3	0	0	3
OBJECTIVES:(Min three) <ul style="list-style-type: none"> To give an idea about various generations of wireless and cellular networks To familiarize students about fundamentals of 3G Services, its protocols and applications To provide basic understanding of the key technologies and enablers of 5G and beyond 5G communication systems 					
UNIT I	INTRODUCTION				9
Introduction: History of mobile cellular systems, First Generation, Second Generation, Generation2.5, Overview of 3G& 4G,3GPP and 3GPP2 standards - LTE Network Architecture – LTE Air Interface.					
UNIT II	CAPACITY OF WIRELESS CHANNELS				9
AWGN Channel Capacity - Resources of the AWGN Channel - Linear Time-Invariant Gaussian Channels - Capacity of Fading Channels.					
UNIT III	LTE AIR INTERFACE				9
LTE radio link Control - LTE Physical Layer - Channel mapping of protocol layers - LTE Air InterfaceLTE Air Interface procedures					
UNIT IV	DRIVERS FOR 5G				9
Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – 10 Pillars of 5G – 5G in North America – 5G in Asia – 5G Architecture – The 5G Internet: Internet of Things and Context - Awareness – Networking Reconfiguration and Virtualization Support – Mobility – Quality of Service Control.					
UNIT V	BEYOND THE FIRST RELEASE OF 5G				9
Integrated Access-Backhaul – Operation in Unlicensed Spectra– NOMA for 5G networks – Machine-Type Communication –Device-To-Device Communication – Spectrum and Duplex Flexibility –D2D and V2X Communications: Introduction – Technical Status and Standardization Overview – V2X Communications for Road Safety Applications – Industrial Implementation of V2X in the Automotive Domain					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the wireless channel characteristics and its statistical models				Understand
CO2	Apply the knowledge of optimization technique to design suitable channel model				Apply
CO3	Analyze the Channel characteristics & Performance evaluation				Analyze
CO4	Analyze various modulation and multiplexing schemes in wireless networks				Analyze
CO5	Evaluate the Channel capacity for various channels used for wireless communication				Evaluate

CO6	Model the wireless channel to estimate the path loss using MATLAB	Apply
TEXT BOOKS:		
1. Juha Korhonen, Introduction to 3G Mobile Communication, Artech House, (www. Artech house .com), Jan 2003, ISBN-10: 1580535070		
2. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks John Wiley &sons, 2015.		
3. Patrick Marsch, Deutsche Bahn AG, Ömer Bulak, 5G System Design Architectural and Functional Considerations and Long Term Research John Wiley &sons, 2018.		
4. David Tse, Fundamentals of Wireless Communication Cambridge University Press 2004.		
REFERENCES:		
1. Erik Dahlman, Stefan Parkvall, Johan Skold.5G NR: The Next Generation Wireless Access Technology, Elsevier 2018.		
2. Hossein Khaleghi Bizaki, —Towards 5G Wireless Networks, A Physical Layer Perspectivell, Intech open book series 2016.		
3. Ayman Elnashar, Mohamed A. El-saidny, Mahmoud R. Sherif Design, Deployment and Performance of 4G-LTE Networks A Practical Approach, 2014.		
COURSE DESIGNER: Mrs. P.Deepa, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO.1	2												3	
CO.2	3	3											3	
CO.3	3	3											3	
CO.4	3	3	2										3	
CO.5	3	2											3	
CO.6	3	2	3		3	3			3			2	3	
CAM (Avg)	2.8	2.2	2.5		3	3			2			2	3	
3- Strong 2- Medium 1- Weak														

R21ECV202	ADVANCED COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the concept of security and explain symmetric and asymmetric key algorithms To impart knowledge on integrity, authentication and key management. To outline the concept of network security and wireless network security. 					
UNIT I	SYMMETRIC KEY CRYPTOGRAPHY				9
OSI Security Architecture – Security Attacks - Classical Encryption techniques - Cipher Principles – Data Encryption Standard - Block Cipher Design Principles and Modes of Operation- Multiple Encryption and Triple DES - Placement of Encryption Function – Traffic Confidentiality.					
UNIT II	PUBLIC KEY CRYPTOGRAPHY				9
Introduction to Number Theory - Public Key Cryptography and RSA - Key Management - Diffie–Hellman key Exchange - Elliptic Curve Arithmetic - Elliptic Curve cryptography					
UNIT III	AUTHENTICATION AND HASH FUNCTION				9
Authentication requirements – Authentication functions - Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs - Secure Hash Algorithm – HMAC- Digital Signatures – Authentication Protocols – Digital Signature Standard					
UNIT IV	NETWORK SECURITY				9
Authentication Applications: Kerberos – X.509 Authentication Service – Public key Infrastructure - Electronic Mail Security – PGP – S/MIME - IP Security – Web Security					
UNIT V	SYSTEM LEVEL SECURITY				9
Intruders -Intrusion detection -Password management - Viruses and related Threats – Virus Counter measures - Firewall Design Principles – Trusted Systems					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe fundamental concepts of security issues in network.				Understand
CO2	Apply the concept of key chipper and hash function to evaluate security mechanism				Apply
CO3	Apply the concepts of Digital Signature, Authentication to secure communication networks.				Apply
CO4	Analyze various classical encryption techniques and block ciphers				Analyze
CO5	Analyze various protocols for network security to protect against the threats in the networks.				Analyze
CO6	Design and analyze various network security algorithms using open source tool.				Analyze

TEXT BOOKS:

1. William Stallings, —Cryptography and Network Security –Principles and PracticesII, 7th Edition, pearson Education, 2016.
2. Behrouz A. Forouzan, —Cryptography and Network SecurityII, Tata McGraw Hill, 3rd edition, 2015.

REFERENCES:

1. Atul Kahate, —Cryptography and Network security II, Tata McGraw- Hill , 2nd Edition, 2008.
2. Yang.H, —Security in Mobile Ad Hoc Networks: Challenges and SolutionII, IEEE Wireless Communications, 2004.David J. Defatta, Joseph G. Lucas, William S. Hodgkiss, —Digital signal processing : a system design approach II, John Wiley, 1995.
3. Bruce Schneier, —Applied Cryptography: Protocols, Algorithms, and Source Code in CII, John wiley Sons Inc, 2017.
4. Charles P. Pfleeger and Shari Lawrence Pfleeger, —Security in ComputingII, 4thEdition, Prentice Hall, 2015.

COURSE DESIGNER: Mr. A.Nagaraj, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	2	-	3	-	-	-	-	-	-	-	3	-
CAM (Avg)	2.8	2.6	2	-	3	-	-	-	-	-	-	-	2.5	-
3- Strong 2- Medium -- 1- Weak														

R21ECV203	HIGH PERFORMANCE NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To develop a comprehensive understanding of multimedia networking. To introduce the layered communication architectures of high performance networks. To study the types of VPN and tunneling protocols for security. To understand various layer protocols and security issues. 					
UNIT I	INTRODUCTION				9
Introduction to Fundamentals of Networking, SONET- DWDM- DSL- ISDN- BISDN, ATM- Features, Addressing signaling & Routing, Header structure, ATM adaptation layer, Management control, Interworking with ATM.					
UNIT II	MULTIMEDIA NETWORKING APPLICATIONS				9
Streaming stored audio and video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism integrated services, RSVP, differentiated services.					
UNIT III	ADVANCED NETWORKS CONCEPTS				9
Architecture and performance, binary block codes, orthogonal, Biorthogonal, VPN-remote access VPN, site-to-site VPN, tunneling to PPP, security in VPN, MPLS-operation, routing, tunneling and use of FEC, traffic engineering, MPLS based VPN, overlay networks, P2P connections					
UNIT IV	TRAFFIC MODELLING				9
Little's theorem, Need for modeling, Poisson modeling and its failure, Non-Poisson models, Network performance evaluation, Non-Markovian – Pollaczek - Khinchin formula and M/G/1, M/D/1, selfsimilar models and Batch-arrival model, Networks of Queues- Burke's theorem and Jackson theorem.					
UNIT V	NETWORK SECURITY AND MANAGEMENT				9
Network Architecture, SNMP basics, SNMP naming and OIDs, MIBs, SNMPv1 data types, SNMP operations, Authentication applications- Kerberos, X.509 authentication service, Electronic mail security-Pretty Good Privacy, IP Security-IP security overview, Firewalls- Firewall design principles.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Differentiate concepts of ATM, SONET and ISDN.	Understand			
CO2	Apply the knowledge of traffic models for the performance evaluation of telecommunications networks.	Apply			
CO3	Analyze the performance parameter of computer network using any network simulation software.	Analyze			
CO4	Analyze the different protocols in multimedia networking	Analyze			

CO5	Evaluate the network performance and security.	Evaluate
CO6	Design and simulate the given network using network simulation Software	Create
TEXT BOOKS:		
1. Walrand. J. Varatya, —High Performance Communication Networksll, Morgan Kaufman publishers, 2nd edition, 2000. 2. J.F.Kurose & K.W. Ross, —Computer Networking-A Top Down Approach Featuring the Internetll, Pearson, 6th Edition, 2012.		
REFERENCES:		
1. Behrouz A. Forouzan, —Cryptography & Network Securityll, Second Edition 2010. 2. Aunurag Kumar, D. M. Anjunath, Joy Kuri, —Communication Networkingll, Morgan Kaufmann Publishers, 1st edition 2004. 3. LEOM-GarCIA, WIDJAJA, —communication networksll, TMH seventh reprint 2002. 4. Nader F.Mir, —Computer and Communication Networksll, first edition 2010.		
COURSE DESIGNER: Ms.J.JUDITH, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3	-
CO6	3	3	3	2	3	-	-	-	3	-	-	2	3	-
CAM (Avg)	2.8	2.8	2.5	2	2.5	-	-	-	3	-	-	2	2.6	-
3- Strong 2- Medium -- 1- Weak														

R21ECV204	MIMO SYSTEM MODELING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge about MIMO Channel modeling and system architecture. To introduce space time block codes and space time trellis codes. To explain the practical applications of MIMO systems. 					
UNIT – 1	Spatial Multiplexing And Channel Modeling	9			
Review of SISO fading communication channels- Multiplexing capability of deterministic MIMO, Physical modeling of MIMO Channels, Modeling of MIMO fading channels, MIMO wireless communication, MIMO channel and signal model, A fundamental trade-off, MIMO transceiver design, MIMO in wireless networks, MIMO in wireless standards.					
UNIT – 2	Capacity and Multiplexing Architectures	9			
The V-BLAST architecture, Fast fading MIMO channel. Receiver architectures, Slow fading MIMO channel, D-BLAST: an outage-optimal architecture.					
UNIT – 3	Diversity–Multiplexing Tradeoff And Space Time Block Codes	9			
Diversity- tradeoff, Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Quasi- orthogonal designs and Performance analysis.					
UNIT – 4	Space Time Trellis Codes	9			
Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.					
UNIT – 5	MIMO Modeling	9			
MIMO modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space time coding, advantages and applications of MIMO, Spatial multiplexing channel modeling: Multiplexing capability of MIMO channels, Multi antenna systems, Multiple Input and Multiple Output systems with various access schemes.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES: At the end of the course the student will be able to:					
CO1	Describe the concepts of mathematical model for the design of MIMO channels	Understand			
CO2	Design a space time MIMO wireless communication architecture for the given specifications	Apply			
CO3	Analyze and Design various space time block codes.	Apply			
CO4	Analyze the wireless channel characteristics and identify appropriate channel models.	Analyze			
CO5	Analyze the performance of MIMO systems in various applications.	Analyze			
CO6	Design space time trellis codes for a given specification and develops skills to solve engineering problems	Evaluate			

TEXT BOOKS:

1. Hamid Jafarkhani, —Space-Time Coding: Theory and Practicell, Cambridge University, Press 2005.
2. Nei David Tse and Pramod Viswanath, —Fundamentals of Wireless Communicationll, Cambridge University Press 2005, Press 2005.
3. Paulraj, R. Nabar and D. Gore, —Introduction to Space-Time Wireless Communicationsll, Cambridge University, Press 2005.

REFERENCES:

1. E.G. Larsson and P. Stoica, —Space-Time Block Coding for Wireless Communicationsll, Cambridge University, Press 2008.
2. M. Janakiraman,—Space-time codes and MIMO systems ll, Artech House, 2004.
3. Ezio Biglieri, Robert Calder bank et al,— MIMO Wireless Communicationsll, c ambridge University, Press 2007.

COURSE DESIGNER: Mr.A.Manoj Prabaharan, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												2	
CO3	3												2	
CO4	3	3	3	2									3	
CO5	3	3	3	2									3	
CO6	3	3	3	3								2	3	
CAM (Avg)	3	3	3	2.5								2	2.5	
3- Strong 2- Medium-- 1- Weak														

R21ECV205	FIBER OPTIC COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the functionalities of fiber optic communication. To get exposed to various fiber optic network components and architectures. To impart knowledge on optical network design and management functions. 					
UNIT I	OPTICAL NETWORK COMPONENTS	9			
Free space optical communication, Introduction to optical Network Evolution, Optical Multiplexers, Optical Filters, Optical Amplifiers, cross talks in SOAs ,Applications.					
UNIT II	TRANSMISSION SYSTEM ENGINEERING	9			
Modulation and Demodulation, spectral efficiency, Error detection and correction, System model, Transmitter and receiver, Power penalty and amplifiers, Crosstalk, dispersion and nonlinearities, Wavelength stabilization, Overall design considerations.					
UNIT III	CLIENT LAYERS OF THE OPTICAL NETWORKS	9			
SONET/SDH, Optical Transport Network, Ethernet, Multiprotocol Label Switching, Resilient PacketRing, Storage-Area Networks					
UNIT IV	WDM NETWORK ELEMENTS AND DESIGN	9			
Optical Add/Drop Multiplexers, Optical Cross connects, Cost Trade-Offs, LTD and RWA Problems, Dimensioning Wavelength-Routing Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Models.					
UNIT V	PHOTONIC PACKET SWITCHING	9			
Optical Time Division Multiplexing, Synchronization, Buffering, Burst Switching, Testbeds- KEOPS, AON, CORD.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe various optical communication network components and architectures.	Understand			
CO2	Apply the concept of data communication network to study optical transmission system engineering.	Apply			
CO3	Design simple optical networks using modern engineering t	Apply			
CO4	Analyze the characteristics of various client layers of optical Networks.	Analyze			
CO5	Analyze the performance of different optical network architectures.	Analyze			
CO6	Evaluate the photonic packet switching networks.	Evaluate			

TEXT BOOKS:

1. Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, —Optical Networks: A practical perspective, II Morgan Kaufman Publishers, Fourth edition, 2018.

REFERENCES:

1. Mohammad Ilyas, Hussein T. Mouftah, —Handbook of Optical Communication Networks II, Taylor and Francis, First edition (Revised), 2019.

2. C.Siva Ram Moorthy and Mohan Gurusamy, —WDM Optical Networks :Concept, Design and Algorithms II, Prentice Hall of India, First Edition, 2002.

3. Biswanath Mukherjee, —Optical Communication Networks II, McGrawHill Revised Edition 2006.

COURSE DESIGNER: Dr.M.Pandimadevi, ASP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CAM (Avg)	2.8	2.2	2	2	-	-	-	-	-	-	-	-	2.5	
3- Strong 2- Medium 1- Weak														

R21ECV206	ULTRA-WIDE BAND COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To give fundamental concepts related to Ultra wide band To understand the channel model and signal processing for UWB .To acquires knowledge about UWB antennas and regulations.					
UNIT I	INTRODUCTION TO UWB				9
Ultra wideband overview, Key benefits of UWB, UWB and Shannon's theory, Challenges for UWB, Basic properties of UWB signals and systems, Generation of UWB waveforms					
UNIT II	UWB CHANNEL MODELS				9
A simplified UWB multipath channel model, A simplified UWB multipath channel model, Two-ray UWB propagation model, Frequency domain autoregressive model, IEEE proposals for UWB channel models					
UNIT III	UWB COMMUNICATIONS				9
Introduction, UWB modulation methods, UWB transmitter, UWB receiver, Multiple access techniques in UWB, Capacity of UWB systems, Comparison of UWB with other wideband communication systems, Interference and coexistence of UWB with other systems					
UNIT IV	UWB ANTENNAS AND ARRAYS				9
Antenna fundamentals, Antenna radiation for UWB signals, Suitability of conventional antennas for the UWB system, Impulse antennas, Beamforming for UWB signals, Radar UWB array systems					
UNIT V	UWB NETWORKS AND APPLICATIONS				9
Wireless Ad hoc Networking, UWB Wireless Sensor, Military applications, Commercial applications, UWB potentials in medicine, Coexistence of DS-UWB with Wi-Max, Vehicular radars in the 22–29 GHz band					
TOTAL :					45 PERIODS
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concepts of ultra-wideband communication				Understand
CO2	Apply the knowledge of UWB modulation, signal parameters depending on the application.				Apply
CO3	Apply UWB technologies for transmission of UWB systems.				Apply
CO4	Analyze the performance of UWB channels for transmission systems				Analyze
CO5	Develop a comprehensive overview of UWB system design that includes propagation, transmitter and receiver, antenna implementation, standards.				Evaluate
CO6	Design UWB antennas for various applications				Create

21ECV207	5G TECHNOLOGY	L	T	P	C	
		3	0	0	3	
OBJECTIVES:						
<ul style="list-style-type: none"> To introduce 5G essentials. To deliver basic understanding of the technologies and enablers of 5G and beyond 5G communication systems. To aware about terms such as MIMO, mmWave and NOMA 						
UNIT I	5G STANDARDIZATION					7
Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – 10 Pillars of 5G – The Next Generation—5G/NR – 5G Standardization: Overview of Standardization and Regulation – ITU-R Activities From 3G to 5G – 5G and IMT- 2020.						
UNIT II	RADIO-INTERFACE ARCHITECTURE					8
Overall System Architecture – Radio Protocol Architecture – User-Plane Protocols – Control-Plane Protocols – Internet of Things and Context Awareness Networking – Reconfiguration and Virtualisation Support.						
UNIT III	COGNITIVE RADIO AND SON FOR 5G WIRELESS NETWORKS					9
Introduction – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Energy Efficient Cognitive Radio Technology – Key Requirements and Challenges for 5G Cognitive Terminals - SON in UMTS and LTE – The Need for SON in 5G – Evolution towards Small Cell Dominant HetNets.						
UNIT IV	RF TECHNOLOGIES AT mm WAVE FREQUENCIES					11
LTE/NR Dual-Connectivity – LTE/NR Coexistence – ADC and DAC Considerations – LO generation and Phase Noise Aspects – Power Amplifier Efficiency in Relation to Unwanted Emission – Receiver Noise Figure, Dynamic Range, and Bandwidth Dependencies – Green Flexible RF for 5G.						
UNIT V	mm WAVE AND TERAHERTZ SPECTRUM FOR 6G WIRELESS					10
Introduction to mmWave and THz Spectrum – Propagation at the mmWave and THz Frequencies – Channel Measurement Efforts – Propagation at mmWave and THz Frequencies – Beam forming and Antenna Patterns – Channel Models – The mmWave Communications Systems – The THz Communications Systems – Standardization Efforts.						
TOTAL : 45 PERIODS						
COURSE OUTCOMES:						
At the end of the course the student will be able to:						
CO1	Describe the function of next generation technology					Understand
CO2	Apply the knowledge of 5G techniques to solve the existing problems in communication.					Apply
CO3	Analyze the performance of 4G and 5G system.					Analyze
CO4	Analyze the factors affecting deployment of 5G - Indian scenario					Analyze
CO5	Evaluate the Spectral efficiency for various frequency bands.					Evaluate

CO6	Generate the 5G uplink and downlink model using MATLAB	Create
TEXT BOOKS:		
1. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, John Wiley & sons, 2015. 2. Erik Dahlman, Stefan Parkvall, Johan Skold., 5G NR: The Next Generation Wireless Access Technology, Elsevier 2018.		
REFERENCES:		
1. 6G Mobile Wireless Networks Yulei Wu, Sukhdeep Singh Springer.2021. 2. Ayman Elnashar, Mohamed A. El-saidny, Mahmoud R. Sherif Design, Deployment and Performance of 4G-LTE Networks A Practical Approach, 2014.		
COURSE DESIGNER: Dr.M.Sheik Dawood, PROF/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	3	3		-	-	-	-	-	-	3	-
CAM (Avg)	2.83	2.4	2.25	2.5	3								2.8	
3- Strong					2- Medium			1- Weak						

S.No	Course Code	Course Title	L	T	P	C
Vertical III – 21ECV300 - Sensor Technologies and IoT						
1.	R21ECV306	Principles of Wireless Sensor Networks	3	0	0	3
2.	R21ECV302	MEMS and NEMS	3	0	0	3
3.	R21ECV303	Nano Electronics	3	0	0	3
4.	R21ECV304	IoT Ecosystem	3	0	0	3
5.	R21ECV305	IoT Networks and Protocols	3	0	0	3
6.	R21ECV3N03	Industrial IoT	3	0	0	3
7.	R21ECV307	Smart Sensor Networks	3	0	0	3
8.	R21ECV308	Block Chain Technology	3	0	0	3
9.	R21ECV309	AI-ML IN IOT	3	0	0	3

R21ECV306	PRINCIPLES OF WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> Understand the fundamental concepts and unique characteristics of Wireless Sensor Networks (WSNs). Explore WSN applications in various domains such as IoT, healthcare, environmental monitoring, and smart cities. Learn techniques in localization, routing, topology control, and sensor network programming. Analyze the latest trends and challenges in WSNs, focusing on integration with modern technologies like IoT, cloud, and AI. 					
UNIT 1	Introduction to Wireless Sensor Networks				9
Overview of WSNs: Characteristics and requirements of WSNs, Unique constraints (energy, bandwidth, latency)-WSN Node and Network Architecture: Components of sensor nodes ,Types of WSN architectures -Simulation Tools and Environments, Real-time event-driven programming for WSNs ,Integration with AI/ML for simulation accuracy-Applications of WSN: Environmental Monitoring, Healthcare, Industrial Automation, Smart Cities, Disaster Management.					
UNIT II	Localization and Routing Protocols for WSNs				9
Localization Techniques: Range-based methods: RF-based techniques (RSSI, TOA) and hybrid methods, Positioning accuracy and challenges in WSNs-Routing Protocols in WSNs: Hierarchical, location-based, and data-centric routing protocols, Energy-efficient routing for reduced power consumption-Performance Evaluation: Methods to assess the efficiency of energy-saving routing protocols					
UNIT III	Medium Access Control (MAC) and Topology Control in WSNs				9
MAC Protocols: Overview of S-MAC, TDMA, CSMA/CA protocols, Energy-efficient MAC techniquesTopology Control: Techniques for adaptive and real-time topology control, Distributed algorithms for network management-Clustering Protocols: Overview of clustering techniques for WSNs, Machine learning-based clustering for optimal node selection, Dynamic clustering in large-scale IoT-enabled sensor networks.					
UNIT IV	Machine Learning in WSN				9
Machine Learning Techniques: ML algorithms for improving localization, routing, and data collection, Edge computing and fog computing in WSNs, AI for Predictive maintenance: Integration of deep learning for predictive maintenance in smart sensor networks, AI/ML for efficient energy management and network optimization for WSN applications.					
UNIT V	Integration of WSNs with IoT and Cloud Platforms				9
Integration of WSNs with IoT Systems- Protocols for WSN-IoT Communications- Data Management in WSN-IoT Integration- Communication Interfaces- Cloud-Based Solutions and Edge Computing.					

COURSE OUTCOMES:		
At the end of the course the student will be able to:		
CO1	Comprehend the fundamental concepts and architecture of Wireless Sensor Networks (WSNs).	Understand
CO2	Use localization techniques to determine positions in WSNs effectively.	Apply

CO3	Apply routing and MAC protocols to optimize energy usage and enhance WSN performance.	Apply
CO4	Use WSN principles, localization methods, and routing protocols to develop optimized solutions for sensor networks in diverse real-world scenarios.	Apply
CO5	Analyze the performance and efficiency of topology control and clustering techniques in WSNs.	Analyze
CO6	Examine the impact of integrating WSNs with IoT systems on data processing efficiency and network scalability for real-world applications.	Analyze

Text Books:

1. Holger Karl & Andreas Willig, *"Protocols and Architectures for Wireless Sensor Networks"*, Wiley, 2005.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, *"Wireless Sensor Networks: Technology, Protocols, and Applications"*, Wiley, 2007.

Reference Books:

1. Feng Zhao & Leonidas Guibas, *"Wireless Sensor Networks: An Information Processing Approach"*, Elsevier, 2004.
2. C.S. Raghavendra, Krishna M. Sivalingam, Taieb Znati, *"Wireless Sensor Networks"*, Springer, 2006.
3. Mohammad S. Obaidat, Sudip Misra, *"Principles of Wireless Sensor Networks"*, Cambridge University Press, 2014.

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	2												2	
CO3	2		2										2	
CO4	3		2									2	2	
CO5	3	3										2	2	
CO6	3	3		2	2								2	
CAM (Avg)	2.5	3	2	2								2	2	
3- Strong - Medium 1- Weak														

R21ECV302	MEMS and NEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the concepts of micro and nano electromechanical devices To explain the fabrication process Microsystems To impart the knowledge of design concepts of micro sensors and micro actuators 					
UNIT I	INTRODUCTION TO MEMS AND NEMS	9			
Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electro mechanical Systems, Applications of Micro and Nano electro mechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals					
UNIT II	MEMS FABRICATION TECHNOLOGIES	9			
Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.					
UNIT III	MICRO SENSORS	9			
MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester					
UNIT IV	MICRO ACTUATORS	9			
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.					
UNIT V	NANO DEVICES	9			
Atomic Structures and Quantum Mechanics, Schrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic principles of MEMS and NEMS	Understand			
CO2	Explain the theoretical foundations of quantum mechanics and Nano Systems	Understand			
CO3	Design a micro sensor for a given specific application	Apply			
CO4	Apply the concept of actuation in design of actuators for various applications	Apply			
CO5	Analyze various MEMS fabrication technologies used in industries	Analyze			
CO6	Analyze the function and performance of electro mechanical transducers like sensors and actuators	Analyze			

TEXT BOOKS:

1. Sergey Edward Lyshevski, —MEMS and NEMS: Systems, Devices, and Structures II CRC Press, 2002, ebook-2018.
2. Chang Liu, —Foundations of MEMS II, Pearson education India limited, 2006.
3. Stephen D.Senturia, II Microsystem Design II, Kluwer Academic Publishers, 2001

REFERENCES:

1. TaiRan Hsu, II MEMS and Microsystems Design and Manufacture II, Tata Mc graw Hill, 2002
2. D. S. Ballantine- Acoustic Wave Sensors: Theory, Design, and Physico-Chemical Applications, Boston: Academic Press, 1997.
3. Massood Tabib-Azar - Microactuators : Academic Press, 1998

COURSE DESIGNER: Ms.M.Brindha, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	-	-	3	2		-	-	-	-	-	3	-
CAM (Avg)	2.6	2.4	2	-	3	2		-	-	-	-	-	3	-
3- Strong - Medium 1- Weak														

R21ECV303	NANO ELECTRONICS	L	T	P	C
		3	0	0	3
OBJECTIVES:(Min three)					
<ul style="list-style-type: none"> To introduce the concept of Nano electronics, Nano devices and molecular electronics. To explain the properties of Nano particles, Carbon nanostructures & Fuel Cells. To Understand the recent trends in Nano electronics and its applications. 					
UNIT I	INTRODUCTION TO NANO ELECTRONICS				9
Nano electronics in recent scenario - Crystal Structure –Semiconductors- Band theory– Donors - Acceptors and Deep traps, Mobility – Excitons, one dimensional, two-dimensional, three-dimensional Nano structured materials, metal Oxides- Physical, Chemical and Optical properties.					
UNIT II	SYNTHESIS AND PREPARATION OF NANOMATERIALS				9
Top down Approaches–Grinding, high energy ball milling, Injection molding–Bottom up ApproachesSol-gel, Self-assembled monolayer, Physical and Chemical vapour deposition, thin films, epitaxyLithography.					
UNIT III	NANO MATERIALS CHARACTERIZATION				9
X-ray diffraction, Powder diffraction, Structural analysis, Scanning Electron Microscopy, FESEM, AFM, Transmission Electron Microscope, Spectroscopic techniques: UV-Visible, Infra-red Spectroscopy, rotational, vibrational photoluminescence (PL).					
UNIT IV	CARBON NANOSTRUCTURES				9
Introduction, Carbon Molecules – Nature of the Carbon Bond, New Carbon Structures, Carbon Clusters – Small Carbon Clusters, Alkali-Doped C60 – Superconductivity in C60 – Larger and Smaller Fullerenes – Other Buckyballs, Carbon Nanotubes – Fabrication – Structure –Graphene, Application of Carbon Nanotubes – Field Emission and Shielding –Computers – Fuel Cells – Chemical Sensors – Catalysis – Mechanical Reinforcement.					
UNIT V	NANO DEVICES AND APPLICATIONS				9
Microelectromechanical systems (MEMSs), Nano electro mechanical systems (NEMSs), FabricationNano devices and Nano machines, Molecular and Supra molecular switches- Spintronics- Nano Crystals devices- Graphene based Liquid Crystal devices, Nano electronics in Energy- Nano sensors for biomedical applications- Nano biometrics -Nanobots- Smart dust sensor for the future, Nano medicine.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Summarize the concept of Nano materials and Nano devices.				Understand
CO2	Apply the concept of quantum mechanics in Nanomaterials to classify				Apply
	the various Nano devices in terms of its applications.				

CO3	Apply the knowledge of spatial distribution of molecules to determine the size of the Nanoparticles.	Apply
CO4	Analyze the various properties of the Nano tubes by applying analysis techniques.	Analyze
CO5	Analyze the characteristics of various Nano materials in terms of methods of synthesis.	Analyze
CO6	Evaluate the performance of Nanomaterials according to its application.	Evaluate

TEXT BOOKS:

1. Charles P. Poole, Jr. and Frank J. Owens, —Introduction to Nano TechnologyII, John Wiley & Sons, First edition (Revised) 2008.
2. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, —Nanotechnology: Basic Science and Emerging TechnologiesII Chapam & Hall / CRC Press, First edition, 2007.

REFERENCES:

1. George W. Hanson, —Fundamentals of Nano electronicsII, Prentice Hall , 2008.
2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, —Introduction to Nano electronics: Science, Nanotechnology, Engineering, and ApplicationsII, Cambridge University Press, Revised edition, 2012.

COURSE DESIGNER: Dr.M.Pandimadevi, ASP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	2	2	-	-	-	-	-	-	-	2	3	-
CAM (Avg)	2.8	2.2	2	2	-	-	-	-	-	-	-	2	2.7	
3- Strong 2- Medium 1- Weak														

R21ECV304	IOT ECOSYSTEM	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce about the fundamentals of sensors and various topologies and types used in sensors To explain the basic sensing techniques in SloT and wearable sensors To impart knowledge on Software tool used in analysis of sensors in IoT 					
Unit – 1	IOT SENSING AND ACTUATION				9
Evolution of IoT, IoT Networking Components, Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuators Types, Actuator Types, Actuator Characteristics, Data Formats					
Unit – 2	IOT PROCESSING TOPOLOGIES AND TYPES				9
Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading, Offload location, Offload decision making, Offloading considerations, Zigbee, Bluetooth, LoRa, NB-IoT					
Unit – 3	SENSING PRINCIPLES AND WIRELESS SENSOR NETWORK				7
Anatomy of Sensors, Physical Principles of Sensing, Use of Basic Sensing Principles in RFID Technology, Wireless Sensor Networks (WSNs), WSN Operating Systems, WSN OS Design Issues					
Unit – 4	SloT and WEARABLE SENSORS				9
Social IoT, Smart Things to Social Things, The Epitome of SloT, Smart Thing Relationships in SloT, SloT Architecture, Features of SloT System, Social Internet of Vehicles (SloV), SloV Application Services, World of Wearables, Attributes of wearables, Textiles And Clothing: The Meta-Wearable, Challenges and Future Wearables					
Unit – 5	PACKET TRACER AND IOT				11
IoT and Packet Tracer, Packet Tracer Programming Environment, Visual (Blockly) Programming Language, Simple Smart Light Project, IoT Projects in Packet Tracer, Smart Things Directly Connected with Gateways, Smart Things and Sensors Directly Connected with MCUs (Without Gateways)					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the characteristics of sensors and actuators				Understand
CO2	Apply the various properties of sensors to process the devices in IoT and SloT				Apply

CO3	Design an IoT system to solve real world problems using sensors.	Apply
CO4	Analyze the fundamental concepts of IoT Packet tracer software tool	Apply
CO5	Analyze different types of sensors with respect to WSN and RFID	Analyze
CO6	Assess the function of various sensors using any simulation tools	Analyze

TEXT BOOKS:

1. Sudip Mishra, Anandarup Mukherjee, Arijit Roy: Introduction to IOT, Cambridge University Press,2014
2. Muhammad Azhar Iqbal, Sajjad Hussain, Huanlai Xing, Muhammad Ali Imran, Enabling the Internet of Things, IEEE Press, John Wiley & Sons, 2021.

REFERENCES:

1. Hiroto Yasuura ,Smart Sensors at the IoT Frontier ,1st ed. 2018
2. Edward Sazonov, Michael R. Neuman, Wearable Sensors Fundamentals, Implementation and Applications, Academic Press,2014

COURSE DESIGNER: Mrs.R.Devika, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2												2	
CO.2	3												2	
CO.3	3												2	
CO.4	3				2							2	2	
CO.5	3	3	3	2								2	3	
CO.6	3	3	3	2	2							2	3	
CAM (Avg)	2.7	3	2	2	2							2	2	
3- Strong 2- Medium 1- Weak														

R21ECV305	IOT NETWORKS AND PROTOCOLS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To introduce IoT and its applications • To understand the concepts of IoT Architecture • To analyze various IoT communication Protocols • To impart knowledge on IoT-based system design 					
Unit – 1	Introduction to IoT				9
Introduction to IoT, IoT Architecture: Physical design of IoT, Logical design of IoT, IoT enabling technologies ,IoT levels and deployment templates					
Unit – 2	IoT Architecture				9
The Need for a Common Ground for the IoT ,The IoT Architectural Reference Model as Enabler, IoT in Practice, IoT in Logistics and Health, IoT Reference Model, SOA based Architecture, APIbased Architecture					
Unit – 3	IoT Communication Technologies				9
Introduction, Infrastructure Protocols, Discovery Protocols, Data protocols (MQTT , MQTT-SN, CoAP , AMQP , XMPP, SOAP , REST, WebSocket)					
Unit – 4	Associated IoT Technologies				9
Cloud Computing, Virtualization, Cloud models and implementations, Sensor-Cloud: Sensors-as-a-Service, Fog Computing in IoT					
Unit – 5	IoT Case studies				9
IoT Paradigms, Challenges, and the Future Trends. Case study: IoT in Smart cities, Agricultural IoT, Vehicular IoT, Healthcare IoT					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Comprehend the essentials of IoT and its applications				Understand
CO2	Apply the concept of IoT Architecture Reference model and IoT Protocols for developing an application				Apply
CO3	Apply the concept in IoT to categorize associated technologies and applications.				Apply
CO4	Analyze the performance of various IoT Communication protocols				Analyze
CO5	Analyze the concerns in real time usage of various IoT protocols				Analyze
CO6	Design IoT-based systems for real-world problems.				Create

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madiseti, Publisher: Universities Press (India) Private Limited, 2015.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, —IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, CISCO Press, 2017.

REFERENCES:

1. Bassi, Alessandro, et al, —Enabling things to talk, Springer-Verlag Berlin An, 2016.
2. Rajkumar Buyya , Amir Vahid Dastjerdi ,Internet of Things Principles and Paradigms, 2016 Elsevier
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
4. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.
5. Sudip Misra Anandarup Mukherjee ,Arijit Roy, Introduction to IoT, Cambridge university press,2021

COURSE DESIGNER : Dr.M.Sheik Dawood, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2					2							2	
CO.2	2												2	
CO.3	3	2											2	
CO.4	3												3	
CO.5	3	2											3	
CO.6	3	2	2	2	2	2						2	3	
CAM (Avg)	2.6	2	2	2	2	2						2	2.5	
3- Strong 2- Medium 1- Weak														

R21ECV3N03	INDUSTRIAL IOT	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To make impart knowledge on various sensors and technologies in IIOT To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application To explain the AI & CPS techniques involved in IIOT 					
UNIT I	INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS	10			
The Various Industrial Revolutions, Role of Internet of Things (IOT) & Industrial Internet of Things (IIOT) in Industry, Catalysts and Precursors of the IIOT, Miniaturization, Cyber Physical Systems, Wireless Technology, IP Mobility, Network Functionality Virtualization (NFV), Network Virtualization, SDN (Software Defined Networks), Smart Phones, The Cloud and Fog, M2M Learning and Artificial Intelligence, AR,3D Printing					
UNIT II	IIOT REFERENCE ARCHITECTURE	8			
M2M and IIOT architecture, Industrial Internet Architecture Framework (IIAF), Architectural Topology, Key System Characteristics, Data Management. Query, Storage, Persistence, and Retrieval Advanced Data Analytics, IIOT Middleware Architecture					
UNIT III	INDUSTRIAL INTERNET SYSTEM DESIGNING	9			
The Concept of IIOT, Proximity Network, WSN Edge Node, Designing Low-Power Device Networks, Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication, Gateways, Access Networks Connecting Remote Edge Networks, API, Web services, SOAP and REST,					
UNIT IV	INDUSTRY 4.0	9			
Defining Industry 4.0, Need and Characteristics of 4.0, The value chain, Differential Prospective, Benefits to Business, Industry 4.0 Design Principles, Industry 4.0 Reference Architecture, Smart Factories, Industry 4.0: The Way Forward					
UNIT V	INDUSTRY 5.0	9			
Need for Industrial Transition, Challenges, Strategy planning, Business Use case, Business Challenge, Precondition, Approach, Result, Workplace of the future					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamentals of Industrial Internet of Things and its standards	Understand			
CO2	Analyze the various real time uses of various architecture in IIOT	Apply			
CO3	Apply the basics of IIOT to monitor and control IIOT data and edge systems	Apply			
CO4	Design a IIOT system to solve any engineering problems	Apply			

CO5	Analyze software design concepts for Industrial Internet of Things	Analyze
CO6	Analyze the Workforce and Human Machine Interaction and Application of Industrial Internet of Things	Analyze
TEXT BOOKS:		
1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress,2016		
2. Sabina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems,2016		
3. Elangovan, Uthayan. Industry 5.0: The Future of the Industrial Economy. United States, CRC Press, 2021.		
REFERENCES:		
1. Dr. Ovidiu Vermesan, Dr. Peter Friess, —Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystemsll, River Publishers,2022		
2. The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119- 99435-0, 2nd Edition, Willy Publications,2014		
3. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science,2016		
4. Hakima Chaouchi, — The Internet of Things Connecting Objects to the Webll ISBN : 978-1-84821- 140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi,2010		
COURSE DESIGNER: Mrs.R.Devika, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												2	
CO3	3												2	
CO4	3												2	
CO5	3	3				2		2				2	3	
CO6	3	3	3	2		2		2				2	3	
CAM (Avg)	2.7	3	3	2		2		2				2	2	
3- Strong 2- Medium 1- Weak														

R21ECV307	SMART SENSOR NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce basic concepts of Sensor Networks To understand the knowledge of programming in Sensor Networks To explain the Applications in Communication fields 					
Unit – 1	WIRELESS SENSOR NETWORKS				9
Introduction-Goals for Real-Time Distributed Network Computing for Sensor Data Fusion -The Convergence of Networking and Real-Time Computing - Network Resource Management- Management Challenges and Dimensions-MANNA as an Integrating Architecture					
Unit – 2	PROGRAMMING IN SENSOR NETWORK				9
Introduction-Differences between Sensor Networks and Traditional Data Networks- Aspects of Efficient Sensor Network Applications-Need for Sensor Network Programmability- Major Models for System-Level Programmability-Frameworks for System-Level Programmability- Miniaturizing Sensor Networks with MEMS					
Unit – 3	SENSOR NETWORK ARCHITECTURE AND APPLICATIONS				9
Introduction-Sensor Network Applications-Functional Architecture for Sensor Networks-Sample Implementation Architectures-SNs-Global View and Requirements- Individual Components of SN Nodes-Wireless SNs as Embedded Systems- Comparison of Data Processing Techniques in Sensor Networks					
Unit – 4	COMMUNICATION PROTOCOLS FOR SENSOR NETWORK				9
Introduction-Application Layer Protocols-Localization Protocols-Time Synchronization ProtocolsTransport Layer Protocols-Network Layer Protocols-Data Link Layer Protocols- Positioning and Location Tracking in Wireless Sensor Networks					
Unit – 5	DYNAMIC POWER MANAGEMENT AND SECURITIES in SENSOR NETWORKS				9
Introduction-Idle Power Management-Active Power Management-System Implementation-Unique Security Challenges in Sensor Networks and Enabling Mechanisms-Security Architectures					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the basics concepts of Sensor Networks.	Understand			
CO2	Describe the technology involved in Wireless Sensor Network.	Understand			

CO3	Apply the knowledge of programming in Sensor Network for various sensor network applications	Apply
CO4	Apply the knowledge of WSN Architecture to develop various applications.	Apply
CO5	Analyze the performance of various Communication protocols	Analyze
CO6	Analyze the performance of various Securities protocol in WSN	Analyze

TEXT BOOKS:

1. Mohammad Ilyas, Imad Mahgoub - Smart Dust- Sensor Network Applications, Architecture and Design
2. Fatos Xhafa, Fang-Yie Leu and Li-Ling Hung, —Smart Sensor Networks – Communication technologies and Intelligent Application

REFERENCES:

1. Luger George F and Stubblefield William A, —Artificial Intelligence: Structures and Strategies for Complex Problem Solvingll, Pearson Education, 2002.
2. Sensors and Transducers Characteristics, Applications, Instrumentation, Interfacing M..J. Usher and D.A. Keating

COURSE DESIGNER : Mrs. P.Murugeswari AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2											2	
CO3	3	2	2										2	
CO4	3	2	2										2	
CO5	3	3	2	2									2	
CO6	3	3	2	2									2	
CAM (Avg)	2.8	2.4	2	2									2	
3- Strong 2- Medium 1- Weak														

R21ECV308	BLOCK CHAIN TECHNOLOGY (INDUSTRY SUPPORTED)				L	T	P	C	
					3	0	0	3	
OBJECTIVES:									
<ul style="list-style-type: none"> To describe Blockchain's fundamental components, and examine decentralization using block chain. To introduce the components of crypto currency. To impart the knowledge blockchain on real time applications 									
UNIT I	INTRODUCTION							9	
History of Block Chain - Introduction to Block chain - Features of Block chain - Types of Block Chain - Decentralized Database - Proof of Work – Proof of Stake - Benefits of Block Chain Technology - Blockchain's Challenges – Advantages and Limitations of Block Chain.									
UNIT II	SECURITY OF BLOCKCHAIN SYSTEMS							9	
The Blockchain Architecture - Data Distribution and Structure of a Block – Layers of Security in a Blockchain Network: Transactions, Consensus, Mining, Information Propagation and Immutability - Blockchain Security Challenges - Distributed or Replicated - Monopoly of Miners - Double Spending									
UNIT III	CRYPTOCURRENCY							9	
Digital Currencies - Concept of Digital Currencies - Categories of Digital Currency - Examples of Digital Currencies: Bitcoin, Ethereum - Advantages of Digital Currencies - Limitations and Risks of Digital Currencies - Smart Contracts - Smart Licensing - Smart Contract Types - Benefits of Smart Contracts - Challenges of Smart Contracts and Licensing									
UNIT IV	BLOCKCHAIN APPLICATIONS AND NEXT EMERGING TRENDS							9	
Blockchain in Science - Blockchain in Health Care - Recent Developments in Blockchain - Technological Revolutions and Financial Capital – Case Study: Health, Finance, Media. - Alternative Blockchains: Kadena, Ripple, Rootstock									
UNIT V	BLOCKCHAIN BUSINESS INNOVATION							9	
Blockchain Practices – Loyal: Developer - Application – Ever ledger: Developer, Application – Gem Health: Developer, Application – Wave: Developer, Application – Align Commerce: Developer, Application – Civic: Developer, Application – ShoCard: Developer, Application – Factom: Developer, Application.									
TOTAL:								45 PERIODS	
COURSE OUTCOMES:									
At the end of the course the student will be able to:									
CO1	Describe the technology components of Blockchain and how it works behind the scenes.							Understand	
CO2	Apply the concept of blockchain technology in real time applications.							Apply	

CO3	Apply the knowledge of cryptography to develop the blockchain security system.	Apply
CO4	Apply the knowledge acquired in blockchain for developing decentralized applications.	Apply
CO5	Analyze the performance of various alternative Blockchains techniques	Analyze
CO6	Analyze various blockchain business innovation models for real time applications.	Analyze

TEXT BOOKS:

1. Imran Bashir, —Mastering Blockchain Distributed ledger technology, decentralization and smart contractsll, 2017.
2. Vincenzo Morabito, —Business Innovation through Blockchainll, 2017.

REFERENCES:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, —Bitcoin and Cryptocurrency Technologies A Comprehensive Introductionll , 2016
2. Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, —Blockchain by Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledgerll, 2018.
3. Joseph J. Bambara and Paul R. Allen, —Blockchain - A Practical Guide to Developing Business, Law, and Technology Solutionsll, 2018.
4. Vikram Dhillon, David Metcalf and Max Hooper, —Blockchain enabled Applicationsll, 2017.
5. Antonopoulos, Andreas M, —Mastering bitcoin unlocking digital cryptocurrenciesll, 2014.

COURSE DESIGNER: Dr.M.Sheik Dawood, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2		2					2	
CO2	3					2							2	
CO3	3					2		2					2	2
CO4	3							2					2	2
CO5	3	2				2							3	2
CO6	3	2				2		2				2	3	2
CAM (Avg)	2.8	2				2		2				2	2.3	2
3- Strong 2- Medium 1- Weak														

R21UEC309	AI-ML IN IOT	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To learn the concepts of searching for AI problems To learn about agents and knowledge representation To get introduced to fundamentals of machine learning To learn about the possibilities of Supervised and Unsupervised learning 					
UNIT I	INTRODUCTION	9			
IoT reference model, IoT platforms, IoT verticals, Big data and IoT Infusion of AI, Data science in IoT, Cross-industry standard process for data mining, AI platforms and IoT platforms					
UNIT II	MACHINE LEARNING FOR IOT	9			
Prediction using linear regression, Logistic regression for classification, classifying wine using logistic regressor, Classification using support vector machines, classifying wine using SVM, Naive Bayes, Decision trees, Ensemble learning, Improving your model, Overfitting, No Free Lunch theorem, Hyperparameter tuning and grid search					
UNIT III	DEEP LEARNING FOR IOT	9			
Deep Learning, Multilayered perceptrons for regression and classification, Convolutional neural networks, Recurrent neural networks, Autoencoders					
UNIT IV	GENETIC ALGORITHMS FOR IOT	9			
Optimization, Deterministic and analytic methods, Natural optimization methods, The genetic algorithm, Genetic algorithm for CNN architecture, Genetic algorithm for LSTM optimization					
UNIT V	APPLICATIONS FOR AI IN IOT	9			
Personal and Home IoT, AI for the Industrial IoT, AI for Smart Cities IoT, Processing different types of data, Computing in the cloud					
TOTAL: 45 Periods					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the foundational concepts, history, and evolution of Artificial Intelligence and its impact on society and technology.	Understand			
CO2	Apply appropriate learning techniques, including search algorithm to AI based problems.	Apply			
CO3	Apply the knowledge of algorithms in building intelligent systems.	Apply			
CO4	Analyze various machine learning approaches methods, and build predictive models.	Analyze			
CO5	Analyze Deep learning and machine learning techniques in real-time applications for AI and IoT domains.	Analyze			
CO6	Analyze the performance of deep learning architectures for various AI tasks	Analyze			

Text Books:

1. Amita Kapoor ,—Hands-On Artificial Intelligence for IoT, First Edition, Packt Publishing, 2019.
2. Kevin Night, Elaine Rich, Nair B., —Artificial Intelligence (SIE)II, McGraw Hill, 2008.

Reference Books:

1. Vinod Chandra SS, Anand Hareendran S, —Artificial and Machine LearningII, First Edition, PHI Learning, 2014.
2. Dan W. Patterson, —Introduction to AI and ESII, Pearson Education, 2007
3. Tom Mitchell, —Machine LearningII, First Edition, Tata McGraw Hill India, 2017

Course Designer : Mrs.R.Devika

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	
CO6	3	3	3	-	-	-	-	-	-	-	-	-	2	
CAM (Avg)	2.83	2.2	2.2	-	-	-	-	-	-	-	-	-		
<div style="display: flex; justify-content: space-around;"> 3- Strong 2- Medium 1- Weak </div>														

S.No	Course Code	Course Title	L	T	P	C
Vertical IV – 21ECV400- Space Technologies						
1.	R21ECV401	Global Positioning and Navigation System	3	0	0	3
2.	R21ECV402	Remote Sensing and Information Systems	3	0	0	3
3.	R21ECV403	Navigation and Communication System	3	0	0	3
4.	R21ECV404	Satellite Communication and services	3	0	0	3
5.	R21ECV405	Avionics Systems	3	0	0	3
6.	R21ECV406	Radar Signal Processing Technology	3	0	0	3
7.	R21ECV4N04	Rocketry and Space Mechanics	3	0	0	3
8.	R21ECV407	Design of UAV systems	3	0	0	3

R21ECV401	GLOBAL POSITIONING AND NAVIGATION SYSTEM	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart the fundamental concepts of GPS. To give an idea about the GPS Navigation and Satellite. To understand the fundamentals of GPS Receiver. 					
UNIT 1	GPS FUNDAMENTALS				9
Introductory GPS System, Description and Technical Design, History of Satellites, Launches, Initial Testing, Applications of GPS, Pioneers of the GPS.					
UNIT II	GPS NAVIGATION DATA				9
Introduction, Detailed Description of the Navigation Data Time, Satellite Clocks and Clock Errors, Satellite Orbit And Position, Ionosphere Correction Using Measured Data.					
UNIT III	GPS SATELLITE AND PAYLOAD				9
Spacecraft and Navigation Payload Heritage, Navigation Payload Requirements, Block IIR Space Vehicle Configuration, Block IIR Payload Design, Characteristics of the GPS L-Band Satellite Antenna, Future performance Improvements.					
UNIT IV	FUNDAMENTALS OF SIGNAL TRACKING THEORY				9
GPS User Equipment –System Architecture, Delay lock loop Receivers for Signal tracking, Coherent and Non coherent Delay lock loop, Vector Delay lock loop, Processing of GPS signals-Quasi optimal and channel Capacity .					
UNIT V	GPS RECEIVER				9
Generic Receiver Description, Technology Evolution, System Design Details, Receiver Software signal Processing, Bit synchronization.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concepts and Navigation payload in GPS.				Understand
CO2	Apply the knowledge of signal tracking theory for delay estimation in a GPS system.				Apply
CO3	Apply the knowledge of GPS Receiver to compute parameters of GPS.				Apply
CO4	Analyze the various types of Signals in GPS communication				Analyze
CO5	Analyze the different navigation solution for precise position.				Analyze
CO6	Develop an android mobile application using GPS.				Create

TEXT BOOKS:

1. G.S.RAO, —Global Navigation Satellite SystemsII, McGraw-Hill, New Delhi, 2010.
2. Rajat Acharya, —Understanding Satellite NavigationII, Academic Press, 1st edition, 2014.

REFERENCES:

1. Parkinson.B, Spilker.J, —GPS:Theory and ApplicationsII, Vol.I & Vol.II, AIAA,370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
2. Hoffman.B, Wellenhop, Lichtenegger.H and Collins.J, —GPS: Theory and Practicell, Springer, Wein, 4th revised edition, New York, 1997.
3. Leick.A, —GPS Satellites SurveyingII, John Wiley & Sons, 2nd edition, New York, 1995.

COURSE DESIGNER: Ms.J.JUDITH, AP/ECE**CO/PO/PSO MAPPING**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	3	3	-	2	-	-	-	-	-	-	-	-	2	-
CO6	3	3	3	2	3	-	-	-	3	-	-	2	2	-
CAM	2.8	2.6	3	2	3	-	-	-	3	-	-	2	2	-

3- Strong 2- Medium 1- Weak

R21ECV402	REMOTE SENSING AND INFORMATION SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamentals of remote sensing and electromagnetic radiation. To explain EMR interactions with the atmosphere and Earth's surface. To introduce Geographic Information Systems (GIS) and their role in spatial data analysis. To explore real-world applications of remote sensing and GIS for resource management. 					
Unit I	REMOTE SENSING – BASIC PRINCIPLES	9			
Definition and scope – Electromagnetic Remote Sensing Process – Nature of Electromagnetic Radiation (EMR), Electromagnetic Spectrum – Energy Sources and Characteristics – Atmospheric Interactions with EMR: Absorption by Ozone, Scattering (Rayleigh, Mie, Non-selective) – Energy Interactions with Earth Surface Materials: Spectral Reflectance Curves.					
UNIT II	REMOTE SENSING PLATFORMS AND SENSORS	9			
Satellite System Parameters: Instrumental and Viewing Parameters – Sensor Parameters: Spatial, Spectral, Radiometric, Temporal Resolution – Imaging Systems: Multispectral, Thermal, Microwave – Earth Resource Satellites: Landsat, SPOT, IRS, AEM – Meteorological Satellites: NOAA, GOES, NIMBUS, Meteosat – Microwave Satellites: Seasat, Radarsat, ERS-1 – Latest Trends: QuickBird, Cartosat, Resourcesat.					
UNIT III	MICROWAVE REMOTE SENSING	9			
Radar Principle – Microwave Measurement Factors – Surface Roughness, Radar Scattering Mechanisms – Radar Wavebands – SLAR and SAR Systems – Microwave Interactions with Earth's Surface – Speckle Noise, Backscatter Intensity – SAR Image Interpretation – Geometrical Effects: Slope Foreshortening, Layover, Aspect, Shadow.					
UNIT IV	ADVANCED GIS CONCEPTS AND SPATIAL DATA MODELLING	9			
GIS Fundamentals – GIS Architecture: Hardware, Software, Data – Spatial Data Models: Raster vs Vector – Data Input: Manual Digitization, Scanning, GPS Integration – Data Management using DBMS and SQL – Advanced Spatial Analysis: Buffering, Overlaying, Interpolation – Spatial Data Modeling: TIN, DTM, Network Modeling – Introduction to Temporal GIS and Spatio-temporal Data Models.					
UNIT V	INTEGRATED APPLICATIONS OF REMOTE SENSING, GIS & GPS	9			
RS and GIS Integration Techniques – Data Fusion Methods – Urban Planning, Land Use Dynamics, Population Modeling – Environmental Monitoring and Resource Management – Advanced Water Resource Applications: Watershed Prioritization, Flood Risk Zoning – Precision Agriculture and Forestry Monitoring – Disaster Management: Earthquakes, Landslides, Cyclones – Advanced Case Studies using GPS and Real-time Data Analytics.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the fundamental principles of Remote Sensing and Electromagnetic Radiation.	Understand			
CO2	Apply remote sensing techniques for satellite data acquisition and interpretation.	Apply			

CO3	Apply Geographic Information System (GIS) techniques for spatial data processing and management.	Apply
CO4	Analyze digital image processing techniques for remote sensing data enhancement.	Apply
CO5	Analyze the role of Microwave Remote Sensing in environmental and disaster management applications.	Analyze
CO6	Evaluate the integration of Remote Sensing, GIS, and GPS for real-world applications.	Evaluate

TEXT BOOKS:

1. Reddy, Anji., M.,|| Textbook of Remote Sensing and Geographical Information Systems|| 3rd Edition, BS Publications, Hyderabad, India,2006.
2. M.G. Srinivas, —Remote Sensing Applications||, Narosa Publishing House, first edition 2001.

REFERENCES:

1. Jensen, J.R, —Remote sensing of the environment||, Prentice Hall, 2000.
2. Kang-Tsung Chang, —Introduction to Geographic Information Systems||, Tata McGraw Hill, 2002.
3. Lillesand T.M. and Kiefer R.W, —Remote Sensing and Image Interpretation||, John Wiley and Sons, Inc, New York, 1987.
4. Burrough P A, —Principle of GIS for land resource assessment||, Oxford Michael Hord, 1986.

COURSE DESIGNER: MrsS.Ramya, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		-	-	-				2	2	3	-	3	2
CO2	3			-	-				2	2	2	-	3	2
CO3	3		-	-	-				2	2	2	-	3	2
CO4	3			-	-				2	2	2	-	3	2
CO5	3	3	2	2	-				2	2	2	-	3	2
CO6	3	3	2	-	3				2	2	2	-	3	2
CAM (Avg)	3	3	2	2	3				2	2	2.16	-	3	2
3- Strong - Medium 1- Weak														

R21ECV403	NAVIGATION AND COMMUNICATION SYSTEM	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To understand the principles, operation and maintenance of aircraft communications and navigation systems. To study the range of navigation systems used on modern transport and military aircraft. To learn about the computation of navigation data and advancement in inertial navigation. 					
UNIT I	Introduction to Antennas and navigation	9			
The isotropic radiator-The half-wave dipole-Radiated power and efficiency-Antenna gain-The Yagi beam antenna-Directional characteristics-Other practical antennas- Aircraft navigation-The earth and navigation-Dead Reckoning-Position Fixing- Navigation terminology -Navigation systems development-Automatic direction finder- Introducing ADF-ADF principles and equipment-Operational aspects of AD.					
UNIT II	Hyperbolic radio navigation and Doppler navigation	9			
Hyperbolic position fixing-Loran overview, operation, ground equipment Enhanced Loran (eLoran)- The Doppler effect - Doppler navigation principles - Airborne equipment overview - Typical Doppler installations - Doppler summary - Other Doppler applications					
UNIT III	Advancements of Aircraft navigation	9			
RNAV equipment Kalman Filters-Navigation Performance-Inertial navigation systems- Inertial navigation principles-System overview and description - Alignment process - Inertial navigation accuracy - System integration					
UNIT IV	Global navigation satellite system	9			
GPS overview-Principles of wave propagation-Satellite navigation principles-GPS segmentsGPS signals-GPS operation-Flight management systems - FMS overview - Flight management computer system initialization- FMCS operation					
UNIT V	Air traffic control and collision avoidance	9			
ATC overview - ATC transponder modes - Airborne equipment - System operation - Automatic dependent surveillance-broadcast Communications, navigation and surveillance/air traffic management.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the concept of space navigation systems ranges, working principles and operational purposes.	Understand			
	Apply the concept of doppler effect for various doppler applications	Apply			
CO2					
CO3	Apply the concept of inertial navigation system and global satellite systems to compute the navigation data.	Apply			

CO4	Analyze the propagation types of radio waves and their relations with radio frequency.	Analyze
CO5	Analyze the navigation methods to augment their precision and range of use.	Analyze
CO6	Evaluate the operational limitations of aircraft based air navigation systems.	Evaluate

TEXT BOOKS:

1. Mike Tooley and David Wyatt, —Aircraft Navigation and communication systemsll, Routledge, 2nd edition, 2017.
2. Chris Binns, —Aircraft Systems: Instruments, Communications, Navigation, and Controll, 2018, Wiley Press.

REFERENCES:

1. Mohinder S. Grewal,—Global Navigation Satellite Systems, Inertial Navigation, and Integrationll, 3rd Edition,2017.
2. Michael H. Tooley, Mike Tooley, David Wyatt,—Aircraft Communications and Navigation Systemsll, 1st edition, 2016.

COURSE DESIGNER: Mrs. S.Ramya, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	-
CO5	2	3	2	2	-	-	2	-	-	-	-	2	2	-
CO6	3	3	3	2	-	-	2	-	3	-	-	2	2	-
CAM	3	3	2	2	-	-	2	-	3	-	-	2	2	-
3- Strong 2- Medium 1- Weak														

R21ECV404	SATELLITE COMMUNICATION AND SERVICES	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the elements of satellite Communication. To explain the modulation and multiple access schemes. To summarize about satellites and its applications 					
UNIT 1	ELEMENTS OF SATELLITE COMMUNICATION	9			
Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.					
UNIT II	TRANSMISSION, MODULATION, MULTIPLE ACCESS	9			
Phased arrays for satellite communications, satellite laser communications, Features of RF and optical space communication systems, wireless standards in satellite networking, Tracking and Data Relay Satellite K (TDRS-K) , Multiple Access Techniques – DMA, TDMA, CDMA, and DAMA.					
UNIT III	SATELLITE LINK DESIGN	9			
The Space Segment: The Power Supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem , Transponders, The Antenna Subsystem, The Space Link: Equivalent Isotropic Radiated Power, Transmission Losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Downlink, Effects of Rain, Combined Uplink and Downlink C/N Ratio, Intermodulation Noise, Inter-Satellite Links					
UNIT IV	SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM	9			
Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS.					
UNIT V	SERVICES AND APPLICATIONS	9			
Mixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms - INTELSAT series , Remote Sensing - Special services, E-mail, Video conferencing and Internet connectivity , Mission Chandrayaan and Mission Mangalyaan.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concepts of satellite communication.	Understand			
CO2	Apply various modulation techniques and interference involved in satellite communication	Apply			
CO3	Apply the knowledge of GPS to describe the satellite Navigation.	Apply			
CO4	Illustrate various services in satellite communication.	Apply			
CO5	Analyze the various interference in satellite link design	Analyze			

CO6	Design real time applications for satellite communication.	Create
TEXT BOOKS:		
1. Wilbur Pritchard. L, Suyderhoud. H.D,Robert Nelson. A, —Satellite Communication Systems EngineeringII, Prentice Hall, New Jersey, 2006.		
REFERENCES:		
1. Timothy Pratt, Charles Bostian.W, —Satellite Communications II, John Wiley and Sons, 2010.		
2. Roddy.D, —Satellite Communication II, McGrawHill, 2008.		
3. Tri T Ha, —Digital Satellite Communication II, McGraw Hill, 2009.		
COURSE DESIGNER: Mr.P.Selvaprasanth, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	
CO2	3												2	
CO3	3												2	
CO4	3												3	
CO5	3	2	2	2									3	
CO6	3	3	3	3	2							2	3	
CAM (Avg)	3	2.5	3	2.5	2							2	2.5	
3- Strong 2- Medium 1- Weak														

R21ECV405	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To introduce the basics of avionics and its need for civil and military aircrafts. • To impart knowledge about the avionic architecture and various avionics data buses. • To gain more knowledge on various avionics subsystems. 					
UNIT I	INTRODUCTION TO AVIONICS	9			
Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.					
UNIT II	DIGITAL AVIONICS ARCHITECTURE	9			
Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 429 – ARINC – 629 – AFDX.					
UNIT III	FLIGHT DECKS AND COCKPITS	9			
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.					
UNIT IV	INTRODUCTION TO NAVIGATION SYSTEMS	9			
Radio navigation – Dead – Reckoning systems, Hyperbolic Navigation - ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.					
UNIT V	AIR DATA SYSTEMS AND AUTO PILOT	9			
Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Auto pilot – Basic principles, Longitudinal and lateral auto pilot.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the basics of avionics and its sub systems.	Understand			
CO2	Apply the basics of avionics subsystems architecture to calculate the air data parameters.	Apply			
CO3	Apply the knowledge of display technologies on avionic systems to measure the parameters.	Apply			
CO4	Analyze the principle of avionics for the needs of civil and military avionics systems.	Analyze			

CO5	Analyze Digital avionics systems from analog avionics architecture.	Analyze
CO6	Design navigation system and to perform analysis on air data systems using open source platform.	Create

TEXT BOOKS:

1. Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 7th Edition, 2012.
2. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 2003.

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Pallet.E.H.J., Aircraft Instruments and Integrated Systems, Longman Scientific, 1992.
3. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
4. Spitzer. C.R. The Avionics HandBook, CRC Press, 2000.

COURSE DESIGNER: Ms.A.Jansi Rani, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO2	3	1	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	1	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	1	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	2	-	2	-	-	-	-	-	-	2	3	-
CO6	3	2	3	-	3	2	1	-	-	-	-	2	3	-
CAM (Avg)	3	2	2.4	-	2.5	2	1	-	-	-	-	2.2	3	-
3- Strong 2- Medium 1- Weak														

R21ECV406	RADAR SIGNAL PROCESSING TECHNOLOGY	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To study about different radar signal processing techniques such as matched filtering, modeling, signal detection etc. • To familiarize the concept of matched filter techniques to identify the moving targets. • To study the Pulsed RADAR signals for sampling and quantization. 					
UNIT I	RADAR SIGNAL MODEL	9			
Basics of RADAR - Components of RADAR Signal: Amplitude, Clutter, Noise and Jamming RADAR Signal Frequency model: Doppler Shift, Stop and Hop Approximation - Spatial model: Coherent and Non coherent scattering, Variation with Angle and Range.					
UNIT II	RADAR DATA ACQUISITION	9			
RADAR Signal Sampling: Sampling in Fast and Slow Time Dimension; Sampling Doppler Spectrum - Nyquist Rate, Straddle Loss; Sampling in Spatial and Angle Dimension - Spatial Array Sampling, Sampling in Angle; I/Q Imbalance and Corrections					
UNIT III	RADAR WAVEFORMS	9			
The Waveform Matched Filter, Matched Filtering for Moving Targets, The Ambiguity Function, The Pulse Burst Waveform, Frequency Modulated-Pulse Compressed Waveform, Range Sidelobe Control for FM waveforms, Costas Frequency Codes.					
UNIT IV	DOPPLER PROCESSING	9			
Moving Target Indication(MTI),Pulse Doppler Processing, Pulse Pair Processing, Additional Doppler Processing issues, Clutter Mapping and Moving Target Detector, MTI for moving platforms.					
UNIT V	TRACKING AND MEASUREMENTS	9			
Signal Reprocessing Operation - Target Range Track Detection Using Surveillance Radar Data: Statistical Analysis of False Target Range and True Target Range Detection - Target Track Parameter measurement: Recurrent Filtering Algorithm, Adaptive Filtering Algorithm.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the basic concept of Radar systems	Understand			
CO2	Compare the various techniques to process the RADAR signals	Understand			
CO3	Apply the knowledge of sampling concepts to process the pulsed RADAR signals.	Apply			
CO4	Apply the knowledge of matched filter techniques to identify the moving targets	Apply			
CO5	Apply the concept of detection techniques to identify the unknown interference.	Apply			

CO6	Analyze the performance of the radar system both in detection and tracking modes.	Analyze
TEXT BOOKS:		
1. Mark.A.Richards, —Fundamentals of RADAR signal ProcessingII, McGraw Hill, 2005.		
2. Vyacheslav Tuzlukov, —Signal Processing in RADAR systemsII, CRC press, 2013.		
REFERENCES:		
1. Harry L.Van Trees, —Detection, Estimation and Modulation Theory – RADAR, SONAR signal processing and Gaussian signals in noiseII,2001.		
2. Nadav Levanon, Eli Mozeson, —RADAR SIGNALSII, Wiley Interscience, 2004.		
COURSE DESIGNER: Mr.T.Muthuraja, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PS Os	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	3	-	2	-	-	-	-	-	-	-	-	2	-
CO 5	3	3	-	2	-	-	-	-	-	-	-	-	2	-
CO 6	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CA M (Avg)	2.6	2.6	3	2	3	-	-	-	-	-	-	-	2	-
3- Strong 2- Medium 1- Weak														

R21ECV4N04	ROCKETRY AND SPACE MECHANICS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To introduce the concept of orbital mechanics and satellite dynamics. • To explain the properties of rocket motion and aerodynamics • To Understand the recent trends in staging and control of rocket vehicles. 					
UNIT 1	ORBITAL MECHANICS	9			
Description of solar system – Kepler’s Laws of planetary motion – Newton’s Law of Universal gravitation – Two body and Three-body problems – Jacobi’s Integral, Librations points - Estimation of orbital and escape velocities					
UNIT II	SATELLITE DYNAMICS	9			
Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – methods to calculate perturbations- Hohmann orbits – calculation of orbit parameters – Determination of satellite rectangular coordinates from orbital elements					
UNIT III	ROCKET MOTION	9			
Principle of operation of rocket motor - thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories determinations of range and altitude – simple approximations to burnout velocity.					
UNIT IV	ROCKET AERODYNAMICS	9			
Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag –Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.					
UNIT V	STAGING AND CONTROL OF ROCKET VEHICLES	9			
Need for multistaging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	To understand the advanced concepts in Rocketry and Space Mechanics to the engineers	Understand			
CO2	Analyze mathematical knowledge that are needed in understanding the physical processes	Analyze			
CO3	Derive numeric problems related to satellite perturbations	Apply			

CO4	Process trajectories determinations of range and altitude for analytics purpose	Analyze
CO5	Performance at various altitudes	Apply
CO6	Design aerodynamic and jet control methods of rocket vehicles	Apply
TEXT BOOKS:		
1. 1. G.P. Sutton, —Rocket Propulsion ElementsII, John Wiley & Sons Inc., New York, 5th Edition, 1986.		
2. 2. J.W. Cornelisse, —Rocket Propulsion and Space DynamicsII, J.W. Freeman & Co., Ltd., London,1982		
REFERENCES:		
1. Van de Kamp, —Elements of astro mechanicsII, Pitman Publishing Co., Ltd., London, 1980.		
2. 4. E.R. Parker, —Materials for Missiles and SpacecraftII, McGraw-Hill Book Co., Inc., 1982.		
COURSE DESIGNER: Mr.S.Selvakumar, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO2	3	1	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	1	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	1	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	2	-	2	-	-	-	-	-	-	2	3	-
CO6	3	2	3	-	3	2	1	-	-	-	-	2	3	-
CAM (Avg)	3	2	2.4	-	2.5	2	1	-	-	-	-	2.2	3	-
3- Strong 2- Medium 1- Weak														

R21ECV407	DESIGN OF UAV SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • To impart knowledge on the hardware components and their application in the UAV systems. • To infer about the communication and control detail of UAV. • To introduce the basic operational futures of UAV systems. 					
Unit-1	INTRODUCTION to UAV	9			
History of UAV –classification – Introduction to Unmanned Aircraft Systems- models and prototypes – System Composition-applications.					
Unit-2	UAV STANDARDS	9			
Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects- UK,USA and Europe- Design for Stealth–control surfaces specifications.					
Unit-3	AVIONICS HARDWARE	9			
Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supplyprocessor, integration, installation, configuration, and testing.					
Unit-4	Communication Payloads and Controls	9			
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.					
Unit-5	Development of UAV Systems	9			
Waypoints navigation-ground control software- System Ground Testing- System In-flight TestingFuture Prospects and Challenges-Case Studies – Mini and Micro UAVs.					
TOTAL:45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Acquire knowledge on the importance of UAVs with respect to their Applications.	Understand			
CO2	Identify the various subsystems and configurations of UAV.	Apply			
CO3	Distinguish between needs of mini and micro UAVs.	Apply			
CO4	Analyze the Gain insights with design standards and regulatory aspects of UAVs.	Analyze			
CO5	Design micro aerial vehicle systems by considering practical limitations.	Evaluate			
CO6	Evaluate the Perform ground test and troubleshooting with respect to UAV operation.	Create			

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, Introduction to UAV Systems, UAV Systems, Inc, 1998
2. Reg Austin Unmanned Aircraft Systems UAV design, development and deployment, Wiley, 2010.

REFERENCES:

1. Dr. Armand J. Chaput, Design of Unmanned Air Vehicle Systems, Lock heed Martin Aeronautics Company, 2001
2. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer, 2007
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

COURSE DESIGNER: Mrs.Rajalakshmi J, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												2	2
CO2	3	2											3	3
CO3	3	3											3	3
CO4	3	2	2										3	3
CO5	3	2	2										3	3
CO6	2	3			3	2	2						3	2
CAM (Avg)	2.6	2.4	2		3	2	2						3	2.6
3- Strong - Medium 1- Weak														

S.No	Course Code	Course Title	L	T	P	C
VERTICAL V – 21ECV500 - Semiconductor Chip Design and Testing						
1.	R21ECV501	Device Modeling	3	0	0	3
2.	R21ECV502	Validation and Testing Technology	3	0	0	3
3.	R21ECV503	Low Power VLSI Systems	3	0	0	3
4.	R21ECV504	VLSI Design and Testing	3	0	0	3
5.	R21ECV505	Mixed Signal Integrated Circuits	3	0	0	3
6.	R21ECV506	Analog CMOS Circuit Design	3	0	0	3
7.	R21ECV507	Microelectronics and VLSI Design Technology	3	0	0	3
8.	R21ECV5N05	ASIC & FPGA based Design	3	0	0	3
9.	R21ECV508	AI in Semiconductor Chip Design	3	0	0	3
10.	R21ECV509	CMOS Advanced Micro Fabrication Using Simulator 3D	3	0	0	3

R21ECV501	DEVICE MODELING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart the knowledge of MOS models and their second order effects To describe the methods for analyzing MOSFET scaling To introduce the concept of Quantum phenomena in MOS transistors 					
UNIT I	MOS TRANSISTOR MODEL				9
MOS Transistor operation, Equivalent circuit representation of MOS Transistor, Types of Compact Model, Basic modeling, Advanced MOSFET modeling, RF modeling of MOS transistors- Charge model.					
UNIT II	MOS SECOND ORDER EFFECT				9
Review of MOSFET Current Equation - MOSFET Channel Mobility- MOSFET capacitances and Inversion- Layer Capacitance effect - Short Channel MOSFETs					
UNIT III	MOSFET DEVICE SCALING				9
Constant-Field scaling – Generalized Scaling – Non scaling Effects- Threshold-Voltage Requirement – Channel Profile Design – Non-uniform Doping - MOSFET Channel Length.					
UNIT IV	QUANTUM EFFECTS IN MOS TRANSISTORS				9
Carrier Energy Quantization in MOS capacitor-2-D Density of States- Electron Concentration Distribution-Approximate Methods- Quantization Correction in Compact MOSFET Models- Quantum Tunneling.					
UNIT V	MOS DEVICE STRUCTURES				9
Silicon-On-Insulator Devices – SOI CMOS – Partially Depleted SOI MOSFETs – Fully Depleted SOI MOSFETs- Dual Material Gate MOSFETs, Surrounding Gate MOSFETs - Multigate MOSFETs.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain in detail about the different modeling of MOS Transistor				Understand
CO2	Apply the concept of quantum phenomena in MOS Transistors models				Apply
CO3	Apply the technologies used in non-classical MOSFET structure in real time applications				Apply
CO4	Apply the concept of device modeling to differentiate Non-classical and Multigate MOSFET.				Apply
CO5	Analyze the different types of MOSFET Scaling				Analyze

CO6	Analyze long channel and short channel MOSFET devices	Analyze
TEXT BOOKS:		
1. Y. Taur and T.H. Ning, —Fundamentals of Modern VLSI DevicesII, Cambridge University Press, Cambridge, United Kingdom, 2015		
2. A.B.Bhattacharyya , — Compact MOSFET Models for VLSI DesignII, John Wiley & Sons Ltd, 2009		
REFERENCES:		
1. Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, —Device Modeling for Analog and RF CMOS Circuit DesignII, John Wiley & Sons Ltd.		
2. Snowden C. M., —Introduction to Semiconductor Device ModelingII, World Scientific Press, Singapore, 1986		
3. J.P.Colinge, —FinFETs and other Multigate TransistorsII, 2007.		
COURSE DESIGNER: Mr.P.s,AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													2
CO3	3													2
CO4	3			2										2
CO5	3	3												3
CO6	3	3	3	2										3
CAM (Avg)	2.7	3	3	2										2.3
3- Strong 2- Medium 1- Weak														

R21ECV502	VALIDATION AND TESTING TECHNOLOGY	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To involve the students in the theory and practice of VLSI test and validations. To introduce advanced techniques for efficiently testing and validating the VLSI design. To introduce the concept of Design for Test and the technique of automated test pattern generation. 					
UNIT 1	Introduction to VLSI Testing				9
Introduction - VLSI Testing Process and Test Equipment – Challenges in VLSI Testing -Test Economics and Product Quality – Fault Modelling- Relationship among fault models.					
UNIT II	Test Generation for Combinational and Sequential Circuits				9
Test generation for combinational logic circuits - Testable combinational logic circuit design - Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG					
UNIT III	Advanced Testing				9
Memory Test- Memory Density and Defect Trends, Faults memory test Delay Test- IDDQ Test					
UNIT IV	Design for Testability				9
Design for Testability - Ad-hoc design - Storage cells for scan designs - Generic scan based design - System level DFT approaches					
UNIT V	Self-Test and Test Algorithms				9
Built-In Self-Test - Test pattern generation for BIST - Circular BIST – BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	VLSI Testing methodologies with the equipment"s and tools.				Understand
CO2	Able to identify and analyze the yield of chips.				Analyze
CO3	To construct a Design for Testability (DFT) algorithm for VLSI Circuits				Apply
CO4	Apply a methodology to test the combinational and sequential circuits.				Apply
CO5	Able to design any testable combinational logic circuit.				Apply
CO6	Perform Fault Diagnosis				Apply

CO/PO/PSO MAPPING														
COS	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3	3												2
CO3	3													2
CO4	3		2	2	2									2
CO5	3	3												2
CO6	3	2		2										2
CAM (Avg)	2. 5	2	2	2	2									2
<div style="display: flex; justify-content: space-around;"> 3- Strong 2- Medium 1- Weak </div>														

R21ECV503	LOW POWER VLSI SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the concepts of power in an IC. To Identify the power reduction techniques based on technology independent and technology dependent methods To explain the suitable techniques to reduce the power dissipation. 					
UNIT I	POWER DISSIPATION IN CMOS	9			
Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.					
UNIT II	POWER OPTIMIZATION	9			
Logic level power optimization – Circuit level low power design – Gate level low power design Architecture level low power design – VLSI subsystem design of adders, multipliers, PLL, low power design.					
UNIT III	DESIGN OF LOW POWER CMOS CIRCUITS	9			
Computer arithmetic techniques for low power system – reducing power consumption in combinational logic, sequential logic, memories – low power clock – Advanced techniques – Special techniques, Adiabatic techniques – Physical design, Floor planning, placement and routing.					
UNIT IV	POWER ESTIMATION	9			
Power Estimation techniques, circuit level, gate level, architecture level, behavioral level, – logic power estimation – Simulation power analysis – Probabilistic power analysis.					
UNIT V	SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER	9			
Synthesis for low power – Behavioral level transform – Algorithms for low power – software design for low power.					
TOTAL: 45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
CO1	Identify the sources of power dissipation in digital IC Systems.	Understand			
CO2	Design of low power CMOS circuits	Apply			
CO3	Apply probabilistic analysis to characterize dynamic power estimation	Apply			
CO4	Examine various power optimization algorithms in low power VLSI design system	Analyze			
CO5	Analyze various techniques for low power dissipation	Analyze			
CO6	Develop algorithm to reduce power dissipation by software	Create			
TEXT BOOKS:					
1. Kaushik Roy and S.C.Prasad, —Low power CMOS VLSI circuit designll, Wiley, 2000.					

REFERENCES:

1. J.B.Kulo and J.H Lou, —Low voltage CMOS VLSI CircuitsII, Wiley 1999.
2. A.P.Chandrasekaran and R.W.Broadersen, —Low power digital CMOS designII, Kluwer,1995.
3. Gary Yeap, —Practical low power digital VLSI designII, Kluwer, 1998.
4. P. Rashinkar, Paterson and L. Singh, —Low Power Design MethodologiesII, Kluwer Academic, 2002

COURSE DESIGNERS: Mr. D John Pragasam, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													2
CO2	2	3												2
CO3	3		2											2
CO4	2	3												2
CO5	3		2											2
CO6	2	3												2
CAM (Avg)	2.5	3	2											2
3- Strong 2- Medium 1- Weak														

R21ECV504	VLSI DESIGN AND TESTING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To know the basics of VLSI testing concepts To impart the knowledge to Learn test generation for sequential and combinational logic circuit <p>□ To Understand logic fault models</p>					
UNIT I	TESTING AND FAULT MODELING				9
Introduction to testing – Faults in Digital Circuits – Modeling of faults – Logical Fault Models –Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation –Delay models – Gate Level Event – driven simulation.					
UNIT II	TEST GENERATION				9
Test generation for combinational logic circuits – Testable combinational logic circuit design – Test generation for sequential circuits – Design of testable sequential circuits.					
UNIT III	DESIGN FOR TESTABILITY				9
Design for Testability – Ad-hoc design – Generic scan based design – Classical scan based design– System level DFT approaches.					
UNIT IV	SELF – TEST AND TEST ALGORITHMS				9
Built-In self-test – Test pattern generation for BIST – Circular BIST – BIST Architectures – Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs.					
UNIT V	FAULT DIAGNOSIS				9
Logical Level Diagnosis – Diagnosis by Unit under test reduction – Fault Diagnosis for Combinational Circuits– Self-checking design – System Level Diagnosis.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the basic concepts of VLSI testing				Understand
CO2	Apply the BIST techniques for improving testability.				Apply
CO3	Apply the testing concepts to design suitable IC for low power applications.				Apply
CO4	Illustrate testability techniques for combinational and sequential circuits.				Apply
CO5	Analyze the various methods of testing for combinational & Sequential circuits				Analyze
CO6	Analyze the various test generation methods for static & dynamic CMOS circuits				Analyze

TEXT BOOKS:

1. A.L.Crouch, —Design Test for Digital IC"s and Embedded Core Systemsll, Prentice Hall International, 2002.
2. M.Abramovici, M.A.Breuer and A.D. Friedman, —Digital systems and Testable Designll, Jaico Publishing House, 2002.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal, —Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuitsll, Kluwer Academic Publishers, 2002.
2. P.K. Lala, —Digital Circuit Testing and Testabilityll, Academic Press, 2002.

COURSE DESIGNER: Mr. B.Michael Vinoline Rinoj, AP\ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3													3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
				3- Strong			2- Medium			1- Weak				

R21ECV505	MIXED SIGNAL INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To Study the mixed signal of submicron CMOS circuits To Understand the various integrated based filters and topologies To Learn the data converters architecture, modeling and signal to noise ratio 					
UNIT I	SUBMICRON CMOS CIRCUIT DESIGN AND MODELING OF VERILOG HDL				9
Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise. Basic concepts-Gate level modeling- Dataflow modeling- Behavioral modeling-Design examples of Combinational and Sequential circuits.					
UNIT II	INTEGRATOR BASED CMOS FILTERS				9
Integrator Building Blocks , Low pass Filters, Active-RC Integrators, MOSFET-C Integrators, gm- C (Transconductor-C) Integrators, Discrete-Time Integrators, Filtering Topologies, Filtering Topologies, The Ideal ADC, Sinc-Shaped Digital Filters, Filtering Topologies.					
UNIT III	DATA CONVERTER ARCHITECTURES				9
Quantization Noise, Quantization Noise Voltage Spectral Density, Signal-to-Noise Ratio (SNR), Clock Jitter, Tool: The Spectral Density, Improving SNR using Averaging, The One-Bit ADC and DAC, Passive Noise-Shaping, Improving SNR and Linearity, Introduction to ASICs, ASIC Design Flow, Scan design					
UNIT IV	DATA CONVERTER MODELING				9
First-Order Noise Shaping, Quantization Noise in a First-Order Modulator, Decimating and Filtering the Output of a NS Modulator, Pattern Noise from DC Inputs, Op-Amp Gain (Integrator Leakage), Second-Order Noise-Shaping, Second-Order Modulator Topology, Noise-Shaping Topologies, Cascaded Modulators.					
UNIT V	CLOCK SIGNAL AND FILTERING				9
Continuous-Time Bandpass Noise-Shaping, Active-Component Bandpass Modulators ,Switched-Capacitor Bandpass Noise-Shaping, Clock Signals Path Settling Time, Filtering, Understanding the Clock Signals, Practical Implementation, Generating the Clock Signals, The Switched- Capacitors.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basics concepts of Submicron CMOS Circuits.				Understand
CO2	Apply the filtering topology concepts for designing digital filter.				Apply
CO3	Design various data converters architecture using Mos Transistors.				Apply

CO4	Design a filter using different data converter methods.	Apply
CO5	Analyze the different modulation techniques for design ordering modulation.	Analyze
CO6	Analyze the various SNR for different modelling of mixed signals.	Analyze
TEXT BOOKS:		
1. R.Jacob Baker, Wiley india —CMOS Mixed Signal Circuit Design IEEE Press, reprint 2008. 2. Behzad Razavi —Design of Analog CMOS Integrated Circuits McGraw Hill, 33rd Re- print, 2016.		
REFERENCES:		
1. R.Jacob Baker, Wiley India —CMOS Circuit Design, Layout and Simulation IEEE Press,Second Edition, reprint 2009. 2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis andDesign of Analog Integrated Circuits, 5th Edition, Wiley, 2009.		
COURSE DESIGNER: Mr.S.Janarthanan, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	3
CO6	3	3	3	3	-	-	-	-	-	-	-	-	-	3
CAM (Avg)	2.8	2.4	3	3	-	-	-	-	-	-	-	-	-	2.3
3- Strong 2- Medium 1- Weak														

R21ECV506	ANALOG CMOS CIRCUIT DESIGN	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To study the fundamentals of analog circuits and MOS device models. To gain knowledge on various configurations of MOS transistors and feedback concepts. To study the characteristics of noise and frequency response of the amplifier. To learn the concepts of Op-Amp frequency compensation, capacitor switches and PLLs 					
UNIT I	ANALOG IC DESIGN, MOS DEVICE MODEL AND CURRENT MIRRORS				9
MOSFET basics - Concepts of Analog Design - General consideration of MOS devices - MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors- large and small signal analysis- Common mode properties.					
UNIT II	AMPLIFIERS AND FEEDBACK				9
Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.					
UNIT III	FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE				9
General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.					
UNIT IV	OPERATIONAL AMPLIFIER STABILITY & FREQUENCY COMPENSATION				9
General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multipole system- Phase margin- Frequency compensation- Compensation of two stage op Amps-Other compensation techniques.					
UNIT V	SWITCHED CAPACITOR CIRCUITS AND PLLS				9
General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops- Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Concepts of Analog MOS devices and current mirror circuits.				Understand
CO2	Design different configurations of Amplifiers and feedback circuits.				Apply

CO3	Analyze the characteristics of frequency response of amplifier and its noise.	Analyze
CO4	Analyze the performance of the stability and frequency compensation techniques of Op- Amp Circuits.	Analyze
CO5	Apply other compensation Techniques.	Apply
CO6	Construct a switched capacitor circuit and PLLs	Apply

TEXT BOOKS:

1. Behzad Razavi, —||Design of Analog CMOS Integrated Circuits||, Tata McGrawHill||, 2001, 33rd re-print, 2016.
2. Philip E. Allen, Douglas R Holberg – —CMOS Analog Circuit design||, OxfordUniversity Press, 2012, Third Edition

REFERENCES:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009.
2. Grebene, —Bipolar and MOS Analog Integrated circuit design||, John Wiley & sons, Inc., 2003

COURSE DESIGNER: Dr. V.Gopi, PROF / ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	2	-	-	-	-	-	-	-	-	--	-	2
CO3	3	3	-	-	-	-	-	-	-	-	--	-	-	2
CO4	3	3	2	-	-	-	-	-	-	-	-	--	-	2
CO5	3	-	-	-	-	-	-	-	-	--	-	-	-	2
CO6	3	-	-	-	-	-	-	-	-	--	-	-	-	2
CAM (Avg)	2.5	2	2	-	-	-	-	-	-	-	-	--	-	2
3- Strong 2- Medium 1- Weak														

R21ECV507	MICROELECTRONICS AND VLSI DESIGN TECHNOLOGY	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To Impart Knowledge on physics of semiconductors and quantitative models. To understand the basics of semiconductor crystal properties, IC fabrication and automation. To identify the issues at various stages of VLSI physical design involved in fabrications. 					
UNIT I	INTRODUCTION TO MEMS	9			
MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelero meters and Micro fluidics, MEMS materials, Micro fabrication					
UNIT II	MECHANICS FOR MEMS DESIGN	9			
Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics					
UNIT III	INTRODUCTION TO VLSI FABRICATION	9			
BJT and CMOS Fabrication Process a Brief Overview – Unit Process Steps in Planar Process. Environment for VLSI Technology: Clean Room and Safety Requirements. Wafer Cleaning Processes and Wet Chemical Etching Techniques, Silicon Crystal Growth, Epitaxy– VPE and MBE.					
UNIT IV	OXIDATION AND DIFFUSION	9			
Oxidation: Kinetics of Silicon Dioxide Growth for Thick and Thin Films – Oxidation Rate Constants- Dopant Redistribution and Oxide Charges - Characterization of Oxide Films - Impurity Diffusion: Solid State Diffusion Modeling and Technology - Characterization of Impurity Profiles Diffusion Systems - Ion Implantation Modeling and Technology – Damage Annealing – Masking during Implantation.					
UNIT V	LITHOGRAPHY AND ETCHING	9			
Basic Process Explaining Lithography – Positive and Negative Resist and their Comparison– Light Sources – Mask Making Process – Layout Generation using Software Tools – Optical Lithography - Issues in Optical Lithography – X-ray Lithography – E-beam Lithography. Wet Chemical Etching- Dry Etching, Plasma Etching System – Etching of Various Materials Used in VLSI Fabrication.					
TOTAL: 45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
CO1	Outline the basics of semiconductor properties	Understand			
CO2	Build an idea on microelectronics and its technology	Apply			
CO3	Apply the semiconductor phenomena relevant to the field of electronics	Apply			
CO4	Apply the VLSI technology into IC circuits	Analyze			
CO5	Analyze the various stages of VLSI physical design involved in fabrications.	Analyze			
CO6	Analyze the different methods involved in VLSI fabrication process	Analyze			

TEXT BOOKS:

1. Stephen Santerria, "Micro systems Design", Springer, 2016.
 2. Nadim Maluf, —An Introduction to Micro Electro Mechanical System Engineering, Artech House, 2004.
 3. S. A. Campbell, —The Science and Engineering of Microelectronic FabricationII, 2nd Edition, Oxford University Press, 2001
- S.M. Sze (Ed), —VLSI TechnologyII, 2nd Edition, McGraw Hill, 1988.

REFERENCES:

5. Ai Qun Liu, "Photonic MEMS Devices", CRC press Bocaraton, 2009.
6. Tai Ran Hsu, "MEMS & Micro Systems Design, Manufacture and Nanoscale Engineering", John Wiley, New Jersy, 2008.
7. Chang Liu, "Foundations of MEMS", Pearson Education, 2012.
8. S.K. Ghandhi, —VLSI Fabrication PrinciplesII, 2nd Edition, John Wiley Inc., New York, Reprint 2004.

COURSE DESIGNERS: Mr. D John Pragasam, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													2
CO3	3													2
CO4	3	3	2											2
CO5	3	3	2											2
CO6	3	3	2											2
CAM (Avg)	2.87	3	2											2
3- Strong 2- Medium 1- Weak														

R21ECV5N05	ASIC & FPGA BASED DESIGN	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the design flow of different types of ASIC. To familiarize the different types of programming technologies and logic devices. To impart knowledge on the architecture of different types of FPGA. 					
UNIT I	Introduction to ASIC AND PLD				9
Types of ASICs - Design flow – CAD tools used in ASIC Design, Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices : ROMs and EPROMs – PLA –PAL, Gate Arrays – CPLDs and FPGAs					
UNIT II	ASIC PHYSICAL DESIGN				9
System partition -partitioning - partitioning methods, interconnect delay models and measurement of delay, floor planning – placement, Routing : global routing - detailed routing - special routing - circuit extraction - DRC					
UNIT III	LOGIC SYNTHESIS, SIMULATION AND TESTING				9
Design systems - Logic Synthesis, Half gate ASIC -Schematic entry - Low level design language, PLA tools -EDIF- CFI design representation					
UNIT IV	FIELD PROGRAMMABLE GATE ARRAY				9
FPGAs- Logic blocks, routing architecture, Design flow, technology - mapping for FPGAs, Xilinx XC4000 - ALTERA,s FLEX 8000/10000, Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs					
UNIT V	SYSTEM ON CHIP				9
Design Methodologies – Processes and Flows - Embedded software development forSOC – Techniques for SOC Testing – Configurable SOC – Hardware / Software co-design Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the design flow, types programming technologies of ASIC.				Understand
CO2	Design the basics of system on-chip and on chip communication architectures.				Apply
CO3	Design a digital circuit with ASIC design flow steps.				Apply
CO4	Apply the various partitioning algorithms to different digital networks.				Apply
CO5	Analyze the high performance algorithms available for ASICs				Analyze
CO6	Analyze the various routing algorithms for IC fabrication				Analyze

TEXT BOOKS:

1. M.J.S. Smith , Application Specific Integrated Circuits, Pearson, 2003
2. Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
3. Farzad Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall modern semiconductor design series, 2003.

REFERENCES:

1. K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.
2. Steve Kilts, Advanced FPGA Design: Architecture, Implementation, and Optimization, Wiley-IEEE Press, 2007.

COURSE DESIGNER: Dr.I.Sheik Arafat, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													2
CO3	3													2
CO4	3													2
CO5	3	2	2	2										2
CO6	3	2	2	2										2
CAM (Avg)	2.87	2	2	2										2
3- Strong 2- Medium 1- Weak														

R21ECV508	AI in Semiconductor Chip Design	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamentals of semiconductor chip architecture and traditional design workflows in VLSI systems. To provide an overview of Artificial Intelligence and Machine Learning techniques relevant to chip design automation. To develop the ability to design, simulate, and evaluate AI-integrated semiconductor components using software tools. 					
UNIT I	Fundamentals of Semiconductor Chip Design				9
Introduction to semiconductor devices and chip design process-Overview of VLSI and SoC design flowDesign metrics: Power, Performance, Area (PPA)- Challenges in traditional chip design- Introduction to EDA tools and their limitations.					
UNIT II	AI for Circuit Optimization and Validation				9
Basics of digital and analog circuit design - Overview of RTL to GDSII flow- Key challenges in circuit optimization and validation- Physical Design Optimization -Feature extraction from netlists, timing reports, and layouts.					
UNIT III	AI Powered Simulation and Performance Prediction				9
Introduction to Simulation and Performance Metrics- Timing and Delay Prediction- Power Estimation ModelsThermal Modeling and Prediction- AI in Signal and Noise Simulation- AI for constraint checking and rule violation prediction					
UNIT IV	Machine Learning in Logic Synthesis and Verification				9
Introduction to Machine Learning and Deep Learning - Supervised, unsupervised, and reinforcement learning Neural networks, decision trees, and optimization techniques- Logic synthesis using ML models- Timing analysis using ML.					
UNIT V	Applications and Future Trends				9
AI in 3D ICs, Semiconductor Tile technology-AI in semiconductor tile and chiplet based architectures, Applications in robotics-biomedical systems- brain-machine interfaces-nano-neuromorphic systems.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand VLSI and SoC design flows, key metrics (PPA), and challenges in chip development.				Understand
CO2	Apply AI and ML techniques for circuit optimization to improve design outcomes (timing, power, and area).				Apply
CO3	Develop machine learning models for simulation acceleration and performance prediction in timing, and signal integrity				Apply
CO4	Apply AI/ML algorithms for logic synthesis, timing analysis, and verification in chip design automation.				Apply

CO5	Analyze the impact of AI-based design tools on chip layout and verification efficiency and accuracy.	Analyze
CO6	Analyze the applications of AI in semiconductor chip design, emphasizing design automation and optimization.	Analyze
TEXT BOOKS		
1. Introductory Semiconductor Device Physics for Chip Design and Manufacturing: A High-Performance Silicon Technology Approach, Springer, October 2021 2. Neil H. E. Weste, David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson 2022, 4th or 5th Edition.		
REFERENCES:		
1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", Wiley India, 2006. 2. Abishek Kumar, K.Srinivasa Rao, Suman Lata Tirupathi, Machine Learning Techniques for VLSI Chip Design, John Wiley & Sons Inc 2023, ISBN 978-1119910398		
Course Designer: Ms.K.Subbulakshmi		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													2
CO3	3													2
CO4	3	3	2											2
CO5	3	3	2											2
CO6	3	3	2											2
CAM (Avg)	2.87	3	2											2
3- Strong 2- Medium 1- Weak														

R21ECV509	CMOS ADVANCED MICRO FABRICATION USING SEMULATOR 3D (Vertical-Professional Elective)	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamental principles of CMOS fabrication. To understand key semiconductor processes such as oxidation, lithography, etching, doping, and deposition, along with their role in IC manufacturing. To familiarize students with advanced fabrication techniques and tools, including SEMulator3D, FINFET architecture, Dual Damascene process and 3D IC integration. 					
UNIT 1	FUNDAMENTALS OF CMOS FABRICATION				9
Overview of the semiconductor industry and VLSI fabrication processes - Basics of NMOS, PMOS and CMOS transistors - Design Rules - Wafer Preparation - Introduction to SEMulator 3D-Installation and Exploration of SEMulator 3D for virtual fabrication-Layout Design and Virtual Fabrication of NMOS, PMOS and CMOS inverter using SEMulator 3D.					
UNIT 2	OXIDATION AND GATE FORMATION				9
Introduction to Epitaxy - Oxidation - LOCOS and Shallow Trench Isolation (STI), Gate - SiO ₂ versus Hi-k dielectrics, polysilicon versus metal gate, gate-first versus gate-last- Comparative Analysis of LOCOS and Shallow Trench Isolation (STI) Techniques- Evaluation of Gate-First and Gate-Last process flow in CMOS fabrication					
UNIT 3	LITHOGRAPHY AND ETCHING				9
Introduction to Lithography - Photoresists and mask aligners, Etching - Wet and dry etching - Plasma and reactive ion etching (RIE)- Process Exploration of Spacer formation and Multiple Patterning Techniques in Advanced Lithography- Implementation and Analysis of the Replacement Metal Gate (RMG) process in CMOS technology.					
UNIT 4	DOPING AND METALIZATION				9
Doping - Diffusion and Ion Implantation - Annealing and activation – Deposition - Physical Vapor Deposition (PVD) - Chemical Vapor Deposition (CVD) - Atomic Layer Deposition (ALD) – Study of Ion Implantation and Silicidation processes in CMOS fabrication-Analysis of the Damascene process for copper interconnect formation.					
UNIT 5	INTERCONNECT AND ADVANCED FABRICATION TECHNIQUES				9
Interconnect technologies: metallization, dual damascene process - FINFET Device architecture- High-k/Metal gate technology- Emerging Trends - 3D ICs and Through-Silicon Vias (TSVs) Process integration-challenges in integration, yield and reliability considerations- Process study of Dual –Damascene technique for advanced interconnect fabricationComparative analysis of Planar FET and FINFET Inverter design and performance					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the fundamental concepts of CMOS technology and its fabrication processes.				Understand
CO2	Apply CMOS design rules and simulate basic layouts such as inverter structures using tools like SEMulator3D.				Apply
CO3	Apply the techniques involved in Oxidation, isolation, lithography and gate in CMOS fabrication process using SEMulator 3D.				Apply
CO4	Design FINFET device by adopting advanced integration techniques using SEMulator 3D.				Apply

CO5	Extract cross-sectional images and geometric parameters by simulating the process flow of a FINFET device.	Analyze
CO6	Analyze interconnect technologies including metallization, dual damascene, and FinFET architecture, along with High-k/Metal gate and 3D IC trends	Analyze

Text Books:

1. Weste and Harris: CMOS VLSI DESIGN (fourth edition) Pearson Education, 2013
- John P. Uyemura, —Introduction to VLSI Circuits and systems, John Wiley & Sons, Reprint 2009
2. G.S. May and S.M. Sze, Fundamentals of Semiconductor Fabrication, Wiley India, 2004
3. J.D. Plummer, M.D. Deal and P.B. Griffin, Silicon VLSI Technology, Fundamentals, Practice and Modeling, Pearson education, 2000

References:

1. S. Yang *et al.*, "A high performance 180 nm generation logic technology," *International Electron Devices Meeting 1998. Technical Digest (Cat. No. 98CH36217)*, San Francisco, CA, USA, 1998, pp. 197-200, doi: 10.1109/IEDM.1998.746320.
 2. S. Tyagi *et al.*, "A 130 nm generation logic technology featuring 70 nm transistors, dual Vt transistors and 6 layers of Cu interconnects," *International Electron Devices Meeting 2000. Technical Digest. IEDM (Cat. No. 00CH37138)*, San Francisco, CA, USA, 2000, pp. 567-570, doi: 10.1109/IEDM.2000.904383.
 3. S. E. Thompson *et al.*, "A 90-nm logic technology featuring strained-silicon," in *IEEE Transactions on Electron Devices*, vol. 51, no. 11, pp. 1790-1797, Nov. 2004, doi: 10.1109/TED.2004.836648.
 4. K. Mistry *et al.*, "A 45nm Logic Technology with High-k+Metal Gate Transistors, Strained Silicon, 9 Cu Interconnect Layers, 193nm Dry Patterning, and 100% Pb-free Packaging," *2007 IEEE International Electron Devices Meeting*, Washington, DC, USA, 2007, pp. 247-250, doi: 10.1109/IEDM.2007.4418914.
 5. S. Natarajan *et al.*, "A 32nm logic technology featuring 2nd-generation high-k + metal-gate transistors, enhanced channel strain and 0.171µm² SRAM cell size in a 291Mb array," *2008 IEEE International Electron Devices Meeting*, San Francisco, CA, USA, 2008, pp. 1-3, doi: 10.1109/IEDM.2008.4796777.
 6. C. H. Jan *et al.*, "A 22nm SoC platform technology featuring 3-D tri-gate and high-k/metal gate, optimized for ultra low power, high performance and high density SoC applications," *2012 International Electron Devices Meeting*, San Francisco, CA, USA, 2012, pp. 3.1.1-3.1.4, doi: 10.1109/IEDM.2012.6478969.
 7. C.H. Jan *et al.*, "A 14 nm SoC platform technology featuring 2nd generation Tri-Gate transistors, 70 nm gate pitch, 52 nm metal pitch, and 0.0499 µm² SRAM cells, optimized for low power, high performance and high density SoC products," *2015 Symposium on VLSI Circuits (VLSI Circuits)*, Kyoto, Japan, 2015, pp. T12-T13, doi: 10.1109/VLSIC.2015.7231380.
 8. S.Y. Wu *et al.*, "A 7nm CMOS platform technology featuring 4th generation FinFET transistors with a 0.027µm² high density 6-T SRAM cell for mobile SoC applications," *2016 IEEE International Electron Devices Meeting (IEDM)*, San Francisco, CA, USA, 2016, pp. 2.6.1-2.6.4, doi: 10.1109/IEDM.2016.7838333.
- Nandakumar, M., S. Sridhar, S. Nag, P. Mei, D. Rogers, M. Hanratty, A. Amerasekera, and I.-C. Chen. —A Shallow Trench Isolation for Sub-0.13 µm CMOS Technologies. In *International Electron Devices Meeting. IEDM Technical Digest*, 657–60, 1997. <https://doi.org/10.1109/IEDM.1997.650469>

Vertical VI – 21ECV600 - Bio Medical Technologies

1.	R21ECV601	Wearable Electronics	3	0	0	3
2.	R21BMV702	Human Assist Devices	3	0	0	3
3.	R21BMV704	Therapeutic Equipment	3	0	0	3
4.	R21ECV6N06	Healthcare Engineering	3	0	0	3
5.	R21ECV605	Biomedical Measurements and Instrumentation	3	0	0	3
6.	R21ECV606	Body Area Networks	3	0	0	3
7.	R21ECV607	Embedded Systems in Medical Devices	3	0	0	3
8.	R21ECV608	Tele Medicine	3	0	0	3

R21ECV601	WEARABLE ELECTRONICS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the need for development of wearable devices and its implications on various devices. To impart knowledge on various wearable inertial sensors. To gain knowledge on various energy harvesting systems. 					
UNIT 1	FUNDAMENTALS AND ADVANCEMENTS				9
World of Wearable and Attributes of wearables, Textiles and clothing, Challenges and Opportunities, Future of Wearables, Making Electronics wearable. Designing wearable devices.					
UNIT 2	FLEXIBLE ELECTROINCS-FROM FOIL TO TEXTILE				9
Introduction, Thin Film Transistors-Materials and Technologies .Review of semiconductors-Employed in Flexible Electronics, Thin Film Transistors Based on IGZO. Further Improvements and Implements, Plastic Electronics for smart Textiles					
UNIT 3	WEARABLE INERTIAL SENSORS AND THEIR APPLICATIONS				9
Introduction, Wearable Inertial sensors, Obtained parameters from Inertia sensors, Applications from wearable Motion sensors, Practical considerations from wearable sensors.					
UNIT 4	ENERGY HARVESTING FOR WEARABLE SYSTEMS				9
Introduction to Energy Harvesting Systems, Energy Harvesting from Temperature Gradient from Human body, Energy harvesting from Foot Motion, Wireless Energy Transmission, Energy harvesting from Light. Energy and Power consumption Issues.					
UNIT 5	EMBROIDERED ANTENNAS FOR COMMUNICATION SYSTEMS				9
Introduction-Background of Textile Antenna, Design Rules for embroidered antenna, Characterizations of embroidered conductive textiles at radio frequencies, Losses in embroidered antennas, Applications of embroidered antennas, Influence of the human body on antenna performance, Body-worn textile antenna for cellular communications.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the fundamentals and Advancements in wearables.	Understand			
CO2	Apply the knowledge of flexible electronics for smart textiles.	Apply			
CO3	Design antennas for the various applications of Wearable systems	Apply			
CO4	Analyze the types of sensors used in real time applications for wearable systems	Analyze			
CO5	Analyze the various types of Energy Harvesting methods for real time wearables	Analyze			
CO6	Analyze the various applications of wearable devices.	Analyze			

TEXT BOOKS:

1. —Seamless Healthcare MonitoringII, Toshiyo Tamura and Wenxi Chen, Springer 2018
—Wearable Sensors -Fundamentals, Implementation and ApplicationsII, by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014.
2. —Wearable and Autonomous Biomedical Devices and Systems for Smart EnvironmentII, by Aime Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010

REFERENCES:

1. —Wearable Electronics Sensors - For Safe and Healthy LivingII, Subhas Chandra Mukhopadhyay, Springer 2015G.S.N.Raju, —Antenna Wave PropagationII, Pearson Education, 2004.
2. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018

COURSE DESIGNER: Dr. I.Sheik Arafat, PROF/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3	2	2											3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
3- Strong 2- Medium 1- Weak														

R21BMV702	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> • Study various mechanical techniques that will help failing heart. • Learn the functioning of the unit which does the clearance of urea from the blood. • Understand the tests to assess the hearing loss and development of electronic de compensate for the loss. 					
UNIT I	HEARING AIDS				9
Deafness – Types of Deafness – Hearing Aids, Construction and Functional Characteristics – Principles, drawbacks in the conventional unit, DSP based hearing aids. - Audiogram, Air conduction, Bone conduction - Masking techniques, SISI.					
UNIT II	RESPIRATORY AND CARDIAC ASSIST DEVICES				9
Heart/Lung System – Different types of Oxygenators and Pumps – Pulsatile and Continuous Type – Monitoring Process – Shunting – Blood Handling System – Types and Functions of different types of Heart Intra-Aortic Balloon Pumping (IABP) - Venous Arterial Pumping – Prosthetic Cardio Valves.					
UNIT III	ARTIFICIAL KIDNEY				9
Artificial kidney – Dialysis action – Hemodialyser unit - Principles of Haemodialysis – Membrane dialysis – Dialysate – Types of Haemodialyzers – Portable dialyser monitoring and functional parameters - Wearable Artificial Kidney – Implanting types.					
UNIT IV	PROSTHETIC AND ORTHOTIC DEVICES				9
Hand and Arm replacement – Different types of models: Externally powered limb prosthesis - Feedback in Orthotic system - Functional Electrical Stimulation – Sensory assist devices: Vision, dentures – Materials for Prosthetic and Orthotic Devices – Haptic Devices: Tactile, types and applications.					
UNIT V	MEDICAL ROBOTIC				9
Introduction and Overview – History and Clinical Applications - Components and Configurations of Robots – Case Study: Robotic arm – Sensors – Associated accessories for Robotic arm – Flexion and Extension.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the concept and characteristics of assistive devices for human.				Understand
CO2	Apply the principle and application of cardiac assist devices for solving heart related problems.				Apply
CO3	Apply the principle of Hemodialysis to know about the artificial kidney.				Apply
CO4	Analyze the devices which are used for respiration and hearing of human being.				Analyze
CO5	Analyze the knowledge of various prosthetic and orthotic devices in new and unfamiliar situations.				Analyze

CO6	Evaluate the functions of robotics in medical applications.	Evaluate
TEXT BOOKS:		
1. Levine S.N. (ed), —Advances in Bio-medical engineering and Medical physicsII, Vol. I, II, IV, inter university publications, New York, 1968.		
2. Kolff W.J, —Artificial OrgansII, John Wiley and sons, New York, 1976.		
3. Albert M.Cook and Webster J.G, —Therapeutic Medical DevicesII, Prentice Hall Inc., New Jersey, 1982.		
REFERENCES:		
1. D.S. Sunder, —Rehabilitation Medicinell, 3rd Edition, Jaypee Medical Publication, 2010.		
2. James Moore, George Zouridakis, —Biomedical Technology and Devices HandbookII, CRC Press 2004.		
COURSE DESIGNER: Ms. A.Jansi Rani, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	2	-	-	-	-	-	3	-	3
CO2	3			-	-	2		-	-	-	-	3	-	3
CO3	3			-	-	2		-	-	-	-	3	-	3
CO4	3	3	2	-	-	2		-	-	-	-	3	-	3
CO5	3	3	2	-	-	2		-	-	-	-	3	-	3
CO6	3	3	2	-	-	2		-	-	-	-	3	-	3
CAM (Avg)	2.87	3	2	-	-	2		-	-	-	-	3	-	3
3- Strong 2- Medium 1- Weak														

R21BMV704	THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To gain knowledge on basic concepts of therapeutic methods. To explore the therapeutic equipment used in medical applications. To comprehend the radiation protection principles and radiation safety in medicine. 					
Unit – 1	CARDIAC ARREST DEVICES				9
Cardiac pacemakers-Need, types and functional characteristics, AC Cardiac defibrillators, disadvantages, DC defibrillator, types- Instantaneous, Cardioverter.					
Unit – 2	DIATHERMY AND MEDICAL STIMULATORS				9
IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electrosurgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures. Electric stimulators- current waveforms-Galvani, Faradic, exponential surged-IFT and TENS-Lithotripsy- Therapeutic applications of laser.					
Unit – 3	NEONATOLOGY AND EXTRACORPOREAL DEVICES				9
Introduction-Neonatal-Intensive Care Unit – Neonatal thermal balance -Therapeutic devices in obstetrics and gynecology - Functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, monitoring systems.					
Unit – 4	RESPIRATORY AIDS				9
Ventilator- Need, Types, Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameters, Humidifier, Nebulizer, Aspirator, Infant incubators.					
Unit – 5	RADIATION THERAPY AND RADIATION SAFETY				9
Effects of ionizing radiation, Radiation therapy – Cobalt, Cesium therapy, linear accelerator, betatron, cyclotron, brachytherapy. Radiation safety-Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, Radiation protection in medicine radiation protection principles, ICRP regulation, Protection metrics					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Interpret the basic principles of cardiac and respiratory assist devices.				Understand
CO2	Apply the knowledge of various procedures to electrically test therapeutic equipment.				Apply
CO3	Explore the radiation safety principles and radiation				Apply

	protection methods.	
CO4	Analyze the performance of therapeutic equipment on the given condition.	Apply
CO5	Design and analyze basic therapeutic equipment for medical applications using simulation tool	Analyze
CO6	Evaluate the characteristics of different therapeutic methods.	Evaluate

TEXT BOOKS:

1. John G. Webster, —Medical Instrumentation: Application and DesignII, Fifth edition, John Wiley & Sons- Inc, 2020.
2. Khandpur R.S, —Handbook of Biomedical InstrumentationII, Fifth edition, Tata McGrawHill, New Delhi, 2014.

REFERENCES:

1. Leslie Cromwell, Fred. J. Weibell, Erich. A. Pfeiffer, —Biomedical Instrumentation and MeasurementsII, Second edition, Prentice Hall India, New Delhi, 2014.
2. Albert M. Cook and Webster J. G, —Therapeutic Medical DevicesII, Prentice Hall Inc., New Jersey, 1982.
3. Gopal B. Saha, —Physics and Radiobiology of Nuclear MedicineIII, Fourth edition, Springer, 2016.
4. Joseph. J. Carr and John. M. Brown, —Introduction to Biomedical Equipment TechnologyII, Fourth edition, John Wiley & Sons Inc, New York, 2002.

COURSE DESIGNER: Ms.K. Shanmugapriya, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO5	2	3	-	-	-	3	-	-	-	-	-	-	3	3
CO6	2	2	-	-	-	3	-	-	-	-	-	-	3	3
CA M	2.3	2.2	2	-	-	3	-	-	-	-	-	-	2.3	2.3
3- Strong 2- Medium 1- Weak														

R21ECV6N06	HEALTHCARE ENGINEERING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> ➤ To Identify various areas of Healthcare system. ➤ To Identify various activities of health care departments like out/inpatient treatment Equipment. ➤ To introduce students with fundamentals instrumentation of the equipments used in health care system 					
UNIT I	Introduction to Healthcare System				9
Health organization of the country, Indian hospitals- challenges, and strategies, modern techniques of hospital management. Physiological Transducers, Related Anatomy and Physiology.					
UNIT II	Engineering Services on Healthcare:				9
Biomedical engineer's role in Healthcare, Maintenance department, MRO, Electrical safety, Centralized gas supply system, Air conditioning system, Hospital waste management system, Fire safety and threat Alarm system.					
UNIT III	Bioelectric signals and Bioelectric amplifiers in healthcare				9
Origin of bioelectric signals, Electrodes, Electrode-tissueinterface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector.					
UNIT IV	Mechanical & lab Equipments in healthcare system				9
BP Apparatus, Suction Machine and Microscope. Recording and Monitoring Equipment: ECG and EEG Machines, Pulse Oximeter, Cardiac Monitor and Audiometer. Colorimeter, Spectrophotometer, Semi-Auto Analyzer, Centrifuge and Oven. Imaging Systems: X-Ray and Ultrasound Machines.					
UNIT V	PC based medical equipments in healthcare system				9
Introduction to - System configuration and BIOS, Identification & Troubleshooting of PC components viz- Motherboard, HDD, FDD, CD ROM, Monitor, Printers, Modems, Ports etc Installation and operation of - Windows Operating System, Antivirus Software, Internetworking.					
TOTAL: 45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
CO1	Understand the fundamental instrumentation of equipments used in health care systems				Understand
CO2	Applying the Engineering and Technical concepts to Observe and Identify the Biomedical signals.				Apply
CO3	Describe and characterize the sources of biomedical signals and needs of using biomedical instruments & their limitations.				Apply
CO4	Study & Identify the different bio potential signals of various parts of Human body using sensors and electrodes.				Analyze
CO5	Analyze the Bio-potential signals observed from sensors and Identify the Symptoms of diseases at initial stage.				Analyze
CO6	Analyze the symptoms of disease at different stages from initial condition and take preventive actions to protect life				Analyze

TEXT BOOKS:

1. Hans Pfeiff, Vera Dammann (Ed.), Hospital Engineering in Developing Countries, Z report Eschbom, 1986.
 2. R. S. Khandpur —Handbook of Bio-Medical InstrumentationII, 2nd Edition, Tata McGrawHill, 2003.
- J.J.Carr & J.M.Brown, —Introduction to Biomedical Equipment TechnologyII Pearson Education, Asia, 2010.

REFERENCES:

1. R.C. Goyal, Handbook of Hospital Personal Management, Prentice Hall of India, 1993
2. Joseph Bronzino, —Biomedical Engineering and InstrumentationII, PWS Engg . , Boston.
3. J.Webster, —BioinstrumentationII, Wiley & Sons.
4. R.Anandanatarajan, —Biomedical InstrumentationII, PHI Learning, 2009.
5. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.

COURSE DESIGNERS: Dr. T. Venkatesh Kanna, ASP / ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	2	-	-	-	-	-	-	-	2	
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	
CO3	3	2	-	2	2	-	-	-	-	-	-	-	2	
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	
CO5	3	3	3	2	2	-	-	-	-	-	-	-	2	
CO6	3	-	2	-	2	2	-	-	-	-	-	-	2	
CAM	2.83	2.8	2.5	2	2	2							2	
3- Strong 2- Medium 1- Weak														

R21ECV605	BIOMEDICAL MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To Introduce Fundamentals of Biomedical Engineering and communication mechanics in biomedical system To study measurement of certain important electrical and non-electrical parameters To understand the basic principles in imaging techniques ,life assisting and therapeutic devices 					
Unit – 1	INTRODUCTION				9
Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals- Basic components of a biomedical system- Cardiovascular systems- Respiratory systems - Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors					
Unit – 2	NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES				9
Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography –Blood Gas analysers, pH of blood –measurement of blood pCO ₂ , pO ₂ , finger-tip oxymeter - ESR, GSR measurements.					
Unit – 3	ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS				9
Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment.					
Unit – 4	IMAGING MODALITIES AND ANALYSIS				9
Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems-PET					
Unit – 5	LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES				9
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Illustrate the philosophy of biomedical measuring instruments.				Understand
CO2	Apply the working principle of the medical assistance/techniques, robotic and therapeutic equipment in various application				Apply

CO3	Apply electronic concepts for the design of various biomedical instrumentations.	Apply
CO4	Analyze the performance of traditional and modern medical instrumentation using case studies	Analyze
CO5	Analyze different parameters applicable in the development of instrumentation for healthcare applications.	Analyze
CO6	Analyze various biomedical Signals Using MATLAB simulation software(Modern tool usage)	Analyze

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi,2015
2. Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGraw-Hill New Delhi,2014

REFERENCES:

1. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012
2. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
3. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
5. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
6. M.Arumugam, „Bio-Medical Instrumentation“, Anuradha Agencies, 2003.

COURSE DESIGNER : Mrs.G.Ramu Priya, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2		2					2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	2										2	
CO5	3	3				2	2						2	
CO6	3	2				2	2						2	
CAM (Avg)	3	2.2	2			2	2	2					2	
3- Strong 2- Medium 1- Weak														

R21ECV606	BODY AREA NETWORKS	L	T	P	C	
		3	0	0	3	
OBJECTIVES:						
<ul style="list-style-type: none"> • To know the hardware requirement of BAN • To understand the communication and security aspects in the BAN • To know the applications of BAN in the field of medicine 						
UNIT 1	INTRODUCTION					9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.						
UNIT II	HARDWARE FOR BAN					9
Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio Transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.						
UNIT III	WIRELESS COMMUNICATION AND NETWORK					9
RF communication in Body, Antenna design and testing, Propagation, Base Station- Network topology- Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.						
UNIT IV	COEXISTENCE ISSUES WITH BAN					9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self- protection.						
UNIT V	APPLICATIONS OF BAN					9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.						
TOTAL : 45 PERIODS						
COURSE OUTCOMES:						
At the end of the course the student will be able to:						
CO1	Understand the basic concepts of wireless sensor Networks and Medical device regulations.					Understand
CO2	Comprehend technical information and challenges in body area networks.					Apply
CO3	Illustrate the need for medical device regulations followed in various regions.					Apply

CO4	Apply wireless sensor Network concept to implement	Apply
	Healthcare Applications.	
CO5	Analyze the efficiency of communication and the security parameters	Analyze
CO6	Design a BAN for appropriate application in medicine.	Create
TEXT BOOKS:		
1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.		
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, —Body Area, Networks Safety, Security, and Sustainability"", Cambridge University Press, 2013.		
REFERENCES:		
1. Zhang, Yuan-Ting, —Wearable Medical Sensors and Systems"", Springer, 2013.		
2. Guang-Zhong Yang(Ed.), —Body Sensor Networks"", Springer, 2006.		
3. Mehmet R. Yuce, Jamil Y.Khan, —Wireless Body Area Networks Technology, Implementation, and Applicationsll, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.		
COURSE DESIGNER: Mr. P.Selvaprasanth, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2												2	
CO.2	3												3	
CO.3	3												3	
CO.4	3												3	
CO.5	3	2	2	2									3	
CO.6	3	3	3	3		2						2	3	
CAM (Avg)	2.5	2.5	2.5	2.5		2						2	2	
3- Strong 2- Medium 1- Weak														

R21ECV607	EMBEDDED SYSTEMS IN MEDICAL DEVICES	L	T	P	C	
		3	0	0	3	
OBJECTIVES:						
<ul style="list-style-type: none"> To know the fundamental concepts of medical devices in embedded systems To apply the microcontroller concept for designing medical devices To understand the biosensors and embedded devices for clinical practices To expose the student to various healthcare applications 						
UNIT 1	OVERVIEW OF SENSORS AND ELECTRODES					9
Generalized medical instrumentation systems and classification- Bio potential amplifiers – Filters Bio Sensors – Displacement Measurement – Temperature Measurement – Optical Measurement- Bio potential electrodes – Polarizable and Nonpolarizable Electrodes, Body- Surface Recording Electrodes, Internal Electrodes, Electrode Arrays, Microelectrodes, Design criteria and development process of commercial medical devices						
UNIT II	MICROCONTROLLERS IN MEDICAL DEVICES					8
Basics of microcontroller – Embedded Medical System- Selection of a Microcontroller – IoT- Based Medical Devices- ECG, EEG and EMG-Based Embedded Medical System						
UNIT III	EMBEDDED SYSTEMS IN HEALTH CARE MONITORING					9
Measurement of Blood Pressure and Sound – Direct Measurements, Measurement of System Response, Systems for Measuring Venous Pressure, Indirect Measurements of Blood Pressure, Heart Sounds, Phonocardiography- Measurement of Flow and Volume of Blood- Measurements of the Respiratory System – Modeling the Respiratory System – Measurement of Pressure – Measurement of Gas Flow – Lung Volume – Respiratory Plethysmography						
UNIT IV	EMBEDDED DEVICES FOR CLINICAL LABORATORY					10
Chemical biosensors – Electrochemical Sensors, Chemical Fibrosensors, Ion-Sensitive Field-Effect Transistor (ISFET), Immunologically Sensitive Field-Effect Transistor (IMFET), Noninvasive Blood Gas Monitoring, Blood-Glucose Sensors, Electronic Noses and Lab-on-a-chip- Clinical Laboratory Instrumentation – Spectrophotometry, Automated Chemical Analyzers, Chromatology, Electrophoresis, Hematology, Ethical issues related to clinical research						
UNIT V	WIRELESS SENSING IN HEALTHCARE					9
Introduction to m-health – Smart m-Health Sensing, m-Health Computing m-Health2.0, Social Networks, Health Apps, Cloud and Big Health Data- Open source software & hardware for designing embedded based medical devices – The Future of m- Health –case study						
TOTAL : 45 PERIODS						
COURSE OUTCOMES:						
At the end of the course the student will be able to:						
CO1	Understand the basic concepts of embedded systems in medical devices.					Understand

CO2	Apply the basic knowledge of sensors and m-health to design various healthcare devices.	Apply
CO3	Apply the fundamental principles of embedded systems to implement healthcare devices for a given problem.	Apply
CO4	Apply the basic mathematical knowledge to provide a solution for the given specification.	Apply
CO5	Analyze the use of various embedded systems for the given problem.	Analyze
CO6	Develop simple health care monitoring systems for different applications by considering all the ethical factors.	Create

TEXT BOOKS:

1. John G. Webster, Amit J. Nimunkar , — Medical Instrumentation - Application and Design, Fifth Edition, JohnWiley and Sons, 2020
2. Roberts. H. Istepanian and Bryan Woodward, —m-Health Fundamentals and Applications, Wiley, 2017
3. Subhas Chandra Mukhopadhyay and Aime Lay-Ekuakille,—Advances in Biomedical Sensing, Measurements, Instrumentation and Systems, Springer, 2010

REFERENCES:

1. Niezen G, Eslambolchilar P, Thimbleby H, —Open-source hardware for medical devices, BMJ Innovations 2016.
2. Joseph D. Bronzino, —The Biomedical Engineering Handbook, Third Edition, RCPress, Taylor & Francis Group, 2006

COURSE DESIGNER: Mrs.T.Ruba, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3	2	2	2	2									2
CO3	3	2	1											2
CO4	3	2												2
CO5	3	2	1											3
CO6	2	1	3	3	3									3
CAM (Avg)	3	1.8	1.75	2.5	2.5									2.4
3- Strong					2- Medium					1- Weak				

R21ECV608	TELE MEDICINE (Industry Supported)	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> ● Explain basic parts of Tele radiology systems like Image Acquisition System, Display System, Communication Network and Interpretation. ● Impart the need of Various telemedical technology in designing the Telemedicine system ● Describe the medical image information processing and ethical aspects of Telemedicine 					
UNIT I	INTRODUCTION TO TELEMEDICINE				9
History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Scope, Benefits and limitations of Telemedicine.					
UNIT II	TELEMEDICAL TECHNOLOGY				9
Principles of Multimedia - Text, Audio, Video, data, Data communications networks and Services. Wireless communication; Wireless Networks: Bluetooth, Infrared, WLAN and Wi-Fi, Zig-Bee and Cellular networks – RFID in Telemedicine; Wireless Technology in Patient monitoring; General health assessments.					
UNIT III	MEDICAL INFORMATION PROCESSING				9
Collecting Data from Patients; Bio-signal Transmission and Processing; Information Security overview- Risks and Security management – Cryptography; Digital Signature, Safeguarding Patient Medical History; Anonymous Data collection and Processing; Biometric Security and Identification.					
UNIT IV	TELEMEDICINE APPLICATIONS				9
Telecare; Telecare for Senior Citizens, Telemedicine in Physiotherapy; Healthcare access for rural areas; Healthcare Technology and the Environment, Home care for the Elderly, Smart home Assistive Technologies.					
UNIT V	ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE				9
Confidentiality and Law, patient rights and consent, access to medical Records, Consent treatment, jurisdictional Issues, Intellectual property rights.					
TOTAL:					45 PERIODS
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concept, ethical and legal Aspects of telemedical system.				Understand
CO2	Apply the concept of communication system for the design of telehealth applications				Apply

CO3	Apply the concept of multimedia technologies in the healthcare applications	Apply
CO4	Analyze the various medical information processing techniques for safeguarding medical data	Analyze
CO5	Describe the role of Information technology in alternative medicines with case studies	Apply
CO6	Apply telemedicine technologies and practices in a variety of health care Environments	Apply
TEXT BOOKS:		
<ol style="list-style-type: none"> Norris, A.C. —Essentials of Telemedicine and Tele carell, Wiley, 2002 Bernard Fong, A.C.M Fong and C.K.Li, —Telemedicine Technologiesll, John Wiley, 2011. Wootton, R., Craig, J, Patterson, —Introduction to Telemedicinell Royal Society of Medicine Press Ltd. , (2nd ed.), 2006 		
REFERENCES:		
<ol style="list-style-type: none"> H.K. Huang, —PACS and imaging informatics – Basic Principles & applicationll, Wiley Blackwell Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), —Public Health Informatics and Information Systemsll, Springer, 2003. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002. Latifi, R. —Current Principles and Practices of Telemedicine and e-Healthll. Washington DC: IOHS, 2008. 5. Mohan Bansal, —Medical Informaticsl, Tata McGraw-Hill, 2004 		
COURSE DESIGNER: Taj Orthopedic Research Centre (TORC), Taj Hospital Madurai.		

O/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2		2					2	2
CO2	3	2											2	3
CO3	3	2											2	
CO4	3	2	2										2	
CO5	2	3				2	2						2	
CO6	2	2				2	2						2	
CAM (Avg)	2.5	2.2	2			2	2	2					2	
3- Strong 2- Medium 1- Weak														

OTHER ELECTIVES

S.No	Course Code	Course Title	L	T	P	C
Other Electives						
1.	R21UEC901	Linear Control Engineering	3	0	0	3
2.	R21UEC902	Robotics and Applications	3	0	0	3
3.	R21UEC903	Principles of Artificial Intelligence	3	0	0	3
4.	R21UEC904	Multimedia Compression and Communication	3	0	0	3
5.	R21UEC905	ARM System Development	3	0	0	3
6.	R21UEC906	AR & VR	3	0	0	3
7.	R21UEC907	Cyber security systems	3	0	0	3
8.	R21UEC908	Essentials of Big Data Analytics	3	0	0	3
9.	R21UEC909	Fundamentals of Ubiquitous Computing	3	0	0	3

R21UEC901	LINEAR CONTROL ENGINEERING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the concept of open loop and closed loop (feedback) systems To provide knowledge of time domain and frequency domain analysis of control systems. To present the compensation technique that can be used to stabilize control systems 					
Unit – 1	CONTROL SYSTEMS MODELING				9
Control System: Terminology and Basic Structure, Open loop and Closed Loop Systems -Feed forward and Feedback control theory, Mechanical and Electrical Transfer Function Models, Block diagram Models, Signal flow graphs models.					
Unit – 2	TIME RESPONSE ANALYSIS				9
Transient response-Steady state response, Measures of performance of the standard first order and second order system, Steady error constant and system- type number, PID control- Analytical design for PD, PI,PID control systems					
Unit – 3	FREQUENCY RESPONSE AND SYSTEM ANALYSIS				9
Closed loop frequency response, Performance specification in frequency domain, Frequency response of standard second order system , Bode Plot , Polar Plot , Nyquist plots, Design of compensators using Bode plots					
Unit – 4	STABILITY ANALYSIS				9
Concept of stability, Bounded - Input Bounded - Output stability, Routh stability criterion, Root locus concept-Guidelines for sketching root locus, Nyquist stability criterion.					
Unit – 5	CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS				9
State variable representation, Conversion of state variable models to transfer functions, Conversion of transfer functions to state variable models, Solution of state equations, Concepts of Controllability and Observability, Stability of linear systems					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic principles, types, and modeling approaches of control systems.				Understand
CO2	Apply system modeling and time-domain analysis techniques to determine and improve control system performance.				Apply
CO3	Apply frequency-domain analysis and stability techniques to examine system behavior and design compensators for improved				Apply

	performance.	
CO4	Analyze system stability using standard analytical techniques and interpret system time and frequency responses.	Analyze
CO5	Analyze and represent control systems using state-space methods and examine controllability and observability.	Analyze
CO6	Evaluate appropriate techniques to enhance system performance in both time and frequency domains	Evaluate

TEXT BOOKS:

1. M.Gopal, —Control System – Principles and Design, Tata McGraw Hill, 4th Edition, 2012.
2. J.Nagrath and M.Gopal, —Control System Engineering, New Age International Publishers, 5th Edition, 2009.

REFERENCES:

1. Norman S. Nise, Control Systems Engineering, 6th edition, Wiley, 2011.
2. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 12th Edition, Prentice Hall, 2011.
3. Benjamin.C.Kuo, Automatic control systems, Prentice Hall of India, 6th Edition, 2013

COURSE DESIGNER : Mr.A.Nagaraj, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3													3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
3- Strong					2- Medium					1- Weak				

R21UEC902	ROBOTICS AND APPLICATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To Introduce basic concepts in robotics. To make students aware of technologies used in robotics. To impart the knowledge of various programming techniques for robotics design. 					
Unit – 1	INTRODUCTION				9
Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and Control issues- Various manipulators – Sensors - work cell - Programming languages.					
Unit – 2	ROBOT MOTION ANALYSIS AND CONTROL				9
Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedomDirect kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.					
Unit – 3	MANIPULATOR DIFFERENTIAL MOTION AND STATICS				9
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance. Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.					
Unit – 4	PATH PLANNING				9
Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.					
Unit – 5	ROBOT PROGRAMMING				9
Methods of Robot programming; lead through programming methods; a robot program as a path in space; motion interpolation; weight, signal and delay commands; Branching, capabilities and limitations of lead through methods.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concept of robotics.				Understand
CO2	Apply the various concepts of motion control and statics to design a robotics parts				Apply
CO3	Apply the knowledge of the dynamics in robotics control				Apply
CO4	Analyze the various path planning techniques in robotics				Analyze

CO5	Apply the knowledge of basic programming for various controls on robots.	Apply
CO6	Evaluate the manipulator differential motion and various path planning techniques in robotics.	Evaluate
TEXT BOOKS:		
1. R.K. Mittal and I.J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4 th Reprint, 2005.		
2. Mikell P.Groover, Michell wein, Roger N. Nagal and Nicholas G. Ordey, "Industrial Robotics, technology, Programming and applicationsll McGraw Hill.		
REFERENCES:		
1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis__, Oxford University Press, Sixth impression, 2010.		
2. K. K.Appukuttan, Robotics, I K International, 2007.		
3. V.Damel Hunt, —Smart Robotsll, Chappan and Hall		
4. S.Ghoshal, —Embedded Systems & Roboticsll – Projects using the 8051 Microcontrollerll, Cengage Learning, 2009.		
COURSE DESIGNER: Mrs. N.Kani Amudham, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3													3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
3- Strong 2- Medium 1- Weak														

R21UEC903	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamental concepts in artificial intelligence. To impart the make the students to apply the artificial intelligence techniques in application which involve reasoning and learning. To give an idea about the basics of designing intelligent agents that can solve general purpose problems. 					
UNIT 1	INTRODUCTION & PROBLEM SOLVING				9
The foundation of Artificial Intelligence, The History of Artificial Intelligence, The state of Art Intelligence Agents, Structure of Agents & Problem Solving Agent Searching for solution Uninformed search strategies ,Heuristics– informed search strategies					
UNIT 2	LOGICAL REASONING				9
Logical agents, Knowledge Based Agent, The Wumpus World, Propositional Theorem Proving, Effective Propositional Model ,checking, Agent Based on Propositional Logic					
UNIT 3	PLANNING				9
Algorithm for Planning With State-Space Search, Planning Graphs, Other classical Planning Approaches, Planning and Acting In The Real World -Hierarchical Planning.					
UNIT 4	UNCERTAIN KNOWLEDGE AND REASONING				9
Quantifying Uncertainty, Basic probability Notation, Probabilistic Reasoning- Bayesian Networks, Inferences In Bayesian Networks, Dynamic Bayesian Networks					
UNIT 5	DESIGN THINKING IN BUSINESS PROCESSES				9
Forms of Learning, Learning From Observation-Supervised Learning, Decision Trees ,Statistical Learning Methods, Reinforcement Learning-Passive Reinforcement Learning ,Active Reinforcement Learning					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concepts of Artificial Intelligence.				Understand

CO2	Apply the basic principles of AI in solutions that require problem solving and learning.	Apply
CO3	Apply the knowledge of Bayesian networks under uncertain environment.	Apply
CO4	Apply learning algorithms to derive facts from the given data set.	Apply
CO5	Analyze the various reinforcement Learning in intelligence systems	Apply
CO6	Analyze the various planning methods in Intelligence systems.	Analyze

TEXT BOOKS:

1. D. Poole and A. Mack worth. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
2. Stuart J. Russell and Peter Norvig, 'Artificial Intelligence A Modern Approach, Third edition, Pearson Education, 2010

REFERENCES:

1. David Poole, Alan Mackworth, Randy Goebel, Computational Intelligence : a logical approach, Oxford University Press, 2004.
2. J. Nilsson, —Artificial Intelligence: A new Synthesis, Elsevier Publishers, 1998.
3. R. Brachman, H. Levesque. Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

COURSE DESIGNER : Mrs. N.Kani Amudham, AP/ECE

CO/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2	2										2	
CO6	3	3	2										2	
CAM (Avg)	2.8 3	2.2	2										2	

3- Strong 2- Medium 1- Weak

R21UEC904	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To familiarize the basic concepts of multimedia components. To be well known to the compression techniques. To enrich the knowledge of VoIP technology. 					
Unit – 1	MULTIMEDIA COMMUNICATIONS				9
Introduction: Multimedia Multimedia information, Multimedia networks ,Multimedia applications, Application ,Text, sound, images, graphics, animation, Video, hardware					
Unit – 2	AUDIO AND VIDEO COMPRESSION				9
Audio compression ,DPCM ,Adaptive PCM, Adaptive predictive coding, linear Predictive coding code excited LPC, Perpetual coding Video compression, principles- H.261,H.263- MPEG 1, 2, 4					
Unit – 3	TEXT AND IMAGE COMPRESSION				9
Compression Principles, Source Encoders And Destination Encoders, Lossless And Lossy Compression, Entropy Encoding –Source Encoding, Text Compression, Static Huffman Coding Dynamic Coding, Arithmetic Coding, Lempel Ziv-Welsh Compression- Image Compression					
Unit – 4	VOIPTECHNOLOGY				9
VoIP Components, Voice Quality, Measuring Voice Quality, Testing VoIP, Case Studies, VoIP Applications VoIP: Present and Future					
Unit – 5	MULTIMEDIA NETWORKING				9
Multimedia networking, Applications, Streamed stored and audio-making the best Effort service, Voice-over IP, Protocols for real time interactive Applications-distributing multimedia-beyond best effort service, Scheduling Mechanisms and policing Mechanisms-integrated services, Differentiated Services-RSVP, Recent application in multimedia					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Explain the compression techniques for different applications				Understand
CO2	Apply various predictive coding techniques for audio and video applications				Apply
CO3	Apply the multimedia compression techniques for wireless communication protocols				Analyze
CO4	Analyze the performance metrics of various compression techniques				Analyze
CO5	Analyze the QOS mechanisms for real-time online multimedia systems				Evaluate

CO6	Simulate Image Compression techniques for different images using simulation tools.	Apply
TEXT BOOKS:		
1. Fred Halsall —Multimedia communication - Applications, Networks, Protocols and Standards II, Pearson Education, 2001.		
REFERENCES:		
1. Tay Vaughan, —Multimedia: Making it workII, 7 th Edition, TMH 2008		
2. Kurose and W.Ross —Computer Networking —a Top Down ApproachII, Pearson Education 2005		
3. Mr. Angus Ma—Voice over IPII, Spirent Communications, 2001.		
4. Dr. TamalChakraborty —VoIP technology: applications and challengesII2019.		
5. KR. Rao,Z S Bojkovic, D A Milovanovic, —Multimedia Communication Systems: Techniques, Standards, and NetworksII, Pearson Education 2007.		
6. R. Steimnetz, K. Nahrstedt, —Multimedia Computing, Communications and ApplicationsII, Pearson Education.		
COURSE DESIGNER : Mrs. G.Ramu Priya, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3													3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
3- Strong 2- Medium 1- Weak														

R21UEC905	ARM SYSTEM DEVELOPMENT	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce ARM fundamentals. To impart knowledge on ARM language and organization. To introduce the hardware architecture support and instruction set. 					
Unit – 1	ARM EMBEDDED SYSTEM FUNDAMENTALS				9
The RISC and ARM Design Philosophy, Embedded system Hardware, Embedded system Software, ARM processor Fundamentals, Current Program status Registers, Pipeline, Exceptions, Interrupts and Vector Table, ARM processor families, Instruction Set					
Unit – 2	ARM CORTEX M3 ARCHITECTURE				9
Architecture, Registers, operating Modes, Exception and interrupts, vector table, Stack memory operations, Instruction set, Bus Interfaces, Interrupt Behavior					
Unit – 3	MEMORY SYSTEMS				9
Memory hierarchy and cache memory, Cache Architecture, ARM MMU, Page Tables, Translation Look aside buffer, Cache and write Buffer, Coprocessor 15 and MMU configuration					
Unit – 4	ARM PROGRAMMING				9
Efficient C programming, ARM assembly code writing, FIIR and IIR filter design					
Unit – 5	SYSTEM DEBUGGING				9
Debugging feature, Core sight overview, Debug modes and events, Breakpoints in the Cortex M3, Accessing Registers, Debugging Components					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the function of ARM and Cortex M3 systems				Understand
CO2	Apply the various data types of ARM and Cortex M3 systems to develop various codes.				Apply
CO3	Analyze the different types of programming mode for ARM and Cortex M3 systems				Analyze
CO4	Validate the ARM and Cortex M3 systems using its various functions.				Evaluate
CO5	Design the real time system using ARM and Cortex M3 systems				Create

CO6	Design the project Motor Speed Controlling through Voice using LabVIEW	Apply
TEXT BOOKS:		
1. ARM System Developer's Guide, Designing and Optimizing system software, Elsevier, 2008, Andrew N Sloss, Dominic Symes, Chris Wright.		
2. The Definitive Guide to the ARM® Cortex-M3, Second Edition, Joseph Yiu.		
REFERENCES:		
1. ARM system on chip architecture, Steve Furber, Addison Wesley, 2000		
2. Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley, 2013		
COURSE DESIGNER : Mrs. P.Deepa, AP/ECE		

CO/PO/PSO MAPPING														
COs	PO												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													2
CO2	3													3
CO3	3													3
CO4	3													3
CO5	3	2	2											3
CO6	3	2	2											3
CAM (Avg)	2.7	2	2											2.8
3- Strong 2- Medium 1- Weak														

R21UEC906	AR &VR	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction To Impart Geometric Modeling Techniques Review the Virtual Environment To make use of various types of Hardware and Software in Virtual Reality systems to varieties of Applications 					
UNIT I	Introduction to Virtual Reality (VR)				9
Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark					
UNIT II	Computer Graphics and Geometric Modelling				9
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection					
UNIT III	Virtual Environment				9
Input / Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices) Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft					
UNIT IV	Augmented Reality (AR)				9
Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, enhancing interactivity in AR Environments, Evaluating AR systems					
UNIT V	Development Tools and Frameworks				9
Human factors: Introduction, the eye, the ear, the somatic senses Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					

CO1	Describe the fundamental concepts related to VR/AR	Understand
CO2	Apply the Knowledge of Computer vision to design Geometric Modeling Techniques	Apply
CO3	Apply the Knowledge of Human Computer Interaction to understand the Basic Virtual Environment	Apply
CO4	Apply various types of Hardware and Software in Virtual Reality systems	Apply
CO5	Analyze the various VR/AR Technologies	Analyze
CO6	Design and formulate Virtual/Augmented Reality Applications	Create

TEXT BOOKS:

1. Coiffet, P., Burdea, G. C., (2003), —Virtual Reality Technology,|| Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), —Augmented Reality: Principles & Practice,|| Pearson, ISBN: 9789332578494
3. Norman, K., Kirakowski, J., (2018), — Wiley Handbook of Human Computer Interaction,|| Wiley-Blackwell, ISBN: 9781118976135.

REFERENCES:

1. Craig, A. B., (2013), —Understanding Augmented Reality, Concepts and Applications,|| Morgan Kaufmann, ISBN: 9780240824086
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), —Developing Virtual Reality Applications, Foundations of Effective Design,|| Morgan Kaufmann, ISBN: 9780123749437
3. John Vince, J., (2002), —Virtual Reality Systems, — Pearson, ISBN: 9788131708446 4. Anand, R., —Augmented and Virtual Reality,|| Khanna Publishing House

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2												3	
CO2	3	2											3	
CO3	3	2											3	
CO4	3	3	2										3	
CO5	3	3	2	2									3	
CO6	2	3	2	2	3	2	2		2			2	3	
CAM (Avg)	2.6	2.6	2	2	3	2	2		2			2	3	
3- Strong 2- Medium 1- Weak														

R21UEC907	CYBER SECURITY SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To impart knowledge in basic networking and web technology To train about of information security & fundamentals of cryptography To prepare the students to learn about security standards and regulations 					
UNIT I	NETWORKING AND WEB TECHNOLOGY	8			
Network Components - Network Communication-Types-Network Management Protocols – Network Communication Protocols-Network Security Protocols -Web Technologies: Front-End and Back – End Technologies - Web Services - Simple Object Access Protocol (SOAP) and Representational State Transfer (REST).					
UNIT II	INTRODUCTION TO CYBERSECURITY	9			
Recent Cyber Attacks - Cyber Security Concepts - Layers of Cyber Security –Introduction to Application Security - Secure Coding OWASP Top 10 - Coding Practices Secure Design.					
UNIT III	INFORMATION SECURITY & CRYPTOGRAPHY	10			
Information security- Data Security - Network security - Application Security – Cryptography - Symmetric Key Cryptography -AES, DES Algorithm - Asymmetric Key Cryptography-RSAAlgorithm -Shared Key Cryptography – Public Key Cryptography – Hashing -Digital Signature – Illustration - Applications of cryptography.					
UNIT IV	PRIVACY IN CYBER SPACE	9			
Privacy Concepts -Principles and Policies - Privacy on the Web - Email Security – Privacy Impacts of Emerging Technologies - Data Mining and Big Data.					
UNIT V	SECURITY STANDARDS AND REGULATIONS	9			
PCIDSS for cardholder data protection –ISMS for Organization data -FIPS and NIST for federal and defense cyber security compliance–FISMA for protection of government information and operations –GDPR for personal data of individuals –HIPAA for privacy of Patient Health Information –SOX for prevent corporate fraud.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic concepts of network components, OSI and TCP/IP architecture with network security standards.	Understand			
CO2	Apply the concept of Security algorithm in networks standards	Apply			
CO3	Apply the knowledge of cryptography in web and security management	Apply			
	Apply the working principles of access-based control systems,	Apply			
CO4	security threats, wireless security threats analysis				

CO5	Analyze the security incident response tools to quickly detect the cyber -attacks in the network (Modern tool usage)	Analyze
CO6	Analyze the importance of Security Standards with different algorithm for security issues.	Analyze
TEXT BOOKS:		
1. Patrick Ciccarelli, Christina Faulkner, Jerry Fitzgerald, Alan Dennis, David, Groth, And Toby Skandier, “NETWORKING BASICSII, Second edition John Wiley & Sons, Inc, Newyork.2012		
2. Simon Hakim, Philadelphia, PA, USA, Erwin A. Blackstone, Philadelphia, PA, USA, —CyberPhysical SecurityII, ISBN 978-3-319-32822-5 ISBN 978-3-319-32824-9 (eBook) DOI10.1007/978-3319-32824-9, New Delhi.2017		
REFERENCES:		
1. Walter Goral ski, —The illustrated Network How TCP/IP Works in a Modern NetworkII Second Edition, Copyright 2017, 2009 Elsevier Inc.		
2. Ilya Grigorik, —High-Performance Browser NetworkingII. O’Reilly Media, 2013.		
3. Martti Lehto, Pekka Neittaanmäki, —Cyber Security: Analytics, Technology and AutomationII Intelligent Systems, Control and Automation: Science and Engineering, 2015.		
4. Atul kahate, —Cryptography and Network securityII Tata Mc Graw –Hill Publishing companyItd, New Delhi 2015.		
5. George K.Kostopoulos, Cyber Space and Cyber Security, CRC Press, 2016.		
COURSE DESIGNER: Dr.J.Rajalakshmi, ASP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	2			3							2	
CO5	3	2	2	2		3							3	
CO6	3	2	2			3	2	2				2	3	
CAM (Avg)	3	2	2	2		3	2	2				2	2	
3- Strong 2- Medium 1- Weak														

R21UEC908	ESSENTIALS OF BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To know the fundamental concepts of big data and analytics. To explore tools and practices for working with big data □ To learn about stream computing. To know about the research that requires the integration of large amounts of data. 					
UNIT I	INTRODUCTION TO BIG DATA	9			
Data – Data Life Cycle - History or Evolution and Definition of Big Data – Sources, Characteristics and Benefits of Big Data - Traditional Data Versus Big Data – Application of Big Data - Types of digital data: Structured, Unstructured and Semi-structured - Applications of Big Data.					
UNIT II	DATA ANALYTICS	9			
Data Analytics: Overview – Classification of Analytics – Analytical tools - Big Data Analytics Important - Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Machine Learning Algorithms: Regression Model, Clustering, Collaborative Filtering, Associate Rule Making, Decision Tree.					
UNIT III	BIG DATA TECHNOLOGIES - HADOOP DISTRIBUTED FILE SYSTEM	9			
Hadoop Overview – Hadoop Cluster: Architecture – Components – Work-Flow of file stored in Hadoop. HDFS Architecture – HDFS Concepts – Blocks – NameNode – Secondary Name Node – DataNode - HDFS Federation – Basic File System Operations – Data Flow – Anatomy of File Read – Anatomy of File Write.					
UNIT IV	MAPREDUCE	9			
Getting to know Map Reduce – Map Reduce Execution Pipeline – Runtime Coordination and Task Management – Map Reduce Application – Hadoop Word Count Implementation.					
UNIT V	BIG DATA DATABASE	9			
MongoDB: Introduction – Database Model – Mongo Shell Command: Import CSV, TSV or JSON data into MongoDB, Create, Insert, Update, Delete, and Read the Database and collection- Reading and Writing Data to MangoDB					
TOTAL:45 Periods					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					

CO1	Elaborate the Big Data Analytics, Types, Tools, Database and the Big Data Technologies.	Understand
CO2	Apply various Techniques and Tools of Processing data with Hadoop to solve the problems relevant to Big Data Analytics.	Apply
CO3	Apply and perform analytics on real-time streaming data.	Apply
CO4	Apply different mining algorithms and recommendation systems for large volumes of data.	Apply
CO5	Analyze the program using various big data technologies and databases.	Analyze
CO6	Analyze various technologies, Tools by means of Big Data Analytics.	Analyze

TEXT BOOKS:

1. Seema Acharya and Subhashini Chellappan, —Big Data and AnalyticsII, Wiley India Pvt. Ltd., 2016
2. Seema Acharya, Subhashini Chellappan, —Big Data and AnalyticsII, Wiley Publication, 2015. 3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
4. J. Han, M. Kamber, —Data Mining Concepts and TechniquesII, Morgan Kaufmann
5. Paulraj Ponnian, —Data Warehousing FundamentalsII, John Willey.
6. Robert D. Schneider , Hadoop for Dummies, Wiley India

REFERENCE BOOKS:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
2. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.
3. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
4. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	2			3							2	
CO5	3	2	2	2		3							3	
CO6	3	2	2			3	2	2				2	3	
CAM (Avg)	3	2	2	2		3	2	2				2	2	
3- Strong					2- Medium				1- Weak					

R21UEC909	FUNDAMENTALS OF UBIQUITOUS COMPUTING	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamental concepts, key principles, and paradigms of ubiquitous computing. To impart the knowledge of HCI in the context of ubiquitous computing for interacting with smart environments and wearable devices. To help students to understand the security threats and privacy challenges in ubiquitous computing 					
UNIT 1	INTRODUCTION TO UBIQUITOUS COMPUTING	9			
Concept of Ubiquitous Computing and Advantages, Ubiquitous Computing Applications and Scope, Properties of Ubiquitous Computing, Modeling the Key Ubiquitous Computing Properties. Ubiquitous System Environment Interaction. Architectural Design for UbiCom Systems: Smart DEI Model					
UNIT 2	UBIQUITOUS COMPUTING SMART DEVICES AND SERVICES	9			
Smart Devices and Service properties, Smart mobile devices and Users, Mobile code, Smart Card Devices and Networks, Service Architecture Models. Service Provision Life-Cycle. Virtual Machines and Operating Systems, OS for Mobile Computers and Communicator Devices.					
UNIT 3	ACTUATION AND CONTROL	9			
Tagging the Physical World, Sensors and Networks, Micro- Electro-Mechanical Systems (MEMS), Embedded Systems and Real-Time Systems. Programmable and PID type control system, Robots.					
UNIT 4	HUMAN COMPUTER INTERACTION	9			
User Interfaces and Interaction for devices, Abstract user interface through Basic Smart Wearable and Implanted Devices. Human-Centered Design (HCD). User Models: Direct and indirect user input and modelling, modelling users' planned tasks and multiple tasks-based computing.					
UNIT 5	UBIQUITOUS COMPUTING PRIVACY	9			
Ubiquitous computing privacy definition, Solove's taxonomy of privacy, legal background, Interpersonal privacy, UbiComp challenges to privacy: Collection scale, manner and motivation, data types, data accessibility; Case study of privacy solution such as Protecting RFID tags, ways of addressing privacy in UbiComp.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Demonstrate the knowledge of UbiComp fundamentals and its applications.	Understand			
CO2	Explain smart devices and services used by UbiComp Systems.	Apply			
CO3	Apply the principles of actuation and control to employ programmable systems and robots for specific tasks in UbiComp environments.	Apply			
CO4	Analyze the design principles of user interfaces and interactions for Ubiquitous Computing devices in facilitating human-centered design	Analyze			

CO5	Analyze the taxonomy of Ubicomp privacy and ways of addressing Ubicomp privacy.	Analyze
CO6	Analyze innovative user interfaces and interaction mechanisms for Ubiquitous Computing devices.	Analyze
Text Books		
1. Ubiquitous Computing Fundamentals, John Krumm, CRC Press, 2010		
2. Stefan Poslad: Ubiquitous Computing: Smart Devices, Environments and Interactions, Wiley, London, 2009, Indian reprint, 2014.		
Reference Books		
1. Yin-Leng Theng and Henry B. L. Duh, Ubiquitous Computing, IGI, 2nd Edition, ISBN: 9781599046938.		
2. Adam Greenfield, Everywhere the Drawing age of Ubiquitous Computing, AIGA, 1st Edition, ISBN: 9780321384010.		
3. Laurence T. Yeng, Evi Syukur and Seng W. Loke, Handbook on Mobile and Ubiquitous Computing, CRC, 2nd Edition, ISBN: 9781439848111.		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	2			3							2	
CO5	3	2	2	2		3							3	
CO6	3	2	2			3	2	2				2	3	
CAM (Avg)	3	2	2	2		3	2	2				2	2	
3- Strong					2- Medium					1- Weak				

OPEN ELECTIVE COURSES OFFERED TO OTHER PROGRAMMES

S. No.	Course Code	Course Title	L	T	P	C
1.	R21UEC971	Design thinking for Innovations	3	0	0	3
2.	R21UEC972	IoT Concepts and Applications	3	0	0	3
3.	R21UEC973	Sensors	3	0	0	3
4.	R21UEC974	Fundamentals of VLSI Design	3	0	0	3
5.	R21UEC975	Wearable Devices	3	0	0	3
6.	R21UEC976	Basics of Communication systems	3	0	0	3
7.	R21UEC977	Automotive Electronics	3	0	0	3
8.	R21UEC978	CMOS Fabrication Using Simulator 3D	3	0	0	3

R21UEC971	DESIGN THINKING FOR INNOVATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To explain the process of Design Ideas. To familiarize the students about the prototype and testing. To develop design ideas in Strategic Innovations and Business. 					
UNIT 1	FUNDAMENTALS OF DESIGN THINKING				9
Design Thinking Process: Types of the thinking process, Common methods to change the human thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, the need of design thinking; Design thinking tools.					
UNIT 2	EMPATHIZE, IDEATION, PROTOTYPING AND TESTING				9
Human Centered Design (HCD) process - Empathize, Define, Ideate, Role of Empathy in design thinking, methods and tools of empathy, understanding empathy tools, Ideation methods, brain storming, advantages of brain storming, methods and tools of ideations, prototyping and methods of prototyping, user testing methods, Advantages and disadvantages of user Testing/Validation					
UNIT 3	DESIGN THINKING FOR STRATEGIC INNOVATIONS				9
Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design					
UNIT 4	PRODUCT INNOVATION				9
Design thinking for strategic innovation, Definition of innovation, art of innovation, teams for innovation, materials and innovation in materials, definition of product and its classification. Innovation towards product design					
UNIT 5	DESIGN THINKING IN BUSINESS PROCESSES				9
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs					
TOTAL: 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Appreciate various design process procedure and develop design ideas through different techniques	Understand			
CO2	Apply the principles of empathy, Ideation and find the solutions for human centered design problems	Apply			
CO3	Apply design thinking techniques for Strategic Innovations	Apply			
CO4	To expose the student with ideas, concepts, and solutions related to design and execution of projects using design thinking principles	Apply			
CO5	Apply design thinking techniques for product innovation	Analyze			

CO6	Analyze the design thinking in business process in various models	Analyze
TEXTBOOKS:		
1. —Engineering DesignII, Cengage learning (International edition) Second Edition, 20131. John.R.Karsnitz, Stephen O’Brien and John P. Hutchinson.		
2. —Change by designII, Tim Brown, HarperCollins, 2009		
3. — Engineering design —George E Dieter, Tata McGraw-Hill, 4 th edition, 2010		
REFERENCES:		
1. Yousef Haik and Tamer M.Shahin, —Engineering Design ProcessII, Cengage Learning, Second Edition, 2011.		
2. .IdrisMootee, —Design Thinking for Strategic InnovationII, John Wiley & sons(2013).		
3. —DesignThinking-The Guide BookII– Facilitated by the Royal Civil service Commission, Bhutan.		
4. . www.tutor2u.net/business/presentations/. /product life cycle/default.html		
5.https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf		
6. www.bizfilings.com › Home › Marketing › Product Development		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2											2	2	
CO2	2											2	2	
CO3	3		3									2	2	
CO4	3		3									2	2	
CO5	3		3			2		2			2	2	3	2
CO6	3		3			2	2	2			2	2	3	2
CAM (Avg)	2.6		2		-	0.6	0.3	0.6			0.6	2	2.3	0.6
3- Strong 2- Medium 1- Weak														

R21UEC972	IOT CONCEPTS AND APPLICATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the fundamentals of Internet of things To impart knowledge on various automation and monitoring applications in Internet of things To introduce the concept of various soft wares used in IoT 					
Unit – 1	IoT FUNDAMENTALS & BUILDING BLOCKS				9
Introduction-Evolution of IoT Concept-IoT Vision & Definition-IoT Basic Characteristics- IoT Distinction & General Enablers -IoT Architectures: Three, Five ,Six and Seven Layered architecture-IoT Building Blocks-The Smart Things, The IoT Gateway, Network Infrastructure-IoT Cloud-IoT Analytics, IoT and Smart Home					
Unit – 2	SENSING PRINCIPLES & APPLICATIONS IN IOT				9
Sensor Fundamentals, Sensor Classification, Anatomy of Sensors, WSN-Sensing Domain and Architecture of IoT Gateway, Selection of Gateway-IoT and Smart Home & Framework-IoT and Healthcare, IoT and Smart Mobility, Car Parking System-IoT and Agriculture- IoT Architecture of Smart Agriculture-Smart Grid, IoT-based Smart Cities, IoT and Smart Education, Industrial IoT					
Unit – 3	IOT AUTOMATION				9
The need for new technology, From DCS to SCADA-Automation System Architectures, Current trends in automation systems-Next Generation automation and digitization technology-The Local Cloud Concept-Local cloud establishment-Automation support- Automation application engineering in local clouds-Latency and security in clouds					
Unit – 4	IOT PLATFORMS AND TOOLS				9
Packet Tracer Programming Environment- Visual Programming Language -Hello world Program, Simple Smart Light Project-Open source IoT Platforms and Tools					
Unit – 5	APPLICATIONS AND CASE STUDIES				9
Agricultural IoT-Vehicular IoT-Healthcare IoT-Evolution of New IoT Paradigms- Challenges Associated with IoT-Emerging Pillars of IoT					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamental concepts of Internet of Things.				Understand
CO2	Apply the knowledge of architectural IoT and sensing principles concept to build the blocks in various applications of IoT				Apply

CO3	Apply the knowledge of IoT concepts and sensors to implement IoT in various applications using available open source software Tools	Apply
CO4	Design the basic electronic devices used in IoT using CISCO Packet Tracer	Apply
CO5	Analyze the different automotive applications in IoT	Analyze
CO6	Analyze various state of the art IoT based automation systems for different case studies	Analyze

Text Book

1. Muhammad Azhar Iqbal, Sajjad Hussain, Huanlai Xing, Muhammad Alilmran, Enabling the Internet of Things, IEEE Press, John Wiley & 2021.
2. Jerker Delsing, IoT Automation II, CRC Press Taylor & Francis Group, 2017.
3. Sudip Misra, Anandrup Mukherjee, Arjit Roy, Introduction to IoT, Cambridge University Press, 2020

REFERENCES:

1. Daniel Minoli,—Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M CommunicationsII, ISBN:978-1-118-47347- 4,WileyPublications
2. Bernd Scholz-Reiter, Florian Michahelles,—Architecting the Internet of ThingsII, ISBN978-3- 642-19156-5 e-ISBN978-3-642-19157-2, Springer
3. Hakima Chaouchi,—The Internet of Things Connecting Objects to the WebIIISBN:9781-84821-140-7,WileyPublications

Web Resources: <https://www.netacad.com/courses/packet-tracer><https://www.tinkercad.com/>

COURSE DESIGNER : Mrs. R.Devika, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2										2	2	2	
CO.2	2										2	2	2	
CO3	3										2	2	2	
CO4	3										2	2	2	
CO5	3	3	2	2	2						2	2	3	
CO6	3	3	2	2	2						2	2	3	2
CAM (Avg)	2.5	3	2	2	2						2	2	2	2
3- Strong 2- Mediuⁿ 1- Weak														

R21UEC973	SENSORS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> Describe the operation of various sensors and actuators. Select an appropriate sensor and actuator for sensing and control action respectively. Differentiate between smart sensor and conventional sensor. Compare analog and digital transducers with actuators. Discuss the latest technology in sensor development 					
UNIT I	Introduction				9
Principles of operation Sensors and transducers, classification, characteristics. Recent trends in sensor technology: Fibre Optic Sensors, Film Sensors, Semiconductor IC Technology, Micro electro mechanical System (MEMS), Nano Sensors.					
UNIT II	Transducers				9
Resistive potentiometer, Inductive Sensors, Stretched Diaphragm Variable Capacitance Transducer, Hall effect and Inductance and Eddy current sensors. Angular/Rotary movement Transducer, Electromagnetic Flowmeter.					
UNIT III	Electro analytical Sensors				9
Introduction, Electro-chemical Cell, Cell potential, Sd. Hydrogen Electrode (SHE), Liquid Junction and Other potentials, Polarization, Reference Electrodes, Sensor Electrodes, Radiation Sensors: Basic Characteristics, Photo-emissive Cell and Photomultiplier, Photovoltaic Cell, X-ray and Nuclear Radiation Sensors.					
UNIT IV	Smart Sensors				9
Introduction, Primary Sensors, Amplification, Filters, Converters, Compensation, Information coding/processing, Data Communication, Spectroscopic thermometry, Heat flux sensors.					
UNIT V	Applications				9
On – board automatic sensors, Home appliance sensors, Aerospace sensors, Sensors for manufacturing, Medical diagnostic sensors, sensors for environmental monitoring.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the principle of operation of different sensors and actuators.				Understand
CO2	Design a real time sensor using any simulation software				Apply
CO3	Apply the concept of operation of various sensors in various applications.				Apply
CO4	Analyze transducers for measurement of pressure and force.				Analyze

CO5	Analyze and select proper sensor electrodes for electrochemical application.	Analyze
CO6	Design a smart sensor using conventional sensors and microcontrollers for specified application.	Apply
TEXT BOOKS:		
1. Sensors and TransducersII, 2/E by D. Patranabis.		
2. Electrical & Electronics Measurements and Instrumentation by A.K.Shawhney, Dhanpat Rai & Sons.		
3. Electronics instrumentation by H. S. Kalsi [TMH]		
4. Hand Books of Instrumentation.		
REFERENCES:		
1. Process control Instrumentation Technology by CD Johnson, PHI Learning		
COURSE DESIGNER: Mrs. P.Deepa, AP/ECE		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	-	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2
CO4	2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO6	3	2	3	-	-	-	-	-	-	-	-	-	2	2
CAM (Avg)	2.5	2.4	2.4	-	2	-	-	-	-	-	-	-	2	2
3- Strong 2- Medium 1- Weak														

R21UEC974	FUNDAMENTALS OF VLSI	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To present the Digital fundamentals, Boolean algebra and its applications. To familiarize with the design of various combinational digital circuits using logic gates • Study the fundamentals of CMOS circuits and its characteristics. 					
UNIT I	DIGITAL FUNDAMENTALS				9
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums.					
UNIT II	COMBINATIONAL AND SEQUENTIAL CIRCUITS				9
COMBINATIONAL CIRCUITS: Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder –BCD Adder, Multiplexer, Demultiplexer.					
SEQUENTIAL CIRCUITS: Flip flops – SR, JK, T, D, Master/Slave FF – operation, Ring Counters.					
UNIT III	INTRODUCTION TO MOS TRANSISTOR				9
MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, DC Transfer characteristics.					
UNIT IV	COMBINATIONAL MOS LOGIC CIRCUITS				9
Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates.					
UNIT V	SEQUENTIAL MOS LOGIC CIRCUITS				9
Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the basic knowledge of digital electronics.				Understand
CO2	Apply the concepts of Boolean function to design combinational circuits.				Apply
CO3	Design transmission gate using MOS Transistor.				Apply
CO4	Design various Sequential circuits using CMOS Transistor				Apply
CO5	Analyze different MoS Logic circuits using Pass transistor.				Analyze
CO6	Analyze the performance of combination and sequential circuits using various design methodologies.				Analyze

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspectivell, 4th Edition, Pearson , 2017
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, II Digital Integrated Circuits:A Design perspectivell, Second Edition , Pearson , 2016.

REFERENCES:

1. Charles H.Roth. —Fundamentals of Logic DesignII, 6th Edition, Thomson Learning, 2013.
2. M. Morris Mano and Michael D. Ciletti, —Digital DesignII, 5th Edition, Pearson, 2014.
3. Thomas L. Floyd, —Digital FundamentalsII, 10th Edition, Pearson Education Inc, 2011
4. M.J. Smith, —Application Specific Integrated CircuitsII, Addison Wesley, 1997.
5. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim —CMOS Digital Integrated Circuits: Analysis & DesignII, 4th edition McGraw Hill Education, 2013

COURSE DESIGNER: Mr. S.Janarthanan, AP / ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2													2
CO2	3													2
CO3	3													2
CO4	3	3												2
CO5	3	3	2	2										2
CO6	3	3	2	2										2
CAM (Avg)	2.8	3	2	2										2
3- Strong 2- Medium 1- Weak														

R21UEC975	WEARABLE DEVICES	L	T	P	C
		3	0	0	3
OBJECTIVES:					
➤ To know the sensor and signal processing requirement of wearable systems					
➤ To understand the communication and security aspects					
➤ To know the level of energy involvement in wearable systems					
UNIT 1	Fundamentals, Advancements, and a Roadmap 9 for the Future				
World of Wearable and Attributes of wearables, Textiles and clothing, Challenges and Opportunities, The Future of Wearables: Defining the Research Roadmap, Making Electronics wearable, Designing wearable devices.					
UNIT 2	Wearable Inertial Sensors and Their Applications				9
Introduction, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable motion sensors, CMOS –Based Biosensors, E-Textiles					
UNIT 3	Wireless Body Area Networks				9
Need for wireless monitoring, Definition of body area network, BAN and Healthcare, Technical challenges, System security and reliability, BAN Architecture.					
UNIT 4	Energy Harvesting at the Human Body				9
Introduction to Energy Harvesting Systems, Energy Harvesting from Temperature Gradient from Human body, Energy harvesting from Foot Motion, Wireless Energy Transmission.					
UNIT 5	Applications				9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly Patients, Neural recording, Gait analysis, Sports Medicine, Smart Watch.					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the fundamentals and Advancements in wearable.				Understand
CO2	Apply the various properties of sensors to process the wearable devices				Apply
CO3	Analyse the need for BAN and the challenges involved in the design of BAN				Apply
CO4	Analyse the sensors and wearable devices of wireless health systems.				Analyze
CO5	Analyze the various types of Energy Harvesting methods for real time wearables				Analyze
CO6	Design the basic wearable system for various applications.				Analyze

TEXT BOOKS:

1. Edward Sazonov, Michael R. Neuman, Wearable Sensors Fundamentals, Implementation and Applications, Academic Press, Nov 2020
2. Annalisa Bonfiglio and Danilo De Rossi, Wearable Monitoring System, Springer,2011

REFERENCES:

1. Gaetano D. Gargiulo and Ganesh R. Naik, Wearable/Personal Monitoring Devices: Present to Future, Springer, 2022
2. Hiroto Yasuura, Smart Sensors at the IoT Frontier ,1st ed. 2018
3. Sudip Mishra, Anandarup Mukherjee, Arijit Roy: Introduction to IOT, Cambridge University Press,2014
4. Mehmat R.Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation application,Pan Stanford Publishing Pte.Ltd,Singapore,2012

O/PO/PSO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	3	2											2	
CO3	3	2	2										2	2
CO4	3	3	2										2	2
CO5	3	3	2										3	2
CO6	3	3	2										3	2
CAM (Avg)	2.8	2.6	2										2.3	2
			3- Strong			2- Medium			1- Weak					

R21UEC976	BASICS OF COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES:					
<ul style="list-style-type: none"> To introduce basics of Communication system To impart knowledge on Analog and Digital modulation techniques To preface about the wave propagation To describe about the applications of Communication systems 					
UNIT I	Introduction	9			
Review on Communication- Elements of an Electrical Communication System- Digital Communication System –Early work in Digital Communication- Communication Channels and their characteristics					
UNIT II	Analog Modulation	9			
Amplitude Modulation- Virtues and Limitations of Amplitude modulation- Angle Modulation – Frequency Modulation – Narrowband frequency modulation – wideband Frequency modulation – Transmission bandwidth of FM signals - Phase Modulation					
UNIT III	Digital Modulation	9			
Amplitude Shift keying – Frequency Shift keying- Phase shift keying – QPSK- PCM - Sampling					
UNIT IV	Wave Propagation	9			
Concept of propagation of radio waves- Ground wave Propagation- Sky wave : Ionospheric layers, multipath space wave propagation - Duct propagation(microwave space-wave propagation)- Troposphere scatter propagation					
UNIT V	Applications of Communication Systems	9			
Satellite, RADAR, Optical, Mobile and Computer Communication(Block diagram approach only)					
TOTAL : 45 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Describe the evaluation of the communication systems and its fundamental concepts	Understand			
CO2	Describe the principles of amplitude modulated and angle modulated communication systems and be able to analyze their performance.	Apply			
CO3	Describe the principles of various digital modulation systems and their properties	Apply			
CO4	Apply the knowledge of wave propagation to determine the radiation characteristics	Apply			

CO5	Determine the communication channels types with their characteristics	Analyze
CO6	Design antennas for given specification using modern tools	Create

TEXT BOOKS:

1. Fundamentals of Communication Systems, Second edition, John.G.Proakis and Masoud Salchi (Pearson) 2014.
2. Communication Systems, John Wiley & Sons, INC. 4th Edition 2000.

REFERENCES:

1. An Introduction to Analog and digital Communications, 2nd Edition, Simon Haykin 2010
2. Fundamentals of Analogue and Digital Communication systems- Sunil Bhooshan – Springer, 2022

COURSE DESIGNER : Dr.G.Krishnaveni, ASP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2												2	
CO2	3	3	2										2	
CO3	3	3	2										2	
CO4	3	3	2									2	2	
CO5	3	3	3	3									2	
CO6	3	3	3	3	3							2	2	
CAM (Avg)	2.83	3	2.4	3	3							2	2	
3- Strong 2- Medium 1- Weak														

R21UEC977	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3
OBJECTIVES: To understand Automotive Electronic Engine Control in today_s automotive industry. <ul style="list-style-type: none"> To analyze various automotive sensors and actuators while interfacing with processors during automotive system design. To understand the future Automotive Electronic Systems.					
Unit 1	Automotive Fundamentals	9			
Evolution of Automotive Electronics, Automobile Physical Configuration, Alternative Engines: Diesel Engine, Drive Train, Differential, Suspension, Brakes, Steering System, Case study					
Unit 2	Electronics Fundamentals	9			
Semiconductor Devices:Diode, Rectifier, Transistors, Amplifiers. Digital Circuits: Number System, Logic Circuits. Integrated Circuits,Case study					
Unit 3	Sensors and Actuators	9			
Sensors: Basics and Overview -- Automotive control System, Applications of Sensors and Actuators – Different types of sensors.Actuators: Automotive Engine Control Actuators- Exhaust Gas Recirculation actuator - Ignition System,Case Study					
Unit 4	Digital Engine Control Systems	9			
Introduction:Digital Engine Control,Features,EGR Control,Variable Valve Timing Control,Electronic Engine Control, Integrated Engine Control System, Case study					
Unit 5	Future Automotive Electronic System	9			
Engine and Drive train, Safety, Instrumentation, Navigation – Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Automatic driving Control, Case study					
TOTAL: 45 Periods					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Understand the basic automotive components, subsystems, and basics of Electronic Engine Control in today_s automotive industry	Understand			
CO2	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems	Apply			
CO3	Design a circuit by using the concept of various sensors and networking	Apply			
CO4	Apply knowledge of modern technologies in automotive design	Apply			

CO5	Analyze various automotive sensors and actuators while interfacing with microcontrollers and microprocessors during automotive system design.	Analyze
CO6	Analyze the various techniques to control the systems automatically	Analyze
Text Books:		
1. William B. Ribbens, —Understanding Automotive ElectronicsII, 6th Edition, Elsevier Publishing.		
2. Robert Bosch Gmbh (Ed.) Bosch —Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drivell, 5th edition, John Wiley& Sons Inc., 2007.		
Reference Books:		
1. NajamuzZaman , — Automotive Electronics Design Fundamental“ first edition, Springer 2015.		
2.—Automotive Computer Controlled SystemsII (Diagnostic tools and techniques. Allan. W. M Bonnick Butterworth-Heinemann		
Course Designer : N.Sathiyathan		

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	I	II
CO1	2	-	-	-	-	-	-	-	-	-	-	-		2
CO2	3	2	3	-	-	-	-	-	-	-	-	-		2
CO3	3	2	2	-	-	-	-	-	-	-	-	-		2
CO4	3	2	2	-	-	-	-	-	-	-	-	-		2
CO5	2	3	2	-	-	-	-	-	-	-	-	-		2
CO6	2	3	2	-	-	-	-	-	-	-	-	-		2
CAM (Avg)	2.5	2.4	2.2	-	-	-	-	-	-	-	-	-		2
3- Strong 2- Medium 1- Weak														

COURSES OFFERED TO OTHER DEPARTMENTS

Sl. No.	Course Code	Course Name	Dept	L	T	P	C
1.	R21UEC225	Principles of Electronics Engineering	CSBS	3	0	0	3
2.	R821UEC226	Electronics Engineering Laboratory	CSBS	0	0	2	1
3.	R21UEC425	Microprocessors And Microcontrollers	CSE	3	0	0	3
4.	R21UEC426	Microprocessors And Microcontrollers Laboratory	CSE	0	0	2	1
5.	R21ECV102	Speech and Audio Signal Processing	BME	3	0	0	3
6.	R21ECV107	Machine Vision	BME	3	0	0	3

R21UEC225	PRINCIPLES OF ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES :					
<ul style="list-style-type: none"> To explain the operation of semiconductor diodes and their characteristics. To enable the student to understand the construction, operation and characteristics BJT, FET and MOSFET. To enable the students to understand the fundamentals of digital circuits. 					
UNIT I	SEMICONDUCTORS	9			
Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers. Diodes and Diode Circuits: Formation of P-N junction, forward and reverse biased P-N junction, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency.					
UNIT II	BIPOLAR JUNCTION TRANSISTORS	9			
Formation of PNP / NPN junctions; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, current amplification factors for CB and CE modes					
UNIT III	FIELD EFFECT TRANSISTORS	9			
Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles.					
UNIT IV	DIGITAL COMBINATIONAL CIRCUITS	9			
Number systems, Boolean algebra, Basic and Universal Gates, Half adder – Full Adder – Half subtractor – Full subtractor - Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder , Multiplexer/Demultiplexer, code converters.					
UNIT V	DIGITAL SEQUENTIAL CIRCUITS	9			
Latches, Flip-flops: SR, JK, D, T, and Master-Slave, Asynchronous Ripple or serial counter, Asynchronous Up/Down counter, Synchronous counters, Synchronous Up/Down counters, shift registers and its types.					
TOTAL: 45 Periods					
COURSE OUTCOMES					
After completion, the student will be able to					
CO 1	Describe the fundamental concept of various electronic Devices.	Understand			

CO 2	Describe the functions of the various building blocks of digital circuits.	Understand
CO 3	Apply the concepts of semiconductor devices to design electronic circuits.	Apply
CO 4	Apply the knowledge of logic gates to design digital circuits.	Apply
CO 5	Analyze different logics to identify suitable logic circuits for various applications.	Analyze
CO 6	Analyze the various parameters of diodes and transistors for suitable application.	Analyze

TEXT BOOKS:

1. Salivahanan S., Suresh kumar N. and Vallavanraj A., —Electronic Devices and CircuitsII, Tata McGraw Hill., 4th Edition, 2017.
2. M. Morris Mano, Digital Logic & Computer Design, Pearson Education.

REFERENCE BOOKS :

1. Robert T. Paynter, —Introducing Electronics Devices and CircuitsII, Pearson Education, Seventh Edition, 2010.
2. Millman J. &Halkins and Satyebranta Jit, —Electronic Devices &CircuitsII, Tata Mc- Graw Hill, Second Edition, 2008.
3. Mandal, —Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
4. D.P.Kothari, J.S.Dhillon, Digital circuits and Design, Pearson Education, 2016.

COURSE DESIGNER: Mr.T.MUTHURAJA, AP/ECE

R21UEC226	ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVE					
<ul style="list-style-type: none"> To enable the students to identify the components and operation of semiconductor diodes and their characteristics. To enable the students to design digital logic circuits. To make the students to identify component for suitable applications. 					
LIST OF EXPERIMENTS:					
1. Characteristics of PN Junction diode					
2. Characteristics of Zener diode					
3. Half wave rectifier with capacitive filter.					
4. Full wave rectifier with capacitive filter.					
5. Characteristics of CB and CE Configuration.					
6. Drain and transfer characteristics of JFET.					
7. Study of logic gates.					
8. Design and implementation of Adder and subtractor.					
9. Design and implementation of Code Converter.					
10. Design and implementation of Multiplexer and Demultiplexer.					
11. Design and implementation of Shift registers					
12. Design and Implementation of Synchronous and Asynchronous counters.					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
After completion, the student will be able to					
CO1	Apply the knowledge of transistors to measure various parameters in different configuration for suitable applications.(K3)				Apply
CO2	Apply the knowledge of semiconductor diodes to construct Rectifiers.(K3)				Apply
CO3	Design Combinational and Sequential Logic circuits.(K3)				Apply
CO4	Apply appropriate instrumentation tools to make measurements of physical quantities.(K3)				Apply
CO5	Use appropriate procedure to conduct experiments and collect data.(K3)				Apply
CO6	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task.(A4)				Organize
COURSE DESIGNER: Mr.T.MUTHURAJA, AP/ECE					

R21UEC425	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES :					
<ul style="list-style-type: none"> To develop an in-depth understanding of the operation of microprocessors & Microcontrollers assembly language programming To develop skills in interfacing peripheral devices with microprocessor & Microcontroller. To learn about advanced microcontrollers 					
UNIT I	8086 MICROPROCESSOR ARCHITECTURE AND PROGRAMMING				9
8086 Microprocessor architecture – Signals – Maximum & Minimum mode Configuration - Addressing modes - Instruction set and assembler directives – Assembly Language Programming –Procedures – Macros – Interrupts and interrupt service routines					
UNIT II	PERIPHERAL INTERFACING				9
Memory interfacing and I/O interfacing - Serial Communication Interface (8251)- parallel port Interface (8255) - Keyboard and Display controller (8279) – Programmable Interval Timer(8253/8254) – Programmable Interrupt Controller(8259) - DMA Controller(8237).					
UNIT III	8051 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING				9
8051 Architecture– Memory organization - Special Function Registers (SFRs) - I/O Pins / Ports – Instruction sets and Addressing modes - 8051 Modes and Programming – Timer, Interrupts, Serial ports- Assembly Language Programming					
UNIT IV	8051 INTERFACING AND APPLICATIONS				9
8051 Interfacing: LCD & Keyboard interfacing - ADC, DAC & Sensor interfacing, External Memory Interfacing - Stepper Motor and Wave form generation-Traffic light controller.					
UNIT V	ADVANCE MICROCONTROLLER				9
Arduino – Features – Architecture and Applications, PIC - Features – Architecture and Applications.					
TOTAL : 45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
CO1	Describe the architecture and operation of typical microprocessors and microcontrollers.				Understand
CO2	Apply knowledge of addressing modes and instructions set to demonstrate programming ability.				Apply
CO3	Apply the knowledge of interfacing techniques to develop code for specific problem.				Apply

CO4	Develop microprocessor and microcontroller-based applications by analyzing various interfacing techniques.	Analyze
CO5	Design and develop code for Microcontroller based real time Applications.	Create
CO6	Develop microprocessor & Microcontroller based programs using modern tools	Apply

TEXT BOOKS:

1. Douglas V Hall, —Microprocessors and Interfacing, Programming and Hardware, Tata McGraw Hill, 2006.
2. Kenneth J Ayala, —The 8051 Microcontroller Architecture Programming and Application, Penram International Publishers (India), 2nd Edition, 1996
3. Mazidi M. A., McKinlay R. D., Causey D —PIC Microcontroller And Embedded Systems, Pearson Education International, 2008

REFERENCES:

1. Oppenheim A V, Discrete Time Signal Processing, Prentice Hall India, New Delhi, 2010.
2. Mitra S K, Digital Signal Processing – A Computer based Approach, Tata McGraw Hill, New Delhi, 2010.
3. David J. Defatta, Joseph G. Lucas, William S. Hodgkiss, Digital signal processing: a system design approach, John Wiley, 1995.
4. B.Venkataramani, M.Bhaskar, Digital Signal Processor, Architecture, Programming and Applications, Tata McGraw Hill, 2011.

COURSE DESIGNERS: Dr.M.Fathu Nisha, ASP /ECE, Mr.A.Nagaraj, AP/ECE

CO/PO/PSO MAPPING														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					2				2		2	3	
CO2	2	3				2						2	3	
CO3	2	3	2									2	3	
CO4	2					2						2	3	
CO5	3	3	3						2	2		2	3	
CO6	3	3	3		3				2	2		2	3	
CAM (Avg)	2.3	3	2.6		3	2			2	3		2	3	
3- Strong 2- Medium 1- Weak														

R21UEC426	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<ul style="list-style-type: none"> To develop knowledge in assembly language programming with microprocessor and microcontrollers. To give knowledge in various peripheral interfacing with microprocessor and microcontrollers. 					
LIST OF EXPERIMENTS:					
<ol style="list-style-type: none"> Basic Arithmetic and Logical operation using 8086 Microprocessor Code conversion and Matrix operation using 8086 Microprocessor String manipulation using 8086 Microprocessor Searching and Sorting operation using 8086 Microprocessor Basic Arithmetic and Logical Operation using 8051 Microcontroller Square and cube Program, 2's compliment of a number using 8051 Microcontroller Interfacing 8086 microprocessor with 8255 Interfacing 8086 microprocessor with 8279 Interfacing ADC and DAC with 8086 microprocessor. Stepper Motor interfacing with 8051 microcontroller. LCD display interfacing using Arduino. 					
TOTAL : 30 PERIODS					
COURSE OUTCOMES:					
At the end of the course the student will be able to:					
CO1	Develop assembly language programs to perform arithmetic and logical operations using 8086 and 8051	Apply			
CO2	Develop assembly language programs for various applications using 8086 microprocessor and 8051 microcontroller	Analyze			
CO3	Analyze the various interfacing techniques to develop real time applications using 8086 microprocessor and 8051 Microcontroller.	Apply			
CO4	Apply appropriate instrumentation tools to make measurements of physical quantities.	Apply			
CO5	Use appropriate procedure to conduct experiments and collect data	Apply			
CO6	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organize			