GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Electrical, Electronics and Communication Engineering

Program: B. Tech Electronics and Communication Engineering

Scheme: 2018 – 2022

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BECE1001	Introduction to Electronics and Communication Engineering	0	0	2	1	50	-	50
2	BCSE1002	Computer Programming and Problem Solving	0	0	4	2	50	-	50
3	MATH1001	Multivariable Calculus	3	0	0	3	20	50	100
4	MATH1002	Exploration with CAS-I	0	0	2	1	50	-	50
5	PHYS1001	Engineering Physics	3	0	0	3	20	50	100
6	PHYS1002	Engineering Physics Lab	0	0	2	1	50	-	50
7	CHEM1001	Engineering Chemistry	3	0	0	3	20	50	100
8	CHEM1002	Engineering Chemistry Lab	0	0	2	1	50	-	50
9	BEEE1002	Basic Electrical and Electronics Engineering	2	1	0	3	20	50	100
10	SLBT1001	Basic English	0	0	2	1	20	30	50
11	JAPA1001	Japanese-I					20	30	50
	FREN1001	French-I					20	30	50
	GERN1001	German-I					20	30	50
12	BEEE1003	BEEE Lab	3	0	0	3	50	-	50
		Total	**14**	**1**	**14**	**21**			

Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BCSE1003	Application Oriented Programming using Python	0	0	4	2	50	-	50
2	PSSO1001	Psychology and Sociology	2	0	0	2	20	50	100
3	ENVS1001	Environmental Science	3	0	0	3	20	50	100
4	MATH1003	Matrices and Differential Equations	3	0	0	3	20	50	100
5	MATH1004	Exploration with CAS-II	0	0	2	1	50	-	50
6	PHYS1004	Physics of Semiconductor Devices	3	0	0	3	20	50	100
7	PHYS1005	Advanced Physics Lab	0	0	2	1	50	-	50
8	BTME1002	Product Design using Graphics	0	0	4	2	50	-	50
9	BTME1003	Product Manufacturing	0	0	2	1	50	-	50
10	UHVE1001	Universal Human Values and Ethics	0	0	4	2	20	50	100
11	SLBT1002	English Proficiency and Aptitude Building-1	0	0	4	2	20	50	100
12	JAPA1002	Japanese-I					20	50	100

	FREN1002	French-I					20	50	100
	GERN1002	German-I					20	50	100
		Total	**11**	**0**	**24**	**23**			

Semester III

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1.	BECE2015	Electronics Devices and Circuits	3	0	0	3	20	50	100
2.	MATH2002	Numerical Methods	3	0	0	3	20	50	100
3.	BECE2001	Electronics and Communication Engineering Project Based Learning -1	0	0	2	1	50	-	50
4.	BECE2018	Electronics Design and PCB Lab	0	0	2	1	50	-	50
5.	BECE2002	Network Analysis and Synthesis	3	0	0	3	20	50	100
6.	BECE2016	Signals and Systems	3	0	0	3	20	50	100
7.	BECE2010	Digital Electronics	3	0	0	3	20	50	100
8.	BECE2011	Digital Electronics Lab	0	0	2	1	50	-	50
9.	BECE9001	Object Oriented Programming	0	0	2	1	20	50	100
10	SLBT2001	English Proficiency and Aptitude Building - 2	0	0	4	2	20	50	100
		Total	**15**	**0**	**12**	**21**			

Semester IV

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1.	MATH2004	Probability and Stochastic processes	3	0	0	3	20	50	100
2.	BECE2008	Integrated Circuits	3	0	0	3	20	50	100
3.	BECE2009	Integrated Circuits Lab	0	0	2	1	50	-	50
4.	BEEE3002	Control System	3	0	0	3	20	50	100
5.	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	50	100
6.	BECE2004	Analog Communication	3	0	0	3	20	50	100
7.	SLBT2002	English Proficiency and Aptitude Building - 3	0	0	4	2	20	50	100
8	BECE2020	Digital Signal Processing	3	0	0	3	20	50	100
9	BECE9003	Data Structure	0	0	2	1	50	-	50
10	BCSE9006	AI & MLusing Python	0	0	2	1	50	-	50
11	BEEE9001	Disruptive Technologies	3	0	0	3	20	50	100
		Total	**21**	**0**	**10**	**26**			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	BECE3020	Digital Communication	3	0	0	3	20	50	100
2.	BECE3021	Digital Communication Lab	0	0	2	1	50	-	50
3.	BECE3017	Microprocessors and Its Application	3	0	0	3	20	50	100
4.	BECE3018	Microprocessors Lab	0	0	2	1	50	-	50
5.	BECE3006	Microwave Engineering	3	0	0	3	20	50	100
6.	BECE3007	Microwave Engineering Lab	0	0	2	1	50	-	50
7.	BECE3008	ECE Project Based Learning-3	0	0	2	1	50	-	50
8.	SLBT3001	English Proficiency and Aptitude Building – 4	0	0	4	2	50	-	50
9.	UE3	Humanities Course (from basket)	3	0	0	3	20	50	100
10		Program Elective (from basket) - 1	3	0	0	3	20	50	100
11		Database Management System	3	0	0	3	20	50	100
		Total	**18**	**0**	**12**	**24**			

Semester VI

SlNo	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	SLBT3002	Campus to Corporate	0	0	4	2	50	-	50
2.	BECE3011	ECE Project Based Learning-4	0	0	2	1	50		50
3.	BECE3012	Wireless and Mobile Communication	3	0	0	3	20	50	100
4.	BECE3013	VLSI Design	3	0	0	3	20	50	100
5.	BECE3014	VLSI Design Lab	0	0	2	1	50	-	50
6.	BECE3015	Antenna and Wave Propagation	3	0	0	3	20	50	100
7.	BECE3019	Embedded Systems	3	0	0	3	20	50	100
8.		Program Elective (from basket) - 2	3	0	0	3	20	50	100
9.		Program Elective (from basket) - 3	3	0	0	3	20	50	100
10		**Total**	**18**	**0**	**8**	**22**			

Semester VII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	BECE9998	Capstone Design - 1	0	0	6	3	50	-	50
2.	BECE4002	ECE Seminar	0	0	2	1	50	-	50
3.	BECE4003	Embedded System Lab	0	0	2	1	50	-	50
4.		Program Elective (from basket) - 4	3	0	0	3	20	50	100

5.		Program Elective (from basket) - 5	3	0	0	3	20	50	100
6.	UE1	Management Course (from basket)	3	0	0	3	20	50	100
7.	UC23	Management Course (from basket)	3	0	0	3	20	50	100
8.		**Total**	**12**	**0**	**10**	**17**			

Semester VIII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BECE9999	Capstone Design - 2	0	0	18	9	50	-	50
		Total	**0**	**0**	**18**	**9**			

List of Electives

List of programme electives						
Sl.No.	**CourseCode**	**CourseTitle**	**L**	**T**	**P**	**C**
		Basket 1				
1	BECE3101	Database Concepts	3	0	0	3
2	BECE3102	Automation and Robotics	3	0	0	3
3	BECE3103	Satellite Communication	3	0	0	3
4	BECE3104	Digital System Design using VHDL	3	0	0	3
5	BECE3105	Computer Networks	3	0	0	3
		Basket 2				
1	BECE3201	Principles of Secure Communication	3	0	0	3
2	BECE3202	Neural Networks and Fuzzy Control	3	0	0	3
3	BECE3203	Wireless Sensor Networks	3	0	0	3
4	BECE3204	Mobile Ad Hoc Networks	3	0	0	3
		Basket 3				
1	BECE3301	Digital Image Processing	3	0	0	3
2	BECE3302	Information Theory and Coding	3	0	0	3
3	BECE3303	Modern Digital Signal Processing	3	0	0	3
4	BECE3304	ASIC Design and FPGA	3	0	0	3
		Basket 4				
1	BECE4401	Soft Computing	3	0	0	3
2	BECE4402	Mobile Computing	3	0	0	3
3	BECE4404	Radar Guidance and Navigation	3	0	0	3
		Basket 5				
1	BECE4501	Introduction to IoT and its Applications	3	0	0	3
2	BECE3016	Optical Communication	3	0	0	3

Detailed Syllabus

Name of The Course	Introduction to Electronics and Communication Engineering				
Course Code	BECE1001				
Prerequisite	Basic Number System, Basic Electronics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

The course will provide the knowledge on basic electronics engineering. The design and analysis of half wave and full wave rectifiers, clipping circuits and zeener regulators, BJT characteristics and amplifiers will be discussed in the course. It will also explain the logic gates family, combinational circuits and sequential circuits. Their application as pulse generators, ripple counter and numerical display will be discussed to ensure the basic knowledge among students. The process of communication system with the modulation techniques will be taught in this course.

Course Outcomes

CO1	Analyze the concepts of electrical network theorems
CO2	Define the fundamental concepts of electronic components
CO3	Design and operate digital circuits
CO4	Explain the basic concepts of communication techniques
CO5	Develop the concept to design the circuits for a given problem

Text Book :

1. A. P. Malvino, Electronic Principles, TMH, New Delhi, 1993
2. R. J. Tocci, Digital Systems, PHI, 6th Ed, 2001

Reference Books

1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th Ed., Oxford University Press, 2010

Course Content:

Unit-1 Principle of communication networks 8 hours Components of networks: Resistance, inductance, capacitance and semiconductor devices. Kirchoff's voltage and current laws, approximations, voltage source, current source, Thevenin's theorem, Norton theorem, troubleshooting
Unit II: Diodes 8 hours
Diode Circuits: Half wave rectifiers, transformers, full wave rectifiers, power supply, clippers and limiters, clampers, voltage multipliers, Zener diode, voltage regulators.
Unit-III Transistors fundamentals 8 hours
Transistors fundamentals: Unbiased transistor, biased transistor, CE connections, load line, operating point, saturation current, led driver.
Unit IV : Basic Digital Electronics 8 hours
Basic Digital Electronics: logic gates, inverter, NAND, NOR, OR, CMOS and TTL logic. Combinational and sequential digital circuits.
Unit V: Basic Communication Engineering 8 hours

Basic Communication Engineering: Amplitude modulation, Frequency modulation, Phase modulation, detection, phase-locked-loop (PLL), Frequency division multiplexing (FDM)

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Basic Electrical and Electronics Engineering				
Course Code	BEEE1002				
Prerequisite	Basic Number System, Basic Electronics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To develop solid foundation for further study of electrical and electronics courses
2. To develop the analytical skills for solving the electrical and electronics circuits
3. To learn the utility of basic electronics devices and circuits
4. To understand the basic principles of electrical machines

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Course Outcomes

CO1	Summarize the basic network theorems and laws, Boolean algebra, BJT characteristics, principle of different types of electrical machines
CO2	Solve and analyze transient and steady state of AC and DC network, phasors, representation and conversion of data, Synthesis of logic circuits, BJT and diode biasing, wave shaping circuits and operation of the machines
CO3	Apply the AC and DC theorems and laws in networks circuits, Boolean algebra, BJT characteristics, operation of the machines
CO4	Demonstrate AC and DC network circuits using network theorems and laws, Boolean logic circuits, BJT biasing and its characteristics, connections and testing of the machines
CO5	Understand transformer and motor basic characteristic and working

Text Book :

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill, 20016.
1. V. Mittle and Arvind Mittle, “Basic Electrical Engineering”, McGraw Hill, 2005.
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education, 2007.
3. A. P. Malvino and Donald Leach, “Digital Principles and Applications”, 6th Edition, Tata McGraw Hill, 2006.

Reference Books

1. D. C. Kulshreshtha,”Basic Electrical Engineering”, Tata McGraw Hill, 2009.
2. J. Edminister and M. Nahvi , “Electric Circuits”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2002.
3. Jacob Millman, Christos C. Halkias, Satyabrata Jit, “Electronics Devices and Circuits”, 3rd Edition, Tata McGraw Hill, 2008

Course Content:

Unit-1 **Elementary Circuit Analysis** **8 Hours** Ohm’s law, KCL, KVL, node voltage analysis, mesh current, circuits with independent sources, Thevenin’s & Norton’s equivalent, maximum power transfer and superposition theorem.
Unit II: **8 Hours**

Analysis of DC and AC Circuits RL and RC transients in circuits with DC source, RMS values, the use of phasors for constant frequency sinusoidal sources, steady state AC analysis of a series circuit, parallel circuits, AC power calculations.
Unit-III **8 Hours**
Digital Systems Basic logic circuit concepts, Basic Gates and Universal Gates, representation of numerical data in binary form – Binary to decimal, Octal, Hexadecimal, Boolean algebra, combinational logic circuits-Half adder, full adder, synthesis of logic circuits, minimization of logic circuits.
Unit IV **8 Hours**
Semiconductor Devices Basic diode concepts, ideal diode model, rectifier and wave-shaping circuits, zener diode voltage regulator concepts, bipolar junction transistors, current and voltage relationship, common emitter characteristics.
Unit V: **8 Hours**
Electro-mechanics Transformers-Ideal and real transformers, Construction, Principle of operation of transformer, E.M.F Equation, Phasor diagram of transformer, Losses, efficiency. D.C Machines-Construction, principles of rotating DC machines, Types of Excitations-separately excited and self excited (shunt, series and compound) DC machines. Three phase induction motors-Construction, Principle of operation, synchronous speed, slip, and frequency of rotor emf. Synchronous Machines-construction, principle of operation of synchronous motor and applications.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Signals and Systems				
Course Code	BECE2016				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

This subject is about the mathematical representation of signals and systems. The most important representations we introduce involve the *frequency domain* – a different way of looking at signals and systems, and a complement to the time-domain viewpoint. Indeed engineers and scientists often think of signals in terms of frequency content, and systems in terms of their effect on the frequency content of the input signal. Some of the associated mathematical concepts and manipulations involved are challenging, but the mathematics leads to a new way of looking at the world.

Course Outcomes:

CO1	Understand about various types of signals, classify them, analyze them, and perform various operations on them.
CO2	Understand about various types of systems, classify them, analyze them and understand their response behaviour
CO3	Appreciate use of transforms in analysis of signals and system.
CO4	Carry simulation on signals and systems for observing effects of applying various properties and operations.
CO5	Create strong foundation of communication and signal processing to be studied in the subsequent semester

Text Book:

1. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi, ISBN 1259083349, 9781259083341

Reference Books

1. Signals and Systems by Oppenheim & Wilsky Millman

Course Content:

Unit I: Introduction to Signals **9 Hours**
Definition, types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step, unit ramp (and their inter-relationships),exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit II :Introduction to Systems **8 Hours**
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit III: Fourier Transforms (FT) **10 Hours**
Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit IV: Laplace-Transform (LT) and Z-transform (ZT) **10 Hours**

One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping
Unit V: Time and frequency domain analysis of systems **8 Hours**
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electronic Devices and Circuits				
Course Code	BECE2015				
Prerequisite	Physics,Modern Physics				
Corequisite	Physics				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

Course Outcomes

CO1	Realize the transistor biasing methods and Design analog electronic circuits using discrete components
CO2	Design common amplifier circuits and analyze the amplitude and frequency responses
CO3	Design various analog circuits to analyze their responses
CO4	Understand the principle of operation of different Oscillator circuits.
CO5	Understand the principle of operation of various amplifier circuits

Text Book (s):

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634556, 9780070634558.
2. Jacob Millman and C. Halkias, 'Integrated Electronics – Analog and Digital Circuits and Systems', Tata Mc Graw Hill, 2001, ISBN 0074622455, 9780074622452
3. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10th EditionPrentice Hall, 2009, ISBN 0135026490, 9780135026496

Reference Book (s):

1. Jacob Millman and Arvin Grabel, 'Microelectronics', McGraw Hill, 2001, ISBN 0074637363, 9780074637364.
2. Electronic Devices & Circuits – David. A. Bell, 3rd Edition, Prentice – Hall, 1986 ISBN 083591559X, 9780835915595Syllabus

Course Content:

Unit-1 Introduction	**8 hours**
BJT and BJT Biasing .Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, Cascode amplifier. HF & LF compensation of RC coupled amplifier. Multistage Amplifiers.	
Unit-2 FET Biasing	**8 hours**

FET and FET Biasing. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. Small signal analysis of FET Amplifiers. High Frequency analysis of FET Amplifiers, VMOS & CMOS Concepts.
Unit-3 Feedback Amplifiers **8 hours**
The feedback concept – Transfer gain with feedback – general characteristics and advantages of negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions
Unit-4 Oscillators **8 hours**
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators.
Unit-5 Tuned Amplifiers **8 hours**
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization. Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Network Analysis and Synthesis				
Course Code	BECE2002				
Pre-requisite	Basic Electrical and Electronics Engineering				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To learn the concepts of network analysis in electrical and electronics engineering.
2. To learn linear circuit analysis, graph theory and network theorems.
3. Analyze two port networks using Z, Y, ABCD and h parameters

Course Outcomes:

CO1	Analyze an electric network using graph theory
CO2	Solve the electric networks using different network theorems e.g. Thevenin's theorem, superposition theorem and maximum power transfer theorem etc
CO3	Synthesize an electric network using driving point and transfer functions
CO4	Analyze LTI systems using two ports networks
CO5	Design active and passive filter circuits

Text Books

1. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. A C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007,
3. D.RoyChoudhary, "Networks and Systems" Wiley Eastern Ltd.

Reference Books

1. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.
2. A.Chakrabarti, "Circuit Theory" DhanpatRai& Co

Course Content:

Unit I: Graph Theory **8 Hours**
Loop and Nodal methods of analysis, Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality.
Unit II: Network Theorems (Applications to ac networks) **10 Hours**
Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Compensation theorem, Tellegen's theorem.
Unit III: Network Functions and Transient analysis **9 Hours**
Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.
Unit IV : Two Port Networks **8 Hours**
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.
Unit V: Network Synthesis & Filters **9 Hours**
Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Integrated Circuit			
Course Code	BECE2008			
Pre-requisite	Basic Electrical and Electronics Engineering			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

Course Outcomes:

CO1	Illustrate the AC, DC characteristics and compensation techniques of Operational Amplifier
CO2	Realize the applications of Operational Amplifiers
CO3	Clarify and Analyze the working of Analog Multipliers and PLL
CO4	Classify and realize the working principle of various converter circuits using Op-Amps
CO5	Demonstrate the function of various signal generators and Waveform Shaping Circuits

Text Books:

1. Sergio Franco, " Design with operational amplifiers and analog integrated circuits ", McGraw Hill, 2002, ISBN 0070530440, 9780070530447
2. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", 4th Edition, Prentice Hall, 2000, ISBN 0132808684, 9780132808682

Reference Books:

1. Botkar K.R., " Integrated Circuits ", Khanna Publishers, 1996.
2. Taub and Schilling, " Digital Integrated Electronics ", Tata McGraw-Hill Education, 2004, ISBN 0070265089, 9780070265080
3. Millman J. and Halkias C.C., " Integrated Electronics ", McGraw Hill, 2001, ISBN 0074622455, 9780074622452Syllabus.

Course Content:

Unit I: Operational Amplifiers **8 Hours**
Analysis of difference amplifiers, Monolithic IC operational amplifiers, specifications, frequency compensation, slew rate and methods of improving slew rate, Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers.
Unit II: Applications of Operational Amplifiers **10 Hours**
Differentiator, Integrator Voltage to Current convertor, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, comparator, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator.
Unit III: Analog Multiplier and PLL **8 Hours**
Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators. Frequency synthesizers, Compander ICs.
Unit IV: D/A and D/A Converters **9 Hours**

Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter- Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope, Successive approximation, DM and ADM, Voltage to Time and Voltage to frequency converters.
Unit V: Signal generators & Waveform shaping Circuits **8 Hours**
Wave shaping circuits, Multivibrator- Monostable & Astable, Schmitt Trigger circuits, IC 555 Timer, Application of IC 555, Switched capacitor filter, Frequency to Voltage converters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Integrated Circuits Lab				
Course Code	BECE2009				
Prerequisite	Linear Integrated Circuits, Op-amp				
Corequisite	Analog electronics				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	2	

Course Objectives:

To understand the basics of linear integrated circuits and available ICs

- To understand the characteristics of the operational amplifier.
- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function IC.
- To use SPICE software for circuit design

Course Outcomes

CO1	Design amplifiers, oscillators, D-A converters using operational amplifiers
CO2	Design filters using op-amp and performs an experiment on frequency response.
CO3	Analyze the working of PLL and describe its application as a frequency multiplier
CO4	Design DC power supply using ICs.
CO5	Analyze the performance of filters, multivibrators, A/D converter and analog multiplier using SPICE.

List of Experiments

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable & Monostable multivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. DC power supply using LM317 and LM723.

USING SPICE:

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostable multivibrators using NE555 Timer.
3. A/ D converter
4. Analog multiplier

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Digital Electronics				
Course Code	BECE2010				
Pre-requisite	Basic Electrical and Electronics Engineering				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Understanding the numbering systems and their transformations used in computerized system
2. Simplification of logic expressions and realize to design combinational and sequential digital circuits
3. Analyzing the operation and design constraints of CMOS and TTL circuit for logic fabrication.
4. To gain an in-depth understanding of VHDL and to realize different circuits using it both sequential and combinational
5. To learn the concept of memories and how they are designed using VHDL

Course Outcomes:

CO1	Smooth understanding on digital circuits with inputs/outputs
CO2	Understand the logic circuits, minimize and design the circuits through K-map reduction
CO3	Design a combinational logic circuits like: adder, substractor, multiplexer and demultiplexers
CO4	Design digital register with using different types of flip flops
CO5	Design a circuit of combinational/sequential VHDL platform

TEXT BOOKS

1. Mano, Morris. "Digital logic." *Computer Design. Englewood Cliffs Prentice-Hall* (1979).
2. Kumar, A. Anand. *Fundamentals Of Digital Circuits 2Nd Ed*. PHI Learning Pvt. Ltd., 2009.
3. Taub, Herbert, and Donald L. Schilling. *Digital integrated electronics*. New York: McGraw-Hill, 1977.
4. Stephen Brown and Zvonko Vranesic," Fundamentals of Digital Logic with VHDL Design" , Mc-Graw-Hill (2nd edition).*ISBN*-10: 0077211642

REFERENCE BOOKS

1. Floyd, Thomas L. *Digital Fundamentals, 10/e*. Pearson Education India, 1986.
2. Malvino, Albert Paul, and Donald P. Leach. *Digital principles and applications*. McGraw-Hill, Inc., 1986.
3. Jain, Rajendra Prasad. *Modern Digital Electronics 3e*. Tata McGraw-Hill Education, 2003.

Course Content:

Unit I: Number System & Boolean Algebra **8 Hours**
Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions, Prime Implicants and Essential Prime Implicants definition and simplification using K-maps upto 5 variables & Quine McCluskey method.
Unit II: Combinational Circuits 8 Hours
Introduction to Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR and their combinations. Design of adder, subtractors, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers, Function realization using gates & multiplexers.
Unit III: Synchronous Sequential Ciruits 10 Hours
Introduction to Latches and Flip flops - SR, D, JK and T. Design of synchronous sequential circuits – Counters, shift registers. Finite State Machine Design, Mealy, Moore Machines, Analysis of synchronous sequential circuits;, state diagram; state reduction; state assignment with examples.
Unit IV: Introduction VHDL 10 Hours

INTRODUCTION to Hardware Description Languages (HDL) and HDL based design, VHDL-Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, VHDL model for a counter.
Unit V: VHDL Synthesis and Models **8 Hours**
Attributes, Transport and Inertial delays, Operator overloading, Multivalued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and TEXTIO.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Control Systems				
Course Code	BEEE3002				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

Study of Open loop & closed control; servomechanism, Transfer functions, Block diagram algebra, Signal flow graph, time response of first and second order systems, time response specifications, dynamics of linear systems, and frequency domain analysis and design techniques. Constructional and working concept of ac servomotor, synchronous and stepper motor, their characteristics, performance. The Routh-Hurwitz, root-locus, Bode, and Nyquist techniques. Design and compensation of feedback control systems. Diagonalization, Controllability and observability and their testing.

Course Outcomes:

CO1	Summarize different control system and solve transfer function, block diagram and signal flow diagram reduction of control system.
CO2	Design and solve control system engineering problems in time response of first and second order systems.Analyze concept of ac servomotor, synchronous and stepper motor and and understand Stability and Algebraic Criteria concept of stability and necessary conditions
CO3	Applying concept of ac servomotor, synchronous and stepper motor and understand Stability and Algebraic Criteria concept of stability and necessary conditions
CO4	Demonstrate & analyse frequency response analysis for stability by polar and inverse polar plots, Bode plots, Nyquist stability criterion, gain margin and phase margin
CO5	Realize the design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain, diagonalization, Controllability and observability and their testing

Text and Reference Books

1. Nagrath&Gopal, “Control System Engineering”, 4th Edition, New age International.
2. 2. K. Ogata, “Modern Control Engineering”, Prentice Hall of India.
3. 3. B.C. Kuo & FaridGolnaraghi, “Automatic Control System” Wiley IndiaLtd, 2008.
4. N.C. Jagan, “Control Systems”, B.S. Publications,2007. K. Ogata, “Modern Control Engineering”, Prentice Hall of India.
5. D.RoyChoudhary, “Modern Control Engineering”, Prentice Hall of India.

Course Content:

Unit-1 Introduction to Control Systems 8 hours
Open loop & closed control system, servomechanism, Physical examples. Transfer functions, Block diagram algebra, and Signal flow graph, Mason’s gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.
Unit-2 Time Response of feedback control systems 8 hours
Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants. Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices.
Unit-3 Stability analysis 8 hours
Routh-Hurwitz criteria and limitations, root locus concepts, construction of root locus. Constructional and working of ac servomotor, synchronous and stepper motor.

Unit-4 Frequency domain analysis and stability 8 hours
Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.
Unit-5 Introduction to Digital Control System 8 hours
The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain**.** Review of state variable technique: Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Electromagnetic Field Theory				
Course Code	BECE2012				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcomes:

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.

Reference Books

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
4. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999Syllabus

Course Content:

UNIT I STATIC ELECTRIC FIELDS
Introduction to Co-ordinate System – Rectangular –Cylindrical and Spherical Co- ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges – Electric field due to continuous charge distribution – Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet.Electric Scalar Potential – Relationship between potential and electric field – Potential due to infinite uniformly charged line – Potential due to electrical dipole – Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications
UNIT II: STATIC MAGNETIC FIELDS
The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I –Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.

UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS
Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials- Definition of Capacitance – Capacitance of various geometries using Laplace's equation– Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability – magnetic boundary conditions
UNT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS
Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form. Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.
UNIT V: ELECTRO MAGNETIC WAVES
Derivation of Wave Equation – Uniform Plane Waves – Maxwell's equation in Phasor form – Wave equation in Phasor form – 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. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization, Brewster angle.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Digital Communication				
Course Code	BECE3020				
Pre-requisite	Electronic Circuit				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Difference between analog and digital communication systems, and compare their respective advantages and disadvantages.
2. Performance limitation, detection and estimation in digital communication system.
3. Waveform coding techniques and the design and use of A/D convertors or D/A convertors.
4. Role of Digital Modulation and Demodulation techniques in different application.
5. Use of spreading of signals and multiple access schemes

Course Outcomes:

CO1	Define Sampling theorem and explain the various aspects of sampling theorem viz. Aliasing, signal distortion. Explain quadrature sampling of band pass signals
CO2	Identify and explain the techniques used for waveform coding viz. Pulse Amplitude Modulation (PAM) and Pulse Code Modulation. (PCM).
CO3	Identify various types of error introduced in the processes viz. sampling, quantizing, and Describe Inter Symbol Interference(ISI), adaptive equalization techniques
CO4	Describe different digital modulation schemes, and compare advantages/ Disadvantages of each as applied to baseband signal.
CO5	Identify the presence of error bits signal, and calculate unknown phase of noise in the received signal. Describe spread spectrum and pseudo noise sequence

Text Books

1. Simon Haykin, "Digital Communications", Wiley student edition- 1988, ISBN 978-81-265-0824-2

2. Bernard Sklar, "Digital Communication", 2nd Edition, Pearson Education,edition- 2006, ISBN-10: 0130847887.

Reference Books

1. John.G. Proakis, "Fundamentals of Communication Systems", Pearson Education, 2006, ISBN 978-81-317-05735

2. Amitabha Bhattacharya, "Digital Communications", Tata McGraw Hill, 2006, ISBN: 978-0-07-059117-2.

3. Herbert Taub& Donald L Schilling – Principles of Communication Systems (3rd Edition) – Tata McGraw Hill, 2008, ISBN 0070648115.

4. Michael. B. Purrsley, "Introduction to Digital Communication", Pearson Education, 2006, ISBN 978-0-07-2957 I6-7,4th edition.

Course Content:

Unit- I: Communication System & Information Theory 9 Hours
Introduction to Digital Communication; Basic building blocks of digital communication, GSOP, Mutual information, Information and Channel Capacity, Entropy, Shano- Fano and Huffman's Coding, Overview of Sampling, Quantization – Uniform and Non-uniform (A-law & μ-law). Classification of line codes, characteristics and power spectra of line codes.
Unit – II: Baseband Transmission 8 Hours
Baseband data Transmission Systems: Baseband and Bandpass transmission through AWGN channel, Coherent and noncoherent receiver structures, Error Probability, Pulse Shaping, M-ary Signalling Schemes, Matched Filter, Correlation receiver, Equalization, ISI, Eye Pattern analysis.

Unit – III: Waveform Coding Techniques **8 Hours**
Pulse-Code modulation (PCM), Quantization Noise and Signal-to-noise Ratio, Differential-PCM, Delta Modulation and Adaptive delta-Modulation
Unit – IV: Modulation Schemes **8 Hours**
Digital Modulation Schemes, ASK, PSK, DPSK, FSK, QPSK, QAM and MSK systems, Probability of Error in Digital Modulation Schemes, Continuous Phase Carrier Modulation, Differential modulation schemes, receiver structure and error performance, Performance comparison of modulation schemes.
Unit – V: **Spread Spectrum & Multiple Access Techniques** **8 Hours**
Introduction – Generation of PN Sequences – Properties of PN Sequences – Direct Sequence Spread Spectrum – Frequency Hopped Spectrum. Introduction to Multiple Access– TDM/TDMA – FDM/FDMA – CDMA – SDMA - OFDM/OFDMA.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Digital Signal Processing			
Course Code	BECE2020			
Pre-requisite	Signals and System, Engineering Mathematics			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. Introduce to discrete time signal processing and characterization of random signals, filter design techniques, and imperfections caused by finite word length.
2. Learn how design FIR and IIR filters.
3. Learn the theory of digital signal processing and digital filter design, including hands-on experience with important techniques involving digital filter design and digital simulation experiments
4. Introduce the fundamental principles and techniques of digital signal processing for understanding and designing new digital signal processing systems and for continued learning.

Course Outcomes:

CO1	Apply Digital Signal Processing fundamentals.
CO2	Acquire the knowledge of representation of discrete-time signals in the frequency domain,using z-transform and discrete Fourier transform
CO3	Learn the basic forms of FIR and IIR filters.
CO4	Design filters with desired frequency responses
CO5	Understand the concept of linear prediction and spectrum estimation.

TEXT BOOKS

1. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms And Applications", Pearson Education, 3rd Ed., 2003

2. Babu Ramesh P., "Digital Signal Processing", SciTech Publication, 41FL Ed., 2008.

REFERENCE BOOKS

1. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", 3rd Ed., Tata McGraw-Hill, 2008.

2. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing", PHI, 2nd Ed., 2000.

3. Shaliwahan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw-Hill, 2nd Ed., 200

Course Content:

UNIT I SIGNALS AND SYSTEMS **8 Hours**
Basic elements of DSP, concepts of frequency in Analog and Digital Signals, sampling theorem, Discrete–time signals, systems, Analysis of discrete time LTI systems, Z transform, Convolution, Correlation.
UNIT II FREQUENCY TRANSFORMATIONS **8 Hours**
Introduction to DFT, Properties of DFT, Circular, Convolution , Filtering methods based on DFT, FFT Algorithms, Decimation–in–time Algorithms, Decimation–in–frequency Algorithms, Use of FFT in Linear Filtering, DCT, Use and Application of DCT.
UNIT III IIR FILTER DESIGN **8 Hours**
Structures of IIR, Analog filter design, Analog Low Pass Butterworth Filter, Analog Low Pass Chebyshev Filter, Comparison Between Butterworth Filter And Chebyshev Filter, Frequency Transformation In Analog Domain, Design Of High Pass, Bandpass And Bandstop Filters, Design Of IIR Filters From Analog Filters, Approximation Of Derivatives, Design Of IIR Filter Using Impulse Invariance Technique, Design Of IIR Filter Using Bilinear Transformation, Frequency Transformation In Digital Domain.
UNIT IV FIR FILTER DESIGN **8 Hours**

Structures of FIR, Linear phase FIR filter, Frequency Response Of Linear Phase FIR Filters, Location Of The Zeros Of Linear Phase FIR Filters, The Fourier Series Method Of Designing FIR Filters, Design Of FIR Filter Using Windows, Digital Differentiator, Hilbert Transformers, Frequency Sampling Method Of Designing FIR Filters, Optimum Equi-ripple Approximation Of FIR Filters.
UNIT IV INTRODUCTION TO DSP PROCESSORS 8 Hours
Introduction to programmable DSPs: Multiplier and Multiplier Accumulator (MAC), Modified Bus Structures and Memory Access schemes in DSPs Multiple access memory, multiport memory, VLSI Architecture, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS 320C5X- Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Registrar, Index Registrar, Auxiliary Register Compare Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, program controller, Some flags in the status registers, On-chip registers, On-chip peripherals

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Microwave Engineering				
Course Code	**BECE3006**				
Pre-requisite	Electromagnetic field theory				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Concept of scattering parameters used to characterize devices and system behavior.
2. The high frequency behavior of circuit and network elements as well as the analysis and the design of active and passive microwave devices.

Course Outcomes:

CO1	Illustrate the basic concepts of microwave transmission lines.
CO2	Identify and use microwave guides and components.
CO3	Apply the conceptual knowledge of microwave solid state technology and traveling wave tube techniques
CO4	Distinguish between microwave solid state and technology and traveling wave tube techniques
CO5	Demonstrate and evaluate the microwave measurement techniques.

Text Book

1.D.M.Pozar, "Microwave engineering", John Wiley, 3/e, 2005
2. Samuel Y.Liao, "Microwave Devices and Circuits", 3/e, PHI, New Delhi,1987.

Reference Books

1. Rober.E.Collin, "Foundations of Microwave Engineering", John Wiley, 3/e, 2001
2. Annapurna Dasand S,.K.Das, "Microwave Engineering", Tata Mc Graw-Hill, New Delhi, 2000
3. R.Chatterjee, "Microwave Engineering", Affiliated East west Press PVT Ltd, 2001
4. O.P.Gandhi, "Microwave Engineering", Pergamon Press, NY, 1983

Course Content:

Unit – I: Introduction 8 Hours
Microwave frequency, Applications of Microwave, microwave transmission line, Introduction to Micro strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL.
Unit – II: Microwave waveguides and components 8 Hours
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant (TE10) mode, Power Transmission, Power losses, Excitation of modes, Circular Waveguides: TE, TM modes, Microwave cavities (Resonators), Scattering matrix- The transmission matrix, Passive microwave devices: Microwave Hybrid Circuits, E Plane Tee, H plane Tee and Magic Tee , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Isolators, Circulators.
Unit – III: Microwave Semiconductor Devices 8 Hours
Operation, characteristics and application of BJTs and FETs, Principles and characterstics: -tunnel diodes, Varactor diodes, PIN diode, Schottky diodes, Transferred Electron Devices : Gunn diode(Gunn Effect, RWH theory, two valley model theory, modes of operation), Avalanche Transit time devices: IMPATT and TRAPATT devices.
Unit – IV: Microwave linear-beam tubes (O TYPE) and microwave crossed-field tubes (M TYPE) 8 Hours
Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, Multicavity Klystron Amplifiers, Beam-Current Density, Output Current Output Power of Two-Cavity Klystron, Reflex Klystrons, Velocity Modulation, Power Output and Efficiency, Helix Traveling-Wave Tubes (TWTs), Slow-Wave structures, Amplification Process, Convection Current, Axial Electric Field, Wave Modes, Gain Consideration, Microwave Crossed-

Field Tubes , Magnetron Oscillators, Cylindrical Magnetron, Coaxial Magnetron, Tunable Magnetron , Backward wave Oscillators
Unit – V: Microwave Measurements **9 Hours**
Introduction, Microwave Measurements devices: Slotted line carriage, Tunable detectors, VSWR Meter, microwave power measurements techniques, frequency measurement, wavelength measurements, Impedance and Refection coefficient measurements, VSWR, Insertion and attenuation measurements: Power ratio method, RF substitution method, VSWR measurements (Low and High)

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Wireless and Mobile Communication			
Course Code	BECE3012			
Pre-requisite	Computer Networks, Analog and Digital Communications			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objective:

This course builds an understanding of the core issues encountered in the design of wireless (vs wired) networks. It also exposes students to fairly recent paradigms in wireless communication.

Course Outcomes:

CO1	Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
CO2	Educate students to understand the bandwidth of operation of cellular technology and plan spectrum deployment for cellular systems to provide better customer services as well as earn revenue of service provider
CO3	Apply the mobile and wireless principles for creating solutions for data and voice communication in various Industries like Banking, Marketing and Automobile.
CO4	Understand the Modulation and Equalization Techniques
CO5	Understand the needs of technological solution for designing and developing next generation cellular technology to fulfill the ever growing service demands of customer

Text Book (s)

1. Theodore S. Rappaport, “wireless communications Principles and Practices”, PHI, 2005
2. Jochen Schiller, “Mobile Communications”, Pearson Education, second edition, 2009.

Reference Book (s)

1. Lee W.C.Y, “Mobile communication Engineering Theory and Applications”, 2/e McGraw-Hill,New York, 2003
2. Andreas F. Molisch, “Wideband Wireless Digital Communication”, Pearson Education 2001.
3. R. Blake, “Wireless Communication Technologies,” Thomson Delmer, 2003
4. Schwartz, "Mobile Wireless Communications", Cambridge University Press.2003

Course Content:

Unit-1 Introduction of Wireless Communication8 hours 8 Hours
History and evolution of mobile radio systems. Types of mobile wireless services/systems-Cellular, WLL, Paging, Satellite systems, Future trends in personal wireless systems.
Unit-2 Cellular Concepts and System Design Fundamentals 10 Hours
Cellular concept and frequency reuse, channel assignment, handoff strategies, Interference and system capacity, Trunking and GOS, cell splitting, cell sectoring.
Unit-3 Mobile radio Propagation Models 8 Hours
Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and Base band impulse respond models, parameters of mobile multipath channels, Antenna systems in mobile radio.
Unit-4 Modulation, Equalization & Diversity Techniques 8 Hours
Overview analog and digital modulation techniques, GMSK, QAM, OFDM, Spread spectrum modulation, Equalization, Rake receiver concepts, Diversity Techniques, channel coding.

Unit-5 Multiple Access Techniques, Wireless Systems & Standards	**7 Hours**
Multiple Access Techniques-FDMA, TDMA and CDMA systems, Introduction to 2G,3G and emerging technologies.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**VLSI Design**			
Course Code	**BECE3013**			
Pre-requisite	**Semiconductor Devices, Integrated Circuits, Digital Design**			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To bring both Circuits and System views on design together.
2. Study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits.
3. Understand standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis.
4. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes:

CO1	Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
CO2	Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
CO3	Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
CO4	Be able to design and solve complex problems.
CO5	Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.

Text Book (s)

1. S.M.Sze, “VLSI technology”, 2nd Edition, Tata McGraw Hill Education, 2003, ISBN 9780070582910
2. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
3. N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.

Reference Book (s)

1. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.
2. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits”, Addison Wesley 1993.
3. Randel& Geiger, “ VLSI Analog and Digital Circuit Design Techniques” McGraw- Hill,1990.
4. John P. Uyemura, "Introduction to VLSI Circuits and Systems," John Wiley & Sons, ,Inc, 2002.

Course Content:

Unit-1 Integrated Circuit: Fabrication And Characteristics	**7 hours**
Integrated circuit technology, basic monolithic integrated circuits, epitaxial growth, Masking and etching, diffusion of impurities, transistors for monolithic circuits, monolithic diodes, Integrated resistors, Integrated capacitors and inductors, monolithic circuit layout, additional isolation methods, LSI and MSI, the metal semiconductor contacts.	

Unit-2 Introduction to MOS Transistor	**8 Hours**
The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS, Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances, Numerical and spice simulations.	
Unit-3 MOS Inverters: Static and Switching Characteristic, Interconnect Effects	**10 Hours**
Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters, Numerical and spice simulations	
Unit-4 Combinational and Sequential MOS Logic Circuits	**7 Hours**
Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High-Performance Dynamic CMOS Circuits, Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates), Introduction, Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop	
Unit-5 Memories and VLSI Design Methodologies	**7 Hours**
Introduction, Read-Only Memory (ROM) Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits Introduction, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles, Design Quality, Packaging Technology, Computer-Aided Design Technology	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**VLSI Design Lab**				
Course Code	**BECE3014**				
Pre-requisite	**Digital Logic Circuits**				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. To provide experience designing integrated circuits using Computer Aided Design (CAD) Tools.
2. Be able to design static CMOS combinational and sequential logic at the transistor level, including mask layout.
3. Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.
4. Have an understanding of the characteristics of CMOS circuit construction.

Course Outcomes

CO1	Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
CO2	Be able to create models of moderately sized CMOS circuits that realize specified digital functions.
CO3	Be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
CO4	Be able to design static CMOS combinational and sequential logic at the transistor level.
CO5	Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.

Text Book (s)

1. Jacob Backer, Harry W. Li and David E. Boyce, "CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.
2. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits", Addison Wesley 1993.
3. Randel& Geiger, "VLSI Analog and Digital Circuit Design Techniques" McGraw- Hill,1990.
4. John P. Uyemura, "Introduction to VLSI Circuits and Systems," John Wiley & Sons, ,Inc, 2002.

Syllabus

1. Study DC characteristics of NMOS compute pinch off point and find various region of operation.
2. Study DC characteristics of PMOS compute pinch off point and find various region of operation.
3. Study DC characteristics of CMOS inverter and compute. a) Switching threshold voltage Vth. b) Noise Margin.
4. Study CMOS inverter transient characteristics, to compute rise time and fall time, tphl and tplh for varying output capacitance while keeping widths of NMOS and PMOS transistor same.
5. Study CMOS NAND DC characteristics and compute a) Switching threshold voltage Vth, b) Noise Margin
6. Study CMOS NOR DC characteristics and compute. a) Switching threshold voltage Vth.b) Noise Margin

7. Study the DC transfer characteristics of CMOS transmission gate and compute equivalent resistance.
8. Study the DC transfer characteristics of TG based two input multiplexer.
9. Study the transient characteristics of D-latch made using Transmission gate.
10. Draw layout and simulate a CMOS inverter.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Antenna and Wave Propagation			
Course Code	BECE3015			
Pre-requisite	Electromagnetic Field Theory			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

Antenna and Wave Propagation is to introduce to the students the basics of radiating elements and effect of propagation of radio waves in actual environment. This course provides students with comprehensive coverage of a wide variety of antennas and propagation topics related to numerous communication systems with a particular emphasis on military applications. The course presents fundamental theory together with techniques for the practical design, measurement and application of antennas over the RF (radio-frequency) to millimetre wave frequency range

Course Outcomes

CO1	Identify basic antenna parameters.
CO2	Design and analyze antenna arrays.
CO3	Design and analyze wire and aperture antennas.
CO4	Identify the characteristics of radio-wave propagation.

Text Book (s)

1. J.D.Krauss, "Antenna for all Applications", TMH, 3rd Edition, 2010, ISBN 0-89006-513-6.
2. C.A.Balanis, "Antenna Theory - Analysis and Design", Third Edition, John Wiley & Sons, 2010. ISBN 0-471-66782-X

Reference Book (s)

1. R.S.Elliot, "Antenna Theory and Design", IEEE Press, John Wiley, 2005, ISBN-13 978-0-470-01741-8, 3rd edition.
2. K.D.Prasad, "Antennas and Radiating Systems", Satyaprakasan

Course Content:

Unit-1 Antenna Fundamentals **9 hours**
Retarded potential - Radiation mechanism, directivity and gain, bandwidth, polarization, co polarization and cross polarization level, beam width, input impedance, bandwidth, efficiency, input impedance, antenna effective length and area, antenna temperature- radiation pattern- Gain-Directivity and Impedance measurements.
Unit-2 Design of Arrays **6 Hours**
Linear Array - Two element array, N-element linear array- broadside array, End fire array-Directivity, radiation pattern. Planar array – array factor, beam width, directivity. Circular array - array factor.
Unit-3 Design of Antennas **9 Hours**
Long wire, V-Antenna, Rhombic antenna, Monopole Antenna - dipole antenna, helical antenna, Spiral antenna, Log periodic antenna, Yagi-Uda antenna. Aperture antenna - Horn antenna, parabolic reflector antenna. Micro-strip antenna.
Unit-4 Antennas for modern wireless communications **7 Hours**
Antennas for Terrestrial mobile communication - mobile handsets and base stations. Antennas for Satellite Communication- MSAT briefcase terminal and vehicle mounted Antennas.
Unit-5 Wave Propagation **8 hours**

Propagation Mechanism- Reflection, refraction and Transmission, Scattering and diffraction. Propagation Model- Path Loss, Free space loss, Plane earth Loss. Noise Modeling. Modes of propagation- Ground wave Propagation, Sky wave Propagation, Space wave, Tropospheric Refraction, Obstruction Loss, Diffraction, Influence of Clutter. - Tropospheric effects, Ionospheric Effects

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Embedded System			
Course Code	BECE3019			
Pre-requisite	VLSI Design			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

To learn the basic concepts of Embedded Systems

1. To learn the concept of designing computer organization and architecture
2. To gain an understanding of applications of embedded systems involving real-time programming of microcontrollers.

Course Outcomes

CO1	To learn the basic concepts of Embedded Systems
CO2	Explain and work on Real time operating systems.
CO3	Apply the concepts of embedded system.
CO4	Design and program for Embedded Systems.
CO5	Demonstrate applications of RTOS with case studies

Text Book (s)

1. Raj Kamal , Embedded Systems Architecture, Programming and Design, Tata McGraw-Hill, New Delhi, 2003. ISBN 0-07-049470-3
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001. ISBN=012388436

Reference Book (s)

1. Frank Vahid and Tony Givargi Embedded System Design: A Unified Hardware/Software Introduction's, John Wiley & Sons, 2000. ISBN: 978-0-471-38678-0
2. John B Peatman, Design with PIC Microcontrollers, Prentice Hall of India, 2007 ISBN=0130462136

Course Content:

Unit-1 PIC Microcontroller **7 hours**
Architecture - Features – Resets –Memory Organizations: Program Memory, Data Memory – Instruction Set – simple programs. Interrupts –I/O Ports –Timers- CCP Modules- Master Synchronous serial Port (MSSP)- USART –ADC- I2C
Unit-2 Embedded Processors **9 Hours**
ARM processor- processor and memory organization, Data operations, Flow of Control, CPU Bus configuration, ARM Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example : Alarm Clock.
Unit-3 Embedded Programming **10 Hours**
Programming in Assembly Language (ALP) Vs. High level language – C program elements, Macros and Functions – Use of pointers – NULL pointers – use of function calls – multiple function calls in a cyclic order in the main function pointers – Function queues and interrupt service Routines queues pointers – Concepts of Embedded programming in C++ - Object oriented programming – Embedded programming in C++, C program compilers – Cross compiler – optimization of memory codes
Unit-4 Embedded System design **6 Hours**

Embedded System project management – Embedded system design and Co-Design Issues in System Development process – Design cycle in the development phase for an embedded system – Uses of Target system or its emulator and In-Circuit Emulator – Use of software Tools for Development of an embedded system – Use of scopes and logic analyzers for system hardware tests – Issues in Embedded System Design.
Unit-5 Real Time Operating Systems **8 Hours**
Operating system services –I/O subsystems – Network operating systems –Interrupt Routines in RTOS Environment – RTOS Task scheduling models, Interrupt – Performance Metric in Scheduling Models – IEEE standard POSIX functions for standardization of RTOS and inter-task communication functions – List of Basic functions in a Preemptive scheduler – Fifteen point strategy for synchronization between processors, ISRs, OS Functions and Tasks – OS security issues- Mobile OS.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Project based Learning – 4				
Course Code	BECE3011				
Pre-requisite					
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Work in team to formulate solution for Electronic System using hardware or software tools
3. Analyze & research about the work to be implemented with resources available from internet & other sources.
4. "Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electronic Engineering discipline."

Course Outcomes

CO1	Use analog and digital electronics technologies to solve problems and complete
CO2	projects in their academic, professional, and personal lives.
CO3	Build good quality technical report and present a comprehensive and intelligent introduction of the project to scope of specialized and nontechnical audience.
CO4	Using modern tools to solve complex engineering problems.
CO5	Executes the task on enginnering project in planned manner.

Reference Book (s)

1. Research Papers of reputed journals like, IEEE Jpurnals and transactions, Elsevier, Springer and so on.
2. Procedings of International Conferences.
3. Various Magzines and Newslaters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Capstone Design - 1				
Course Code	BECE9998				
Pre-requisite					
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		0	0	6	3

Course Objectives:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Work in team to formulate solution for Electronic System using hardware or software tools.
3. Analyze& research about the work to be implemented with resources available from internet & other sources.
4. "Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electronic Engineering discipline."

Course Outcomes

CO1	Identify project goals and constraints
CO2	Acquire knowledge about the project through previous works in the current field.
CO3	Formulate the methodologies to obtain experimental results.
CO4	Plan for the resource requirements.
CO5	Obtain the experimental results based on the methodologies formulated.

Reference Book (s)

1. Research papers from reputed journals.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Program Electives (Basket 1)

Name of The Course	Database Concepts			
Course Code	BECE3101			
Pre-requisite	Data Structures			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

This course is an introduction to principles, use and applications of database systems. On completion of the course you will be able to understand the purposes for which databases are used, design and create databases, query/extract information from databases and understand in broad terms how database systems work.

Course Outcomes

CO1	Understand the relational database theory, application of database system in real life.
CO2	Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models.
CO3	Learn and apply Structured query language (SQL) for database definition and database manipulation.
CO4	Illustrate relational database theory, and be able to write relational algebra expressions for queries.
CO5	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

Text Book (s)

1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
2. Date C J, " An Introduction to Database Systems", Addision Wesley
3. Elmasri, Navathe, " Fudamentals of Database Systems", Addision Wesley

Reference Book (s)

1. O'Neil, Databases, Elsevier Pub.
2. Leon &Leon,"Database Management Systems", Vikas Publishing House
3. J.Gowar, "Optical Communication System", 2nd edition, Prentice Hall of India, 2001
4. "Majumdar& Bhattacharya, "Database Management System", TMH (14) "

Unit-1 Introduction	**10 hours**
Introduction: An overview of database management system, database system Vs file system, Database system concept and architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML, Overall Database Structure. Data Modelling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model.	
Unit-2 Relational data Model and Language	**8 Hours**

Relational data model concepts, integrity constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus. Introduction on SQL: Characteristics of SQL, advantage of SQL. SQl data type and literals. Types of SQL commands. SQL operators and their procedure. Tables, views and indexes. Queries and sub queries. Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus.
Unit-3 Data Base Design & Normalization **7 Hours**
Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD.
Unit-4 Data Base Design **7 Hours**
Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.
Unit-5 Concurrency Control Techniques **8 Hours**
Concurrency control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Automation and Robotics				
Course Code	BECE3102				
Pre-requisite	IoT, Electronic System Design				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To provide the student with basic knowledge and skills associated with robot control.
2. Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Demonstrate an ability to perform kinematics and inverse kinematics analysis of robot systems.
4. Demonstrate knowledge of robot controllers.
5. To develop the student's knowledge in various robot structures and their workspace.

Course Outcomes

CO1	Explain Basic Robotic model & its applications.
CO2	Differentiate types of control and the standardization for some robotic system. K4
CO3	Critically evaluate robots for particular applications.
CO4	Analyze particular industrial applications and evaluate possible solutions in terms of automated dedicated/flexible) or mixed manual/automated systems.
CO5	Realize the design problem and preliminary consideration of Industrial automation.

Text Book (s)

1. Mikell P Grover et. al. "Industrial Robots: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 1980, ISBN 9781259006210.
2. Robert J. Schilling, "Fundamentals of Robotics-Analysis and Control", PHI Learning, 2009, ISBN 9788120310476 (Unit-II and Unit-III)

Reference Book (s)

1. K.S. Fu, Ralph Gonzalez, C.S.G. Lee, "Robotics: control, sensing, vision and Intelligence", 1st Edition,TataMcgraw-Hill, 2008, ISBN 9780070265103

Course Content:

Unit-1 INTRODUCTION ROBOTICS **9 hours**
Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magneto-astrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors –ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems.
Unit-2 ROBOT CONTROL **8 Hours**
Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.
Unit-3 END EFFECTORS **8 Hours**
End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation- continuous path motion-interpolated motion-straight line motion.
Unit-4ROBOT MOTION ANALYSIS **7 Hours**
Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates-Homogeneous transformations and rotations and Robot dynamics

Unit-5 ROBOT APPLICATIONS	**6 Hours**
Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Satellite Communication			
Course Code	BECE3103			
Pre-requisite	Analog and Digital Communication			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives: Satellite Communication Systems provide vital and economical fixed and mobile communication services over very large coverage areas of land, sea and air. In this course, you will learn the fundamentals and the techniques for the design and analysis of satellite communication systems

Course Outcomes

CO1	Explain the fundamentals of satellite communication systems
CO2	Design a satellite communication link under specified characteristics.
CO3	Explain the modulation and multiplexing techniques in satellite communication.
CO4	Describe propagation effects and their impact on satellite-earth links
CO5	Demonstrate the working of satellite based systems.

Text Book (s)

1. Satellite Communications / Dennis Roddy / McGraw-Hill
2. Satellite Communications / Pratt, Bostian, Allnutt / John Wiley & Sons.

Reference Book (s)

1. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill.

Course Content:

Unit-1 Basic Knowledge **6 hours**
Elements of Satellite Communication Orbital mechanics look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.
Unit-2 Sub Systems **10 Hours**
Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.
Unit-3 Different modulation schemes **8 Hours**
Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access techniques.
Unit-4 Amplifiers & Switches **8 Hours**
Error control for digital satellite links: error detection and correction, channel capacity, error control coding schemes. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.
Unit-5 Power Supply **8 Hours**
Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Digital System design using VHDL				
Course Code	BECE3104				
Pre-requisite	Digital Design				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To gain an in-depth understanding of VHDL and to realize different circuits using it both sequential and combinational.
2. To learn the concept of memories and how they are designed using VHDL.
3. To gain an understanding of applications of VHDL in PLDs and Field Programmable Logic Arrays (FPGAs).

Course Outcomes

CO1	Explain VHDL as a programming language.
CO2	Design the combinational and sequential logic circuits using VHDL.
CO3	Design Programmable logic devices(PLDs) and Networks of Arithmetic operations.
CO4	Gain proficiency with VHDL software package and utilize software package to solve problems on a wide range of digital logic circuits.
CO5	Explain VHDL as a programming language.

Text Book (s)

1. Stephen Brown and ZvonkoVranesic," Fundamentals of Digital Logic with VHDL Design", Mc-Graw-Hill (2nd edition). ISBN-10: 0077211642

Reference Book (s)

1. Peter J. Ashenden, "Designers guide to VHDL ",Morgan Kaufman Publishers. 3rd edition, ISBN-10: 0120887851

Course Content:

Unit-1 Introduction **7 hours**
Introduction to Hardware Description Languages (HDL) And HDL Based Design, VHDL-Variables, Signals And Constants, Arrays, VHDL Operators, VHDL Functions, VHDL Procedures, Packages And Libraries, VHDL Description Of Combinational Networks, Modeling Flip-Flops Using VHDL, VHDL Models For A Multiplexer, Compilation And Simulation Of VHDL Code, Modeling A Sequential Machine, VHDL Model For A Counter.
Unit-2 VHDL Synthesis and Models **8 Hours**
"Attributes, Transport and Inertial delays, Operator overloading, Multivalued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and TEXTIO.Introduction to data path and control path synthesis."
Unit-3 Digital Design with State Machine Charts **7 Hours**
State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines, Asynchronous state machine based design.
Unit-4 Programmable Logic devices (PLDs) **9 Hours**
"DESIGNING WITH PROGRAMMABLE LOGIC DEVICES: Read-only memories (ROM, EPROM, EEPROM/FLASH), Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner. DESIGN OF NETWORKS FOR ARITHMETIC OPERATIONS: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider."
Unit-5 Field Programmable Gate Arrays (FPGA) **8 Hours**

"Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series COLDs. Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations."

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Computer Networks				
Course Code	BECE3105				
Pre-requisite	Digital Electronics				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes

CO1	Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.
CO2	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
CO3	have a basic knowledge of the use of cryptography and network security;
CO4	Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
CO5	familiar with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

TEXT BOOKS

1. A. Leon –Garcia, IndraWidjaja, “Communication Networks”, Tata McGraw Hill.
2. W. Stallings, “Data and Computer Communication”, 7th edition, PHI, New Delhi

REFERENCEBOOKS

3. M.SteenStrub, “Routing in Communication networks”, PH, New York.
4. William Stallings, High speed Networks TCP/IP & ATM Design Principles, PH, NY
5. Alder.M..Scheideler.Ch.Annual ACM Symposium on Parallel Algorithms and Architectures, ACM, NewYork.
6. Sivarammurthy, Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson Education, 2004.
7. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2008.

Course Content:

Unit-1 Network and Services	**8 hours**
Approaches to Network design, Network topologies and design constraints, Transmission media - copper and optical fiber, OSI Reference Model; Overview of TCP/ IP, Application Layer Protocols and TCP/IP, Application Layer Protocols and TCP/IP Utilities. Peer-to-peer protocols: Service Models, ARQ Protocols and reliable data transfer service, sliding Window Flow Control.	
Unit-2Medium Access Control Protocol	**8 hours**
Multiple access communication, Random access scheduling approaches to medium access control, Delay performance of MAC and channelization schemes, LAN Access methods,	

Introduction to LAN Standards, IEEE 802.5, FDDI, WLAN, Hubs, Bridges and Switches Ethernet networking.
Unit-3 Packet Switching Networks 8 hours
Network Services and Internal Network Operation, Packet Network Topology, Routing in packet Networks, shortest path Algorithms, and Introduction to traffic management &QoS.
Unit-4 TCP/IP Architecture 8 hours
The Internet Protocol, IP addressing and subnetting, Limitations of IPv4 and Introduction to IPv6, User Datagram protocol, Transmission Control Protocol, Introduction to Internet Routing Protocols.
Unit-5 Wireless Routing Protocols 8 hours
Routing in cellular radio mobile communication networks, Packet radio Routing Internet based mobile ad-hoc networking, communication strategies, routing algorithms Destination sequenced Distance Vector(DSDV),Dynamic source Routing (DSR),Ad-hoc On demand Distance Vector(AODV) &Temporarily Ordered Routing algorithm (TORA),Quality of service.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket 2

Name of The Course	Principles of Secure Communication				
Course Code	BECE3201				
Pre-requisite	Communication Systems				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To understand Various spread spectrum systems
2. Cryptographic techniques Understanding,
3. Standards like Data Encryption standard
4. Advanced Encryption Standard

Course Outcomes

CO1	Understanding of the various types of spread spectrum techniques for secure communication
CO2	Slow and fast frequency hopping, performance of FHSS in AWGN Channel
CO3	Analyze the various cryptographic techniques and Apply the Encryption standards like DES, AES.
CO4	Understanding the principle of Block Cipher and Encryption Standards
CO5	Knowing current network authentication applications, PKI, Web security and their vulnerabilities that are exploited by intentional and unintentional attacks

Text Book (s)

1. Digital Communication by Simon Haykin, Wiley.1 st edition ISBN 978-1-1185-4405-1
2. Cryptography and Network Security by W. Stallings 5th Ed., PHI ISBN-10: 0136097049 ISBN-13: 978-0136097044"
3. "Cryptography and secure Communications by M.Y. Rhee, McGraw Hill, ISBN-10:0071125027; ISBN-13: 978-0071125024,"
4. Communication System Security by LidongChen,Guang Gong, ISBN 9781439840368-CAT# K11870

Reference Book (s)

1. "Principle of Communication systems by Taub& Schilling TMH. ISBN=0070648115, 3 rd edition"
2. J.G. Proakis, Digital Communications, McGraw-Hill, 4th ed., ISBN 0-07-118183-0
3. "Cryptography and Network Security, BehrouzForouzan 2 nd edition,ISBN-13 9780070702080"
4. Secure Communication Using Rossler Attractor" by FarrukhAtif

Course Content:

Unit-1 Direct Sequence Spread Spectrum Systems	**11 hours**
Model of Spread Spectrum digital communication system, direct sequence spread spectrum signal, error rate, performance of the decoder, processing gain and jamming margin, uncoded DSSS signals, applications of DSSS signals in anti-jamming, Code division multiple access and multipath channels, effect of pulsed interference on DSSS systems, Generation of PN sequences using m sequence and Gold sequences, narrowband interference in DSSS systems, acquisition and tracking of DSSS system	
Unit-2 Frequency Hopped Spread Spectrum Systems	**7 Hours**

Basic concepts of Frequency Hopping, slow and fast frequency hopping, performance of FHSS in AWGN Channel, FHSS in CDMA system, Time hopping and hybrid Spread spectrum system, acquisition and tracking of FH SS systems.
Unit-3 Cryptographic Techniques 8 Hours
Classical encryption techniques, Symmetric cipher model, cryptography and cryptanalysts, Substitution techniques, transposition techniques
Unit-4 Block Cipher and Encryption Standards 9 Hours
"Block cipher principle, data encryption standard (DES), strength of DES, differential and linearcryptanalysts, block cipher design principles, Finite fields, simplified advanced encryption standard (S-AES), multiple encryption and triple DES, Block cipher modes of operation, stream ciphers and RC4 algorithm"
Unit-5 Public Key Cryptography 6 Hours
"Prime numbers, Fermat and Euler's theorem, Chinese remainder theorem, discrete algorithms, principles of public key cryptosystems, RSA algorithm, key management Diffie-Hellman key exchange, message authentication requirements and functions."

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Neural Networks and Fuzzy Control				
Course Code	BECE3202				
Pre-requisite	Control Systems				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	3	0	5

Course Objectives:

1. Get the exposure to Artificial Neural Networks & Fuzzy Logic.
2. Understand the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines
3. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers
4. Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application

Course Outcomes

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
CO3	Understanding of fuzzy relation rule and aggregations
CO4	Understand concept of classical and fuzzy sets, fuzzification and defuzzification
CO5	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition "
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications "

Reference Book (s)

1. "Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI, 1996."
2. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill, 2007.
3. "Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004"
4. "Timothy J Ross, "Fuzzy Logic with Engineering Applications",John Willey and Sons, West Sussex, England, 2005."

Course Content:

Unit-1Introduction to Artificial Neural Network **9 hours**
Artificial neural networks and their biological motivation – Terminology – Models of neuron – Topology – characteristics of artificial neural networks – types of activation functions – learning methods – error correction learning – Hebbian learning – Perceptron – XOR Problem –Perceptron learning rule convergence theorem – Adaline.
Unit-2 Feed-forward and Recurrent Neural Networks **12 Hours**

"Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network."
Unit-3 Fuzzy Logic & Fuzzy Sets 9 Hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.
Unit-4 Fuzzy Relations & Aggregations 9 Hours
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit-5 Fuzzy Optimization and Neuro Fuzzy Systems 6 Hours
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Wireless Sensor Networks				
Course Code	BECE3203				
Pre-requisite	Computer Networks				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To identify communication protocols employed in WSNs
2. To explain usefulness of OSI model for Communication System Design
3. To select the appropriate technology to implement a WSN.
4. To design a WSN

Course Outcomes

CO1	Know Basics challenges and technologies in Wireless Sensors Network.
CO2	Understand Various Architectures and Protocols of Wireless network.
CO3	Know Various Topology and Tools of Wireless Network.
CO4	Analyze the problems related to sensor networks.
CO5	Different communication protocols and their usefulness in different applications

Text Book (s)

1. Holger Karl & Andreas Willig, "" Protocols And Architectures for Wireless Sensor Networks"" , John Wiley, 2005"
2. "Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach"", Elsevier, 2007"
3. Yang, Shuang-Hua , "Wireless Sensor Networks"
4. Fahmy, Hossam Mahmoud Ahmad, "Wireless Sensor Networks"

Reference Book (s)

1. "KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007"
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003
3. “Wireless Sensor Networks: Technology, Protocols and Applications” by KazemSohrab
4. "Fundamentals of Wireless Sensor Networks: Theory and Practice (WSE)” by WaltenegusDargie and Christian Poellabauer"

Course Content:

Unit-1 Overview Of Wireless Sensor Networks	**4 hours**
Overview of Wireless Sensor Networks, Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor	
Unit-2 Architectures	**9 Hours**
"Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts."	
Unit-3 Networking Sensors	**9 hours**
"Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing,Geographic Routing."	

Unit-4 Infrastructure Establishment	**9 hours**
"Topology Control , Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control."	
Unit-5 Sensor Network Platforms And Tools	**9 Hours**
"Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming."	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Mobile Ad Hoc Networks				
Course Code	BECE3204				
Pre-requisite	Wireless Communication				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To gain an in-depth understanding the concepts of wireless ad-hoc networks.
2. To learn and understand the current and emerging trends in Wireless Networks.
3. Design ad-hoc network for the heterogeneous environment
4. "Hands-on experience in designing and implementing ad hoc network functionality using network simulation tools and Pocket PCs"

Course Outcomes

CO1	Explain the architecture, organization and operation of ad-hoc networks
CO2	Construct ad-hoc network anywhere on temporary basis
CO3	Design ad-hoc network for the heterogeneous environment
CO4	Have an understanding of the principles of mobile ad hoc networks (MANETs)
CO5	Distinguish between infrastructure-based networks

Text Book (s)

1. "C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, 1st Edition, Prentice Hall, PTR, 2006, ISBN 9788131706886"
2. C. K. Toh, “Ad Hoc Mobile Wireless Networks: Protocols and Systems”, 1st Edition, Pearson, 2007, ISBN 9788131715109
3. Mobile Ad Hoc Networking by Stefano Basagni ,Marco Conti , Silvia Giordano , Ivan Stojmenovic
4. Mobile and Wireless Communication Networks by Guy Pujolle IFIP 19th World Computer Congress

Reference Book (s)

1. "Charles E. Perkins, “Ad Hoc Networking”, 1st Edition, Pearson, 2008, ISBN 9788131720967"
2. Mohammed Ilyas, “The Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, 1st Edition, CRC press, 2004, ISBN 9780849319686.
3. "Mobile Ad-hoc and Sensor Networks: Second International Conference, MSN 2006, Hong Kong,China, December 13-15, 2006, Proceedings"
4. Mobile Agents in Networking and Distributed Computing by Jiannong Cao, Sajal Kumar

Course Content:

Unit-1 Introduction to Wireless Ad Hoc Networks	**9 hours**
Introduction to cellular and ad hoc wireless networks, applications of ad hoc networks, issues in ad hoc wireless networks – medium access scheme, routing, multicasting, transport layer protocols, pricing scheme, quality of service provisioning, self organization, security, address and security discovery, energy management, scalability, deployment considerations, ad hoc wireless Internet.	
Unit-2 Medium Access Control Protocol	**9 Hours**

Issues in Designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms, Other MAC protocols.
Unit-3 Routing Protocol **9 Hours**
Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols.
Unit-4 Multicasting Protocol **8 Hours**
"Design issues and operation, Architecture Reference Model, classification, Tree-based and Mesh-Based Protocols, Energy-Efficient Multicasting, Multicasting with Quality of Service Guarantee.Quality of Service: Issues and challenges in providing QoS, Classification of QoSsolutions."
Unit-5 Energy Management **6 Hours**
Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket 3

Name of The Course	Digital Image Processing				
Course Code	BECE3301				
Pre-requisite	Digital Signal Processing				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To impart the basic concepts of image segmentation and shaping
2. To apply different types signal processing techniques in image processing

Course Outcomes

CO1	Students will be able to describe and Interpret basic elements of Digital Image Processing, Analyze the need and suitability of transforms in image processing applications
CO2	Design and implement filters for image enhancement in spatial domain and frequency domain for real time applications and apply image restoration algorithms
CO3	Segment and Extract features from images for analysis and recognition
CO4	Perform Wavelet analysis on images
CO5	Interpret Still and Video compression algorithms

Text Book (s)

1. Gonzalez and Wood, "Digital Image Processing", Addison Wesley, 1993
2. Anil K.Jain, "Fundamental of Image Processing", Prentice Hall of India

Reference Book (s)

1. Rosenfeld and Kak, "Digital Picture Processing" vol.I&vol.II, Academic,1982
2. Ballard and Brown, "Computer Vision", Prentice Hall, 1982.
3. Wayne Niblack, "An Introduction to Digital Image Processing", Prentice Hall, 1986
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Vikas Publications

Course Content:

Unit-1 Introduction to Image Processing 5 hours
Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.
Unit-2 Signal Processing 9 Hours
Signal Processing - Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification. Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour Enhancement
Unit-3 Image Restoration 8 Hours
Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.
Unit-4 Segmentation Techniques 7 Hours
Segmentation Techniques-thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.

Unit-5 Shape Analysis	**8 Hours**
Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications – Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Information Theory and Coding				
Course Code	BECE3302				
Pre-requisite	Signals and Systems, Modulation Theory, Digital Communication				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To understand the fundamental concept of entropy and information as they are used in communications.
2. To enhance knowledge of probabilities, entropy, measures of information.
3. To identify the implications and consequences of fundamental theories and laws of information theory and coding with reference to the application in modern communication and computer systems.
4. To design different encoders using the different coding schemes like Huffman Coding, ShannaonFano Coding, Cyclic codes, etc.,

Course Outcomes

CO1	Calculate the information content of a random variable from its probability distribution.
CO2	Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities.
CO3	Define channel capacities and properties using Shannon Theorems.
CO4	Construct efficient codes for data on imperfect communication channels.
CO5	Generalize the discrete concepts to continuous signals on continuous channels.

Text Book (s)

1. R Bose, “Information Theory, Coding and Cryptography”, TMH 2007.
2. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002

Reference Book (s)

1. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006.
2. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007.
3. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

Unit-1 INFORMATION THEORY **8 hours**
Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.
Unit-2 ERROR CONTROL CODING: BLOCK CODES **7 Hours**
Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC
Unit-3 ERROR CONTROL CODING: CONVOLUTIONAL CODES **5 Hours**
Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding.
Unit-4 SOURCE CODING: TEXT, AUDIO AND SPEECH **8 Hours**

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding
Unit-5 SOURCE CODING: IMAGE AND VIDEO **7 Hours**
Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Modern Digital signal Processing				
Course Code	BECE3303				
Pre-requisite	Signals and Systems, Digital Communication				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	3	0	3	

Course Objectives:

1. This course examines the fundamentals of detection and estimation for signal processing.
2. It will help the students to implement new algorithms for signal processing applications in frequency, time and mixed domains

Course Outcomes

CO1	Learn Multirate signal processing.
CO2	Design and Analyze adaptive, Kalman filter and Wiener filter.
CO3	Understand the spectral estimation.
CO4	Know digital signal processing application in frequency and time domain.
CO5	Understand the fundamentals of DSP processor architecture

Text Book (s)

1. Oppenheim A.V., Schafer, Ronald W. & Buck, John R., "Discrete Time Signal processing",Pearson Education ,2nd Edition.
2. Monson H. Hayes "Statistical Digital Signal Processing and Modeling" John Wiley & Sons, 2009
3. Steven W. Smith, " Digital Signal Processing: A Practical Guide for Engineers and Scientists", Elsevier, 2003.
4. Papoulis, Circuits and Systems, Modern Approach, HRW, 1980

Reference Book (s)

1. John G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition , PHI 2007.
2. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital SignalProcessing", PHI 2001.
3. Roberto Cristi "Modern Digital Signal Processing", Thomson Brooks/Cole, 2004.
4. R.F. Ziemer, W.H. Tranter and D.R. Fannin, Signals and Systems - Continuous and Discrete, 4th Edn. Prentice Hall, 1998.

Course Content:

Unit-1 Introduction to Modern Digital Signal Processing **6 hours**
"Introduction to Modern Digital Signal Processing: Signals, systems and signal processing (continuous & discrete an overview), time domain and frequency domain analysis of signals. Sampling and reconstruction of signals, Concepts of Two dimensional, Multi-rate and adaptive signal processing."
Unit-2 Design of Filters **9 Hours**
Design of digital filters, Introduction to adaptive signal processing, LMMSE filters – Wiener and Kalman, Adaptive filters – LMS and RLS, Lattice filters, Tracking performance of time varying filters, Adaptive filters, Applications, moving average filters, adaptive filters: FIR adaptive filters adaptive channel equalization ,adaptive noise cancellation ,IIR adaptive filters - RLS filters and Filter banks.

Unit-3 Fast Fourier Transform and Spectral estimation **9 Hours**
Discrete and fast Fourier transform algorithms, Goertzel and Chirp-z transform for computation of DFT, effect of finite register length in DFT computation, Fourier analysis of non-stationary signals, Power spectral estimation
Unit-4 Introduction to Digital signal Processors **9 Hours**
Introduction to Digital signal Processors:Architecture and applications , Fixed and Floating Point Processors, Complex numbers – fixed and floating point representation. Applications: Applications of Digital ,Signal Processing to Speech & Audio coding and processing
Unit-5 Design and implementation example **9 Hours**
"An IIR and FIR audio filters - Modelling in MATLAB - Analog measurement on DSP Systems, Fixed and floating Point Realization impacts. Speech production, Articulatory and Acoustic phonetics, Time domain analysis, Frequency domain analysis, Cepstral analysis, LPC analysis."

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	ASIC Design and FPGAs				
Course Code	BECE3304				
Pre-requisite	Digital system design				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To introduce students to the process of designing application specific hardware implementations of algorithms for ASICs and FPGAs. Students will work with commercial computer aided design tools to synthesize designs described in hardware description languages. Topics covered will include differences between hardware description languages for synthesis and simulation, behavioral synthesis, gate-level design, register transfer level design, design methodologies, finite state machines, design reuse and intellectual property cores, and optimization**.**

Course Outcomes:

CO1	Understand the fundamentals of logic designing and Analog / Mixed signal (AMS) IC designing
CO2	Develop advanced RTL design using Verilog
CO3	Perform ASIC verification
CO4	Conduct analysis of backend design parameter
CO5	Demonstrate high performance designs using HDL techniques

Text Book (s)

1. M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison -Wesley Longman Inc., 1997
2. Skahill, Kevin," VHDL for Programmable Logic", Addison-Wesley, 1996

Reference Book (s)

1. John F. Wakherly, " Digital Design: Principles and Practices", 2nd Edn 1994, Prentice Hall International Edn
2. Charles W. Mckay, "Digital Circuits a proportion for microprocessors", Prentice

Course Content:

Unit-1 Introduction to ASIC and VHDL 9 hours
"Introduction To ASICS, CMOS Logic And ASIC Library Design,Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort -Library cell design - Library architecture. Review of VHDL/Verilog: Entities and architectures "
Unit-2 Programmable ASICS 7 Hours
Programmable Asics, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks
Unit-3 Programmable ASIC Interconnect & Software 9 Hours
Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX - Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation.
Unit-4 ASIC Construction & FPGA partitioning 8 Hours

ASIC Construction, Floor Planning, Placement And Routing,System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing -circuit extraction - DRC.
Unit-5 Design using Xilinx **9 Hours**
Design using Xilinx family FPGA

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket 4

Name of The Course	Soft Computing Techniques				
Course Code	BECE4401				
Pre-requisite	C++/Java/ Matlab programming				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Introduce the fundamentals of Soft Computing.
2. Apply Computing models to solve problems.
3. Get the exposure of soft computing, especially evolutionary computation, fuzzy logic, GA and neural networks
4. Become expert in calculating and comparing complexities of various searching and sorting algorithms.

Course Outcomes

CO1	Identify and describe Soft-Computing techniques and their roles in building intelligent machines
CO2	Apply Soft – Computing models & reasoning to handle uncertainty and solve engineering problems.
CO3	Recognize the feasibility of applying a soft computing methodology for a particular problem
CO4	Apply genetic algorithms to optimization problems
CO5	Identify the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines.

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.

Reference Book (s)

1. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.
2. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 1996.
3. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.

Course Content:

Unit-1 Artificial Neural Networks **9 hours**
Introduction, model of neuron, activation functions, important terminologies of ANN, Hebb's learning, Supervised learning, Unsupervised learning, reinforcement learning, Adaline, Perceptron, Back propagation networks, Adaptive Resonance Theory, Associative Memories, Applications.
Unit-2 Fuzzy Logic & Fuzzy Sets **9 Hours**
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers
Unit-3 Fuzzy Relations & Aggregations **9 Hours**

Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit-4 Neuro-Fuzzy Systems **6 Hours**
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks. Application of Fuzzy Logic: Medicine, Economics, Industry etc.
Unit-5 Genetic algorithm **8 Hours**
Genetic Algorithm: An Overview, GA in problem solving, Implementation of GA fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modelling: Inheritance operator, crossover, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Mobile Computing				
Course Code	BECE4402				
Pre-requisite	Computer Networks				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives: With the increasing popularity of mobile devices, mobile computing has become part of our daily life. This course will cover various topics of mobile computing, networking, and systems, including but not limited to: applications of smartphones, cellular networks, embedded sensor systems, localization systems, energy efficiency of mobile devices, wearable and vehicular mobile systems, mobile security, virtual reality and augmented reality. We will discuss research papers from top conferences, brainstorm cool ideas, and build real mobile systems through team projects.

Course Outcomes

CO1	Apply the knowledge of wireless and mobile communications systems.
CO2	Examine the MAC issues and demonstrate wireless networking principles, for various applications.
CO3	Analyze GSM architecture, operation and services offered by GSM networks.
CO4	Analyze GPRS architecture, operation and services offered by GPRS networks.
CO5	Analyze the performance of various routing protocols and security issues associated with mobile computing

Text Book (s)

1. Asok K. Talukder, Mobile Computing-Technology, Applications & Service Creation, TMH
2. Schiller, Mobile Communications, Pearson Education Asia Ltd., 2000

Course Content:

Unit-1 Introduction **8 hours**
Introduction of mobile computing, overview of wireless telephony: cellular concept, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, Multiple access techniques like Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA).
Unit-2 Wireless Networking **8 Hours**
Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.
Unit-3 Global System for Mobile Communications **8 Hours**
GSM Architecture, GSM Entities ,Call Routing in GSM, GSM Addresses and Identifiers, Network Aspects in GSM , GSM Frequency Allocation, Authentication and Security, Mobile Computing over SMS, Short Message (SMS) , Value Added Services through, MS, Accessing the SMS Bearer, GPRS and packet Architecture GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS ,Application for GPRS, Limitation of GPRS, Billing and Charging in GPRS, WAP , MMS , GPRS Applications, Spread – Spectrum Technology.
Unit-4 Data Management **8 Hours**
"Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations. Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment."
Unit-5 Routing Adhoc Network & Security Issues **8 Hours**

Routing Protocols: Adhoc Network Routing Protocols, Destination Sequenced Distance Vector Algorithm, Cluster Based Gateway Switch Routing, Dynamic Source Routing, Adhoc on-demand Routing, Location Aided Routing, Zonal Routing Algorithm.Mobile Computing Security Issues, Authentication, Encryption, Cryptographic Tools: Hash, Message Authentication Code (MAC), Digital Signature, Certificate. Secure Socket Layer (SSL). Characteristics of SIM, Equipment Identification.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Radar Guidance and Navigation				
Course Code	BECE4404				
Pre-requisite	Antenna and Wave Propagation				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To introduce the fundamental concepts of RADAR (Radio Detection And Ranging) and Navigational aids
2. To provide exposure the students to different types of RADAR systems and Navigation
3. To Understand the needs of technological solution for designing and developing Radar functions and signal scanning
4. To Apply the knowledge of Radar Transmitters and Receivers

Course Outcomes

CO1	Apply the knowledge Radar Equation in various applications
CO2	Analyze Doppler effect, CW and multiple frequency CW Radar
CO3	Describe MTI and Pulse Radar functions and operations
CO4	Understand Radar signal scanning and tracking technique
CO5	Understand function and operation of Radar Transmitters, Antennas and Receivers

Text Book (s)

1. Introduction to Radar System M.I. Skolnik ,Publisher: McGraw Hill
2. Radar Systems and Radio Aids to Navigation, Sen& Bhattacharya, Publisher: Khanna publishers

Reference Book (s)

1. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
2. Andreas F. Molisch, "Wideband Wireless Digital Communication", Pearson Education 2001.
3. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
4. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics

Course Content:

Unit-1 Introduction and Radar equation 10 hours
Introduction: The simple form of Radar Equation, Radar Block diagram and Operation, Radar Frequencies, millimeter and submilimeter waves, Applications of Radar. Radar Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Matched filter impulse response, Integration of radar Pulses, Radar Cross Section of Targets, Cross section Fluctuations, Radar Clutter-surface clutter, sea clutter and Land clutter ,weather clutter, Transmitter Power, Pulse Repetition Frequency and Range ambiguities, Antenna Parameters, system losses, propagation effects, other considerations.
Unit-2 CW and FM CW Radar 8 Hours
Doppler effect. CW radar. FM CW radar. Multiple frequency CW Radar.
Unit-3 MTI And Pulse Doppler Radar 8 Hours
Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters, Block Diagram of Digital Signal Processor, Example of MTI radar Processor, , Pulse Doppler Radar, Non coherent MTI ,MTI from moving platform, Other types of MTI, Airborne radar.
Unit-4 Tracking Radar 8 Hours
Sequential loping, conical scan, Monopulse, Tracking in range and Doppler, Acquisition
Unit-5 Radar Transmitters, Antennas and Receivers and Electronic Scanning Radar 7 Hours

Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket 5

Name of The Course	Optical Communication				
Course Code	BECE3016				
Pre-requisite	Optoelectronics, Electromagnetic Field Theory				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Discuss the technology developments in Optical Communication with major emphasis on related theory/analysis of technical characteristics of Optical Fibre/Components, Systems and Network nodes to enable the design and selection of proper Functional modules/Building blocks intended for practical network applications
2. Impart practical network knowledge based on Optical Communication Network Evolution viz. SONET in terms of Network Elements/Architecture, Network Management, Protection(Reliability),Synchronization
3. Introduce all- optical signal processing based on Optical components and related network functions based on Multi wavelength Optical layers, with Assignment& Routing algorithms along with associated Network architecture. Introduce advanced topics on Photonic packet switching, Optical Transport Network(OTN).

Course Outcomes

CO1	Recall basic laws of optical physics. Distinguish between the various modes of operation of Optical fibers. Identify the various causes for signal degradation. Calculate the various types of losses occurring in transmission of energy.
CO2	Categorize the types of sources of light on basis of physical construction and principle of operation and describe the various phenomenon involved in the conversion of electrical energy into light energy.
CO3	Explain the operation of optical receiver. Identify the various effects introducing noise in the system and evaluate the performance of digital receiver by calculating the probability of error.
CO4	Define and apply the Wavelength Division Multiplexing. (WDM) principles and concepts.
CO5	Discuss the basic applications of optical amplifiers like Erbium Doped Fiber Amplifier (EDFA). Look into the widely used networks like SONET/SDH.

Text Book (s)

1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, Singapore, 3rd edition, 2000
2. Rajiv Ramaswami, Kumar N. Sivaranjan, "Optical Networks A practical perspective", 2nd edition, Elsevier, 2004

Reference Book (s)

1. Djafar K. Mynbaev, Lowell L. Scheiner, "Fiber-Optic Communications Technology", 1st edition, Pearson Education, 2001
2. John Powers, "An Introduction to Fiber optic Systems", 2nd edition, IrwinMcGraw Hill, 1999
3. J.Gowar, "Optical Communication System", 2nd edition, Prentice Hall of India, 2001

Course Content:

Unit-1 Introduction to Optical Fiber Communication **9 hours**
Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication. Fiber materials, Photonic Crystal Fibers. Spectral characteristics. Optical Fiber wave guide: Structure, Single and Multimode operation; Attenuation, Material and wave guide dispersion
Unit-2 Optical Sources and Transmission Characteristics of Optical Fibers **9 Hours**
Light Emitting Diode; principle, structures, power and efficiency, coupling to fibers. Laser diodes; principle, double hetero structure, gain and index guiding, distributed lasers. Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion
Unit-3 Optical Detectors and Optical Receiver **7 Hours**
Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors. Optical Receiver Operation, eye diagrams, signal to noise ratio
Unit-4 Point-to-point link and Wavelength Division Multiplexing **7 hours**
Building blocks; Multiplexing; Intensity Modulation/Direct Detection system; Principle of Regeneration; WDM link, Optical amplifiers; EDFA, SOA, Raman amplifier, Fabry-Perot filters. Dispersion compensation and management, Link analysis and Bit-Error-Rate calculation.
Unit-5 WDM Concepts and Optical Network **8 Hours**
LAN, MAN, WAN; Topologies: bus, star, ring; WDM concepts, overview of WDM operation principles, WDM standards, Ethernet; FDDI; Telecom networking: SDH/SONET. Different forms of access networks: Telephony; ISDN; Cable TV; Broadcast and Switched Networks; HFC networks; FTTC and FTTH networks; All optical networks

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Introduction to IoT and its Applications			
Course Code	BECE4501			
Pre-requisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To understand the fundamentals of Internet of Things.
2. To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
3. To apply the concept of Internet of Things in the real world scenario

Course Outcomes

CO1	Understand the concepts of Internet of Things
CO2	Analyze basic protocols in wireless sensor network
CO3	Design IoT applications in different domain and be able to analyze their performance
CO4	Implement basic IoT applications on embedded platform
CO5	Analyse Design of commercial products

Text Book (s)

1. RajkumarBuyya, Amir VahidDastjerdi, " Internet of Things Principles and Paradigms " Copyright © 2016 Elsevier Inc.
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen

Reference Book (s)

1. API Features and Arduino Projects for Linux Programmers", Apress, 2014.
2. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

Course Content:

Unit-1 IoT& Web Technology **9 hours**
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics
Unit-2 Managing IoT Resources in the Cloud Introduction **7 Hours**
Background/Related Work – Open IoT Architecture for IoT/Cloud Convergence - Scheduling Process and IoT Services Lifecycle - Scheduling and Resource Management - Validating Applications and Use Cases - Future Research Directions
Unit-3 Device/Cloud Collaboration Framework for Intelligence Application **9 Hours**
Introduction - Background and Related Work - Device/Cloud Collaboration Framework - Powerful Smart Mobile Devices - Runtime Adaptation Engine - Privacy-Protection Solution - Applications of Device/Cloud Collaboration - Context - Aware Proactive Suggestion - Semantic QA Cache - Image and Speech Recognition.- Future Work
Unit-4 Fog Computing **8 Hours**
Principles, Architectures, and Applications.: Introduction - Motivating Scenario - Definitions and Characteristics. - Reference Architecture - Applications - Research Directions and Enablers.- Commercial Products - Case Study
Unit-5 IoT APPLICATIONS **6 Hours**

Introduction - Scenario - - Architecture Overview- Sensors - The Gateway - Summary - Data Transmission

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Analog Communication				
Course Code	BECE2004				
Prerequisite	Signals And Systems, Principles of Basic Electronic Circuits				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	1	0	3	

Course Objectives:

1. Concepts of communication engineering.
2. Different analog modulation techniques used.
3. Effects of noise and interference.
4. Systematic comparison of various modulation techniques.

Course Outcomes

CO1	Understand the basics of communication system and analog modulation techniques
CO2	Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
CO3	Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system
CO4	Interpret the effect of noise performance of FM system
CO5	Realize TDM and Pulse Modulation techniques

Text Book (s)

1. Simon Haykin, “Communication Systems”, 4th edition, John Wiley & Sons, 2006, ISBN 812650904X, 9788126509041.
2. J. Proakis& M. Salehi, “Communication system engineering”, 2nd edition, Prentice Hall, 2002, ISBN 0130617938, 9780130617934
3. Simon Haykin, “Digital Communication”, 3rd Edition, John Wiley and Sons, 2008, ISBN 8126513667, 9788126513666.
4. Bernard Sklar, "Digital Communication”, Pearson Education India 2009, ISBN 8131720926, 9788131720929

Course Content:

Unit-1Basics of Communication Theory **8 Hours**
Need and Importance of Communication, Elements of Communication System, Generalized block diagram of communication system, Types of communication systems- Simplex and Duplex systems, Analog and digital systems, Applications of Electronic Communications, Electromagnetic Spectrum used in communication and various frequency bands, Concept of bandwidth. Noise in communication and types of noise (External and Internal), Noise voltage, Signal-to-noise ratio, Noise Figure, Noise temperature.
Unit-2Amplitude Modulation **8 Hours**
Concept of modulation and demodulation, baseband and pass band signals. Amplitude Modulation (AM)- generation & demodulation, Modified forms of AM- Double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and Vestigial sideband (VSB) modulation, Mixers, Frequency Division Multiplexing.
Unit-3Angle Modulation **8 Hours**

Phase modulation (PM) and Frequency modulation (FM), narrow and wideband FM, Generation & demodulation, phase locked loop (PLL), homodyne and heterodyne receivers, elements of TV broadcast and reception.
Unit-4Noise in CW modulation 8 Hours
Receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and de-emphasis.
Unit-5Pulse Modulation 8 Hours
Sampling Process, Basics of Pulse modulation, Types of Pulse Modulation – PAM, PWM and PPM.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Microprocessors and its Application				
Course Code	**BECE3017**				
Pre-requisite	Digital Electronics				
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

Course Outcomes:

CO1	Design and implement programs on 8086 microprocessor.
CO2	Design I/O circuits.
CO3	Design Memory Interfacing circuits.
CO4	Design and implement 8051 microcontroller based systems.
CO5	Demonstrate microprocessor based applications

Text Book

1. D.M.Pozar, “Microwave engineering”, John Wiley, 3/e, 2005
2. Samuel Y.Liao, “Microwave Devices and Circuits”, 3/e, PHI, New Delhi,1987.

Reference Books

1. Rober.E.Collin, “Foundations of Microwave Engineering”, John Wiley, 3/e, 2001
2. Annapurna Dasand S,.K.Das, “Microwave Engineering”, Tata Mc Graw-Hill, New Delhi, 2000
3. R.Chatterjee, “Microwave Engineering”, Affiliated East west Press PVT Ltd, 2001
4. O.P.Gandhi, “Microwave Engineering”, Pergamon Press, NY, 1983

Unit – I: THE 8086 PROCESSOR 8 hours
Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.
Unit – II: 8086 SYSTEM DESIGN 8 hours
8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.
Unit – III: Interfacing 8 hours
Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.
UNIT IV MICROCONTROLLER 8 hours
Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.
UNIT V INTERFACING MICROCONTROLLER 8 hours

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100