GALGOTIAS
UNIVERSITY

Syllabus of

Electronics and Communication Engineering(B.Tech)

Name of School: School of Electrical, Electronic and Communication Engineering

Department: Electronic and Communication Engineering

Year: 2017-21

ECE 2017-2021

Semester 1

Sl. No.	Course Code	Course Title	L	T	P	C
1	BECE1001	Introduction to Electronics and Communication Engineering	0	0	2	1
2	BCSE1002	Computer Programming and Problem Solving	0	0	4	2
3	MATH1001	Multivariable Calculus	3	0	0	3
4	MATH1002	Exploration with CAS-I	0	0	2	1
5	PHYS1001	Engineering Physics	3	0	0	3
6	PHYS1002	Engineering Physics Lab	0	0	2	1
7	ENVS1001	Environmental Science	2	0	0	2
8	BTME1003	Product Manufacturing	0	0	2	1
9	BEEE1002	Basic Electrical and Electronics Engineering	2	1	0	3
10	BEEE1003	Basic Electrical and Electronics Engineering Lab	0	0	2	1
11	SLBT1001	Basic English	0	0	4	2
12	PSSO1001	Psychology and Sociology	2	0	0	2
13	JAPA1001	Japanese-I				
	FREN1001	French-I				
	GERN1001	German-I	0	0	2	1
		TOTAL				22

Semester 2

Sl. No.	Course Code	Course Title	L	T	P	C
1	BCSE1003	Aplication Oriented Programming using Python	0	0	4	2
2	CHEM1001	General Chemistry	3	0	0	3
3	CHEM1002	General Chemistry Lab	0	0	2	1
4	MATH1003	Matrices and Differential Equations	3	0	0	3
5	MATH1004	Exploration with CAS-II	0	0	2	1
6	PHYS1004	Physics of Semiconductor Devices	3	0	0	3
7	PHYS1005	Advanced Physics Lab	0	0	2	1
8	BTME1002	Product Design using Graphics	0	0	4	2
9	UHVE1001	Universal Human Values and Ethics	0	0	4	2
10	SLBT1002	English Proficiency and Aptitude Building-1	0	0	4	2
	JAPA1002	Japanese-I				
	FREN1002	French-I				
11	GERN1002	German-I	0	0	2	1
		TOTAL				23

Semester 3

1	BECE2016	Signals and Systems	3	0	0	3
2	MATH2002	Numerical Methods	3	0	0	3
3	BECE2001	Electronics and Communication Engineering Project Based Learning -1	0	0	2	1
4	BECE2002	Network Analysis and Synthesis	3	0	0	3
5	BECE2003	Network Analysis and Synthesis Lab	0	0	2	1
6	BECE2004	Analog Communication	3	0	0	3
7	BECE2010	Digital Electronics	3	0	0	3
8	BECE2011	Digital Electronics Lab	0	0	2	1
9	BTME2001	Engineering Mechanics	3	0	0	3
10	SLBT2001	English Proficiency and Aptitude Building - 2	0	0	4	2
		TOTAL				23

Semester 4

				3	0	0	
1	MATH2004	Probability and Stochastic Processes					3
2	BECE2007	ECE Project Based Learning -II		0	0	2	1
3	BECE2008	Integrated Circuits		3	0	0	3
4	BECE2009	Integrated Circuits Lab		0	0	2	1
5	BEEE3002	Control Systems		3	0	0	3
6	BECE2012	Electromagnetic Field Theory		3	0	0	3
7	BECE3020	Digital Communication		3	0	0	3
8	BECE3021	Digital communication lab		0	0	2	1
9	SLBT2002	English Proficiency and Aptitude Building - 3	0	0	4	2
10	BTME2002	Engineering Thermodynamics		3	0	0	3
		TOTAL					23

Semester 5

1	BTMG3001	Entrepreneurship	3	0	0	3
2		Program Elective-I (from basket) - 1	3	0	0	3
3	BECE2020	Digital Signal Processing	3	0	0	3
4	BECE2021	Digital Signal Processing Lab	0	0	2	1
5	BECE3004	Microprocessors and Embedded Systems	3	0	0	3
6	BECE3005	Microprocessors and Embedded Systems Lab	0	0	2	1
7	BECE3006	Microwave Engineering	3	0	0	3
8	BECE3007	Microwave Engineering Lab	0	0	2	1
9	BECE3008	ECE Project Based Learning-III	0	0	2	1
10	SLBT3001	English Proficiency and Aptitude Building - 4	0	0	4	2
11	BECE9001	Objected Oriented Programming (Added)	0	0	2	1
12	BECE9003	Data Structure (Added)	0	0	2	1
		TOTAL				23

Semester 6

1	SLBT3002	Campus to Corporate	0	0	4	2
2	BECE3204	Mobile Ad Hoc Networks (PE-1)	3	0	0	3
	BECE3301	Digital Image Processing (PE-1)				
3	BECE3305	Neural Networks and Deep Learning (PE-2)	3	0	0	3
	BECE3302	Information and Theory Coding (PE-2)				
4	BECE9007	AI AND ML USING PYTHON	3	0	0	3
5	BECE3012	Wireless and Mobile Communication	3	0	0	3
6	BECE3013	VLSI Design	3	0	0	3
7	BECE3014	VLSI Design Lab	0	0	2	1
8	BECE3015	Antenna and Wave Propagation - NPTEL	3	0	0	3
9	BECE9001	Disruptive Technologies	3	0	0	3
10	BECE9008	Advanced Electronic System Design	3	0	0	3
		TOTAL				

Semester 7

1	BECE9998	Capstone Design - I	0	0	6	3
2	BECE4001	Simulation Lab	0	0	4	2
3		Program Elective (from basket) - 4	3	0	0	3
4		Program Elective (from basket) - 5	3	0	0	3
5	UE1	Management Course (from basket)	3	0	0	3
6	UC23	Management Course (from basket)	3	0	0	3
7						
8						
		TOTAL				17

Semester 8

1	BECE9999	Capstone Design - II	0	0	18	9
		TOTAL				9

Course Code	BEEE1002	Course Name	Basic Electrical and Electronics Engineering

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

Prerequisites: Basic Number System, Basic Electronics, Mathematics

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

Syllabus

Unit I: Elementary Circuit Analysis
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: 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: 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: 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: 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.

Course Code	BECE2016	Course Name	
			Signals and Systems

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.

Prerequisites: Engineering Mathematics

Course Outcomes

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

Text Book:

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

Reference Books

Signals and Systems by Oppenheim & Wilsky

Syllabus

Unit I: Introduction to Signals
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)

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):

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
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
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.

Course Code	BECE2002	Course Name	Network Analysis and Synthesis

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

Unit I: Graph Theory

Loop and Nodal methods of analysis, Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality.

Unit II: Network Theorems (Applications to ac networks)

Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Compensation theorem, Tellegen's theorem.

Unit III: Network Functions and Transient analysis

Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.

Unit IV : Two Port Networks

Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.

Unit V: Network Synthesis & Filters

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.

Course Code	BECE2004	Course Name	Analog Communication

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.

Prerequisites: Principle of Basic Electric Circuit

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:

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

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Unit I: Basics of Communication Theory

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 II: Amplitude Modulation

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 III: Angle Modulation

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 IV : Noise in CW modulation

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 V: Pulse Modulation

Sampling Process, Basics of Pulse modulation, Types of Pulse Modulation – PAM, PWM and PPM.

Course Code	BECE2010	Course Name	Digital Electronics

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

Prerequisites: Number system

Course Outcomes

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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Unit I: Number System & Boolean Algebra

Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions, Prime Implicants and Essential Prime Implicants definition and simplification using K-maps upto 5 variables & Quine McCluskey method.

Unit II: Combinational Circuits

Introduction to Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR and their combinations. Design of adder, subtractors, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers, Function realization using gates & multiplexers.

Unit III: Synchronous Sequential Ciruits

Introduction to Latches and Flip flops - SR, D, JK and T. Design of synchronous sequential circuits – Counters, shift registers. Finite State Machine Design, Mealy, Moore Machines, Analysis of synchronous sequential circuits;, state diagram; state reduction; state assignment with examples.

Unit IV: Introduction VHDL

INTRODUCTION to Hardware Description Languages (HDL) and HDL based design, VHDL- Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, VHDL model for a counter.

Unit V: VHDL Synthesis and Models

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.

Course Code	BECE2008	Course Name	Integrated Circuits

Course Objectives

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

Course Outcomes

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

Text Books:

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

Reference Books:

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

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Unit-1

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

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

Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, Frequency synthesizers, Compander ICs.

Unit-4

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

Wave shaping circuits, Multivibrator- Monostable & Bistable, Schmitt Trigger circuits, IC 555 Timer, Application of IC 555, Switched capacitor filter, Frequency to Voltage converters.

Course Code	BEEE3002	Course Name	Control Systems

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.

Prerequisites: Engineering Mathematics

Course Outcomes

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

Text and Reference Books

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

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UNIT I

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 II

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 III

Routh-Hurwitz criteria and limitations, root locus concepts, construction of root locus. Constructional and working of ac servomotor, synchronous and stepper motor.

UNIT IV

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 V

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.

Course Code	BECE2012	Course Name	Electromagnetic Field Theory

Course Objectives

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

Course Outcomes

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

Reference Books

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

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UNIT I STATIC ELECTRIC FIELDS

Introduction to Co-ordinate System – Rectangular –Cylindrical and Spherical Co- ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges – Electric field due to continuous charge distribution – Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet.Electric Scalar Potential – Relationship between potential and electric field – Potential due to infinite uniformly charged line – Potential due to electrical dipole – Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications

UNIT II: STATIC MAGNETIC FIELDS

The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I –Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.

UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS

Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials- Definition of Capacitance – Capacitance of various geometries using Laplace's equation– Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability – magnetic boundary conditions.

UNT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS

Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form. Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.

UNIT V: ELECTRO MAGNETIC WAVES

Derivation of Wave Equation – Uniform Plane Waves – Maxwell's equation in Phasor form – Wave equation in Phasor form – Plane waves in free space and in a homogenous material.Wave equation for a conducting medium – Plane waves in lossy dielectrics –Propagation in good conductors – Skin effect. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization, Brewster angle.

Course Code	BECE3020	Course Name	Digital Communication

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.

Syllabus

Course Content
Unit- I: Communication System & Information Theory
Introduction to Digital Communication; Basic building blocks of digital communication, GSOP, Mutual information, Information and Channel Capacity, Entropy, Shano- Fano and Huffman's Coding, Overview of Sampling, Quantization – Uniform and Non-uniform (A-law & μ-law). Classification of line codes, characteristics and power spectra of line codes.

Unit – II: Baseband Transmission
Baseband data Transmission Systems: Baseband and Bandpass transmission through AWGN channel, Coherent and noncoherent receiver structures, Error Probability, Pulse Shaping, M-ary Signaling Schemes, Matched Filter, Correlation receiver, Equalization, ISI, Eye Pattern analysis.

Unit – III: Waveform Coding Techniques
Pulse-Code modulation (PCM), Quantization Noise and Signal-to-noise Ratio, Differential-PCM, Delta Modulation and Adaptive delta-Modulation

Unit – IV: Modulation Schemes
Digital Modulation Schemes, ASK, PSK, DPSK, FSK, QPSK, QAM and MSK systems, Probability of Error in Digital Modulation Schemes, Continuous Phase Carrier Modulation, Differential modulation schemes, receiver structure and error performance, Performance comparison of modulation schemes.

Unit – V: Spread Spectrum & Multiple Access Techniques
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.

Course Code	BECE2020	Course Name	Digital Signal Processing

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.

Prerequisites: Signals and System, Engineering Mathematics

Course Outcomes

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

TEXT BOOKS

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

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

REFERENCE BOOKS

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

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

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

Syllabus

UNIT I SIGNALS AND SYSTEMS

Basic elements of DSP, concepts of frequency in Analog and Digital Signals, sampling theorem, Discrete–time signals, systems, Analysis of discrete time LTI systems, Z transform, Convolution, Correlation.

UNIT II FREQUENCY TRANSFORMATIONS
Introduction to DFT, Properties of DFT, Circular, Convolution , Filtering methods based on DFT, FFT Algorithms, Decimation–in–time Algorithms, Decimation–in–frequency Algorithms, Use of FFT in Linear Filtering, DCT, Use and Application of DCT.

UNIT III IIR FILTER DESIGN
Structures of IIR, Analog filter design, Analog Low Pass Butterworth Filter, Analog Low Pass Chebyshev Filter, Comparison Between Butterworth Filter And Chebyshev Filter, Frequency Transformation In Analog Domain, Design Of High Pass, Bandpass And Bandstop Filters, Design Of IIR Filters From Analog Filters, Approximation Of Derivatives, Design Of IIR Filter Using Impulse Invariance Technique, Design Of IIR Filter Using Bilinear Transformation, Frequency Transformation In Digital Domain.

UNIT IV FIR FILTER DESIGN
Structures of FIR, Linear phase FIR filter, Frequency Response Of Linear Phase FIR Filters, Location Of The Zeros Of Linear Phase FIR Filters, The Fourier Series Method Of Designing FIR Filters, Design Of FIR Filter Using Windows, Digital Differentiator, Hilbert Transformers, Frequency Sampling Method Of Designing FIR Filters, Optimum Equi-ripple Approximation Of FIR Filters.

UNIT IV INTRODUCTION TO DSP PROCESSORS

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

Course Code	BECE3006	Course Name	Microwave Engineering

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.

Prerequisites: Electromagnetic field theory

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

Syllabus

Unit – I: Introduction
Microwave frequency, Applications of Microwave, microwave transmission line, Introduction to Micro strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL.

Unit – II: Microwave waveguides and components
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant (TE10) mode, Power Transmission, Power losses, Excitation of modes, Circular Waveguides:
TE, TM modes, Microwave cavities (Resonators), Scattering matrix- The transmission matrix, Passive microwave devices: Microwave Hybrid Circuits, E Plane Tee, H plane Tee and Magic Tee , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Isolators, Circulators.

Unit – III: Microwave Semiconductor Devices

Operation, characteristics and application of BJTs and FETs, Principles and characterstics: -tunnel diodes, Varactor diodes, PIN diode, Schottky diodes, Transferred Electron Devices : Gunn diode(Gunn Effect, RWH theory, two valley model theory, modes of operation), Avalanche Transit time devices: IMPATT and TRAPATT devices.

Unit – IV: Microwave linear-beam tubes (O TYPE) and microwave crossed-field tubes (M TYPE)

Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, Multicavity Klystron Amplifiers, Beam-Current Density, Output Current Output Power of Two-Cavity Klystron, Reflex Klystrons, Velocity Modulation, Power Output and Efficiency, Helix Traveling-Wave Tubes (TWTs), Slow-Wave structures, Amplification Process, Convection Current, Axial Electric Field, Wave Modes, Gain Consideration, Microwave Crossed-Field Tubes , Magnetron Oscillators, Cylindrical Magnetron, Coaxial Magnetron, Tunable Magnetron , Backward wave Oscillators

Unit – V: Microwave Measurements
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)

Course Code	BECE3012	Course Name	Wireless and Mobile Communication

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

Prerequisites: Digital Communication

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

Syllabus

Unit I: Introduction of Wireless Communication
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 II: Cellular Concepts and System Design Fundamentals
Cellular concept and frequency reuse, channel assignment, handoff strategies, Interference and system capacity, Trunking and GOS, cell splitting,cell sectoring.

Unit– III: Mobile radio Propagation Models
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 IV: Modulation, Equalization & Diversity Techniques
Overview analog and digital modulation techniques, GMSK, QAM, OFDM, Spread spectrum modulation, Equalization, Rake receiver concepts, Diversity Techniques, channel coding.

Unit V: Multiple Access Techniques, Wireless Systems & Standards
Multiple Access Techniques-FDMA, TDMA and CDMA systems, Introduction to 2G,3G and emerging technologies.

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

Course Objectives:

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

Course Outcomes

CO1	Explain the architecture, organization and operation of ad-hoc networks
CO2	Construct ad-hoc network anywhere on temporary basis
CO3	Design ad-hoc network for the heterogeneous environment
CO4	Have an understanding of the principles of mobile ad hoc networks (MANETs)
CO5	Distinguish between infrastructure-based networks
CO6	Explain 5G technologies

Text Book (s)

1. "C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", 1st Edition, Prentice Hall, PTR, 2006, ISBN 9788131706886"
2. C. K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", 1st Edition, Pearson, 2007, ISBN 9788131715109
3. Mobile Ad Hoc Networking by Stefano Basagni ,Marco Conti , Silvia Giordano , Ivan Stojmenovic

4. Mobile and Wireless Communication Networks by Guy Pujolle IFIP 19th World Computer Congress

Reference Book (s)

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

Unit-1 Introduction to Wireless Ad Hoc Networks 9 hours
Introduction to cellular and ad hoc wireless networks, applications of ad hoc networks, issues in ad hoc wireless networks – medium access scheme, routing, multicasting, transport layer protocols, pricing scheme, quality of service provisioning, self organization, security, address and security discovery, energy management, scalability, deployment considerations, ad hoc wireless Internet.
Unit-2Medium Access Control Protocol   9 Hours
Issues in Designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms, Other MAC protocols.
Unit-3 Routing Protocol   9 Hours
Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols.
Unit-4Multicasting Protocol   8 Hours
"Design issues and operation, Architecture Reference Model, classification, Tree-based and Mesh-Based Protocols, Energy-Efficient Multicasting, Multicasting with Quality of Service Guarantee.Quality of Service: Issues and challenges in providing QoS, Classification of QoSsolutions."
Unit-5Energy Management   6 Hours
Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.
Unit 6 Recent Trends and Technologies
New Generation Technology for Best QOS and 5G Technology.

Continuous Assessment Pattern

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

BECE3301	DIGITAL IMAGE PROCESSING	L	T	P	C
Version1.1	Date of Approval: Jun 06, 2013	3	0	2	4
Pre-requisites//Exposure	Signal Processing				
co-requisites					

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

Course Outcomes

On completion of this course, the students will be able to
1. Know Basics of Image formation and transformation using sampling and quantization
2. Define different types of signal processing techniques used for image sharpening and smoothing
3. Perform and demonstrate the compression and coding techniques used for image data

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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

Course Content
Unit I:Introduction to Image Processing   6 lecture hours
Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.

Unit II: Signal Processing   7 lecture hours
Signal Processing - Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification. Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour Enhancement.

Unit III: Image Restoration   9 lecture hours
Image Restoration-Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform

compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.

Unit IV : Segmentation Techniques   8 lecture hours
Segmentation Techniques-thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.

Unit V: Shape Analysis   9 lecture hours
Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications – Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.

Mode of Evaluation: The theory and lab performance of students are evaluated separately.

	Theory	
Components	Internal	SEE
Marks	50	50
Total Marks	100	
Scaled Marks	75	