SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)
UG Programmes CE,CSE,ECE,EEE,IT & ME are Accredited by NBA, Accredited by NAAC with A+
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204
Estd:1980

Regulation: R20	IV / IV - B.Tech. I - Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION & EXAMINATION
(With effect from 2020-21 admitted Batch onwards)

Course Code	Course Name	Category	Cr	L	T	P	Int. Marks	Ext. Marks	Total Marks
B20HS4102	Managerial Economics and Financial Accountancy	HS	3	3	0	0	30	70	100
#PE-III	Professional Elective -III	PE	3	3	0	0	30	70	100
#PE-IV	Professional Elective -IV	PE	3	3	0	0	30	70	100
#PE-V	Professional Elective -V	PE	3	3	0	0	30	70	100
#OE-III	Open Elective-III	OE	3	3	0	0	30	70	100
#OE-IV	Open Elective-IV	OE	3	3	0	0	30	70	100
B20EC4113	Designing Tools **(Skill Oriented Course)**	SOC	2	1	0	2	--	50	50
B20EC4114	Industrial/Research Internship 2 Months	PR	3	--	--	--	--	50	50
	TOTAL		**23**	**19**	**0**	**2**	**180**	**520**	**700**

	Course Code	Course
#PE-III	B20EC4101	Microwave Engineering
	B20EC4102	Digital Image Processing
	B20EC4103	Advanced Micro Controllers
	B20EC4104	Smart Sensors
#PE-IV	B20EC4105	Information Theory and Coding
	B20EC4106	Radar Engineering
	B20EC4107	Low Power VLSI Design
	B20EC4108	Digital Signal Processors and Architectures
#PE-V	B20EC4109	Wireless & Mobile Communication
	B20EC4110	Fiber Optic Communication
	B20EC4111	Satellite Communication
	B20EC4112	Software Defined Radio
#OE-III & #OE-IV	Student has to study one Open Elective each from OE-III & IV offered by AIDS or CE or CSBS 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
B20HS4102	HS	3	0	0	3	30	70	3 Hrs.

MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY

(Common to ECE & EEE)

Course Objectives:

1.	To Study Managerial Economics and Demand Analysis
2.	To familiarize about the Concepts of Cost and Break-Even Analysis.
3.	To understand the nature of markets and to know the Pricing Policies
4.	To learn about accounting cycle and preparation of Financial Statements.
5.	To know the concept of Capital and sources of raising and Start-ups

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

S. No	Outcome	Knowledge Level
1.	Equip oneself with the knowledge of estimating the Demand and demand elasticities for a product.	K2
2.	Have knowledge of Cost and its types and ability to calculate BEP	K3
3.	Understand the nature of different markets	K2
4.	Understand Pricing Practices prevailing in today's business world	K2
5.	Prepare Financial Statements and know how to calculate Profit & Loss for a firm	K3
6.	Know Types of capital, their sources & start-ups	K2

SYLLABUS

UNIT-I (10 Hrs)	**Introduction to Managerial Economics and demand Analysis:** **Managerial Economics:** Definition of Economics & Classification of Economics (Micro & Macro), Meaning, Nature, & Scope of Managerial Economics. **Demand Analysis:** Concept of Demand, Determinants of Demand, Demand schedule, Demand curve, Law of Demand and its exceptions. Elasticity of Demand, Types of Elasticity of Demand. Importance of demand forecasting and its Methods.
UNIT-II (10 Hrs)	**Cost Analysis**: Importance of cost analysis, **Types of Cost-** Actual cost Vs Opportunity cost, Fixed cost Vs Variable cost, Explicit Vs Implicit cost, Historical cost Vs Replacement cost, Incremental cost Vs Sunk cost; **Elements of costs** – Material, Labour, Expenses; **Methods of costing** - Job costing, contract costing, Process costing, Batch costing, Unit costing, Service costing, Multiple costing. **Break-even analysis:** Determination of Breakeven point - Applications, Assumptions and Limitations of Break -even analysis (Theory only)
UNIT-III (10 Hrs)	**Introduction to Markets & Pricing Policies** **Market Structures:** Salient Features of Perfect Competition, Monopoly, Monopolistic

	competition, Oligopoly and Duopoly. **Pricing:** Importance of pricing and its meaning; **Methods of Pricing**: **Cost Based** -Full cost, Mark-up, Marginal &Break-even; **Demand Based** - Penetrating, Skimming; **Competition Based**- Going rate, Sealed Bid, Discount; **Internet Pricing** - Flat-rate, Usage sensitive
UNIT-IV (08 Hrs)	**Introduction to Financial Accounting:** Importance of Accounting - Double Entry System of Accounting - Types of Accounts - Journal, Ledger, Trail Balance, Trading Account, Profit and Loss Account and Balance Sheet (outlines only).
UNIT-V (12 Hrs)	**Capital & Start-ups:** Types of Capital - Fixed capital & Working Capital, Components of Working Capital, Factors influencing Working capital, Methods of Raising Finance. **Business Startups:** Meaning, Definition, Types, Benefits, Challenges, Limitations and Disadvantages of Startups in India; **Ideas-** Sources and Techniques of generating new ideas.

Text Books:	
1	A R Aryasri, Managerial Economics and Financial Analysis, TMH Pvt. Ltd, New Delhi
2	Dr. N.Appa Rao, Dr.P. Vijayakumar: Managerial Economics and Financial Analysis', Cengage Publications, New Delhi
3	Arya Kumar: "Entrepreneurship", Pearson Publishing House, New Delhi 2012
Reference Books:	
1	Dr.B.Kuberudu & T.V. Ramana : Managerial Economics and Financial anaysis, Himalaya Publishing House
2	Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
3	Shashi K. Gupta & R.K. Sharma Management Accounting, Kalyani Publishers
4	Maheswari S.N, An Introduction to Accountancy, Vikas Publishing House Pvt Ltd
5	VSP Rao, Kuratko: "Entrepreneurship", Cengage Learning, New Delhi

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4101	PE	3	--	--	3	30	70	3.Hrs

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: By the end of the course the learners (students) 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 analyse their operation	K4
3.	Illustrate 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 (12 Hrs)	**Microwave Components and its applications:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves, Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; 2Hole Directional Coupler, Ferrite Components– Faraday Rotation, Isolator, Circulator, Related Problems.
UNIT-II (8 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: Structure of TWT (Qualitative treatment).8-Cavity Magnetron.
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.	Foundations for Microwave Engineering, R. R. Collin, McGraw Hill.
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.	Microwave and Radar Engineering-M.Kulkarni, Umesh Publications, 3rd Edition.
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
B20EC4102	PE	3	--	--	3	30	70	3.Hrs

DIGITAL IMAGE PROCESSING

(For ECE)

Course Objectives: This course presents the students to

1.	Recall and summarize the digital image fundamentals and to be exposed to basic image processing techniques.
2.	Be familiar with image segmentation and compression techniques.
3.	Illustrate the representation of color images in the form of features.

Course Outcomes: On completion of this course, the students will be able to:

S. No	Outcome	Knowledge Level
1.	Explain digital image fundamentals and basic image processing techniques.	K2
2.	Evaluate the techniques for image enhancement and restoration	K3
3.	Define the need for image compression and to analyze various image compression methods	K3
4.	Experiment the Partition of a digital image into multiple objects using various techniques.	K3
5.	Illustrate the use of different color models to represent an image.	K2

SYLLABUS

UNIT-I (8Hrs)	**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 and Image Restoration:** Intensity Transformations: Basic intensity transformations, Histogram processing - Basics of Spatial Filtering: Smoothing and Sharpening of Spatial Filtering. Fundamentals of Image Restoration - Noise models - Mean Filters, Order-Statistic Filters, Adaptive filters: Adaptive local noise reduction filter, Adaptive median filter
UNIT-III (8 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 (8 Hrs)	**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 and Fundamentals of Video Processing:** Color fundamentals - Color Models: RGB color model, CMY and CMYK color models, HSI color model, Color Complements, Basic Steps of Video Processing: Analog Video, Digital Video

Textbooks:	
1.	Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010
2.	Digital Image Processing by S Jayaraman , Education Reference Books: S Esakkirajan , T Veerakumar , Tata McGraw-Hill
Reference Books:	
1.	Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
2.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw Hill Pvt. Ltd., 2011
e-Resources	
1.	https://nptel.ac.in/courses/117/104/117104069/

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4103	PE	3	--	--	3	30	70	3.Hrs

ADVANCED MICRO CONTROLLERS

(For ECE)

Course Objectives:

1.	The internal architecture details, pin configuration, and their timing diagrams of 8051µp
2.	Study the features of PIC Microcontroller 16F877.
3.	Study the instruction set of ARM,MSP 430.

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

S. No	Outcome	Knowledge Level
1.	Illustrate architecture of 8051µp and its modes of operations along with timing diagrams by which improving programming skills on microcontroller	K2
2.	Analyze the memory organization, interrupts of PIC 16F877	K3
3.	Understand difference between RISC and CISC.	K3
4.	Develop the knowledge of the ARM instruction set.	K4
5.	Understand the MSP430 Architecture	K2

SYLLABUS

UNIT-I (10Hrs)	**8051 MICROCONTROLLER**: Architecture, pin description, Register set, Instruction set. Interrupt structure, timer & serial port operations, Simple Assembly language programs on general arithmetic and logical operations.
UNIT-II (10 Hrs)	**PIC MICROCONTROLLER:** Introduction, characteristics of PIC microcontroller, PIC microcontroller families, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.
UNIT-III (10 Hrs)	**ARM Introduction**: Types of computer Architectures, ISA's and ARM, Difference between RISC and CISC, RISC Design philosophy, ARM Design Philosophy, History of ARM microprocessor, ARM processor family. The Acorn RISC Machine
UNIT-IV (10 Hrs)	**ARM Architecture and pipeline structure:** Different Types of Instructions, ARM Instruction set, data processing instructions. Shift Operations, shift Operations using RS lower byte. General purpose registers, CPSR, SPSR, ARM memory map.
UNIT-V (10 Hrs)	**MSP430:** MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430: low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability

Textbooks:

1.	The 8051 Microcontroller & Embedded Systems Using Assembly and C by Kenneth J.Ayala, Dhananjay V.Gadre, Cengage Learninbg , India Edition
2.	ARM Assembly Language Programming & Architecture By. Muhammad Ali Mazidi, Kindle edition
3.	Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. “PIC Microcontroller and Embedded Systems”, Pearson Education, 2008.

Reference Books:

1.	Microprocessors and Microcontrollers-Architecture, Programming and System Design by Krishna Kant, PHI Learning Private Limited, Second Edition, 2014.
2.	Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication
3.	Manuals and Technical Documents from the ARM Inc, web site.
4.	Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier
5.	Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christppher Hinds, CRC Press.
e-Resources	
1.	https://www.ti.com/microcontrollers-mcus-processors/msp430-microcontrollers/overview.html
2.	https://www.oreilly.com/library/view/msp430-microcontroller-basics

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4104	**PE**	**3**	**--**	**--**	**3**	**30**	**70**	**3.Hrs**

SMART SENSORS

(For ECE)

Course Objectives:

1.	To provide basic knowledge in transduction principles, sensors and transducer technology andmeasurement systems.
2.	To provide better familiarity with the Theoretical and Practical concepts of Transducers.
3.	Understand and Analyze Different Signal Generators and Analyzers.
4.	Understand the principle of operation and working of various types of Bridges for measurement of parameters.
5.	Understand the Design of Oscilloscopes for different applications

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

S. No	Outcome	Knowledge Level
1.	Evaluate basics of measurement systems, principle of basic meter	K2
2.	Design different transducers for measurement of different parameters	K3
3.	Evaluate how a signal can be generated using different types of meters.	K3
4.	Use bridges of many types and measure appropriate parameters	K3
5.	Investigate a signal/ waveform with different oscillators	K2

SYLLABUS

UNIT-I (10 Hrs)	**Qualities of Measurements:** Definition of a Smart sensor, Smart sensor systems, Performance characteristics of instruments: static characteristics- accuracy, resolution, Precision, expected value, error, Sensitivity. Errors in measurement: types of static errors-Gross errors, systematic errors, instrumental errors, observational errors, random errors, sources of error, Statistical analysis. Dynamic Characteristics-Speed of response, fidelity, lag and dynamic error. DC Voltmeters, Range extension voltmeters, AC Voltmeters, True RMS responding voltmeter.
UNIT-II (10 Hrs)	**Active and Passive Transducers**: Resistance, Capacitance, Inductance; Resistive Transducer, Unbounded resistance wire Strain Gauge, Bounded resistance wire strain gauge, semi conductor strain gauge, linear variable differential transducer, Piezo Electric Transducer, Resistance Thermo meters, Thermo couples.
UNIT-III (10 Hrs)	**Signal Generator:** Introduction, fixed frequency AF Oscillator, Variable Frequency AF Oscillator, Basic Standard Signal Generator, AF Sine and Square wave signal Generators, Function Generators, Square Pulse, Random Noise, Sweep, Arbitrary Wave form. Wave analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers.
UNIT-IV (8 Hrs)	**Bridges**: Measurement of Inductance-Maxwell's Bridge, Anderson Bridge. Measurement of Capacitance- Schearing Bridge. Wheatstone Bridge. Wien Bridge, Errors and Precautions in using Bridges.
UNIT-V	**Oscilloscopes:** CRT features, Block Diagram of Oscilloscope, Vertical Amplifier,

(12 Hrs)	Horizontal Deflection system, Sweep, Trigger pulse, Delay line. Dual Beam CRO, Dual Trace Oscilloscope, Sampling Oscilloscope, Digital storage Oscilloscope, Lissajous method of frequency measurement, standard spcifications of CRO, CRO probes.
Text Books:	
1.	Electronic Instrumentation by H.S. Kalsi.
Reference Books:	
1.	Sensors and Signal Conditioning, Ramon Pallas-Areny, John G. Webster, 2nd Edition.
2.	Sensors and Transducers: D. Patranabis, TMH 2003.
e-Resources	
1.	https://www.youtube.com/watch?v=Niv2hSGdw4E
2.	https://www.youtube.com/watch?v=bfw_So5cCp4
3.	https://www.youtube.com/watch?v=vlfQvLtanlQ

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4105	**PE**	**3**	**--**	**--**	**3**	**30**	**70**	**3.Hrs**

INFORMATION THEORY AND CODING

(For ECE)

Course Objectives:

1.	To get exposed to information and entropy and to Learn measurement of information and errors.
2.	To obtain knowledge in designing various source codes and channel codes
3.	To design encoders and decoders for block and cyclic codes

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

S. No	Outcome	Knowledge Level
1.	Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of information and Order of a source	K3
2.	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms	K2
3.	Model the continuous and discrete communication channels using input, output and joint probabilities	K4
4.	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes	K3
5.	Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.	K4

SYLLABUS

UNIT-I (10Hrs)	**Information Theory:** Introduction, Measure of information, Information content of message, Entropy, Information rate, Joint and conditional entropies, Source coding theorem**,** Shannon-fano coding, Huffman coding.
UNIT-II (10 Hrs)	**Information Channels:** Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, System Entropies. Mutual Information, Channel Capacity, Discrete memory less channels – BSC, Shannon limit Channel Capacity of Binary Symmetric Channel.
UNIT-III (10 Hrs)	**Error Control Coding:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, methods of Controlling Errors, Single error correction Hamming code, Table lookup Decoding using Standard Array.
UNIT-IV (10 Hrs)	**Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, generation off cyclic codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, generation of cyclic codes using generator methods, Introduction to BCH codes, RS codes and GOLAY codes, ARQ's.
UNIT-V (10 Hrs)	**Convolution Codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm, difference

	between convolution codes and block codes, burst error corrections, turbo encoder, introduction to concatenated codes
Textbooks:	
1.	Digital andAnalog Communication Systems, K. Sam Shanmugam, John Wtley India Pvt Ltd, 1996
2.	Digital Communication, Simon Haykin, John Wtley India Pvt Ltd, 2008
Reference Books:	
1.	lTC and Cryptography Ranjan Bose, TMH, II edition, 2007
2.	Principles ofDigital Communication J. Das, S.K.Mullick, P. K. Chatterjee, Wiley, 1986-Technology &Engineering
3.	Digital Communications- Fundamentals andApplications Bernard Sklar, SecondEdition, Pearson Education, 2016, ISBN: 9780134724058.
4.	Information Theory and Coding HariBhat, Ganesh Rao, Cengage, 2017.
5.	lTC and Cryptography Todd K Moon,Wiley Std. Edition, 2006
6.	Principles of Communication Systems, Herbert Taub and Donald L. Schilling, second edition
e-Resources	
1.	**https://nptel.ac.in/courses/117/101/117101053/**

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4106	**PE**	**3**	**--**	**--**	**3**	**30**	**70**	**3.Hrs**

RADAR ENGINEERING

(For ECE)

Course Objectives:

1.	To provide an ability to apply knowledge of mathematics, science, basic radar equations to measure the range of the stationary objects using Radar.
2.	To provide insight of basic working principles of Radar Transmitter and Receiver
3.	To introduce different types of Radar systems to measurement the Range, angle information etc. of the moving targets
4.	To introduce different types of tracking Radars and other types of Radar systems.
5.	To provide insight of the applications of Radar systems in various Navigational systems, their working principles, limitations, and different methods to overcome their limitations

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

S. No	Outcome	Knowledge Level
1.	Understand the basic working principles of Radars and Apply various mathematical equations to measure the actual Range and unambiguous range of the stationary targets from the radar	K3
2.	Understand the basic working principles of some important blocks in Radar receivers.	K2
3.	Understand the basic working principles of Radars and Apply various mathematical equations to measure the velocity, doppler shift, blind speeds, etc. of the moving targets from the radar	K3
4.	Analyze various tracking Radars, advantages and limitations of various tracking radars	K4
5.	Understand the basic working principles of some special radars	K2

SYLLABUS

UNIT-I (10Hrs)	**The Nature Of Radar:** - Introduction, The Simple form of the Radar Equation, Radar Block Diagram and Operation, List of Applications of Radar, Basic working Principle of Radar, prediction of range performance, minimum detectable signal, false alarm, missed detection, Pulse Repetition Frequency and Maximum Unambiguous Range, integration of radar pulses, system losses.
UNIT-II (10 Hrs)	**Radar Receivers:** Displays and Duplexers:-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 (10 Hrs)	**Mti And Pulse Doppler Radar:** 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, Butterfly effect, Coherent and Non Coherent Moving Target Indication Radar, Delay line Cancellers, Blind speeds, Moving target Detector.

UNIT-IV (10 Hrs)	**Tracking Radars:** Introduction, Types of Tracking Radars, Sequential Lobing, Conical Scan, Amplitude Comparison Monopulse tracking Radar: amplitude-comparison monopulse radar (one angular coordinate), two-coordinate (azimuth and elevation) amplitude-comparison monopulse tracking radar, Comparison of Sequential/ conical scanning tracking Radar and Monopulse Tracking Radar.
UNIT-V (10 Hrs)	**Speacial Radars:** Basic concepts and Radiation Pattern of Phased array Radar, Electronic Counter Measures, Electronic Counter Counter Measures. Direction finder using Rectangular Loop Antenna and Sense Finder. .

Textbooks:	
1.	Introduction to Radar Systems – Merrill I. Skolnik, Second 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.
e-Resources	
1.	How Does Radar Work?
2.	Doppler Radar Explained | How Radar Works | Part 3

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4107	PE	3	--	--	3	30	70	3.Hrs

LOW POWER VLSI DESIGN

Course Objectives:

1.	To provide a basic idea on different low power circuit design techniques.
2.	To identify the power dissipation mechanisms in various MOS logic styles
3.	To familiarize suitable techniques to reduce power dissipation

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

S. No	Outcome	Knowledge Level
1.	Understand the sources of power dissipation in digital IC systems	K2
2.	Understand the impact of power on system performance and reliability	K2
3.	Understand leakage sources and reduction techniques	K2
4.	Recognise and acquaint with the advanced issues in VLSI systems, specific to the deep-submicron silicon technologies	K2
5.	Acquaint with the mechanisms of power dissipation in CMOS integrated circuits	K2

SYLLABUS

UNIT-I (10Hrs)	Physics of Power dissipation in MOSFET devices MIS structure, Need for low power circuit design, Threshold voltage, body effects, Short channel effects-surface scattering, punch through, velocity saturation, impact ionization, Hot electron effects, Drain induced barrier lowering, narrow width effects
UNIT-II (10 Hrs)	Sources of power dissipation in CMOS-Switching power dissipation: Short circuit power dissipation, glitching power dissipation, Leakage power dissipation, Transistor leakage mechanisms of deep submicron transistors
UNIT-III (10 Hrs)	Circuit techniques for leakage power reduction – standby leakage control using transistor stacks, multiple Vth techniques, Dynamic Vth techniques, supply voltage scaling techniques, Deep submicron devices design issues, Minimizing short channel effect
UNIT-IV (10 Hrs)	Design and test of low voltage CMOS – Circuit design style, clocked design style- Basic concept, Domino logic (domino NAND gate), Differential Current Switch Logic
UNIT-V (10 Hrs)	Non clocked circuit design style-fully complementary logic, NMOS and pseudo –NMOS logic, differential cascade voltage switch logic (DCVS), Pass transistor logic

Textbooks:

1.	KiatSeng Yeo, Samir S. Rofail, Wang-Ling Goh, "CMOS/Bi CMOS ULSI Low Voltage Low Power", Pearson Education Asia 1st Indian reprint, 2002.
2.	Kaushik Roy, Sharat C Prasad, Low power CMOS VLSI circuit design, Wiley India,2000.
3.	Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

Reference Books:

1.	Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education
2.	GrayYeap, Practical low power digital VLSI design, Springer, 1998

e-Resources

1.	https://archive.nptel.ac.in/courses/106/105/106105034/

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4108	PE	3	--	--	3	30	70	3.Hrs

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

(For ECE)

Course Objectives:

1.	To study the basic DFT, FFT and rate conversion algorithm. And study the number format, dynamic range and sources of errors in DSP systems
2.	To give practical examples of DSP Processor architectures for better understanding.
3.	To learn about TMS programmable DSPs and their programming capabilities.
4	To develop the programming knowledge using Instruction set of DSP Processors.
5	To understand interfacing techniques to memory and I/O devices.

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

S. No	Outcome	Knowledge Level
1.	Identify and formalize architectural level characterization of P-DSP hardware	K2
2.	Understand the design, programming (assembly and C), and testing code using Code Composer Studio environment	K3
3.	Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.	K4
4.	Understand the architectures of ADSP 2100 DSP devices.	K2
5	Analyze various interfacing devices to DSP Processors.	K4

SYLLABUS

UNIT-I (10Hrs)	Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.
UNIT-II (10 Hrs)	Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.
UNIT-III (10 Hrs)	Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.
UNIT-IV (10 Hrs)	Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Black fin Processor - The Black fin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing

	Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.
UNIT-V (10 Hrs)	Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Textbooks:	
1.	Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2.	A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3.	Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-SengGan, Sen M. Kuo, Wiley-IEEE Press, 2007
Reference Books:	
1.	Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2.	Digital Signal Processing –Jonatham Stein, 2005, John Wiley.
3.	DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co
4.	Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5.	The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
e-Resources	
1.	https://www.dspguide.com
2.	www.ti.com › Processors

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4109	PE	3	--	--	3	30	70	3.Hrs

WIRELESS AND MOBILE COMMUNICATIONS

(For ECE)

Course Objectives:

1.	To know the evolution of Mobile communication and cell concept to improve capacity of the system
2.	To know the fading mechanism and types of fading and effect of fading on Mobile communication.
3.	To know the Architecture and functioning of GSM and its frame structure.
4.	To expose the students to understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.

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

S. No	Outcome	Knowledge Level
1	Understand the concept of cellular communication, upcoming technologies like 3G, 4G etc.	K2
2	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
3	Apply the knowledge of reflection, diffraction and scattering to calculate link budget using path loss models	K3
4	Understand the concepts of GSM and its architecture	K2
5	Understand the functioning of wireless systems and evolution of different wireless communication systems and standards.	K2

SYLLABUS

UNIT-I (10 Hrs)	Evolution of mobile communications, Types of Wireless communication System, Comparison of Common wireless system, 2G 3G and 4G Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area network (WLAN), and Personal Area Networks.
UNIT-II (10 Hrs)	Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction. Methods to improve cell coverage, Frequency management and channel assignment.
UNIT-III (10 Hrs)	Mobile Radio Propagation: Free space propagation model, Three basic propagation mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering. Small Scale Fading: Multipath Propagation, Types of small-scale fading. Outdoor Propagation Models, Indoor Propagation Models.
UNIT-IV (8 Hrs)	GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, GSM frame structure.
UNIT-V (12 Hrs)	Wireless Networks: Introduction to wireless Networks, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards. Introduction to Wi-Fi, WiMAX, Introduction to 5G, 802.15

Text Books:	
1.	Theodore S. Rappaport, “wireless communications Principles and Practices”, PHI, 2005
2.	William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
Reference Books:	
1.	Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2012.
2.	Andreas F.Molisch “Wireless Communications”, Wiley, Second Edition, 2014
3.	G.Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2013.
e-Resources	
1.	https://www.youtube.com/watch?v=f2wlHL1Sok8&list=PLuv3GM6-gsE3ypUYh43pPuZsXxJVG1e7F
2.	https://www.youtube.com/watch?v=iIjwzxnD-b0

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4110	PE	3	--	--	3	30	70	3.Hrs

FIBER OPTIC COMMUNICATION

(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.

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

S. No	Outcome	Knowledge Level
1.	Summarize the basic components of optical communication and demonstrate its components	K2
2.	Apply basic concepts of optical communication components and systems	K3
3.	Understand various sources of light as well as detectors and their comparative study	K2
4.	Analyze concepts of optical communication systems for the basic design of optical communication links.	K4
5.	Understand the wireless access scheme and OWC applications and WDM concepts	K2

SYLLABUS

UNIT-I (10Hrs)	**Overview of optical fiber communication –** Telecommunications, A Fiber-optic communication system: The Basic blocks, Historical notes, EM Waves, Refractive Index, A stream of photons, How optical fibers conduct light, Attenuation, intermodal and chromatic dispersion, Bit rate and bandwidth, More about total internal reflection, more about modes, Single mode fibers, Attenuation, Dispersion and bandwidth, multimode fibers, related problems
UNIT-II (10 Hrs)	**Fabrication, Cabling, Installation &Fiber connectors, coupling – Fabrication:** Two major stages, vapor phase deposition methods, coating, Fiber optic cables, Installation: classification, installation procedure. Splicing: connection loss, splicing procedure. Fiber connectors- Connector- A basic structure, Major characteristics, Fiber Couplers, Connectors, Splitters, Pump and signal combiners, circulators,
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, Introduction: **Optical wireless Communication systems**- wireless access schemes, A Brief History of OWC, OWC/radio Comparison, Link configuration, OWC application areas, Safety and Regulations , OWC challenges.

Textbooks:	
1.	Fiber Optic Communications Technology – D.K. Mynbaev and Lowell L. Scheiner, Pearson Education, 2009.
2.	Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 4th Edition, 2000.
3.	Optical Wireless communications- system and channel modeling with Mat lab-Z.Ghassemlooy, W.Popoola, S.Rajbhandari, CRC press
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.pfd

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4111	PE	3	--	--	3	30	70	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
5	To introduce basic concepts of GPS and Satellite navigation

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 communication 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	K2
5	Understand the basic concepts of GPS and Satellite navigation	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-I (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:** History of GPS, Evolution of GPS, Development of NAVSTAR GPS, GPS working principle, GPS Configuration, Satellite Signal Generation, Signal Power, and Other Global Navigation Systems.
Text Books:	
1.	Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition),John Wiley & Sons.
2.	Global Navigation Satellite systems by G.S.RAO
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
B20EC4112	PE	3	--	--	3	30	70	3 Hrs.

SOFTWARE DEFINED RADIO

(For ECE)

Course Objectives:

1.	To be aware of analog RF components as front-end blocks in implementation of SDR.
2.	To have Knowledge of Hardware and software development methods for embedded wireless systems.
3.	To Make system-level decisions for software defined radio technology and products.

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

S. No	Outcome	Knowledge Level
1.	Understanding of analog RF components as front-end block in implementation of SDR.	K2
2.	Design circuits at different multi rate signaling techniques for frequency conversion and Sampling issues.	K4
3.	Understanding of ADC and DAC technology.	K2
4.	Acquittance of Hardware and software development methods for embedded wireless systems.	K3
5.	Make system-level decisions for software defined radio technology and products.	K4

SYLLABUS

UNIT-I (10Hrs)	Introduction: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios-Importance of the Components to Overall Performance Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion
UNIT-II (10 Hrs)	Multi-Rate Signal Processing: Introduction- Sample Rate Conversion Principles- Poly phase Filters- Digital Filter Banks Timing Recovery in Digital Receivers Using Multirate Digital Filters.
UNIT-III (10 Hrs)	Digital Generation of Signals: Introduction- Comparison of Direct Digital Synthesis with Analog Signal Synthesis-Approaches to Direct Digital Synthesis- Analysis of Spurious Signals- Spurious Components due to Periodic jitter.

UNIT-IV (10 Hrs)	Analog to Digital and Digital to Analog Conversion: Parameters of ideal data converters- Parameters of Practical data converters- Analog to Digital and Digital to Analog Conversion- Techniques to improve data converter performance-Common ADC and DAC architectures.
UNIT-V (10 Hrs)	Digital Hardware Choices: Introduction- Key Hardware Elements- DSP Processors- Field Programmable Gate Arrays Trade-Offs in Using DSPs, FPGAs, and ASICs- Power Management Issues- Using a Combination of DSPs, FPGAs, and ASICs.
Textbooks:	
1.	Software radio a modern approach to radio engineering by Jeffry .H.Reed
2.	Software Defined Radio by Walter Tuttlebee
Reference Books:	
1.	Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems by HÜSEYIN ARSLAN, University of South Florida, Tampa, FL, USA
e-Resources	
1.	nptel/courses/video/108107107/L01.html

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4113	SOC	1	--	2	2	--	50	3 Hrs.

DESIGNING TOOLS
(Skill Oriented Course)

(For ECE)

Course Objectives: This Course will enable students to

1.	Know about behaviour 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 also plot the loss characteristics.

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

S. No	Outcome	Knowledge Level
1.	Identify the different microwave components, equipment's and their uses	K2
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.	K5
4.	Analyze the radiation patterns of antennas.	K4
5.	Assess the performance of optical devices.	K5

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

Regulation: R20	IV / IV - B.Tech. II - Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF INSTRUCTION & EXAMINATION
(With effect from 2020-21 admitted Batch onwards)

Course Code	Course Name	Category	Cr	L	T	P	Int. Marks	Ext. Marks	Total Marks
B20EC4201	Project Work (Project work, seminar and internship in industry)	PR	8	0	0	16	60	140	200
	TOTAL		**8**	**0**	**0**	**16**	**60**	**140**	**200**

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B20EC4201	PR	--	--	16	8	60	140	3 Hrs.

PROJECT WORK

(For ECE)

Course Objectives:

1	To provide an opportunity to work in group on a topic / problem / experimentation
2	To encourage creative thinking process
3	To provide an opportunity to analyze and discuss the results to draw conclusions
4	To acquire and apply fundamental principles of planning and carrying out the work plan of the project through observations, discussions, and decision-making process.

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

S.No.	Outcome	Knowledge Level
1	Identify a current problem through literature/field/case studies	K3
2	Identify the objectives and methodology for solving the problem	K3
3	Design and Develop technology/process for solving the problem	K4
4	Evaluate the technology/process	K5

*The object of Project Work 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.