Estd:1980

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)
All UG Programmes are Accredited by NBA
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

ELECTRONICS & COMMUNICATION ENGINEERING

(Accredited by NBA)

SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R19)

IV/IV B.TECH

I-SEMESTER

(With effect from **2019-2020** Admitted Batch onwards**)**

Course Code	Name of the Course	Category	Cr.	L	T	P	Internal Marks	External Marks	Total Marks
B19EC4101	Microwave Engineering	PC	3	3	-	--	25	75	100
B19EC4102	Internet of Things	PC	3	3	-	--	25	75	100
B19EC4103	Digital Image Processing	PC	3	3	-	--	25	75	100
#PE-III	Professional Elective-III	PE	3	3	-	--	25	75	100
B19EC4108	Microwave & Optical Communication Engineering Lab	PC	1.5	-	-	3	20	30	50
B19EC4109	IOT Lab	PC	1.5	--	--	3	20	30	50
B19EC4110	Project Work-I	PR	3	--	--	6	20	30	50
		TOTAL	**18**	**12**	**--**	**12**	**160**	**390**	**550**

	Course Code	Course
#PE-III	B19EC4104	Fiber Optic Communication
	B19EC4105	Analog IC Design
	B19EC4106	Speech Processing
	B19EC4107	Radar Engineering

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4101	PC	3	--	--	3	25	75	3hrs

MICROWAVE ENGINEERING

(For ECE)

Course Objectives:

1.	The purpose of this course is to provide the operational characteristics and conceptual understanding of active and passive components at microwave frequencies.
2.	This course also emphasizes formulation and application of scattering matrix for the analysis of different microwave passive components.
3.	Further, this course also provides the understanding of measurement techniques of different parameters.

Course Outcomes: Upon successful completion of this course, the student will be able to:

S.No	Outcome	Knowledge level
1.	Describe and Explain the working principle of different passive waveguide components used at microwave frequencies.	K3
2.	Apply the properties of scattering matrix for solving the scattering matrix of different passive microwave components for both ideal and practical considerations and analyze their operation	K4
3.	Aware of conceptual and operational characteristics of different microwave Tube circuits(generators).	K3
4.	Describe and Explain the operational characteristics of different microwave solid state devices.	K3
5.	Demonstrate and implement different experimental procedures involving measurement of microwave parameters	K4

SYLLABUS

UNIT-I (12Hrs)	**Microwave Components and its applications:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves, Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole, Bethe Hole types, Ferrite Components– Faraday Rotation, Gyrator, Isolator, Circulator, Related Problems.
UNIT-II (08 Hrs)	**Scattering Matrix: Scattering Matrix** – Significance, Formulation and Properties, Scattering Matrix of Isolator, circulator, directional coupler, E Plane Tee, H plane Tee and Magic Tee.

UNIT-III (12 Hrs)	**Qualitative treatment on Microwave Tubes:** Limitations and Losses of conventional tubes at microwave frequencies,Re-entrant Cavities,Microwave tubes – O type and M type classifications. O-type tubes :2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process and Applications, Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Electronic Admittance; Electronic and Mechanical Tuning, Applications, Related Problems. HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT (Qualitative treatment). M-type Tubes Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off Condition, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics.
UNIT-IV (08 Hrs)	**Microwave Solid state Devices:** Negative resistance phenomenon, Gunn Diode, domain formation, Tunnel Diode- principle of operation, IMPATT- principle of operation, TRAPATT, PIN Diodes and its applications (Qualitative analysis only).Detector diode or point contact diode and its characteristics.
UNIT-V (08 Hrs)	**Microwave Measurements:** Microwave Test bench, Measurement of Power, VSWR, Frequency, Guide Wavelength, Unknown load impedance, S parameters of reciprocal and non reciprocal devices

Text Books:	
1.	Microwave and Radar Engineering-M.Kulkarni, Umesh Publications, 3rd Edition.
2.	Microwave Devices and Circuits, Third Edition, Samuel Y. Liao, Pearson Education.
Reference Books:	
1.	Microwave Engineering, Annapurna Das, Sisir K. Das, Tata McGraw-Hill Education
2.	Microwave Engineering, 4th Edition, David M. Pozar, November 2011.
3.	Microwave and Radar Engineering, GottapuSasibhushanaRao, Pearson Education, New Delhi, 2014.
4.	Foundation for Microwave Engineering, R.R.Collin, McGraw Hill.
e-Resources:	
1.	https://nptel.ac.in/courses/108/103/108103141/(IIT Guwahati)

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4102	**PC**	**3**	**--**	**--**	**3**	**25**	**75**	**3hrs**

INTERNET OF THINGS

(For ECE)

Course Objectives:

1.	To make students familiar with the basic concepts of M2M &IoT architecture and Communication protocols.
2.	To introduce the Python Scripting Language with Raspberry PI platform, that is widely used in IoT applications.
3.	To introduce the implementation of web-based services on IoT devices.

Course Outcomes: Upon successful completion of this course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Get familiarity with architecture and communication protocols of IoT.	K2
2.	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.	K3
3.	Explore and learn about Python with the help of Raspberry Pi for preparing projects designed for IoT.	K3
4.	Analyze data from physical devices through the cloud using data analytics.	K4

SYLLABUS

UNIT-I (09 Hrs)	Embedded hardware units and Devices in a system, Embedded software in a system, Examples of embedded systems, embedded. Real world interfacing, Introduction to advanced architectures, , I/O types and examples, Serial Bus communication protocols, Parallel bus device protocols,
UNIT-II (09 Hrs)	IoT definition, Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Protocols, M2M, Differences and Similarities between M2M and IOT, SDN and NFV for IoT.
UNIT-III (08 Hrs)	Basic building blocks of an IoT Device, Sensors like ultrasonic, IR sensor, temperature & humidity etc., communication modules like Bluetooth, zigbee, Wi-Fi & WSN, Lora WAN, 6LoWPAN
UNIT-IV (10Hrs)	Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets like ultrasonic, IR sensor, temperature & humidity.

UNIT-V (10 Hrs)	IOT Physical Servers, Cloud Offerings & Data Analytics for IOT Web Application Messaging Protocol (WAMP), Cloud based communication, Data Analytics, IoT Design Methodology with a use.
Text Books:	
1.	Embedded System Architecture Programming and Design, Raj Kamal, 2nd Edition, McGraw Hill.
2.	Internet of Things: A Hands-On Approach, ArshdeepBahga, Vijay Madisetti
Reference Books:	
1.	Embedded Software Primer, David Simon, Pearson
2.	Internet of Things: Principles and Paradigms by RajkumarBuyya, Amir VahidDastjerdi.
e-Resources:	
1.	https://www.youtube.com/watch?v=kOjdExBUqAI
2.	https://www.codemag.com/article/1607071/Introduction-to-IoT-Using-the-Raspberry-Pi

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4103	PC	3	--	--	3	25	75	3hrs

DIGITAL IMAGE PROCESSING

(For ECE)

Course Objectives:

1.	This course provides an understanding of Image fundamentals and techniques.
2.	This course builds various Image enhancement, restoration, and compression techniques.
3.	This course develops various Image segmentation methods, Wavelet based and morphological Image Processing.
4.	This course gives the student a taste of the applications of the theories taught in the subject. This will be achieved through the project and some selected lab sessions.
5.	This course will introduce the students to some advanced topics in digital image processing.

Course Outcomes: Upon successful completion of this course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Explain the basic elements and applications of image processing.	K3
2.	Analyze image sampling and quantization requirements and implications.	K4
3.	Design and implement two dimensional spatial and frequency filters for image enhancement	K4
4.	Model and Demonstrate the image restoration problem in both time and frequency domains.	K3
5.	Explain the image segmentation and image compression problem.	K3

SYLLABUS

UNIT-I (8 Hrs)	**DIGITAL IMAGE FUNDAMENTALS** Introduction - Origin of Digital Image Processing - Fundamental Steps in Digital Image Processing - Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization - Basic Relationships between pixels.
UNIT-II (10 Hrs)	**IMAGE ENHANCEMENT** Introduction - Image Enhancement in Spatial Domain - Enhancement through Point Operation - Types of Point Operation - Histogram, Histogram Equalization - Local and Neighbourhood Operation - Median filter ,Bit-Plane slicing - Spatial Domain high pass filter or image sharpening.
UNIT-III (10 Hrs)	**IMAGE COMPRESSION** Fundamentals: Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information - Basic Image Compression model - Basic Compression methods: Huffman Coding, JPEG-standard and run length coding

UNIT-IV (10Hrs)	**IMAGE SEGMENTATION** Image Segmentation: Fundamentals - Point, Line and Edge Detection: Detection of isolated points, Line Detection, Basic Edge Detection - Thresholding: Intensity Thresholding, Basic Global Thresholding - Region based Segmentation: Region Growing, Region Splitting and Merging.
UNIT-V (8 Hrs)	**COLOR IMAGE PROCESSING** Color fundamentals - Color Models: RGB color model, CMY and CMYK color models, HSI color model, Color Complements, Color slicing, Tone and Color corrections.Basic Steps of Video Processing: Analog Video, Digital Video,Compare analog video and digital video signals.

Text Books:	
1.	Digital Image Processing – Rafael .C. Gonzalez, Richard E Woods, Pearson Education.
2.	Digital Image Processing – S. Jayaraman, S. Esakkirajan, T. Veerakumar.
Reference Books:	
1.	Fundamentals of Digital Image Processing, A.K. Jain, PHI, 1989.
2.	Digital Image Processing using MAT LAB, Rafael, C. Gonzalez, Richard E woods and Stens L Eddings, 2nd Edn, TMH,2010
3.	Introduction to Image Processing & Analysis – John C. Russ, J. Christian Russ, CRC Press, 2010
e-Resources:	
1.	https://nptel.ac.in/courses/117/105/117105135/

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4104	PE	3	--	--	3	25	75	3hrs

FIBER OPTIC COMMUNICATIONS

(For ECE)

Course Objectives:

1.	To expose the students to the basics of optical fibers and their impairments, components & devices, propagation and elementary system design.
2.	Provide insight on types of fibers and fiber materials with their properties and the losses occur in fibers.Analyze the operation of LEDs, laser diodes, and PIN photo detectors and apply in optical systems

Course Outcomes: Upon successful completion of this course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Summarize the basic concepts of optical communication and demonstrate its components	K2
2.	Apply basic concepts of optical communication components and systems.	K3
3.	Gain the knowledge of different sources of light as well as detectors and their comparative study.	K4
4.	Analyze concepts of optical communication systems for the basic design of optical communication links.	K4

SYLLABUS

UNIT-I (10 Hrs)	**Overview of optical fiber communication** – Telecommunications, Basic block diagram, physics of light, advantages of optical fiber communications. Optical fiber waveguides - Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Optical propagation through fiber modes. Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Attenuation and dispersion in multimode and single mode fibers, Related problems.
UNIT-II (10 Hrs)	**Fabrication, Cabling, Installation & Fiber connectors, coupling –** Fiber materials, Fiber Fabrication – Deposition methods. Fiber optic cables – Basic structure, Loose buffer cable, tight buffer cables, Cable classification. Installation- Classification, Procedure. Fiber connectors- Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints.

UNIT-III (10 Hrs)	**Optical Sources & Detectors-LEDs:** Materials, Quantum efficiency, Power, LED structure, Characteristics, Modulation, **LASERS:** Basics, Semiconductor Injection Laser Diodes, Injection laser structures, Injection laser Characteristics, **Optical detectors:** Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems.
UNIT-IV (10 Hrs)	**Power launching and coupling:** Output patterns, Power coupling, Power launching vs Wavelength, Equilibrium Numerical Aperture, Laser diode to fiber coupling.**Optical receiver operation:** Fundamental receiver operation, Digital receiver performance, Eye diagram, Analog receivers.
UNIT-V (10 Hrs)	**Optical system design:** Point-to- point links- Link power budget, Rise time budget with examples, WDM concepts and components: Operation principles of WDM.
Text Books:	
1.	Fiber Optic Communications Technology – D.K. Mynbaev and Lowell L. Scheiner, Pearson Education, 2009. [Unit-I, Unit-II]
2.	Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 4th Edition, 2000. [Unit-IV, & Unit-V]
Reference Books:	
1.	Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
2.	Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.
e-Resources:	
1.	**https://www.thefoa.org/tech/ref/basic/fiber.html**
2.	**https://media.wiley.com/product_ancillary/17/04705051/DOWNLOAD/Fiber_Optic_Communication_Systems.pdf**

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4105	PE	3	--	--	3	25	75	3hrs

ANALOG IC DESIGN

(For ECE)

Course Objectives:

1.	Outline the behaviour of MOS Devices and Small-Signal & Large-Signal Modelling of MOS Transistor and Analog Sub-Circuits
2.	Analyze CMOS Amplifiers like Differential Amplifiers, Cascode Amplifiers, Output Amplifiers, and Operational Amplifiers.
3.	Design and develop the Analog CMOS Circuits for different Analog operations.

Course Outcomes: Upon successful completion of this course, the student will be able to:

S.No	Outcome	Knowledge Level
1.	Outline the concepts of MOS Devices, MOS device characteristics, MOS device modeling, CMOS amplifiers, Open-Loop Comparators, and different types of oscillators	K2
2.	Analyze Analog CMOS Subcircuits and Complex Analog Circuits.	K4
3.	Design Analog CMOS Subcircuits, CMOS amplifiers, CMOS op-amps and Complex Analog Circuits .	K4
4.	Extend the analog circuit design to different applications.	K4

SYLLABUS

UNIT-I (10 Hrs)	**MOS Devices and Modeling:** The MOS Transistor, Passive Component-Resistor Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Sub threshold MOS Model.
UNIT-II (10 Hrs)	**Analog CMOS Sub circuits:** MOS Switch, MOS Diode/ Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References,
UNIT-III (10 Hrs)	**CMOS Amplifiers**: Differential Amplifiers Large Signal Anaysis, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures**.**
UNIT-IV (10 Hrs)	**CMOS Operational Amplifiers:** Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT-V (10 Hrs)	**Comparators:** Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators**.**

Text Books:	
1.	Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition.
2.	CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010
Reference Books:	
1.	Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
2.	Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn, 2013.
e-Resources:	
1.	https://nptel.ac.in/courses/117/106/117106030/
2.	https://onlinecourses.nptel.ac.in/noc21_ee51

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4106	**PE**	**3**	**--**	**--**	**3**	**25**	**75**	**3Hrs.**

SPEECH PROCESSING

(For ECE)

Course Objectives: Students are expected to learn

1.	Speech production models & parameters
2.	To develop time & frequency domain techniques (STFT) for speech analysis
3.	To study waveform coding techniques & Linear predictive technique (LPC) for speech
4.	To introduce Homomorphic speech analysis & Complex cepstrum, and to study Speech recognition, Speech synthesis & Speaker identification applications.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Describe the fundamentals of speech signals & speech models and can able to analyze & extract speech parameters using time & frequency methods.	K3
2.	Perform Pitch detection and Formant analysis.	K4
3.	Compress speech using waveform coding techniques and able to understand STFT & do Spectrogram analysis.	K3
4.	Obtain LPC speech parameters & compress speech.	K2
5.	Explain Cepstral analysis of speech, and can build speech applications.	K2

SYLLABUS

UNIT-I (8Hrs)	**Digital Models for the Speech Signal :** Introduction, Purpose of digital processing of speech signals, Applications, Speech production mechanism, Acoustic phonetics, Acoustic theory of speech production, Nature & classification of sounds, Digital models of speech production.
UNIT-II (10 Hrs)	**Time Domain Methods for Speech Processing :**Introduction to Short-time analysis of speech, Time domain parameters of speech, Methods for extracting the parameters, Short-time Energy and Average Magnitude, Short-time Average Zero-crossing Rate, Speech vs Silence discrimination using energy and zero crossings, Pitch period estimation using parallel processing approach, Short-time autocorrelation function, Pitch period estimation using the autocorrelation function.

UNIT-III (12Hrs)	**Digital Representations of the Speech Waveform and The Short-Time Fourier Analysis :**Sampling & Quantization of Speech signals, Statistical models, Uniform, adaptive & differential quantizations, Delta modulation, Adaptive Delta Modulation (ADM) & Differential PCM (DPCM) coding of speech waveforms. Discrete-Time Fourier Analysis, Short-Time Frequency Analysis, Short-Time Fourier Transform (STFT), Spectrogram, Spectrographic displays, Filter bank analysis, Overlap Addition (OLA) Method of Synthesis, Filter Bank Summation (FBS) Method of Synthesis, Implementation of the FBS Method using the FFT, Modifications of the STFT, Format extraction, Pitch extraction, Analysis-Synthesis systems.
UNIT-IV (10Hrs)	**Linear Predictive Coding of Speech:** Basic principles of Linear Predictive Analysis, Autocorrelation method, Covariance method, Solution of LPC equations, 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, Speech compression, Pitch detection and Formant analysis.
UNIT-V (8 Hrs)	**Homomorphic Speech Analysis &Applications:** Introduction, Homomorphic systems for convolution, Complex Cepstrum, Properties, Cepstral analysis of speech, Pitch detection, Formant estimation, Homomorphic Vocoder. Applications of speech processing, Speech Synthesis, Speech Recognition, Speaker Identification & Verification.
Text Books:	
1.	L.R. Rabiner and R.W Schafer: Digital Processing of Speech Signals, Pearson, 2009.
2.	Thomas F. Quatieri: Discrete-Time Speech Signal Processing: Principles & Practice, Pearson Education, 2009
Reference Books:	
1.	Speech Communications: Human & Machine – Douglas O'Shaughnessy, 2nd Ed., Wiley India, 2000.
2.	Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4107	PE	3	--	--	3	25	75	3

RADAR ENGINEERING

(for ECE)

Course Objectives:

1.	To provide insight of basic working principle of Radar
2.	To apply different methods to measurement the Range, angle information etc. of the target from the radar
3.	provide insight of advantages, limitations and applications of various Radar
4.	introduce different types of tracking Radars and other types of Radar systems.
5.	To provide insight of applications of Radar systems, their working principles, limitations and different methods to overcome their limitations

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Apply various mathematical equations to measure the Range and angle information of the targets from the radar	K3
2.	Able to understand the basic working principles of various Radars	K2
3.	Analyze and design of radar signals, MTI, Pulse Doppler radar and Delay line cancellers.	K4
4.	Analyze various tracking Radars, advantages, limitations and their applications	K4
5.	Analyze the applications of various Radars in Navigational Aids like ECM, ECCM, Direction Finders, Sense Finders, VOR, Aircraft Homing, ILS, Radio Altimeter, Hyperbolic Navigation system.	K4

SYLLABUS

UNIT-I (09 Hrs)	**AN INTRODUCTION TO RADAR-** The origin of Radar, Basic Principle of Radar,Range to a target, Pulse Repetition Frequency and Maximum Unambiguous Range, Radar Block Diagram and Operation, Applications of Radar, Simple form of the Radar Equation, Reasons to failure of the basic radar equation, Parameters included in basic radar equation: Transmitter Power, Noise Figure, Integration of Radar Pulses, System Losses
UNIT-II (09 Hrs)	**RADAR RECEIVER:-**The basic function of the Radar receiver, Noise Figure and Noise Temperature, Types of Duplexers: Branch type duplexer, Balanced duplexer, Circulator and receiver protector, Types of Mixers: Balanced Mixer, Image Recovery Mixer, Radar Displays (Scopes).
UNIT-III (08 Hrs)	Introduction to Doppler Effect, Doppler frequency shift, Simple CW Doppler Radar, Block diagram of a simple pulse radar that extract the doppler frequency shift of the echo signal from a moving target, Sweep to Sweep subtraction, Butterfly effect, Coherent and Non

	Coherent Moving Target Indication Radar, Delay line Cancellers, Blind speeds, Limitation to MTI performance, Moving target Detector, MTI from moving platform.
UNIT-IV (08 Hrs)	Types of Tracking Radars, Sequential Lobing, Conical Scan, Amplitude Comparison Monopulse tracking Radar, Low angle tracking, Synthetic Aperture Radar (SAR), Phasedarray Radar.
UNIT-V (10 Hrs)	Radar Applications: ECM, ECCM, Principle of Direction Finders, Sense Finders, Aircraft Homing and Instrument Landing System, Radio Altimeter, working principle of Hyperbolic Navigation system.
Text Books:	
1.	Introduction to Radar Systems – Merrill I. Skolnik, THIRD EDITION, Tata McGraw-Hill, 2001.
2.	Radar Systems and Radio Aids to Navigation-Prof A.K.Sen and Dr.A.B.Bhattacharya
Reference Books:	
1.	Radar Engineering and Fundamentals of Navigational Aids, G S N Raju, IK International Publishers, 2008.
2.	Microwave Engineering, 4th Edition, Annapurna Das, Sisir K Das
e-Resources:	
1.	https://swayam.gov.in/nd1_noc20_ce16/..
2.	https://onlinecourses.nptel.ac.in/noc22_ee114

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4108	PC	--	--	3	1.5	20	30	3 Hrs.

MICROWAVE & OPTICAL COMMUNICATION LAB

(for ECE)

Course Objectives: This Course will enable students to

1.	Know about behavior of Microwave Components
2.	Study the characteristics of Microwave Oscillators.
3.	Analyze the characteristics and parameters of various microwave components.
4	Study the radiation pattern of dipole and Yagi-uda antennas.
5	Study the performance parameters of optical source and detector and plot the loss characteristics.

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

S.No	Outcome	Knowledge Level
1.	Identify the different microwave components equipment's and their uses	K4
2.	Measure microwave parameters like guide wavelength, frequency, attenuation, VSWR and modes of reflex klystron	K5
3.	Measure performance of simple microwave circuits and devices.	K4
4	Analyze the radiation patterns of antennas.	K3
5	Assess the performance of optical devices.	K4

LIST OF EXPERIMENTS

1.	Measurement of Frequency and Guide Wavelength
2.	Volt-Ampere characteristics of Gunn Diode
3.	Measurement of Low VSWR and Unknown Load Impedance
4.	Mode Characteristics of Reflex Klystron
5.	Study of Directional Coupler Parameters
6.	Measurement of losses in Optical Fiber
7.	Measurement of Numerical Aperture
8	Study of Analog fiber Optic link
9	Study of Radiation pattern of Dipole Antenna in E-plane
10.	Study of Radiation pattern of Dipole Antenna in H-plane
11	Study of Radiation pattern of Yagi-Uda Antenna in E-plane
12	Study of Radiation pattern of Yagi-Uda Antenna in H-plane

Reference Books:

1.	Lab Manual

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4109	PC	--	--	3	1.5	20	30	3 Hrs.

IOT LAB

(for ECE)

Course Objectives: This Course will enable students to

1.	Design a IoT application prototypes with the knowledge of IoT.
2.	This lab course enables students to get practical experience in interfacing IoT Modules with cloud.

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

S.No	Outcome	Knowledge Level
1.	Able to acquire knowledge on interfacing different sensors and communication modules with the System on Chip Modules.	K3
2.	Able to connect SoC devices with the cloud for accessing and analyzing the data.	K4

LIST OF EXPERIMENTS

1.	Introduction to arduino and raspberry-pi and its applications like interfacing LED and Buzzer.
2.	Interfacing Push Button and LED,Buzzer
3.	Introduction to Communication Modules like IR and Bluetooth.
4.	Interfacing Ultrasonic sensor
5.	Interfacing OLED to display text and received data from sensors
6.	Interfacing with TSL2561(Luminosity Sensor)/(LDR)
7.	Establishing Serial Communication
8.	Interfacing DHT11 sensor
9.	Creating account in cloud and pushing data to cloud

Reference Links:

1.	http://www.etilabs.com/products/iot-board/

e-Resources:

1.	https://nevonprojects.com/raspberry-pi-projects/http

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4110	PR	--	--	6	3	20	30	3 Hrs.

PROJECT WORK - I

(For ECE)

Course Objectives:

1	The objective of this course is to apply the knowledge gained by the students in the previous courses to develop a project in their interested domain.

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Identify a current problem through literature/field/case studies	K3
2	Identify the background objectives and methodology for solving the same.	K3
3	Design a technology/ process for solving the problem	K6

*The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics and Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or a group of students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

The assignment to normally include:

a) Survey and study of published literature on the assigned topic.
b) Working out a preliminary approach to the problem relating to the assigned topic.
c) Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/ Feasibility.
d) Preparing a written report on the study conducted for presentation to the department.
e) Final Seminar, as oral Presentation before a departmental committee.

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)
All UG Programmes are Accredited by NBA
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204
Estd:1980

ELECTRONICS & COMMUNICATION ENGINEERING

(Accredited by NBA)

SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R19)

IV/IV B.TECH

II-SEMESTER

(With effect from **2019-2020**Admitted Batch onwards**)**

Course Code	Name of the Course	Category	Cr.	L	T	P	Internal Marks	External Marks	Total Marks
#PE-IV	Professional Elective-IV	PE	3	3	-	--	25	75	100
#OE-II	Open Elective-II	OE	3	3	--	--	25	75	100
B19EC4205	Project Work-II	PR	9	--	--	18	60	90	150
B19EC4206	Seminar	PR	3	--	--	6	--	50	50
		TOTAL	**18**	**6**	**--**	**24**	**110**	**290**	**400**

	Course Code	Course
#PE-IV	B19EC4201	Cellular & Mobile Communication
	B19EC4202	Satellite Communications
	B19EC4203	Low Power VLSI Design
	B19EC4204	Biomedical Signal Processing
#OE-II	Student has to study one Open Elective offered by CE or CSE or EEE or IT or ME or S&H from the list enclosed.	

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4201	PE	3			3	25	75	3Hrs

CELLULAR & MOBILE COMMUNICATION

(For ECE)

Course Objectives:

1.	To make students familiar with the fundamentals of mobile communication systems.
2.	An ability to understand and explain the services of mobile communication systems, multiple access techniques and architecture of GSM
3.	To have an insight into the various propagation models and different path loss strategies.

Course Outcomes: Upon successful completion of this course, the student will be able to

S.No	Outcome	Knowledge Level
1	Apply the fundamentals of mobile communication systems, cellular concepts and Handoff , calculate the amount of interference, frequency reuse distance and capacity of a cellular system.	K3
2	Demonstrate an ability to explain multiple access techniques for Wireless Communication.	K2
3	Understand the basics of GSM mobile communication standard, its architecture.	K2
4	Apply knowledge of reflection, diffraction and scattering to calculate link budget using path loss models	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction to Mobile and Cellular Communication Systems:** Introduction to wireless communications, examples of wireless communication systems, the cellular concept and system design fundamentals.
UNIT-II (10 Hrs)	**Elements of Cellular Radio Systems and Handoff Technologies:** Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunk and grade services, Methods for improving coverage and capacity in cellular systems
UNIT-III (10 Hrs)	**Multiple Access Techniques:** Multiple access techniques for wireless communications FDMA, TDMA, Spread Spectrum techniques, SDMA, Packet Radio, CSMA, capacity of Cellular CDMA and capacity of SDMA.

UNIT-IV (8 Hrs)	**GSM:** Wireless systems and standards, AMPS, GSM traffic, Examples of GSM cells, Frame structure of GSM, GSM Architecture, GSM Channel types.
UNIT-V (12 Hrs)	**Mobile Radio Propagation:** Introduction to mobile radio propagation, free space propagation models, Reflection, Diffraction, Scattering, Outdoor and Indoor propagation models.

Text Books:	
1.	Wireless Communications Principles and Practice, Second Edition, THEODORE S.RAPPAPORT.
2.	Wireless and Cellular Communications by WILLIAM.C.Y.LEE
Reference Books:	
1.	Wireless digital Communications, DR. KAMILO FEHER.
2.	Electronic Communication system, WAYNE TOMASI.
e-Resources	
1.	https://nptel.ac.in/courses/106/106/106106167/
2.	https://www.youtube.com/watch?v=whYljse4Abc

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4202	PE	3	--	--	3	25	75	3 Hrs.

SATELLITE COMMUNICATIONS

(For ECE)

Course Objectives:

1.	Functionality of KEPLAR'S laws planetary motion.
2.	Be aware of space segment equipment.
3.	To know the Principles of deploying earth stations. Understand various parameters of link design.
4	Analyze the various multiple access techniques

Course Outcomes: Upon successful completion of this course, the student will be able to

S.No	Outcome	Knowledge Level
1	Choose necessary components required in modern satellite communications systems.	K2
2	Design and build space segment, depending upon the requirement.	K4
3	Design link margin for various applications.	K4
4	Choose the correct multiple access technique for better communication with minimum	K2

SYLLABUS

UNIT-I (10 Hrs)	ORBITAL MECHANICS AND LAUNCHERS: Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance
UNIT-II (10 Hrs)	SATELLITE SUB-SYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification
UNIT-III (10 Hrs)	SATELLITE LINK DESIGN: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.
UNIT-IV (8 Hrs)	MULTIPLE ACCESS: Frequency division multiple access (FDMA), Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard

	processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.
UNIT-V (12 Hrs)	SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM: Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.
Text Books:	
1.	Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition), John Wiley & Sons.
2.	Satellite Technology, Principles and Applications, by Anil K. Maini, VarshaAgarwal(Second Edition), Wiley.
Reference Books:	
1.	Satellite Communications, by Dennis Roddy(Fourth edition),McGraw Hill.
2.	Satellite Communication Systems Engineering, by Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (Second Edition), Pearson.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4203	PE	3	--	--	3	25	75	3 Hrs.

LOW POWER VLSI DESIGN

(For ECE)

Course Objectives:

1.	Understand the Fundamentals of Low Power VLSI Design.
2.	Study low-Power Design Approaches, Power estimation and analysis.
3.	Study and to analyze the Low-Voltage Low-Power Adders, Multipliers
4.	Understand the concepts of Low-Voltage Low-Power Memories and Future Trend and Development of DRAM.

Course Outcomes: At the end of this course the students will be able to

S.No	Outcome	Knowledge Level
1.	Understand the concepts of Low-Power Design Approaches.	K2
2.	Design and analysis of Low-Voltage Low-Power Circuits	K4
3.	Extend the Low Power Design to Different Applications.	K4
4.	Understand the Low-Voltage Low-Power Memories and Basics of DRAM.	K2

SYLLABUS

UNIT-I (12 Hrs)	**UNIT -I: Fundamentals of Low Power VLSI Design:** Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.
UNIT-II (12 Hrs)	**Low-Power Design Approaches:** Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **Switched Capacitance Minimization Approaches:** System Level Measures, Circuit Level Measures and Mask level Measures
UNIT-III (9 Hrs)	**Low-Voltage Low-Power Adders:**Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low- Voltage Low-Power Logic Styles.

UNIT-IV (8 Hrs)	**Low-Voltage Low-Power Adders:**Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low- Voltage Low-Power Logic Styles.
UNIT-V (8 Hrs)	**Low-Voltage Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.**.**

Text Books:	
1.	Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.
2.	Sung-Mo Kang, Yusuf Leblebici,"CMOS Digital Integrated Circuits – Analysis and Design", TMH,2011
Reference Books :	
1.	Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000
2.	Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
e-Resources:	
1.	https://vemu.org/uploads/lecture_notes/30_12_2019_521719505.pdf
2.	https://www.youtube.com/watch?v=TFOO1JAll2Y

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4204	PE	3	--	--	3	25	75	3 Hrs.

BIO MEDICAL SIGNAL PROCESSING

(For ECE)

Course Objectives:

1.	Describe the origin, properties, and suitable models of important biological signal such as ECG and EEG.
2.	Introduce students to basic signal processing techniques in analyzing biological signals.
3.	Develop the mathematical and computational skills relevant to the field of biomedical signal processing.
4.	Develop thorough understanding on basics of ECG signal compression algorithms
5.	Increase the student‘s awareness of the complexity of various biological phenomena and cultivate an understanding of the promises, challenges of the biomedical engineering.

Course Outcomes: Upon successful completion of this course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Possess the basic mathematical skills necessary to analyze ECG and EEG signals.	K2
2.	Possess the basic scientific skills necessary to analyze ECG and EEG signals.	K2
3.	Possess the basic computational skills necessary to analyze ECG and EEG signals	K2
4.	Apply classical and modern filtering and compression techniques for ECG and EEG signals	K3
5.	Develop thorough understanding on basics of ECG and EEG feature extraction.	K4

SYLLABUS

UNIT-I (10 Hrs)	Introduction to Biomedical Signals The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in biomedical analysis, Electrocardiography: Basic electrocardiography, ECG lead systems, ECG signal characteristics, Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits
UNIT-II (10 Hrs)	Signal Averaging and Adaptive Noise cancelling Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering
UNIT-III (10 Hrs)	Data Compression Techniques Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution,

	Power spectrum estimation, Frequency domain analysis of the ECG
UNIT-IV (8 Hrs)	Cardiological signal processing Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Band pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor
UNIT-V (12 Hrs)	Neurological signal processing and Analysis of EEG signals The brain and its potentials, the electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation, Detection of EEG rhythms, Template matching for EEG, spike and wave detection
Text Books:	
1.	Biomedical Digital Signal Processing- Willis J. Tompkins, PHI2001
2.	Discrete Time Signal Processing - Alan V Oppenheim & R. W Schaffer, PHI.Biomedical Signal Processing Principles and Techniques- D C Reddy, McGraw- Hill publications2005
Reference Books:	
1.	Biomedical Signal Analysis- Rangaraj M. Rangayyan, John Wiley & Sons 2002.
e-Resources	
1.	https://ee.stanford.edu/research/biomedical-imaging

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B19EC4205	PR	--	--	18	9	60	90	3 Hrs.

PROJECT WORK - II

(For ECE)

Course Objectives:

1	The objective of this course is to apply the knowledge gained by the students in the previous courses to develop a project in their interested domain

Course Outcomes:

S.No	Outcome	Knowledge Level
1	Develop a technology/ process for solving the problem.	K6
2	Evaluate that technology/ process at the laboratory level.	K5

* The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under Project Work I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.

The assignment to normally include:

a) In depth study of the topic assigned in light of Report prepared under Project Work I.
b) Review and finalization of the approach to the problem relating to the assigned topic.
c) Preparing an Action Plan for conducting the investigation, including teamwork.
d) Detailed Analysis/ Modeling/Simulation/Design/Problem Solving/Experiment as needed.
e) Final development of product/process, testing, results, conclusions, and future directions.
f) Preparing a paper for Conference presentation/publication in Journals, if possible.
g) Preparing a dissertation in the standard format for being evaluated by the department.