Course Structure for B. Tech (Electronics & Communication Engineering)
First Year (Common courses for all B. Tech Programme)

First Semester					
S. No.	**Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BAS-101	Applied Mathematics-I	3-1-0	4	**BAS**
2.	BAS-103	Applied Physics-I	2-1-2	4	**BAS**
3.	BAS-105	Applied Chemistry	2-1-2	4	**BAS**
4.	BMA-110/ BEC-110	Engineering Mechanics/ Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA-120/ BMA-130	Workshop Practice/ Engineering Graphics	0-1-2	2	**OEC**
6.	HMC-110/ BCS-110	Humanities and Social Science/ Programming in C Language	3-1-0/ 3-0-2	4	**HMC/ OEC**
		Total		**22**	
Second Semester					
S. No.	**Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BAS-102	Applied Mathematics-II	3-1-0	4	**BAS**
2.	BAS-104	Applied Physics-II	2-1-2	4	**BAS**
3.	BAS-106	Environmental Science	2-1-2	4	**BAS**
4.	BEC-110/ BMA-110	Engineering Mechanics/ Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA-130/ BMA-120	Workshop Practice/ Engineering Graphics	0-1-2	2	**OEC**
6.	BCS-110/ HMC-110	Programming in C Language / Humanities and Social Science	3-0-2/ 3-1-0	4	**HMC/ OEC**
		Total		**22**	

Second Year

Third Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-201	Analog Electronics	3-0-2	4	DCC
2.	BEC-203	Signals & Systems	3-1-0	4	DCC
3.	BEC-205	Network Analysis and Synthesis	3-0-2	4	DCC
4.	BEC-207	Digital Electronics	3-0-2	4	DCC
5.	GEC-201	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
6.	BEC-253	Industrial Training/Internship*	-	1	DCC
7.	BAS-201 BAS-203 BCS-201 BIT-201 BMA-211	Material Science & Engineering Numerical Methods Data Structures Database Management Systems Engineering Measurements and Metrology	3-0-2 3-0-2 3-1-0 3-0-2 3-1-0	4	OEC
		Total		**23**	

Fourth Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-202	Linear Integrated Circuits	3-0-2	4	**DCC**
2.	BEC-204	Digital System Design	3-0-2	4	**DCC**
3.	BEC-206	Electromagnetic Field Theory	3-0-2	4	**DCC**
4.	BEC-208	Communication Systems	3-0-2	4	**DCC**
5.	BCS-202 BIT-204 BMA-210 BAS-202 BAS-204 BAS-206	Computer Organization and Architecture Object Oriented Programming Operations Management Nano Structures & Materials in Engg. Optical Engineering Optimization Techniques	3-0-2 3-0-2 3-1-0 3-1-0 2-1-2 3-1-0	4	**OEC**
6.	HMC-202	Disaster Management	1-0-2	2	**HMC**
		Total		**22**	

Third Year

Fifth Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-301	Digital Communication Systems	3-0-2	4	**DCC**
2.	BAS-301	Modelling and Simulation	3-0-2	4	**BAS**
3.	BEC-303	Control Systems	3-0-2	4	**DCC**
4.	DEC-3xx	Departmental Elective Course - 1	3-1-0/ 3-0-2	4	**DEC**
5.	HMC-301	Professional Ethics and Human Values	3-0-0	3	**HMC**
6.	BEC-353	Industrial Training/Internship*	-	1	**DCC**
7.	GEC-301	Generic Open Elective*	0-2-0 0-0-4 2-0-0	2	**GEC**
		Total		**22**	

Sixth Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-302	Digital Signal Processing	**3-0-2**	4	**DCC**
2.	BEC-304	Information Theory & Coding	**3-0-2**	4	**DCC**
3.	BEC-306	VLSI Design	**3-0-2**	4	**DCC**
4.	BEC-308	Microprocessors & Microcontrollers	**3-0-2**	4	**DCC**
5.	DEC-3xx	Departmental Elective Course - 2	**3-1-0/ 3-0-2**	4	**DEC**
6.	HMC-302 HMC-304 HMC-306 HMC-308	Principles of Management Marketing Management Financial Management Human Resource Management	**2-0-0 2-0-0 2-0-0 2-0-0**	2	**HMC**
		Total		**22**	

Fourth Year

Seventh Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-401	Microwave Techniques	**3-0-2**	4	**DCC**
2.	BEC-403	Wireless and Mobile Communication	**3-0-2**	4	**DCC**
3.	DEC-4xx	Departmental Elective Course-3	**3-1-0** **3-0-2**	4	**DEC**
4.	DECï 4xx	Departmental Elective Course-4	**3-1-0/** **3-0-2**	4	**DEC**
5.	BEC-451	Minor Project	**0-0-8**	4	**DCC**
6.	BEC-453	Industrial Training/Internship*	**-**	1	**DCC**
		Total		**21**	

Eighth Semester					
S. No.	**Course Code**	**Subject**	**L-T-P**	**Credits**	**Category**
1.	BEC-402	Embedded Systems	**3-0-2**	4	**DCC**
2.	DEC-4xx	Departmental Elective Course-5	**3-0-2**	4	**DEC**
3.	DEC-4xx	Departmental Elective Course-6	**3-1-0** **3-0-2**	4	**DEC**
4.	BEC-452	Major Project	**0-0-16**	8	**DCC**
5.	GEC-402	Generic Open Elective	**0-2-0** **0-0-4** **2-0-0**	2	**GEC**
		Total		**22**	

*All Industrial Training/Internship will be done in summer break of previous academic session. The assessment for the same will be done within the first two weeks of opening of academic session by the Department.

List of Departmental Elective Courses

Category	Course Code	Subject	L-T-P
Departmental Elective Course-1	BIT-301	Data Communication and Computer Networks	3-0-2
	BEC-305	Electronics Measurement & Instrumentation	3-0-2
	BCS-301	Artificial Intelligence	3-0-2
	BEC-309	Random Signals & Processes	3-0-2
	BCS-309	Algorithmic Analysis	3-0-2
Departmental Elective Course-2	BIT-310	Internet of Things	3-0-2
	BEC-312	Antenna Design	3-0-2
	BEC-314	FPGA & Verification	3-0-2
	BEC-316	Power Electronics	3-0-2
	BIT-304	Cloud Computing	3-0-2
Departmental Elective Course-3	BEC-405	Introduction to Robotics	3-0-2
	BIT-405	Soft Computing	3-0-2
	BIT-407	Big Data Analytics	3-0-2
	BEC-407	Digital Image Processing	3-0-2
	BEC-409	VLSI Technology	3-0-2
Departmental Elective Course-4	BCS-401	Machine Learning	3-1-0
	BEC-411	Introduction to Smart Grid	3-1-0
	BEC-413	Analog VLSI	3-1-0
	BEC-415	Radar Engineering	3-1-0
	BIT-419	Cyber Security and Forensics	3-0-2
Departmental Elective Course -5	BEC- 404	Bio-medical Electronics and Imaging	3-1-0
	BEC-406	Optical Communication & Networks	3-0-2
	BEC-408	Satellite Communication	3-0-2
	BIT-406	Information Retrieval	3-0-2
	BIT-408	Neural Networks and Deep Learning	3-0-2
Departmental Elective Course-6	BEC-410	Non-Conventional Energy Resources	3-1-0
	BEC-412	Wireless Sensor Networks	3-1-0
	BEC-414	Multimedia Communications	3-0-2
	BCS-412	Computational Optimization Techniques	3-1-0
	BIT-410	Cryptography	3-1-0

ANALOG & DIGITAL ELECTRONICS	
Course Code: BEC-209 **Contact Hours:**L-3 T-0 P-2 **Course Category:** OEC	**Credits:** 4 **Semester:** 3

Introduction: The course will introduce fundamental principles of analog and digital electronics. The course provides sufficient basic knowledge for the undergraduate to understand the design of diodes and transistor based circuits, op-amps and their applications as well as the design of digital circuits.

Course Objective:

- Understand the design and analysis of various analog electronic circuits
- Understand the fundamental concepts and techniques used in digital electronics

Pre-requisite:

- Basic concept of circuit theory
- Student should have the prior knowledge of semiconductor electronics
- Basic concept of number system

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

- Understand basic electronic devices such as diodes, BJT & FET transistors
- Understand various applications of Op-Amp
- Analyse logic processes and implement logical operations using combinational logic circuits
- Design sequential circuits

Pedagogy: Class room teaching, problem solving approach, practical based learning, tutorials

Contents

UNIT-I	**12 Hours**
Semiconductor diodes, Characteristics and operation, Applications of p-n junction diode. Bipolar Junction Transistor: Construction and operation, Common base (CB) configuration, Transistor amplifying action, Common emitter (CE) and Common collector (CC) configurations, definition of Ǔand ɓ, saturation, regions of operation of transistor, biasing methods. Amplifiers: CE, CC, CE amplifier circuits and their comparisons, RC coupled amplifier, Frequency response, Gain-bandwidth, and Darlington pair, Class B push pull amplifier. Feedback: Concept of negative & positive feedback and their relative advantages & disadvantages, Sinusoidal oscillators.	
UNIT-II	**10 Hours**
Field Effect Transistor: Introduction, JFET characteristics, Depletion & enhancement MOSFET, CMOS. Operational amplifier: Characteristics of ideal Op-Amp, Inverting & non-inverting amplifier, Differential amplifier, Adder & Subtractor, Integrator, Differentiator, Instrumentation amplifier, Schmitt trigger, Astable multivibrator	
UNIT-III	**10 Hours**
Digital electronics: Analog & digital signals, Logic gates, Boolean algebra. Standard representation of logical functions, K-map representation and simplification of logical functions, Donȇt care conditions, X-OR & X-NOR simplification of K-maps. Combinational circuits: Multiplexers, Demultiplexers, Decoders & Encoders, Adders & Subtractor, Code converters, Comparators, Decoder/drivers for display devices, A/D and D/A converters.	
UNIT-IV	**10 Hours**

Flip Flops: S-R, J-K, D & T Flip-flops, Excitation table of a flip-flop, Race around condition Sequential circuits: Shift registers, Ripple counter, Design of synchronous counters and Sequence detectors, Sequence generators	
Text Books	
1	Morris Mano, ñDigital Designò, PHI, 5^{th} edition, 2013.
2	Millman and Halkias, ñElectronic Devices and Circuitsò TMH, 4^{th} Edition, 2015.
3	Salivahanan, Suresh Kumar, Vallavaraj, ñElectronic Devices and Circuitsò TMH, 4^{th} Edition, 2016.
Reference Books	
1	Balbir Kumar and S. B. Jain, ñElectronic Devices and Circuitsò PHI, 2^{nd} Edition 2014.
2	R.P. Jain, ñModern Digital Electronicsò, TMH, 4^{th} Edtion, 2010
3	Roy Choudhury and Jain, ñLinear Integrated Circuitsò, New Age Publishers, 4^{th} Edition, 2017.

COMMUNICATION SYSTEMS	
Course Code:BEC-208 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 4

Introduction: To introduce the concepts of analog communication systems, and to equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.

Course Objective:

- To provide basic understanding of the random signals and stochastic processes.
- To provide understanding of analog modulation techniques alongwith its applications in various fields.
- To understand various types of noise, their source and their effect on the different modulation techniques.
- To understand applications of communication in allied fields of Electronics, Computers and Industrial control.

Pre-requisite: Signals and Systems, Probability theory and stochastic process

Course Outcome: After successful completion of the course student will be able to

- Understand the use of communication in electronic systems, computers, automation and control system.
- Analyse and apply different modulation techniques as per the design requirements.
- Analyse different parameters of analog communication techniques.
- Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.

Pedagogy: Classroom teaching, Power-point presentations, Design based Problems.

Contents

UNIT-I	10 Hours
Introduction to Pobability theory, Conditional probabilities, Random variables, Cumulative distribution function (cdf), probability mass function, probability density functions and properties, Bayesô rule for continuous and mixed random variables, Sum of two independent random variables, Expectation- mean, variance and moments of a random variable, Joint moments, Covariance and Correlation, Uniform, Gaussian and Rayleigh distributions, Binomial, and Poisson distributions, Multivariate Gaussian distribution. Random process, Discrete and continuous time processes, Mean, Autocorrelation and Autocovariance functions, Stationarity, Strict-sense stationary (SSS) and Wide-sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, Cross-correlation function, Ergodicity and its importance, Cross-power spectral density and properties, Spectral factorization theorem, Gaussian process, Poisson process, Markov Process.	
UNIT-II	**11 Hours**
Introduction to Communication systems, Source of information, Communication channels, Base band pass band signals, Representation of signals and systems, Probabilistic considerations, Modulation process, Primary communication resources, Analog versus digital communication, Applications of communications systems. Linear modulation: Time and frequency domain expression of AM (including intensity modulation of light), DSB, SSB and VSB, Generation of linearly modulated signals, Coherent demodulation and envelope detection.	

UNIT-III	11 Hours
Angle modulation: Instantaneous frequency; phase and frequency modulation. Single tone FM and its spectral analysis. NBFM and WBFM. Bandwidth requirements of angle modulated signals. Demodulation of angle modulated signal Radio and Television broadcasting: AM radio broadcasting and FM radio and TV broad casting. Frequency division multiplexing, radio transmitters and receivers.	
UNIT-IV	**10 Hours**
Noise in Communication systems: Thermal noise, shot noise and white noise. Noise equivalent bandwidth, noise figure and noise temperature. Time domain representation of narrowband noise. Properties of narrowband noise. Noise in CW modulation systems. Figure of merit: Noise performance of linear and exponential modulation. Pre-emphasis and de-emphasis in FM. Comparison of the noise performance of CW modulation schemes	

Text Books	
1.	Simon Haykin, ñCommunication Systemò, John Wiley & sons., 4^{th} Edition, 2006
2.	Taub & Schilling, ñPrinciples of Communication Systemò, McGraw hill, 4^{th} Edition, 2017
3.	John G. Proakis, ñCommunication Systemsò, McGraw Hill, 5^{th} Edition, 2014.
Reference Books	
1.	B. P. Lathi, ñLinear Systems and Signalsò, Oxford Publication, 3^{rd} Edition, 2017.
2.	Leon W. Couch, ñAnalog and Digital Communicationò, Pearson Education, 8^{th} Edition, 2012.
3.	George Kennedy, ñElectronic Communication Systemsò, Tata McGraw Hill, 6^{th} Edition, 2017.

DIGITAL ELECTRONICS	
Course Code: BEC-207 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: Digital circuits are the basic blocks of modern electronic devices like mobile phones, digital cameras, microprocessors and several other devices. This course emphasizes on the fundamentals of digital circuits and how to engineer the building blocks that go into digital subsystems. This will cover the basics of Boolean algebra and combinational logic followed by a thorough understanding of sequential circuits and state machines. The design and analysis of digital circuits will also be an integral part.

Course Objective:

- To understand number representation and conversion between different number system in digital electronic circuits.
- To analyse logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyse sequential systems in terms of state machines.
- To understand concept of Programmable Devices, PLA, PAL, TTL, ECL, CMOS logic families.

Pre-requisite: Basic understanding of diode and transistor operation.

Course Outcome: After successful completion of the course student will be able to

- Create a digital logic and apply it to solve real life problems.
- Analyse, design and implement combinational logic circuits.
- Understand different semiconductor memories.
- Analyse, design and implement sequential logic circuits.
- Analyse digital system design using PLA.

Pedagogy: Class room teaching, Tutorials.

Contents

UNIT-I	11 Hours
Analog & Digital signals, AND, OR, NOT, NAND, NOR & XOR gates, Boolean algebra. Standard representation of Logical functions, K-map representation and simplification of logical functions, Donôt care conditions, X-OR & X-NOR simplification of K-maps. Combinational circuits: Multiplexers, Demultiplexers, Decoders & Encoders, Adders & Subtractor, Code Converters, Comparators, Decoder/ drivers for display devices.	
UNIT-II	**10 Hours**
Flip Flops: S-R, J-K, D & T Flip-flops, Excitation table of a flip-flop, Race around condition. Sequential circuits: Shift registers, Ripple counter, Design of Synchronous counters and sequence detectors, Sequence generators.	
UNIT-III	**11 Hours**
A/D and D/A converters: ADC Performance Characteristics - Resolution, Sampling Rate, Dynamic Range, Binary-weighted DAC, R-2R Ladder type networks, Successive-approximation ADC, Linear ramp ADC, Dual-slope ADC. Logic Families: Characteristics, RTL and DTL circuits, TTL, ECL and CMOS Logic families. Comparison of all Logic Families.	

UNIT-IV		**10 Hours**
Logic Implementations using ROM, PAL & PLA. Semiconductor Memories: Memory organization & operation, Classification and characteristics of memories, RAM, ROM and Content Addressable Memory.		
Text Books		
1	R.P. Jain, ñModern Digital Electronicsò, TMH, 4^{th} Edition, 2014.	
2	Morris Mano, ñDigital Designò, PHI, 5^{th} Edition. 2014.	
3	Malvino and Leach, ñDigital Principles and Applicationsò, TMH, 7^{th} Edition, 2010.	
Reference Books		
1	R. J. Tocci, ñDigital Systemsò, 10^{th} Edition, PHI, 2009.	
2	I. J. Nagrath, ñElectronics, Analog & Digitalò, 2^{nd} Edition, PHI, 2013.	
3	J. M. Yarbrough, ñDigital Logic-Application and Designò, 4^{th} Edition, PWS Publishing, 2012.	

DIGITAL SYSTEM DESIGN	
Course Code: BEC-204 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:**4

Introduction: The objective of this course is to introduce a hardware description language (HDL) for the specification, simulation, synthesis and implementation of digital logic systems. The students will have design practice sessions and implementing digital logic systems with electronic design and automation (EDA) tools.

Course Objective:

- To implement digital logic circuits on FPGA and a CPLD
- To synthesize complex digital circuits at several level of abstractions
- To simulate and debug digital systems described in VHDL
- To learn the Hardware Description Language
- Demonstrate the use and application of Boolean algebra in the areas of digital circuit reduction, expansion, and factoring.

Pre-requisite: Digital Electronics

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

- Apply Boolean algebra in reduction, expansion, factoring
- Synthesize and analyze digital circuits through Verilog/VHDL
- Create complex digital circuits at several level of abstractions
- Understand and analyse logic on an FPGA and a CPLD

Pedagogy: Class room teaching, Problem solving approach, Practical based learning

Contents

UNIT-I	12 Hours
Introduction to VHDL, Modelling concepts, Data types and operations, Basic modelling constructs, Entity, architecture, Signal, variable, Concurrent statements, Sequential statements, Signal drivers, Resolved signals, Delay mechanisms, Dataflow, Behavioural and Structural models, Subprograms, Configurations, Package and test bench, High level description of standard combinational and sequential modules.	
UNIT-II	**10 Hours**
Introduction to Finite State Machine, Pulse and fundamental mode of operation, Realization of state table from verbal description, State diagram & Transition matrix, Mealy and Moore machine, Reduction of flow tables of completely and incompletely specified sequential machines, Concept of secondary state assignment.	
UNIT-III	**10 Hours**
Realization of circuits of FSM, Decomposition of FSM & composite machine, Equivalence between Mealy and Moore model machine, Capabilities and limitations of FSM, Simplification of incompletely specified machines, Analysis of asynchronous FSM, Race and Hazard problems with asynchronous sequential machine.	
UNIT-IV	**10 Hours**
Introduction to EDA tools, Simulation, Event driven simulation, RTL synthesis, Behavioural synthesis, and Synthesis for FPGAs, Testing digital systems, Design for testability. Introduction to programmable logic devices: ROM, PLA, PAL, GAL based circuit. FPGA, CPLD, Architecture and Programming of FPGA/CPLD and hardware implementation.	

Text Books	
1	Mark Zwolinski, ñDigital System Design with VHDLò, 2nd Edition, 2003.

2	Z. Kohavi, ñSwitching And Finite Automata Theoryò, TMH, 3rd Edition, 2010.
3	Peter J. Ashenden, ñThe studentôs guide to VHDLò, Morgan Kaufmann publishers, 3rd Edition, 2008.
Reference Books	
1	Charles. H. Roth, ñDigital System Design using VHDLò, PWS, 2012.
2	Roth, ñFundamental of Logic Designò, Cengage learning, 7th Edition, 2015.
3	Navabi Z., ñVHDL-Analysis & Modelling of Digital Systemsò, McGraw Hill, 2nd Edition, 1998.

ANALOG ELECTRONICS	
Course Code: BEC-201 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: It is a branch of electronics which deals with analog electronic circuits and electronic components. The course will introduce concepts of electronic devices such as p-n junction diode, BJT and FET which form the basic building block of any electronic system.

Course Objective:

- To give an insight into fundamental concepts of semiconductor devices and design of analog integrated circuits
- To give the broad spectrum of analog principles and design equations

Pre-requisite: Theory of semiconductor physics

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

- Understand the basic electronics components such as diodes and transistors
- Develop the capability to analyse and design transistor based circuits
- Understand various models for designing and analysing circuits

Pedagogy: Class room teaching, Practical based learning, Problem solving approach

Contents

UNIT-I	12 Hours
Review of semiconductor physics, p-n junction diode, p-n diode characteristics and its operation, p-n junction capacitances (depletion and diffusion), Breakdown in p-n diodes. Diode applications: Clipping and Clamping circuits, Rectifier circuits, Zener diode, Zener diode as regulators, Voltage multipliers, Switching behaviour of p-n diode. Bipolar junction transistor: Introduction and types of transistors, Construction, BJT characteristics in CB, CE & CC mode, Operating point, ac/dc load line, Leakage current, Saturation and cut off mode of operations, Ebers-moll model. Bias stabilization: Need for stabilization, Various biasing schemes, Bias stability with respect to variations in Ico, V_{BE} & ɓ, Stabilization factors, Thermal stability.	
UNIT-II	**10 Hours**
Models: Low frequency models for transistor (h-parameter, Hybrid ï Ʉ, rı) BJT amplifiers: Analysis at low frequency (CB, CE, CC & CE with R_E), Comparison of various types of configurations, Cascaded Amplifiers, Darlington pair, Cascode amplifiers. High frequency response of amplifier: Hybrid-ı Model at high frequency, CE short circuit current gain, Current gain with resistive load	
UNIT-III	**12 Hours**
Multistage Amplifiers: Methods of coupling, RC coupled amplifier, Frequency response analysis (Low, Mid & High), Calculation of gain bandwidth. Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative feedback amplifiers, Overall gain using feedback, Impedance considerations in different configurations, Examples of analysis of feedback amplifiers. Special semiconductor devices: SCR (Operation, Characteristics & applications), Thyristors, TRIAC, DIAC, Unijunction Transistor (UJT), UJT Relaxation Oscillator	
UNIT-IV	**8 Hours**
Field Effect Transistor: Classification, JFET characteristics, Operating point, Various biasing techniques, Enhancement & depletion type MOSFETs, JFET Model, JFET amplifier analysis (CD, CS & CG), CMOS, MISFET, MESFET, VFET	

Text Books	
1	Millman and Halkias, ñElectronic Devices and Circuitsò TMH, 4^{th} Edition, 2015.
2	Salivahanan, Suresh Kumar, Vallavaraj, ñElectronic Devices and Circuitsò TMH, 4^{th} Edition 2016
3	Boylestad & Nashelsky, ñElectronic Devices & Circuit Theoryò PHI ï 5^{th} Edition, 2014.
Reference Books	
1	Balbir Kumar and S. B. Jain, ñElectronic Devices and Circuitsò PHI, 2012.
2	Sedra & Smith, ñMicro Electronic Circuitsò Oxford University Press, 6^{th} Edition, 2012.
3	J. Millman and Halkias, ñIntegrated Electronics, Analog & Digital Circuits & Systemsò TMH ï 2017.

ELEMENTS OF INFORMATION THEORY	
Course Code:BEC-210 **Contact Hours:**L-3 T-1 P-0 **Course Category:** OEC	**Credits:** 4 **Semester:** 4

Introduction: Information theory deals with the study and solving the problems of communication or transmission of signals over channels. It is an essential component to decide upon the coding technique to be used for a particular application and measurement of the channel capacity. The concepts of information theory are widely used in research.

Course Objective:
- To introduce the principles and applications of information theory.
- To understand how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies.
- To calculate the capacity of a communication channel, with and without noise.
- To introduce coding schemes, including error correcting codes.
- To study efficient coding of audio-visual information, data compression.

Pre-requisite: Advanced courses of analog and digital communication**.**

Course Outcome: At the end of the course students should be able to
- Analyse the information content of a random variable from its probability distribution
- Understand and relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities
- Understand channel capacities and properties using Shannonôs Theorems
- Evaluate efficient codes for data on imperfect communication channels

Pedagogy: Classroom teaching is supported by hand-outs, PowerPoint slides, assignments and notes.

Contents

UNIT-I	**12 Hours**
Information theory: Information rate, Entropy, Joint and conditional entropies, Kraft McMillan inequality, Mutual information - Discrete memory less channels ï BSC, BEC ï Channel capacity, Shannon limit, Source coding theorem, Shannon-Fano coding.	
UNIT-II	**10 Hours**
Huffman coding, Extended Huffman coding, Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Channel, Linear Predictive coding, Introduction to Audio coding, Perceptual coding, Masking Techniques, Introduction to Speech Coding, Channel Vocoder.	
UNIT-III	**10 Hours**
Error control coding, Block codes-Definitions and Principles, Hamming weight, Hamming distance, Minimum distance decoding, Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation.	
UNIT IV	**10 Hours**
Convolution codes, Code tree, Trellis, State diagram, Error control coding, Turbo coding - Principle of Turbo coding, Video Compression - Principles I,B,P frames, Motion Estimation, Motion Compensation.	

Text Books	
1	R Bose, ñInformation Theory, Coding and Cryptography,ò McGraw hill Education, 3rd Edition, 2016.
2	Fred Halsall, ñMultimedia Communications: Applications, Networks, Protocols and Standards,ò Pearson Education Asia, 4th Edition, 2009.

3	K. Sayood, ñIntroduction to Data Compression,ò Elsevier, 5^{th} Edition, 2017.
Reference Books	
1	S Gravano, ñIntroduction to Error Control Codes,ò Oxford University Press, 2007.
2	Amitabha Bhattacharya, ñDigital Communication,ò Tata McGraw Hill,1^{st} Edition, 2017.
3	Cover and Thomas, ñElements of Information Theory,ò Wiley Series in Telecommunication and Signal Processing, 2^{nd} Edition, 2006.

ELECTROMAGNETIC FIELD THEORY	
Course Code: BEC-206 **Contact Hours:** L-3 T-1 P-0 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: Electromagnetic field theory is the most fundamental subject in the curriculum of electrical engineering education. Electromagnetic field theory defines capacitors, inductors and resistors in terms of its primary electric and magnetic quantities like electric charge, electric potential, electric current, electric and magnetic flux. Electromagnetics explains universal concepts in three-dimension real world, i.e., electro-magnetic wave propagation in free-space.

Course Objective:

- To list Maxwellôs equations and solve them for specific regular geometries.
- Understand general electromagnetic wave propagation and its applications to engineering problems.

Pre-requisite: No requisite

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

- Understand EM Waves
- Remember the concepts of Electrostatic and Magneto statics field.
- Analyze and formulate fields and electromagnetic waves propagation problems in a multi-disciplinary frame individually or as a member of a group.
- Remember the different concepts of electrostatic, magnetostatic and time varying electromagnetic systems.
- Understand and remember the different coordinate systems.

Pedagogy: Class room teaching, smart classes, Tutorials.

Contents

UNIT-I	11 Hours
Introduction: Addition, subtraction and multiplications, Cartesian, Cylindrical, Spherical transformation, scalar and vector field, Dot and Cross products, Differential length, area and volume, Line surface and volume integrals, Divergence and curl, Transformation of vectors in different co-ordinate systems, Dirac-delta function, Stokesôs theorem.	
UNIT-II	**10 Hours**
Electrostatic fields: Electric field due to point-charges, Line charges and surface charges, Electrostatic potential, Gaussesô Law - Maxwellôs equation, Solution of Laplace and Poissonôs equation in one dimension, Electric flux density, Boundary conditions, Capacitance - calculation of capacitance for simple rectangular, Cylindrical and spherical geometries, Electrostatic energy.	
UNIT-III	**11 Hours**
Magnetostatics - Magneto-static fields, Biot - Savartôs Law, Ampereôs circuit law, Magnetic Induction and Faradayôs Law, Magnetic Flux Density, Permeability, Energy Stored in a Magnetic Field, Ampereôs Law for a Current Element, Volume Distribution of Current, Maxwellôs Equations - Maxwellôs equation for static fields, Magnetic scalar and vector potential.	
UNIT-IV	**10 Hours**
Electromagnetic Waves - Continuity equations, Displacement current, Maxwellôs equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phase and	

Group velocity, Depth of penetration, Conductors and dielectrics, Impedance of conducting medium. Polarization, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem, Introduction to Transmission Lines and equations, Characteristic impendence, Input impendence of a lossless line, Open and Short circuited lines, Standing wave and reflection losses, Impedance matching.	
Text Books	
1	Matthew N. O. Sadiku, ñElements of Electromagneticsò, Oxford University Press, 7^{th} Edition, 2018.
2	E. C. Jordon, and K. G. Balman, ñElectromagnetic Waves & Radiation Systemò PHI, 2^{nd} Edition, 2015.
3	John R. Reitz, ñFoundations of Electromagnetic Theoryò, Pearson, 4^{th} Edition, 2008.
Reference Books	
1	William H. Hayt, ñEngineering Electromagneticsò, TMH 6^{th} Edition, 2017.
2	David K. Cheng, ñField and Wave Electromagneticò, 5^{th} Edition, Pearson Education Asia, 2014.
3	J.D. Kraus, ñElectromagneticsò, TMH, 2017.

LINEAR INTEGRATED CIRCUITS	
Course Code: BEC-202 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 4

Introduction: This is a course on the design and analysis of Operational Amplifiers (Op-Amps) and Op-Amp based circuits which have varied applications in mathematical operations. This vastly covers the study of linear and non linear applications of Op-Amp. The course also deals in power amplifiers and waveform generators.

Course Objective:
- To study the basic principles, configuration and characteristics of Op-Amp.
- To understand various mathematical applications of Op-Amp.
- To design and understand filters, waveform generators etc which are used in electronic systems

Pre-requisite:
- Basic knowledge of electronic devices, circuit analysis and phasor algebra

Course Outcome: After completion of the course, student will be able to:
- Understand the concept, working principles and applications of Op-Amp
- Analyse linear and non-linear Op-Amp circuits
- Apply Op-Amp to solve a variety of application problems
- Remember the concepts of Op-Amps and its practical applications
- Analyse and design analog electronic circuits using discrete components

Pedagogy: Class room teaching, tutorials, Practical based learning

Contents

UNIT-I	10 Hours
Introduction to Op-Amp, Op-Amp models (Ideal & Practical), Analysis of internal circuit of Op-Amp, Inverting & non-inverting amplifier, Differential amplifier, Transfer characteristics, A_{DM}, A_{CM}, CMRR, Current mirror, Active load, Level Shifter, Output Stages, IC 741 Op-Amp. Op-Amp Characteristics, DC/AC characteristics, Compensating techniques, Slew rate, Op-Amp Data Sheet.	
UNIT-II	**12 Hours**
Op-Amp Applications, Adder, Subtractor, Integrator, Differentiator, Voltage-to-Current converter, Current-to-Voltage converter, Current amplifier, Instrument amplifier. Linear & Non-Linear Applications: Sine wave generation (Barkhausen criterion, Phase shift, Wein bridge, Hartley, Colpitts, LC, RC & Crystal oscillators), Comparator, Schmitt trigger, Astable, Monostable, Triangular, Ramp generator, Log/antilog circuits using Op-Amp, Precision rectifier.	
UNIT-III	**10 Hours**
OTA & its applications, Basic structure and functioning, OTA as Differentiator, Integrator, (OTA)-C filter, (OTA)-C oscillator, OTA as Voltage amplifier, Programmable resistor & OTA as a filter. Power amplifiers, Classification of amplifier, Analysis of class A, B and AB amplifiers, Push pull amplifier, Complementary symmetry amplifiers, Conversion efficiency, Cross over distortion, Power distortion, Heat sinks, Tuned amplifiers, Power BJT, IC power amplifiers, MOS power transistors.	

UNIT-IV	10 Hours
Active RC filters, Idealistic & realistic response of filters (LP, BP, and HP), Butterworth & Chebyshev approximation filter functions, All pass, Notch filter, Quadrature filter. IC PLL **-** Operating principle, Monolithic PLL ICs, PLL applications. IC 555 Timer **-** Internal operation and its applications as Astable and Monostable multivibrator	
Text Books	
1	R. A. Gayakward, ñOp-Amps and Linear Integrated Circuitò PHI.
2	D. Roychaudhary, and S. B. Jain, ñLinear Integrated Circuitsò New Age International ï 2018.
3	Albert Malvino, David J. Bates, ñElectronic principlesò, 8th Edition, 2015.
Reference Books	
1	Sedra and Smith, ñMicroelectronic Circuitsò, 7th Edition, Oxford University Press, 2010.
2	J. B. Gupta, ñElectronic Devices & Circuitsò S. K. Kataria, 2013.

NETWORK ANALYSIS AND SYSTEMS	
Course Code :BEC 205 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	**Credits**: 4 **Semester** : 3

Introduction: This course provides basics of electrical circuit concepts, circuit modelling and methods of circuit analysis in time domain and frequency domain. The individual will be able to solve simple and complex multi-dimensional circuits including direct current (DC) and alternating current (AC) circuits with the help of circuit theory and network theorems. The laboratory exercises will help to design, build, and implement basic AC and DC circuits. The aim of this course is to provide a thorough comprehension of the fundamental behaviour of electrical and electronic circuits, understand concepts of graph theory, two port networks, and network synthesis.

Course Objective:

- To make the students capable of analysing any given electrical network.
- To make the students learn how to synthesize an electrical network from a given impedance/admittance function.
- To analyse the behaviour of the circuitǿs response in time and frequency domain
- To understand the significance of network functions.
- To understand the concept of graphical solution to electrical network
- To learn techniques of solving circuits involving different active and passive elements
- To learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks
- To analyse various types of filters, attenuators and different types of two-port network using network parameters, with different types of connections.

Pre-requisite: Basic course in Electrical Engineering.

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

- Apply the fundamental concepts in solving and analysing different electrical networks
- Analyse the electrical network in different conditions by selecting relevant technique and apply mathematics in synthesizing the networks in time and frequency domain
- Evaluate the performance of a particular network from its analysis
- Understand the various laws and theorems related to electric networks.
- Understand the concept of two port networks.
- Understand and remember network synthesis.

Pedagogy: Classroom teaching which focusses upon relating the textbook concepts with real world phenomena, along with tutorial classes to enhance the problem solving ability.

Contents

UNIT-I	11 Hours
Voltage, Current, Power and Energy, Circuit Elements (R,L,C), Independent and Dependent Sources, Kirchhoffǿs Laws, Series and Parallel combinations of Elements, Voltage division and Current division, Node analysis, Mesh analysis, Three phase networks, Star/Delta connection, Superposition theorem, Theveninǿs theorem, Nortonǿs theorem, Source transformations, Maximum power transfer tTheorem, Compensation theorem, Reciprocity theorem, Millmanǿs theorem, Telegenǿs theorem.	
UNIT-II	**10 Hours**
Time domain response of First order RL and RC circuits, Time domain response of Second order	

linear circuits, Circuit Analysis by Laplace Transform, Graph theory and its application.		
UNIT-III		**10 Hours**
Two- port three terminal Networks, Equations of two-port networks, Z and Y parameters, Hybrid and transmission parameters, Inverse hybrid and inverse transmission parameters, Relationship between two-port parameters, Inter-connection of two-port networksï Lattice networks.		
UNIT-IV		**11 Hours**
Poles and Zeros, Network functions for the one port and two port, Poles and zeros of network functions, Restrictions on pole and zero locations for driving point functions and transfer functions, Time domain behavior from the pole zero plot, Positive real function and its properties, Properties of LC, RC and RL driving point functions - synthesis of LC, RC and RL driving point admittance functions using Foster and Cauer first and second forms.		
Text Books		
1	W. Hayt, J.E. Kemmerley and S. M. Durbin, "Engineering circuit Analysisò, Tata McGraw-Hill, 8th Edition, 2013.	
2	M.E.VanValkenburg, ñNetwork Analysisò, Prentice-Hall, 3rd Edition, 2006.	
3	V. K, Aatre, ñNetwork Theory and Filter Designò, New Age International Publishers, 3rd Edition, 2014.	
Reference Books		
1	J. A, Edminister, ñTheory and Problems of Electric Circuitsò, Schaumôs Outline Series, Tata McGraw Hill, 5th Edition, 2017.	
2	R. C, Dorf & J. A, Svoboda, ñIntroduction to Electric Circuitsò, John Wiley & Sons, 8th Edition, 2010.	
3	Sudhakar. A and Shyammohan S.Palli, ñCircuits and Networks Analysis and Synthesisò, Tata McGraw- Hill Publishing Company Limited, 5th Edition, 2017.	

SIGNAL AND SYSTEMS	
Course Code: BEC-203 **Contact Hours**: L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:**4

Introduction: This course introduces the concept of analog and digital signal processing, that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defence electronics, consumer electronics, and consumer products. The course presents and integrates the basic concepts for both continuous-time and discrete-time signals and systems. It addresses classifications of signals and systems, basic signal operations, linear time-invariant (LTI) systems, time-domain analysis of LTI systems, signal representation using Fourier series, continuous-time Fourier transform, discrete-time Fourier transform, and Laplace transform.

Course Objective:

- To provide strong foundation on signals and systems, which is the foundation of communication and signal processing.
- To make the students learn about basic continuous time and discrete time signals and systems.
- To provide an understanding of application of various transforms for analysis of signals and systems in both continuous time and discrete time domain.
- To create an understanding of the power and energy signals and spectrum.
- To create strong foundation of communication and signal processing to be covered in the subsequent semesters.

Pre-requisite: Inclination to learn mathematics, basic knowledge of differential equations, electrical circuits and networks.

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

- Understand about various types of signals, classify them, analyse them, and perform various operations on them.
- Understand about various types of systems, classify them, analyse them and understand their response behaviour.
- Apply transforms in analysis of signals and system.
- Analyse the effects of applying various properties and operations on signals and systems by carrying out simulation.

Pedagogy: Classroom teaching which focuses upon relating the textbook concepts with real world phenomena, along with tutorial classes to enhance the problem solving ability.

Contents

UNIT-I	11 Hours
Introduction: Continuous and Discrete - Time Signals & their Classification, Continuous & Discreteï Time system & their properties. Linear Time Invariant Systems, Properties of LTI systems, State variable description for LTI systems, Convolution for continuous time systems, Convolution for discrete time systems(DTS), Correlation of DTS.	
UNIT-II	**10 Hours**
Fourier analysis for CTS - Importance of frequency domain analysis, Response of LTI systems to exponential signals, Periodic signals and properties, Fourier Transform (FT) its Properties, system analysis of LTI system using FT Fourier.	
UNIT-III	**11 Hours**
Discrete Time Fourier Series (DFS), Discrete Time Fourier transform (DTFT) & its properties, Analysis of LTI system using DFS, DTFT, Time and Frequency characterization of signals and	

systems, Magnitude phase representation of the fourier transform, Classification of linear and nonlinear phase, Phase delay and group delay. Min phase system, Max phase system, All pass system.		
UNIT-IV		**10 Hours**
Sampling theorem, Effect of under sampling, aliasing, Interpolation, Signal reconstruction using zero order hold system, Sample and Hold circuit, Z-Transform- Definitions and Properties, Significance and properties of ROC, Inversion of Z-Transform using partial fractions and residue theorem, Application of Z-transform for LTI system.		
Text Books		
1.	Alan V. Oppenheim, Alan S. Wilsky and Nawab, ñSignals and Systemsò, Prentice Hall, 2^{nd} Edition, 2017.	
2.	J.G.Proakis and D.G.Manolakis, ñDigital Signal Processing Principles, Algorithms and Applicationsò, Pearson Education, 4^{th} Edition, 2009.	
3.	Simon Haykin and Bary Van Veen, ñSignals and Systemsò, Wiley India Publications, 2^{nd} Edition, 2007.	
Reference Books		
1.	Michal J. Roberts and Govind Sharma, ñSignals and Systemsò, Tata Mc-Graw Hill Publications, 2^{nd} Edition, 2017.	
2.	B.P.Lathi, ñLinear Systems and Signalsò, Oxford University Press, 3^{rd} Edition, 2017.	
3.	Ramesh Babu, ñSignal & Systemsò, Scitech, 4^{th} Edition, 2011.	