

**Dr. Babasaheb Ambedkar Technological University, Lonere.**

**B. Tech (Electronics & Telecommunication Engineering)**

**Proposed Curriculum for Semester V [Third Year]**

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC501	Professional Core Course 1	Electromagnetic Field Theory	2	1	0	20	20	60	100	3
2	BTEXC502	Professional Core Course 2	Control System Engineering	3	0	0	20	20	60	100	3
3	BTETC503	Professional Core Course 3	Computer Architecture	3	0	0	20	20	60	100	3
4	BTEXC504	Professional Core Course 4	Digital Signal Processing	2	1	0	20	20	60	100	3
5	BTEXC505	Professional Core Course 5	Microcontroller and its Applications	3	0	0	20	20	60	100	3
6	BTEXPE506A	Program Elective Course 1	Probability Theory and Random Processes	3	0	0	20	20	60	100	3
	BTEXPE506B		NSQF (Level 7 Course)								
	BTEXPE506C		Data Structure & Algorithms Using Java Programming								
	BTEXPE506D		Introduction to MEMS								

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7	BTETL507	Control System Engineering Lab	0	0	2	--	30	20	50	1
8	BTETL508	Digital Signal Processing Lab	0	0	2	--	30	20	50	1
9	BTETL509	Microcontroller and its Applications Lab	0	0	2	--	30	20	50	1
10	BTETP510	Mini Project	0	0	2	--	30	20	50	1
11	BTETS511	Seminar	0	0	2	--	30	20	50	1
12	BTEXF412	Field Training/ Internship/Industrial Training Evaluation	--	--	--	--	--	50	50	1
<b>Total</b>			<b>16</b>	<b>02</b>	<b>10</b>	<b>120</b>	<b>270</b>	<b>510</b>	<b>900</b>	<b>24</b>

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**B. Tech (Electronics & Telecommunication Engineering)**

**Proposed Curriculum for Semester VI [Third Year]**

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTETC601	Professional Core Course 1	Antennas and Wave Propagation	3	0	0	20	20	60	100	3
2	BTETC602	Professional Core Course 2	Computer Network & Cloud Computing	3	0	0	20	20	60	100	3
3	BTETC603	Professional Core Course 3	Digital Image Processing	3	0	0	20	20	60	100	3
4	BTETPE604A	Program Elective Course 2	CMOS Design	3	0	0	20	20	60	100	3
	BTETPE604B		Information Theory and Coding								
	BTETPE604C		Power Electronics								
	BTETPE604D		Nano Electronics								
	BTETPE604E		NSQF (Level 7 Course)								
	BTETPE604F		Android Programming								
5	BTETOE605A	Open Elective Course 1	Digital System Design	3	0	0	20	20	60	100	3
	BTETOE605B		Optimization Techniques								
	BTETOE605C		Project Management and Operation Research								

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	BTETOE605D		Augmented, Virtual and Mixed Reality								
	BTETOE605E		Python Programming								
	BTETOE605F		Web Development and Design								
6	BTHM606	Humanities & Social Science including Management Courses	Employability & Skill Development	2	0	0	20	20	60	100	2
7	BTETL607	Computer Network & Cloud Computing Lab		0	0	2	--	30	20	50	1
8	BTETL608	Program Elective 2 Lab		0	0	2	--	30	20	50	1
9	BTETL609	Open Elective 1 Lab		0	0	2	--	30	20	50	1
10	BTETP610	Mini-project		0	0	2	--	30	20	50	1
11	BTETF611	Field Training/ Internship/ Industrial Training (Minimum 4 weeks)		--	--	--	--	--	--	--	1* (To be evaluated in VII <sup>th</sup> Semester)
Total				17	0	8	120	240	440	800	21

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<b>Program Elective 2</b>	<b>Open Elective 1</b>
(A) CMOS Design	(A) Digital System Design
(B) Information Theory and Coding	(B) Optimization Techniques
(C) Power Electronics	(C) Project Management and Operation Research
(D) Nano Electronics	(D) Augmented, Virtual and Mixed Reality
(E) NSQF (Level 7 Course)	(E) Python Programming
(F) Android Programming	(F) Web Development and Design

\* To be evaluated in VII<sup>th</sup> Semester

**BTEXC501**

**Electromagnetic Field Theory**

**3 Credits**

**Course Objectives:**

- Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
- To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
- To understand the boundary conditions for different materials /surfaces.
- To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
- To get the basics of microwave, transmission lines and antenna parameters.
- Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

**UNIT - 1**

**Maxwell's Equations**

Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface

**UNIT - 2**

**Uniform Plane Wave**

Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor.

**UNIT - 3**

**Transmission Lines**

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

**UNIT - 4**

**Plane Waves at a Media Interface**

Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

**UNIT - 5**

**Wave propagation**

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide

**UNIT - 6**

**Radiation**

Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna

**TEXT/REFERENCE BOOKS**

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, "Electromagnetics", Prentice Hall.
5. Sadiku, "Elements of Electromagnetics", Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi, 1999.

8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", Wiley Eastern.

**BTEXC502**

**Control System Engineering**

**3 Credits**

**Course Objectives:**

- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.
- To introduce concepts of PID controllers and digital and control systems.
- To introduce concepts programmable logic controller.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

**UNIT - 1**

**Introduction to control problem**

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.



**UNIT - 2**

**Time Response Analysis**

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response.

**UNIT - 3**

**Stability Analysis**

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram,

**UNIT - 4**

**Frequency-response analysis**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response

**UNIT - 5**

**Introduction to Controller Design**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and Bode Plot.

**UNIT - 6**

**State variable Analysis**

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigenvalues and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

**TEXT/REFERENCE BOOKS**

1. N. J. Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2009.

2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall of India, 7th Edition, 1995.
3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
4. Schaum’s Outline Series, “Feedback and Control Systems” Tata McGraw-Hill, 2007.
5. John J. D’Azzo & Constantine H. Houpis, “Linear Control System Analysis and Design”, Tata McGraw-Hill, Inc., 1995.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

**BTETC503**

**Computer Architecture**

**3 Credits**

**Course Objectives:**

- To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
- To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
- Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
- Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer’s working
3. analyze the performance of computers
4. know how computers are designed and built

5. Understand issues affecting modern processors (caches, pipelines etc.).

### **UNIT - 1**

#### **Basics of Computers**

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Queues, Subroutines.

### **UNIT - 2**

#### **Processor organization**

Processor organization, Information representation, number formats.

### **UNIT - 3**

#### **ALU design**

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit.

### **UNIT - 4**

#### **Memory organization**

Memory organization, device characteristics, RAMS, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

### **UNIT - 5**

#### **System organization**

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces.

### **UNIT - 6**

#### **Parallel processing**

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

### **TEXT/REFERENCE BOOKS**

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J.,

4. Prentice Hall Edition
5. M.M.Mano, “Computer System Architecture”, Edition
6. C.W.Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
7. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

**BTEXC504**

**Digital Signal Processing**

**3 Credits**

**Course Objectives:**

- To introduce students with transforms for analysis of discrete time signals and systems.
- To understand the digital signal processing, sampling and aliasing.
- To use and understand implementation of digital filters.
- To understand concept of sampling rate conversion and DSP processor architecture.

**Course Outcomes:**

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

**UNIT - 1**

**DSP Preliminaries**

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

**UNIT - 2**

**Discrete Fourier Transform**

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm

**UNIT - 3**

**Z transform**

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

**UNIT - 4**

**IIR Filter Design**

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Lowpass filter)

**UNIT - 5**

**FIR Filter Design**

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form.

**UNIT - 6**

**Introduction to Multirate signal processing**

Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

**TEXT/REFERENCE BOOKS**

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms

And Applications, Prentice Hall, 1997.

4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley & Sons, 1988

**BTEXC505**

**Microcontroller and its Applications**

**3 Credits**

**Course Objectives:**

- Objective of this course is to introduce to the students the fundamentals of microcontroller.
- After learning Microprocessor course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
- The learner can microcontroller design based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
- The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
- The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.
- The students will get acquainted with recent trends in microcontroller like pipelining, cache memory etc.
- To understand the applications of Microcontrollers.
- To understand need of microcontrollers in embedded system.
- To understand architecture and features of typical Microcontroller.
- To learn interfacing of real world input and output devices.
- To study various hardware and software tools for developing applications.

**Course Outcomes:**

1. Learner gains ability to apply knowledge of engineering in designing different case studies.
2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Graduates will be able to design real time controllers using microcontroller based system.

4. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
5. Students can identify and formulate control and monitoring systems using microcontrollers.
6. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
7. Learners get acquainted with modern tools like Programmers, Debuggers, cross compilers and current IDE i.e. integrated development environment tools.
8. Learn importance of microcontroller in designing embedded application.
9. Learn use of hardware and software tools.
10. Develop interfacing to real world devices.

## **UNIT - 1**

### **Fundamentals of Microcontrollers**

Introduction to the general structure of 8 and 16 bit Microcontrollers Harvard & Von Neumann architecture, RISC & CISC processors, Role of microcontroller in embedded system, Selection criteria of microcontroller Block diagram and explanation of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Sample programs (assembly): Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port.

## **UNIT - 2**

### **Interfacing with 8051 PART I**

Software and Hardware tools for development of microcontroller-based systems such as assemblers, compilers, IDE, Emulators, debuggers, programmers, development board, DSO, Logic Analyzer, Interfacing LED with and without interrupt, Keypads, Seven Segment multiplexed Display, LCD, ADC Interfacing. All Programs in assembly language and C.

## **UNIT - 3**

### **Interfacing with 8051 PART II**

8051 timer programming, serial port and its programming, interrupt programming, LCD and keyboard interfacing, ADC and DAC interfacing, interfacing to external memory Interfacing of DAC, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Opto-isolators. All programs in assembly and C

**UNIT - 4**

**PIC Microcontroller Architecture**

PIC 10, PIC12, PIC16, PIC18 series comparison, features and selection as per application  
PIC18FXX architecture, registers, memory Organization and types, stack, oscillator options,  
BOD, power down modes and configuration bit settings, timer and its programming, Brief  
summary of Peripheral support, Overview of instruction set, MPLAB IDE & C18 Compiler

**UNIT - 5**

**Real World Interfacing Part I**

Port structure with programming, Interrupt Structure (Legacy and priority mode) of PIC18F  
with SFRS, Interfacing of switch, LED, LCD (4&8 bits), and Key board, Use of timers with  
interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control  
with CCP: All programs in embedded C.

**UNIT - 6**

**Real World Interfacing Part II**

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP  
structure (SPI & I2C), UART, Sensor interfacing using ADC, RTC (DS1306) with I2C and  
EEPROM with SPI. Design of PIC test Board, Home protection System: All programs in  
embedded C.

**TEXT/REFERENCE BOOKS**

1. Mazidi & Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2<sup>nd</sup> edi, pearson edu.
2. Microprocessor and interfacing 8085, Douglas V Hall, Tata Mc Gram Hill.
3. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
4. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
5. ARM system-on-chip architecture, 2e pearson education.
6. Calcut, 8051 microcontrollers: Applications based introduction, Elsevier.
7. D V kodavade, S. Narvadkar, 8085-86 microprocessors Architecture prog and interfaces, wiley.
8. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
9. Han-way Huang, using The MCS-51 microcontroller, Oxford university press.



10. Ayala, 8051 microcontroller, cengage (Thomson).

11. Rout 8085 microcontroller-architecture, programming and application, 2<sup>nd</sup>edi, penram international.

**BTEXPE506A**

**Probability Theory and Random Processes**

**3 Credits**

**Course Objectives:**

- To develop basic of probability and random variables.
- The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

**UNIT - 1**

**Introduction to Probability**

Definitions, scope and history; limitation of classical and relative- frequency- based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.

**UNIT - 2**

**Random variables**

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf); probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables, Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables, mean, variance and moments of a random variable,

Joint moments, conditional expectation; covariance and correlation, independent, uncorrelated and orthogonal random variables.

### **UNIT - 3**

#### **Random vector and distributions**

Mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector- space representation of random variables, linear independence, inner product, Schwarz Inequality, Elements of estimation theory: linear minimum mean - square error and orthogonality principle in estimation; Moment - generating and characteristic functions and their applications, Bounds and approximations: Chebysev inequality and Chernoff Bound. .

### **UNIT - 4**

#### **Sequence of random variables and convergence**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

### **UNIT - 5**

#### **Random process**

Random process: realizations, sample paths, discrete and continuous time processes, examples, Probabilistic structure of a random process; mean, autocorrelation and auto - covariance 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.

### **UNIT - 6**

#### **Spectral representation of a real WSS process**

Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, Linear time - invariant system with a WSS process as an input: stationarity of the output, auto -correlation and power - spectral density of the output; examples with white - noise as input; linear shift - invariant discrete- time system with a WSS sequence as

input, Spectral factorization theorem, Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

### **TEXT/REFERENCE BOOKS**

1. T. Veerajan, "Probability, Statistics and Random Processes", Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.
4. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

<b>BTEXPE506C</b>	<b>Data Structure &amp; Algorithms Using Java Programming</b>	<b>03 Credits</b>
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**Prerequisites:** Basic knowledge of C language is required.

**Course Objectives:**

- To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.

- To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
- To employ the different data structures to find the solutions for specific problems

**Course Outcomes:**

On completion of the course, student will be able to:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

**UNIT - 1**

**Introduction**

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

**UNIT - 2**

**Stacks and Queues**

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

**UNIT - 3**

**Linked Lists**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

**UNIT - 4**

**Trees**

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

**UNIT - 5**

**Sorting and Hashing**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

**UNIT - 6**

**Graph**

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

**TEXT/REFERENCE BOOKS**

1. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. “How to Solve it by Computer”, 2nd Impression by R. G. Dromey, Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, “Fundamentals of Data Structures”, Galgotia Books Source. ISBN 10: 0716782928.
4. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum’s Outlines, Tata Mc Graw Hill. ISBN-10: 1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10: 8120311779

**Course Objectives:**

- The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
- This will enables student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

**Course Outcomes:**

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

**UNIT - 1**

**Introduction to MEMS**

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

**UNIT - 2**

**Control and Materials of MEMS**

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezo-resistors, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

**UNIT - 3**

**Review of Basic MEMS fabrication modules:**

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching

**UNIT - 4**

**Micromachining**

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

**UNIT - 5**

**Mechanics of solids in MEMS/NEMS**

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods.

**UNIT - 6**

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

**TEXT/REFERENCE BOOKS**

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

**Course Objectives:**

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

**Course Outcomes:**

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

**UNIT - 1**

**Uniform Plane Waves**

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

**UNIT - 2**

**Wave Propagation**

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

**UNIT - 3**

**Antenna Fundamentals**

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation



efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

#### **UNIT - 4**

##### **Wire Antennas**

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

#### **UNIT - 5**

##### **Antenna Arrays**

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

#### **UNIT - 6**

##### **Antennas and Applications**

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

#### **TEXT/REFERENCE BOOKS**

1. C. A. Balanis, "Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, "Elements of Electromagnetics" 3<sup>rd</sup> edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3<sup>rd</sup> Edition, the McGraw Hill Companies.
4. K. D. Prasad, "Antenna & Wave Propagation", Satya Prakashan, New Delhi.
5. John D Kraus, "Antenna & Wave Propagation", 4<sup>th</sup> Edition, McGraw Hill, 2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

**Course Objectives:**

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

**Course Outcomes:**

1. To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.
5. To be familiar with network tools and network programming.
6. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
7. For a given problem related TCP/IP protocol developed the network programming.
8. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

**UNIT - 1**

**Physical Layer**

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

**UNIT - 2**

**Data Link Layer**

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet.

**UNIT - 3**

**Wireless LANS & Virtual Circuit Networks**

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

**UNIT - 4**

**Network Layer**

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**UNIT - 5**

**Transport Layer**

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

**UNIT - 6**

**Application Layer**

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

**TEXT/REFERENCE BOOKS**

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, Tata McGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

<b>BTETC603</b>	<b>Digital Image Processing</b>	<b>3 Credits</b>
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**Course Objectives:**

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

**Course Outcomes:**

After completion of this course students will be able to

1. Review the fundamental concepts of digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Categories various compression techniques.
4. Interpret image segmentation and representation techniques.

<b>UNIT - 1</b>
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**Concept of Visual Information**

Introduction, Digital Image definitions, Common Values, Characteristics of Image Operations, Types of Operations, Types of neighborhoods, Video parameters, Tools, 2D convolution, Properties of 2D convolution, 2D Fourier Transforms, Properties of 2D Fourier Transforms, Importance of phase and magnitude, Circularly Symmetric Signals, Examples of 2D Signals and transforms, Statistical Description of Images

<b>UNIT - 2</b>
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**Image Perception**

Statistical Description of Images, Perception, Brightness Sensitivity, Wavelength Sensitivity, Stimulus Sensitivity, Spatial Frequency Sensitivity, Psychophysics of Color vision, Perceived color, Color metrics, CIE chromaticity coordinates, Spatial effects in color vision, Optical illusions.

**UNIT - 3**

**Image Sampling**

Two dimensional Sampling theory, Extensions of sampling theory, Non rectangular Grid sampling, Hexagonal sampling, Optimal sampling, Image Quantization: The optimum Mean Square Lloyd-Max quantiser, Optimum mean square uniform quantiser for non-uniform densities, Analytic Models for practical quantisers, Visual quantization, Vector Quantization

**UNIT - 4**

**Image Transforms**

Two dimensional orthogonal and unitary transforms, Separable unitary transforms, Basis images, Dimensionality of Image Transforms, Discrete linear orthogonal, DFT, WHT, KLT, DCT and SVD, Quantisation of Transform coefficients, Transform Coding of Color images

**UNIT - 5**

**Image Enhancement**

Contrast and dynamic Range Modification, Histogram-based operations, Smoothing operations, Edge Detection-derivative based operation, Image Interpolation and Motion Estimation, Pseudo coloring

**UNIT - 6**

**Image Restoration**

Image Restoration, Degradation Estimation, Reduction of Additive Noise, Reduction of Image Blurring, Simultaneous reduction of noise and blurring, Reduction of Signal dependent noise, Temporal filtering.

**TEXT/REFERENCE BOOKS**

1. Rafael C. Gonzalez and Woods, "Digital Image Processing", Addison Wesley, 1998
2. A. K. Jain, "Digital Image Processing", PHI, New Delhi, 1997
3. Pratt W.K., "Digital Image Processing", 2nd Edition, John Wiley, New York, 2001
4. Edward R. Dougherty, "Random Processes for Image and Signal Processing", PHI-2001

**BTETPE604A**

**CMOS Design**

**3 Credits**

**Course Objectives:**

- To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
- To introduce the student how to use tools for VLSI IC design.

**Course Outcomes:**

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

**UNIT - 1**

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, Transistor as a switch. Inverter characteristics

**UNIT - 2**

Integrated Circuit Layout: Design Rules, Parasitics

**UNIT - 3**

Delay: RC Delay model, linear delay model, logical path efforts

**UNIT - 4**

Power, interconnect and Robustness in CMOS circuit layout

**UNIT - 5**

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic

**UNIT - 6**

Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

**TEXT/REFERENCE BOOKS**

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4<sup>th</sup> Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

**BTETPE604B**

**Information Theory and Coding**

**3 Credits**

**Course Objectives:**

- To provide in-depth understanding of principles and applications of information theory.
- To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
- To provide in-depth understanding of different coding techniques for error detection and correction.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

**UNIT - 1**

**Theory of Probability and Random Processes**

Concept of probability, random variables, random process, power spectral density of a random process, probability models, statistical averages, central limit theorem, correlation, linear mean square estimation

**UNIT - 2**

**Noise in Communication Systems**

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

**UNIT - 3**

**Information Theory**

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

**UNIT - 4**

**Error Correcting Codes**

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ

**UNIT - 5**

**Markov sources**

Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels

**UNIT - 6**

**Speech Coding**

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

**TEXT/REFERENCE BOOKS**

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chatterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering (2<sup>nd</sup> Edition), TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Inter science.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2<sup>nd</sup> Edition), Pearson India.
7. N. Abramson, Information and Coding, McGraw Hill, 1963.
8. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.



**Course Objectives:**

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

**UNIT - 1**

**Characteristics of Semiconductor Power Devices**

Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

**UNIT - 2**

**Controlled Rectifiers**

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

**UNIT - 3**

**Choppers**

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

**UNIT - 4**

**Single-phase inverters**

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

**UNIT - 5**

**Switching Power Supplies**

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

**UNIT - 6**

**Applications**

Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive. P M Stepper motor Drive

**TEXT/REFERENCE BOOKS**

1. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
4. V. R. Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander, "Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla, "Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

**Course Objectives:**

- To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
- Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.
- This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
- Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
- The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

**UNIT - 1**

**Overview Nano Technology**

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

**UNIT - 2**

**Basics of Quantum Mechanics**

Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones

**UNIT - 3**

**MOS Scaling theory**

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

**UNIT - 4**

**Nano electronics Semiconductor devices**

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

**UNIT - 5**

**Properties of Nano devices**

Vertical transistors, Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

**UNIT - 6**

**Characterization techniques for Nano materials**

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self-assembly.

**TEXT/REFERENCE BOOKS**

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

<b>BTETPE604F</b>	<b>Android Programming</b>	<b>3 Credits</b>
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**Course Objectives:**

Android Application Development course is designed to quickly get you up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.

**UNIT - 1**

**Introduction to Mobile Operating Systems and Mobile Application Development**

**Introduction to Mobile OS:**

Palm OS, Windows CE, Embedded Linux, J2ME (Introduction), Symbian (Introduction), Overview of Android: Devices running android, Why Develop for Android, Features of android, Architecture of Android, Libraries

How to setup Android Development Environment: Android development Framework - Android-SDK, Eclipse, Emulators – What is an Emulator / Android AVD? , Creating & setting up custom Android emulator, Android Project Framework, My first android application.

**UNIT - 2**

**Android Activities, UI Design and Database**

Understanding Intent, Activity, Activity Lifecycle and Manifest, Form widgets, Text Fields, Layouts: Relative Layout ,Table Layout, Frame Layout, Linear Layout, Nested layouts.

UI design: Time and Date, Images and media, Composite, Alert Dialogs & Toast, Popup.

Menu: Option menu, Context menu, Sub menu.

Database: Introducing SQLite, SQLite Open Helper, SQLite Database, Cursor,

Content providers: defining and using content providers, example- Sharing database among two different applications using content providers, Reading and updating Contacts, Reading bookmarks.

**UNIT - 3**

**Preferences, Intents and Notifications**

Preferences: Shared Preferences, Preferences from xml, Intents:Explicit Intents, Implicit intents. Notifications: Broadcast Receivers, Services (Working in background) and notifications, Alarms.

**UNIT - 4**

**Telephony, SMS and Location Based Services**

Telephony: Accessing phone and Network Properties and Status, Monitoring Changes in Phone State, Phone Activity and data Connection.

SMS: Sending SMS and MMS from your Application, sending SMS Manually, Listening for incoming SMS

Location based Services: Using Location Based Services, Working with Google Maps, Geocoder.

**UNIT - 5**

**Accessing Android Hardware**

Networking: An overview of networking, checking the network status, communicating with a server socket, Working with HTTP, Web Services.

Bluetooth: Controlling local Bluetooth device, Discovering and bonding with Bluetooth devices, Managing Bluetooth connections, communicating with Bluetooth

**UNIT - 6**

**Audio Video Handling**

Playing Audio and Video, Recording Audio and Video, Using Camera and Taking Picture

**TEXT/REFERENCE BOOKS**

1. Reto Meier “Professional Android™ Application Development”, Wrox Publications.
2. Lauren Dercy and Shande Conder “Sams teach yourself Android application development” , Sams publishing
3. Hello Android, Introducing Google’s Mobile Development Platform, Ed Burnette, Pragmatic Programmers, ISBN: 978-1-93435-617-3

**Course Objectives:**

- The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
- The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
- This course will explore the basic concepts of digital electronics.

**Course outcomes:**

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

**UNIT - 1**

**Logic Simplification and Combinational Logic Design**

Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

**UNIT - 2**

**MSI devices**

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

**UNIT - 3**

**Sequential Logic Design**

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

**UNIT - 4**

**Logic Families and Semiconductor Memories**

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing.

**UNIT - 5**

**Memory Elements**

Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices

**UNIT - 6**

**VLSI Design flow**

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

**TEXT/REFERENCE BOOKS**

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
4. D.V. Hall, " Digital Circuits and Systems" , Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

**BTETO605B**

**Optimization Techniques**

**3 Credits**

**Course Objectives:**

- Introduction to optimization techniques using both linear and non-linear programming
- The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization.

**Course Outcomes:**

1. After completion of this course students will be able to



2. Cast engineering minima/maxima problems into optimization framework
3. Learn efficient computational procedures to solve optimization problems

## **UNIT - 1**

### **Introduction and Basic Concepts**

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques

## **UNIT - 2**

### **Optimization using Calculus**

Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples

## **UNIT - 3**

### **Linear Programming**

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar's projective scaling method

## **UNIT - 4**

### **Dynamic Programming**

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic

programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP

**UNIT - 5**

**Integer Programming**

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples

**UNIT - 6**

**Advanced Topics in Optimization**

Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search

**TEXT/REFERENCE BOOKS**

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International, New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

**BTETOE605C**

**Project Management and Operation Research**

**3 credits**

**Course Objectives:**

- To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
- To introduce students to framework that are useful for diagnosing problems involving human behavior.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.

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- To teach students about networking, inventory, queuing, decision and replacement models.
- To introduce students to research methods and current trends in Operations Research.

### **Course Outcomes:**

Student will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
2. Solve transportation problems using various OR methods.
3. Illustrate the use of OR tools in a wide range of applications in industries.
4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.
5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

### **UNIT - 1**

Definition, need and importance of organizational behaviour , nature and scope , frame work , organizational behaviour models.

### **UNIT - 2**

Organization structure , formation , groups in organizations , influence , group dynamics , emergence of informal leaders and working norms , group decision making techniques , interpersonal relations , communication , control.

### **UNIT - 3**

Evolution of Management thoughts, Contribution of Selected Management Thinkers, Various approaches to management, contemporary management practice, Managing in global environment, Managerial functions.

### **UNIT - 4**

Importance of planning , Types of planning , decision making process , Approaches to decision making , Decision models , Pay off Matrices , Decision trees , Break Even Analysis.

### **UNIT - 5**

Departmentation, Span of Control, Delegation, Centralisation and Decentralisation, Committees, Line and Staff relationships , Recent trends in organization structures.

**UNIT - 6**

Process of Recruitment, Selection, Induction Training, Motivation, Leading, Leadership styles and qualities, Communication, process and barriers. Managements control systems, techniques, Types of control.

**TEXT/REFERENCE BOOKS**

1. Bateman Snell, Management: Competing in the new era, McGraw,Hill Irwin, 2002.
2. Chandan J.S., Management Concepts and Strategies, Vikas Publishing House, 2002.
3. Hellriegel, Jackson and Slocum, Management: A Competency,Based Approach, South Western, 9th edition, 2002.
4. Koontz, Essentials of Management, Tata McGraw,Hill, 5th Edition, 2001.
5. Stephen P. Robbins and David A. Decenzo, Fundamentals of Management, Pearson Education, Third Edition, 2001.
6. Tim Hannagan, Management Concepts and Practices, Macmillan India Ltd., 1997.

**BTETOE605D**

**Augmented, Virtual and Mixed Reality**

**3 Credits**

**Course Objectives:**

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

**Course Outcomes:**

After completion of this course students will be able to

1. To develop 3D virtual environments.
2. To develop 3D interaction techniques and immersive virtual reality applications.

**UNIT - 1**

**Introduction & Geometry of Virtual Worlds**

Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view

Geometric modeling, Transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, Viewport transform

**UNIT - 2**

**Light and Optics**

Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

**UNIT - 3**

**Visual Physiology & Visual Perception**

Photoreceptors, Sufficient resolution for VR, light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision, Depth perception, Depth perception, Motion perception, Frame rates and displays, Frame rates and displays

**UNIT - 4**

**Tracking Systems & Visual Rendering**

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

**UNIT - 5**

**Audio & Interfaces**

Physics and physiology, auditory perception, Auditory localization, Rendering, Spatialization and display, combining other senses, Interfaces, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

**UNIT - 6**

**Augmented Reality**

System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment

**TEXT/REFERENCE BOOKS**

1. <http://msl.cs.uiuc.edu/vr/>
2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.

3. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition, 2009.

**BTETOE605E**

**Python Programming**

**3 Credits**

**Course Objective:**

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

**Course Outcomes:**

1. Experience with an interpreted Language.
2. To build software for real needs
3. Prior Introduction to testing software

**UNIT - 1**

**Introduction:** History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation

**UNIT - 2**

**Types, Operators and Expressions:** Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass

**UNIT - 3**

**Data Structures Lists** – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions

**UNIT - 4**

**Default Arguments**, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

**UNIT - 5**

**Object-Oriented Programming OOP in Python:** Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions

**UNIT - 6**

**Brief Tour of the Standard Library** – Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

**TEXT/REFERENCE BOOKS**

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Think Python, Allen Downey, Green Tea Press
4. Core Python Programming, W.Chun, Pearson
5. Introduction to Python, Kenneth A. Lambert, Cengage

**BTETO605F**

**Web Development and Design**

**3 Credits**

**Course Objectives:**

- Define the principle of Web page design
- Define the basics in web design
- Visualize the basic concept of HTML.
- Recognize the elements of HTML.
- Introduce basics concept of CSS.

- Develop the concept of web publishing

**Course Outcomes:**

On completion of the course, student will be able to:

1. Develop the skill & knowledge of Web page design
2. Understand the knowhow and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors.

**UNIT - 1**

Web Design Principles , Basic principles involved in developing a web site , Planning process , Five Golden rules of web designing , Designing navigation bar , Page design, Layout of pages , Design Concept

**UNIT - 2**

Basics in Web Design , Brief History of Internet , What is World Wide Web , Why create a web site , Web Standards , Audience requirement

**UNIT - 3**

Introduction to HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading, Paragraphs, Line Breaks, HTML Tags

**UNIT - 4**

Elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia Working with Forms and controls

**UNIT - 5**

Introduction to Cascading Style Sheets, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute selector) , CSS Color , Creating page Layout and Site Designs

**UNIT - 6**

Introduction to Web Publishing or Hosting , Creating the Web Site ,Saving the site, Working



on the web site, Creating web site structure, Creating Titles for web pages, Themes, Publishing web sites

### **TEXT/REFERENCE BOOKS**

1. J. N. Robbins, Learning Web Design, O'Reilly Media, 4th Edition, 2012
2. Steven M. Schafer, HTML, XHTML, and CSS Bible, Wiley India, 5th Edition, 2010
3. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India, 3rd Edition, 2009
4. Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication, 3rd Edition, 2015
5. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, nd Edition, 2012.

**BTHM606**

**Employability & Skill Development**

**2 Credits**

#### **Course Objectives:**

- To develop analytical abilities.
- To develop communication skills.
- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- To expose the students to leadership and team-building skills.

#### **Course Outcomes:**

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

### **UNIT - 1**

#### **Soft Skills & Communication basics**

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

**UNIT - 2**

**Arithmetic and Mathematical Reasoning**

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, remainder theorem).

**UNIT - 3**

**Analytical Reasoning and Quantitative Ability**

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy)

**UNIT - 4**

**Grammar and Comprehension**

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing

**UNIT - 5**

**Skills for interviews**

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time

**UNIT - 6**

**Problem Solving Techniques**

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

**TEXT/REFERENCE BOOKS**

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, "Soft Skills- An integrated approach to maximize personality", ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chand publications.

2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum's Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. Mc Murrey, "A Guide to Writing as an Engineer", ISBN: 978-1-118-30027-5 4<sup>th</sup> Edition, 2014, Wiley.

**BTETC701**

**Digital Communication**

**3 Credits**

**Course Objectives:**

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

**Course Outcomes:**

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

**UNIT - 1**

**Digital Transmission of Analog Signal**

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error