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: 2017– 2021

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	20	50	100
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	BEEE1003	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50	-	50
11	SLBT1001	Basic English	0	0	4	2	20	50	100
12	JAPA1001	Japanese-I	0	0	2	1	20	50	100
	FREN1001	French-I					20	50	100
	GERN1001	German-I					20	50	100
		Total	**11**	**1**	**20**	**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	0	0	2	1	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	BECE2016	Signals and Systems	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	BECE2002	Network Analysis and Synthesis	3	0	0	3	20	50	100
5	BECE2003	Network Analysis and Synthesis Lab	0	0	2	1	50	-	50
6	BECE2004	Analog Communication	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	BTME2001	Engineering Mechanics	3	0	0	3	20	50	100
10	SLBT2001	English Proficiency and Aptitude Building - 2	0	0	4	2	50	-	50
		Total	**18**	**0**	**10**	**23**			

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	BECE2007	ECE Project Based Learning -II	0	0	2	1	50	-	50
3	BECE2008	Integrated Circuits	3	0	0	3	20	50	100
4	BECE2009	Integrated Circuits Lab	0	0	2	1	50	-	50
5	BEEE3002	Control Systems	3	0	0	3	20	50	100
6	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	50	100
7	BECE3020	Digital Communication	3	0	0	3	20	50	100
8	BECE3021	Digital communication lab	0	0	2	1	50	-	50
9	SLBT2002	English Proficiency and Aptitude Building - 3	0	0	4	2	50	-	50
10	BTME2002	Engineering Thermodynamics	3	0	0	3	20	50	100
		Total	**18**	**0**	**10**	**23**			

Semester V

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BTMG3001	Entrepreneurship	3	0	0	3	20	50	100
2		Program Elective-I (from basket) - 1	3	0	0	3	20	50	100
3	BECE2020	Digital Signal Processing	3	0	0	3	20	50	100
4	BECE2021	Digital Signal Processing Lab	0	0	2	1	50	-	50
5	BECE3004	Microprocessors and Embedded Systems	3	0	0	3	20	50	100
6	BECE3005	Microprocessors and Embedded Systems Lab	0	0	2	1	50	-	50
7	BECE3006	Microwave Engineering	3	0	0	3	20	50	100
8	BECE3007	Microwave Engineering Lab	0	0	2	1	50	-	50
9	BECE3008	ECE Project Based Learning-III	0	0	2	1	50	-	50
10	SLBT3001	English Proficiency and Aptitude Building - 4	0	0	4	2	20	50	100
11	BECE9001	Objected Oriented Programming	0	0	2	1	50	-	50
12	BECE9003	Data Structure	0	0	2	1	50	-	50
		Total	**15**	**0**	**16**	**23**			

Semester VI

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	SLBT3002	Campus to Corporate	0	0	4	2	20	50	100
2	BECE3204	Mobile Ad Hoc Networks (PE-1)	3	0	0	3	20	50	100
3	BECE3301	Digital Image Processing (PE-1)	3	0	0	3	50	-	50
4	BECE3305	Neural Networks and Deep Learning (PE-2)	3	0	0	3	20	50	100
5	BECE3302	Information and Theory Coding (PE-2)	3	0	0	3	20	50	100
6	BECE3012	Wireless and Mobile Communication	3	0	0	3	20	50	100
7	BECE3013	VLSI Design	3	0	0	3	20	50	100
8	BECE3014	VLSI Design Lab	0	0	2	1	50	-	50
9	BECE3015	Antenna and Wave Propagation - NPTEL	3	0	0	3	50	-	50
10	BEEE9001	Disruptive Technologies	3	0	0	3	50	-	50
11	BECE9008	Advanced Electronic System Design	3	0	0	3	50	-	50
12	BCSE9006	Python Programming for Machine Learning	0	0	2	1	50	-	50
		Total	**27**	**0**	**8**	**30**			

Semester VII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE9998	Capstone Design - I	0	0	6	3	50	-	50
2	BECE4001	Simulation Lab	0	0	4	2	50	-	50
3		Program Elective (from basket) - 4	3	0	0	3	20	50	100
4		Program Elective (from basket) - 5	3	0	0	3	20	50	100
5	UE1	Management Course (from basket)	3	0	0	3	20	50	100
6	UC23	Management Course (from basket)	3	0	0	3	20	50	100
		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 - II	0	0	18	9	50	-	50
		Total	**0**	**0**	**18**	**9**			

List of Electives

List of programme elective (Engineering courses)						
Sl.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
		Basket 1				
1	BECE3102	Automation and Robotics	3	0	0	3
2	BECE3103	Satellite Communication	3	0	0	3
3	BECE3104	Digital System Design using VHDL	3	0	0	3
4	BECE3105	Computer Networks	3	0	0	3
		Basket 2				
5	BECE3201	Principles of Secure Communication	3	0	0	3

6	BECE3202/BECE3305	Neural Networks and Fuzzy Control/ Neural Network and Deep Learning	3	0	0	3
7	BECE3203	Wireless Sensor Networks	3	0	0	3
8	BECE3204	Mobile Ad Hoc Networks	3	0	0	3
		Basket 3				
9	BECE3301	Digital Image Processing	3	0	0	3
10	BECE3302	Information Theory and Coding	3	0	0	3
11	BECE3303	Modern Digital Signal Processing	3	0	0	3
12	BECE3304	ASIC Design and FPGA	3	0	0	3
		Basket 4				
13	BECE4401	Soft Computing	3	0	0	3
14	BECE4402	Mobile Computing	3	0	0	3
15	BECE4404	Radar Guidance and Navigation	3	0	0	3
		Basket 5				
16	BECE4501	Introduction to IoT and its Applications	3	0	0	3
17	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**	
	0	0	2	1	

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 Network Theorems **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 Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Basic Electrical and Electronics Engineering				
Course Code	BECE1002				
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 Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Signals and Systems				
Course Code	BECE2016				
Prerequisite	Engineering Mathematics				
Corequisite					
Antirequisite					
		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 (s)

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

Reference Book (s)

1. Signals and Systems by Oppenheim &Wilsky

Course Content:

Unit-1Introduction to Signals 8 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: Laplace-Transform (LT) and Z-transform (ZT) 8 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-III Fourier Transforms (FT) 8 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 :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 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	Network Analysis and Synthesis				
Course Code	BECE2002				
Prerequisite	Basic Electrical and Electronics				
Corequisite					
Antirequisite					
	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-1 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-2 Network Theorems (Applications to ac networks) 8 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-3 Network Functions and Transient analysis 8 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-4 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-5 RLC Circuits 8 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	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 Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Digital Electronics				
Course Code	BECE2010				
Prerequisite	Number Systems				
Corequisite					
Antirequisite					
		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 ZvonkoVranesic," 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-1 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-2 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-3 Synchronous Sequential Ciruits 8 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-4 Introduction VHDL 8 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-5 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	Integrated Circuits				
Course Code	BECE2008				
Prerequisite	Basic Electronics				
Corequisite					
Antirequisite					
		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	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, 9780074622452

Course Content:

Unit-1	**Introduction to ICs**	**8 hours**
Analysis of difference amplifiers, Monolithic IC operational amplifiers, specifications, frequency response of op-amp,, slew rate and methods of improving slew rate, Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers.		

Unit-2 APPLICATIONS OF OPERATIONAL AMPLIFIERS 8 hours
Differentiator, Integrator, Voltage to Current convertor, Low pass, high pass, band pass filters, comparator, Multi-vibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator, Sine wave Oscillators.
Unit-3 WAVEFORM GENERATORS 8 hours
Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, Frequency synthesizers, Compander ICs.
Unit-4 ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 8 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, Voltage to Time and Voltage to frequency converters.
Unit-5 SPECIAL FUNCTION ICS 8 hours
Wave shaping circuits, Multivibrator- Monostable &Bistable, 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	Control Systems				
Course Code	BECE3002				
Prerequisite	Engineering Mathematics				
Corequisite					
Antirequisite					
		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.Analyzeconcept 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				
Prerequisite	Applied Physics				
Corequisite					
Antirequisite					
	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.

Course Content:

Unit-1 STATIC ELECTRIC FIELDS **8 hours**

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-2STATIC MAGNETIC FIELDS **8 hours**
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
Unit-3 ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 8 hours
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
Unit-4 TIME VARYING ELECTRIC AND MAGNETIC FIELDS 8 hours
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-5ELECTRO MAGNETIC WAVES **8 hours**
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 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				
Prerequisite	Basic Electronics				
Corequisite					
Antirequisite					
		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-1 Communication System & Information Theory 8 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-2 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-arySignaling Schemes, Matched Filter, Correlation receiver, Equalization, ISI, Eye Pattern analysis.
Unit-3 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-4 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
Unit-5 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				
Prerequisite	Signals and System, Engineering Mathematics				
Corequisite					
Antirequisite					
	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., 2000

Course Content:

Unit-1 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-2FREQUENCY 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-3IIR 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-4FIR 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-5 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	Microprocessors and Embedded Systems			
Course Code	BECE3004			
Prerequisite	Digital Electronics			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To gain an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques with peripheral devices
2. To learn the concept of designing computer organization and architecture
3. To gain an understanding of applications of microprocessors in designing processor-based automated electronics system.

Course Outcomes

CO1	Recall and apply the basic concept of digital fundamentals to Microprocessor based personal computer system
CO2	Identify the detailed s/w & h/w structure of the Microprocessor.
CO3	Illustrate how the different peripherals are interfaced with Microprocessor.
CO4	Distinguish and analyze the properties of Microprocessors & Microcontrollers.
CO5	Analyze the data transfer information through serial & parallel ports.

Text Books

1. Barry B Brey, The intel microprocessor: architecture, programming and interfacing, Prentice hall of India, NewDelhi, 2003.ISBN-0138027455, 4th Edition

2. Mohammad Ali Mazidi and Janice GillispieMaszidi "The 8051 Microcontroller and Embedded Systems" Pearson education, 2003, ISBN- 9788131710265, 2ndEdition

Reference Books

1. Kenneth J. Ayla, "The 8051 Micro controller", Thomson learning, 3rd edition, 2004, ISBN-140186158X

2. Alan Clements, "Principles of Computer Hardware", OxfordUniversity Press, 3rd Edition, 2003, ISBN-9780198564539

Course Content:

Unit-1 Introduction 8 hours
Introduction to Microprocessors, Microcontrollers and system design – Assembly and High-Level language programming – System Development Environment: assembler, compiler and integrated development environment.
Unit-2 8086 Microprocessor 8 hours
Architecture and Programming of 8086 microprocessor: pipelining, Instruction sets, addressing modes – Memory addressing, decoding and Memory interfacing – Interrupts and interrupts handling.
Unit-3 I/O and Bus Interfacing 8 hours
Interfacing methods – 8255 PPI interface, 8254 timer interface, 8259 PIC and DMA controller interface – Bus Interface: electrical characteristics, interfacing ISA bus, EISA, PCI bus, LPT, USB and RS232 interface.
Unit-4 8051 Microcontroller 8 hours

Introduction to single chip Microcontrollers, Intel MCS-51 family features –8051/8031-architecture – 8051 assembly language programming, addressing modes – Programming interrupts, timers and serial communication – system design with 8051. Application of microprocessor and Microcontrollers in data acquisition systems, process control, signal processing, data communication and distributed computing and networking.
Unit- 5 Introduction to Embedded Systems, Microprocessors and Microcontrollers 8 hours
System level interfacing design; Advanced Microprocessor Architectures- 286, 486, Pentium; Microcontrollers 8051 systems; Introduction to RISC processors; ARM microcontrollers; Embedded system design methodologies, embedded controller design for communication, digital 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	Microwave Engineering				
Course Code	BECE3006				
Prerequisite	Electromagnetic field theory				
Corequisite					
Antirequisite					
	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-1 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-2Microwave 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-3Microwave 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-4Microwave linear-beam tubes (O TYPE) and microwave crossed-field tubes 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-5Microwave Measurements 8 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				
Prerequisite	Digital Communication				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. 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
2. Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
3. Understand the needs of technological solution for designing and developing next generation cellular technology to fulfill the ever growing service demands of customer
4. Apply the mobile and wireless principles for creating solutions for data and voice communication in various Industries like Banking, Marketing and Automobile

Course Outcomes

CO1	Familiar with the evolution and basic concepts of Wireless and Mobile Communication systems
CO2	Examine and analyze the design of a cellular system in a specific radio and geographic environment with specific frequency range
CO3	Evaluate the performance of mobile radio propagation model in the presence of multipath fading and associated issues
CO4	Distinguish among various digital modulation techniques, diversity techniques and channel coding associated with mobile communication.
CO5	Differentiate among multiple access techniques used in wireless communication and emerging technologies.

Text Books

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

Reference Book

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

Course Content:

Unit-1 Introduction to Wireless Communication 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 8 hours

Cellular concept and frequency reuse, channel assignment, handoff strategies, Interference and system capacity, Trunking and GOS, cell splitting,cell sectoring.
Unit-3Mobile 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-5Multiple Access Techniques, Wireless Systems & Standards 8 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			
Prerequisite	Digital Electronics			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

This is an introductory course which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, design tools and methodologies, VLSI architecture.

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	Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of- the-art CMOS technologies and processes
CO3	Be able to design and solve complex problems.
CO4	Be able to complete a significant VLSI design project having a set of objective criteria and design constraints
CO5	Able to design memories and understand the VLSI design methodologies

TEXT BOOKS

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 BOOKS

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.

Course Content:

Unit-1 FABRICATION AND CHARACTERISTICS 8 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 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 CHARACTERISTICS and MOS INVERTERS: SWITCHING CHARACTERISTIC and INTERCONNECT EFFECTS 8 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-4COMBINATIONAL and SEQUENTIAL MOS LOGIC CIRCUITS and DYNAMIC LOGIC CIRCUITS 8 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-5MEMORIES ANDVLSI DESIGN METHODOLOGIES 8 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	Antenna and Wave Propagation				
Course Code	BECE3015				
Prerequisite	Electromagnetic Field Theory				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. Fundamental antenna parameters and numerical methods to analyze and differentiate the antennas.
2. Concept of radiation mechanism of various antennas.
3. Mechanism and models for radio-wave propagation.

Course Outcomes

CO1	Understand the basic terminology associated with antenna
CO2	Understand and Analyze Antenna Arrays
CO3	Calculate basic antenna design parameters
CO4	Understand and Analyze Antenna the usage of antennas in wireless communications
CO5	Understand the concept of radio wave propagation

Text Book

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 Books

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 8 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-2Design of Arrays 8 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 – III: Design of Antennas 8 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. Microstrip antenna.
Unit-4Antennas for modern wireless communications 8 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	**Automation and Robotics**				
Course Code	**BECE3102**				
Prerequisite	**Control Systems, Microprocessor and Microcontroller**				
Corequisite					
Antirequisite					
	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 workspac

Course Outcomes

CO1	Explain basic Robotic model & its applications.
CO2	Differentiate types of control and the standardization for some robotic system
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	Design small automatic applications with the help of Robotics.

TEXT BOOKS

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 BOOKS

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

Course Content

Unit- I INTRODUCTION TO ROBOTICS	**8 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-2ROBOT 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	
Unit-3END 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-4 ROBOT MOTION ANALYSIS 8 hours
Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates-Homogeneous transformations and rotations and Robot dynamics.
Unit-5ROBOT APPLICATIONS 8 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				
Prerequisite	Analog and Digital Communication				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Analyze the various methods of satellite access
- Understand the applications of satellites
- Understand the basics of satellite Networks

Course Outcomes

CO1	Understand the orbital mechanics and various terms associated with satellite communication systems.
CO2	Identify, formulate and choose appropriate technologies for implementation of specified satellite communication systems
CO3	Analyze and design problems associated with satellite link and propose solutions to improve the link performance
CO4	Choose appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link
CO5	Explain the working of VSAT, DBS, GPS and other satellite systems

Text Book:

1. Wilbur L. Pritchard, H.G. Suyderhoud ,RobertA.Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006. ISBN-013-791468-7

2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003. ISBN- 047137007X

3. D.Roddy, Satellite Communication, McGrawHill, 2006 ISBN- 0071486895

Reference Books:

1. Tri T Ha, Digital Satellite Communication, McGrawHill,1990. ISBN-978-0-07-007752-2
2. B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993. ISBN- 0132001144

Course Content:

Unit-1 Inytroduction to Satellite Communications **8 hours**
Elements of Satellite Communication Orbital mechanics look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.
Unit-2 Satellite Subsystems **8 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 Modulation and multiplexing **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 Propagation Effects **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 Applications **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				
Prerequisite	Digital Design				
Corequisite					
Antirequisite					
		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	Demonstrate the use and application of Boolean Algebra in reduction, expansion, Factoring. Use commercially available VHDL software to analyze and synthesize digital circuits
CO2	Simulate and debug digital systems described in VHDL
CO3	Synthesize complex digital circuits at several level of abstractions
CO4	Design PLAs, PLDs using VHDL
CO5	Implement logic on an FPGA

Text Books

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

Reference Books

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

Course Content:

Unit-1 Introduction **8 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-3Digital Design with State Machine Charts **8 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-4Programmable Logic devices (PLDs) 8 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-5Field 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

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				
Prerequisite	Microprocessors and Microcontrollers				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

1. To educate with the architecture, protocols and network organization of the Internet
2. To update the trends in innovation approach towards development of high speed networks.
3. To learn the challenges involved in developing TCP/IP suite wired cum wireless real networks

Course Outcomes

CO1	Understand the OSI layersTCP/IP models
CO2	Analyze MAC layer protocols and LAN technologies
CO3	Compare the performance various routing algorithm in packet switching networks
CO4	Understand TCP/IP architecture and IP addressing schemes
CO5	Develop applications using various wireless routing protocols

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

Name of The Course	Principles of Secure Communication				
Course Code	BECE3201				
Prerequisite	Wireless Communication				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To provide insights to students for secure communication used data communication

- Various spread spectrum systems,
- Cryptographic techniques,
- Standards like Data Encryption standard
- 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:

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, Mc Graw Hill, ISBN-10: 0071125027; ISBN-13: 978-0071125024.
4.Communication System Security by LidongChen,Guang Gong, ISBN 9781439840368-CAT

Course Content:

Unit-1 Introduction	**8 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 FHSS	**8 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 Encryption	**8 hours**
Classical encryption techniques, Symmetric cipher model, cryptography and cryptanalysts, Substitution techniques, transposition techniques.	
Unit-4 Data Encryption Standard	**8 hours**

Block cipher principle, data encryption standard (DES), strength of DES, differential and linear cryptanalysts, 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 Crytosystems 8 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				
Prerequisite	Control System & Digital design				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Get Exposure to the concepts of Artificial Neural Networks, Fuzzy Logic & Genetic Algorithm.
2. Understand the importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines.

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	Analyze the feasibility of applying a Neuro-Fuzzy model for a particular problem
CO4	Applying a soft computing methodology for a particular problem
CO5	Develop genetic algorithms for optimization problems

Text Book:

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. Zurada, Jacek M. *Introduction to artificial neural systems*, West St. Paul, 1992.

Reference Books:

1. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. *Neural network design*. Boston: Pws Pub., 1996.
2. Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice Hall PTR, 1994.
3. Passino, Kevin M., and Stephen Yurkovich. *Fuzzy control*. Vol. 42. Menlo Park, CA: Addison-Wesley, 1998

Course Content:

Unit-1 Architectures	**8 hours**
Introduction –Biological neuron-Artificial neuron-Neuron modeling-Learning rules-Single layer-Multi layer feed forward network-Back propagation-Learning factors.	
Unit-2 NEURAL NETWORKS FOR CONTROL	**8 hours**
Feedback networks-Discrete time hop field networks-Schemes of neuro–control, identification and control of dynamical systems-case studies(Inverted Pendulum, Articulation Control	
Unit-3 Fuzzy Logic & Fuzzy Sets	**8 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 8 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. , Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions.
Unit-5Fuzzy Optimization and Neuro Fuzzy Systems 8 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	Neural Network and Deep Learning				
Course Code	BECE3305				
Prerequisite	Fundamentals of programming				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Course Outcomes

CO1	To illustrate Artificial Neural Networks and deep learning algorithms by explaining case studies.
CO2	To develop algorithms for solving complex problems.
CO3	To identify optimal parameters for solutions to complex problems.
CO4	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
CO5	Implement deep learning algorithms and solve real-world problems.

Text Books

1. T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Artificial Neural Networks , S.N Sivanandam, S.N Deepa

Reference Books

1. R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
4. A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016..
5. A. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer , 2007.

Course Content:

Unit-1
Introduction 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

Feedforward and Recurrent Neural Networks 9 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;
Unit-3 Training Neural Network and Conditional random Fields 8 hours
Training Neural Network and Conditional random Fields: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization. Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy
Unit-4 Deep Learning 8 hours
Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network."
Unit-5 Probabilistic Neural Network 8 hours
Probabilistic Neural Network: Boltzman machine, RBMs, Sigmoid net, Autoencoders, Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing.

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				
Prerequisite	Computer Networks				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks

Have an exposure to mote programming platforms and tools

Course Outcomes

CO1	Apply the knowledge of wireless sensor networks in various application areas
CO2	Comprehend and analyze localization and tracking issues associated with WSN network.
CO3	Evaluate the performance of energy saving approaches used in MAC Protocols.
CO4	Understand and analyze various routing metrics and routing algorithms in WSN network
CO5	Apply the techniques used for sensor data gathering, data storage and data retrievals in WSN.

TEXT BOOKS

1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press
2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Springer.

REFERENCE BOOKS

1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.
2. Wireless Sensor Networks: Technology, Protocols, and Applications: KazemSohraby, Daniel Minoli, TaiebZnati, Wiley Inter Science.

Course Content:

Unit-1 Characteristics of WSN 8 hours
Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges. Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.
Unit-2 Network Protocols 8 hours
Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects.
Unit-3 Deployment and Configuration 8 hours

Wireless Communications: Link quality, shadowing and fading effects Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.
Unit-4 Routing Protocols 8 hours
Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing. Sensor network
Unit-5 Data Storage and Manipulation 8 hours
Databases: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor 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	Mobile Adhoc Networks			
Course Code	BECE3204			
Prerequisite	Wireless Networks			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To understand the knowledge of mobile ad hoc networks, design and implementation issues, and available solutions
2. To enhance knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid.
3. To identify the implications and consequences of clustering mechanisms and the different schemes that have been employed, e.g., hierarchical, flat, and leaderless.
4. To understand 802.11 Wireless LAN (WiFi) and Bluetooth standards. This includes their designs, operations, plus approaches to interoperability

Course Outcomes

CO1	Explain the unique issues in ad-hoc/sensor networks
CO2	Describe current technology trends for the implementation and deployment of wireless ad-hoc/sensor networks
CO3	Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks
CO4	Examine the challenges in designing routing and transport protocols for wireless Ad-hoc/sensor networks
CO5	Develop the various sensor network Platforms, tools and applications

TEXT BOOKS:

1. C.Siva Ram Murthy and B.S.Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education. 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCES:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobilead hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of adhoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network
4. Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.

Course Content:

Unit-1 Introduction to adhoc networks	**8 hours**
Introduction to adhoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models:- Indoor and out door models.	
Unit-2 MAC Protocols	**8 hours**

MAC Protocols: design issues, goals and classification. Contention based protocols-withreservation, scheduling algorithms, protocols using directional antennas. IEEEstandards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.
Unit-3 Routing Protocols **8 hours**
Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.
Unit-4 Routing Protocols **8 hours**
Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in ad-hoc networks: issues and challenges, network security attacks, secure routing
Unit-5 CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G 8 hours
Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective. Integration of ad-hoc with Mobile IP 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	Digital Image Processing				
Course Code	BECE3301				
Prerequisite	Digital Signal Processing, Knowledge of 1D transforms, Filters				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To study the image fundamentals and mathematical transforms necessary for image transform
2. To study the image processing techniques like image enhancement, image reconstruction, image compression, image segmentation and image representation.

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 Books

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

Reference Books

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

Unit-1 Fundamentals of DIP **8 hours**
Need for DIP- Fundamental steps in DIP – Elements of visual perception -Image sensing and Acquisition – Image Sampling and Quantization – Imaging geometry, discrete image mathematical characterization, Two dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT Discrete cosine transform and KL transform.-Discrete Short time Fourier Transform
Unit-2 Image Enhancement and Restoration **8 hours**
Image enhancement in spatial domain: Gray-level transformations, histogram equalization, spatial filters- averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks; Image filtering in frequency domain: Smoothing and sharpening filtering in frequency domain, ideal and Butterworth filters, homomorphic filtering; Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering

Unit-3 Image Segmentation **8 hours**
Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors.
Unit-4 Wavelets and Multiresolution Processing 8 hours
Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.
Unit-5 Image Compression and Video Coding 8 hours
Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000. Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

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				
Prerequisite	Analog and Digital COmmunication				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

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, Shannaon Fano 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's Theorems
CO4	Construct efficient codes for data on imperfect communication channels
CO5	Generalize the discrete concepts to continuous signals on continuous channels

Text Books:

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

References:

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

Course Content:

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-2ERROR CONTROL CODING: BLOCK CODES 8 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-3ERROR CONTROL CODING: CONVOLUTIONAL CODES 8 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-5SOURCE CODING: IMAGE AND VIDEO 8 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				
Prerequisite	Signals and System and digital signal processing				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

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

Course Outcomes

CO1	Understand various time domain, frequency domain and mixed domain signal processing elements
CO2	Designed analyze various single rate and multi rate digital filters
CO3	Understand the spectral estimation
CO4	Understand basics of DSP processors and their various applications
CO5	Design and simulate Digital filters using software

Text Book:

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

Reference Books:

1. Steven W. Smith, " Digital Signal Processing: A Practical Guide for Engineers andScientists", Elsevier, 2003.
2. John G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications",4th edition , PHI 2007.
3. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital SignalProcessing", PHI 2001.
4. Roberto Cristi "Modern Digital Signal Processing", Thomson Brooks/Cole, 2004

Course Content:

Unit-1 Introduction to Modern Digital Signal Processing 8 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 II:Design Of Filters 8 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 III:Fast Fourier Transform and Spectral estimation 8 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 8 hours
Introduction to Digital signal Processors:Architecture and applications , Fixed and Floating Point Processors, Complexnumbers – fixed and floating point representation. Applications: Applications of Digital ,Signal Processing to Speech & Audio coding and processing
Unit-5 Design and implementation example 8 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 FPGA				
Course Code	BECE3304				
Prerequisite	Digital design using VHDL				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

This is an introductory course which is designed to impart the knowledge and skills for RTL (Register Transfer Level) designing and netlist generation. Participants practice static time analysis (STA) for ASIC design verification and validating the timing performance of the design. The learning curve encompasses SOC designing and also focuses on HDL techniques for high performance designs intended for programmable logic devices.

Course Outcomes

CO1	Define the basic concepts of ASIC design and Verilog HDL
CO2	Express the details of programmable ASICs and FPGAs technologies from ACTEL, ALTERA and XILINX
CO3	Practice writing the Dataflow and Behavioral models of digital circuits for simulation and synthesis using ASICs and FPGAs.
CO4	Testing and Verification of Register Transfer Level (RTL) models ofDigital Circuits using ASICs and FPGAs.
CO5	Hardware design using Xilinx and FPGA

Text Book:

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 Books:

1. Charles W. Mckay, "Digital Circuits a proportion for microprocessors", Prentice

Course Content:

Unit-1 Introduction To ASIC and VHDL 8 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-2Programmable ASICS8 Hours 8 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-3Programmable ASIC Interconnect & Software 8 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-4ASIC 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 8 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

Name of The Course	Soft Computing			
Course Code	BECE4401			
Prerequisite	Computer Programmings			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. To learn the basic concepts of Soft Computing
2. To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
3. To apply soft computing techniques to solve problems.

Course Outcomes

CO1	Understand basics of Soft Computing
CO2	Apply suitable ANN techniques for various applications.
CO3	Apply suitable Fuzzy techniques for various applications.
CO4	Apply suitable Genetic Algorithm techniques for various applications.
CO5	Integrate various soft computing techniques for complex problems.

Text Book:

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

Reference Books:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, ―Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. 2. Kwang H.Lee, ―First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. 3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.
4. 4. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.

Course Content:

Unit-1 Introduction	**8 hours**
Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.	
Unit-2 Back propagation Neural **Networks**	**8 hours**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.
Unit-3 Introduction to Fuzzy Logic 8 hours
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.
Unit-4 Genetic Algorithm 8 hours
Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.
Unit-5 Hybrid Systems 8 hours
Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

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				
Prerequisite	Wireless & Mobile Communication				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and principles in mobile computing technology. This course includes wireless networking, GSM & GPRS technology, data management, routing algorithm and security issues in mobile computing. The course provides opportunities for the students to understand and analyze the functions of various components associated with the above technologies, the major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications. This course also provides an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

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	Describe GSM architecture, operation and services offered by GSM networks
CO4	Understand GPRS architecture, operation and services offered by GPRS networks
CO5	Analyze the performance of various routing protocols and security issues associated with mobile computing

Reference Books:

1. Jochen Schiller, *Mobile Communications*, Second Edition, Pearson Education, 2003.
2. Asoke K Talukder and Roopa R. Yavagal, *Mobile Computing – Technology, Applicationsand Service Creation*; TMH Pub., New Delhi, 2006
3. C D M Cordeiro, D. P. Agarwal, *Adhoc and Sensor Networks: Theory and applications*, World Scientific, 2006.

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 GSM 8 hours
GSM Architecture, GSM Entities ,Call Routing in GSM, GSM Addresses and Identifiers,NetworkAspects in GSM , GSM Frequency Allocation, Authentication and Security, Mobile Computing over SMS, Short Message (SMS) , Value Added Services through SMS, Accessing the SMS Bearer
Unit-4 GPRS 8 hours
GPRS andpacket Architecture GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS ,Application for GPRS, Limitation of GPRS, Billing and Charging in GPRS, MMS , GPRSApplications, Spread – Spectrum Technology, Data management and various issues in mobile computing environment.
Unit-5 Routing Protocols 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).

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				
Prerequisite	Fundamental knowledge of Electromagnetics, Wave propagation & Antennas				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To introduce the fundamental concepts of RADAR (Radio Detection And Ranging) and Navigational aids.
- To provide exposure the students to different types of RADAR systems and Navigation.

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

1. Introduction to Radar System M.I. Skolnik ,Publisher: McGraw Hill

Reference Books:

1. Radar Systems and Radio Aids to Navigation, Sen & Bhattacharya, Publisher: Khanna publishers
2. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
3. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
4. Roger J Suullivan, “Radar Foundations for Imaging and Advanced Topics”.
5. N S Nagaraja, “Elements of Electronic Navigation”, TMH.

Course Content:

Unit-1 Introduction **8 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 radar **8 hours**
CW and FM CW Radar: Doppler effect. CW radar. FM CW radar. Multiple frequency CW Radar.

Unit-3 MTI And Pulse Doppler Radar	**8 hours**
MTI And Pulse Doppler Radar: 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**
Tracking Radar: Sequential loping, conical scan, Monopulse, Tracking in range and Doppler, Acquisition.	
Unit-5 Radar Transmitters	**8 hours**
Radar Transmitters, Antennas and Receivers: Hard tube and pulse modulators. Types of Radar antennas, Duplexers, Displays. **Electronic Scanning Radar**: 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

Name of The Course	Introduction to IoT and its Applications				
Course Code	BECE4501				
Prerequisite	Microprocessor and Microcontrollers				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

Students will understand the concepts of Internet of Things and to build IoT based applications.

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	Analyze and design of academic project

Text Books &Reference Books:

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms " Copyright © 2016 Elsevier Inc.
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. 2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen
3. API Features and Arduino Projects for Linux Programmers", Apress, 2014.
4. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

Course Content:

Unit-1 Introduction to IoT 8 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 Network & Communication aspects 8 hours
Background/Related Work - OpenIoT 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 Challenges in IoT 8 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 Domain specific applications of IoT 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 Developing IoTs 8 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	**Advanced Electronic System Design**			
Course Code	**BECE9008**			
Prerequisite	**Electronic Devices and Circuits**			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

- To familiarize the student to the concepts, calculations and pertaining to Know how to model and determine the performance characteristics of a Electronic circuit or system.
- Apply analysis methods and modern tools to determine circuit properties of devices and accordingly demonstrate the same in designing experiments and projects.

Course Outcomes

CO1	Explain the methods of biasing transistors & design of simple amplifier circuits and to develop the ability to analyze and design analog electronic circuits using discrete components.
CO2	Observe the operation of FET amplifiers circuits MOSFET operations.
CO3	Design, construct, the feedback amplifiers and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis
CO4	To understand the principle of operation of different oscillators circuits
CO5	To understand the principle of operation of different amplifier circuits like Tunedamplifiers, power amplifiers.

Text Books

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 McGraw Hill, 2001, ISBN 0074622455, 9780074622452.
3. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10th EditionPrentice Hall, 2009, ISBN 0135026490, 9780135026496.

Reference Books

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

Course Content

UNIT I Analysis And Design of Small Signal Low Frequency BJT Amplifiers 8 Hours
Review of transistor biasing, Classification of Amplifiers, Analysis of CE, CC, and CB Amplifiers, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Design of single stage RC coupled amplifier Different coupling schemes used in amplifiers, Analysis of Cascaded RC Coupled amplifiers, Darlington pair
UNIT II: FET AMPLIFIERS 8 Hours

FET and FET Biasing. FET Amplifiers-Common source, Common gate and Common drain Amplifiers, Small signal analysis of FET Amplifiers.MOSFET operation in Enhancement and Depletion mode,VMOS & CMOS Concepts.
UNIT III: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 IV: Oscillators 8 Hours
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpitts oscillator – frequency stability, inclusive of design, Crystal oscillators.
UNIT V:Tuned Amplifiers and Power Amplifiers 8 Hours
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled 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