DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,

SEMESTER V

BTETC501 Electromagnetic Field Theory   **4 Credits**

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
3. To understand the boundary conditions for different materials/surfaces.
4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
5. To get the basics of microwave, transmission lines and antenna parameters.
6. 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 Understand principle of radiation and radiation characteristics of an antenn

UNIT – 1 Mathematical Fundamentals and Static Electric Fields: **07 Hours**

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density..

UNIT – 2 Steady Electric Currents and Static Magnetic Fields: **07 Hours**

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, ContinuityEquationandKirchhoff"sCurrentLaw,PowerDissipationandJoule'sLaw,Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

UNIT – 3 Time Varying Field &Maxwell's Equations: **07 Hours**

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

UNIT – 4Transmission Lines: **07 Hours**

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 – 5 Electromagnetic Waves: **07 Hours**

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.

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", PrenticeHall.

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", WileyEastern.

BTETC502 Digital Signal Processing   4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems.

2. To understand the digital signal processing, sampling and aliasing.

3. To use and understand implementation of digital filters.

4. 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.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,

UNIT – 1 DSP Preliminaries: **07 Hours**

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: **07 Hours**

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: **07 Hours**

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: **07 Hours**

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 Low pass filter)

UNIT – 5 FIR Filter Design and introduction to MDSP: **07 Hours**

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. Introduction to Multirate signal processing: Concept of Multirate DSP,

Introduction to Up sampler, Down sampler and two channel filter banks, 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.

BTETC503 Analog Communication   4 Credits

Course Objectives:

1. To introduce the concepts of analog communication systems.
2. To equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
3. To understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase)

Course Outcomes:

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

1. Understand and identify the fundamental concepts and various components of analog communication systems.
2. Understand the concepts of modulation and demodulationtechniques.
3. Design circuits to generate modulated and demodulated wave.
4. Equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noiseperformance.

5. Understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase).

6. Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.

7. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

UNIT – 1 Introduction to Communication System   07 Hours

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation, sampling theorem and pulse analog modulation, multiplexing: TDM, FDM.

UNIT – 2 Amplitude Modulation   07 Hours

Introduction, Mathematical analysis and expression for AM, Modulation index, Frequency spectrum and bandwidth of AM, Power calculations, Generation of AM using nonlinear property, Low and high level modulation, Balance Modulator.

Types of AM: DSB-FC, DSB-SC, SSB-SC, ISB and VSB, their generation methods and comparison.

UNIT – 3 Angle Modulation   07 Hours

Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct and indirect methods of FM generation, Pre emphasis and de-emphasis, Comparison of AM, FM and PM.

UNIT – 4 Radio Receivers and Demodulators   07 Hours

Introduction, Performances characteristic of receivers: Sensitivity, Selectivity, Fidelity, Image frequency and IFRR, Tracking and Double spotting, TRF, Super heterodyne receivers, RF amplifier, Local oscillator and mixer, IF amplifier, AGC.

UNIT – 5 AM and FM Detectors and noise   07 Hours

AM Detectors: Envelop detector and practical diode detector.

FM Detectors: Slope detector, phase discriminator and ratio detector.

Noise: Introduction, Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.

TEXT/REFERENCE BOOKS:

1. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4th Edition.

2. Anokh Singh, "Principles of communication engineering"S.Chand

3. Roddy&Coolen, "Electronic communication"PHI

4. Taub & Schilling "Principles of communication systems" Tata Mc GrawHill

5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.

6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.

7. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill NewDelhi-2008.

BTETPE504A Analog Circuits   4 Credits

Course Objectives:

1. To understand characteristics of IC and Op-Amp and identify the internal structure.

2. To introduce various manufacturing techniques.

3. To study various op-amp parameters and their significance for Op-Amp.

4. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.

5. To analyze and identify linear and nonlinear applications of Op-Amp.

Course Outcomes:

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

1. Understand the characteristics of IC and Op-Amp and identify the internal structure.

2. Understand and identify various manufacturing techniques.

3. Derive and determine various performances-based parameters and their significance forOp-Amp.

4. Verify parameters after exciting IC by any stated method.

5. Analyze and identify the closed loop stability considerations and I/O limitations.

6. Analyze and identify linear and nonlinear applications of Op-Amp.

7. Understand and verify results (levels of V & I) with hardware implementation.

8. Implement hardwired circuit to test performance and application for what it is being designed.

UNIT – 1 Introduction to operational Amplifiers: **07 Hours**

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots.

Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.

UNIT – 2 Linear applications of operational amplifiers: **07 Hours**

Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.

UNIT – 3 Non-linear applications of operational amplifiers: **07 Hours**

Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.

UNIT –4 Oscillators: **07 Hours**

Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square-triangle oscillators

UNIT – 5 Analog and Digital interface circuits: **07 Hours**

Analog and Digital interface circuits: Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc., V-F, I-V and V-I converter.

TEXT/REFERENCE BOOKS:

1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York,1992.

2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill,1988.

3. P.Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.

4. A. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, EditionIV.

5. Paul R. Gray & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rdEdition.

6. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education 2000.

7. Salivahanan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill, India2008.

8. George Clayton and Steve Winder, "Operational Amplifiers", 5th EditionNewnes.

9. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGrawHill.

10. Bali, "Linear Integrated Circuits", McGraw Hill 2008.Gray, Hurst, Lewise, Meyer, "Analysis & Design of Analog Integrated Circuits", Wiley Publications on Education.

BTETPE504B Embedded System Design   4 Credits

Prerequisites: Good understanding of the concepts of basic electronics such as circuits, logic gates, Number systems, fundamentals of C programming

Course Objectives:

1. To understand Embedded Design Specification.
2. Understand the ARM Design Philosophy
3. Understand the ARM architecture and the pipeline structure
4. Understand the instruction sets of ARM Processor

Course Outcomes:

1. The student will study ARM Processor based Embedded System design
2. The student will be able to do programming in Embedded programming in C,C++
3. The student will understand Linux operating system and device driver
4. The student will demonstrate the knowledge of Real Time Operating System

UNIT – 1 INTRODUCTION TO EMBEDDED SYSTEMS   07 Hours

Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip.

Embedded system design and development: Embedded system design, Life-Cycle Models, Problem solving, The design process, Requirement identification, Formulation of requirements specification. Development tools.

System design specifications: System specifications versus system requirements, Partitioning and decomposing a system, Functional design, Architectural design, Functional model versus architectural model, Prototyping, Other considerations, Archiving the project

UNIT – 2 ARM PROCESSOR FUNDAMENTALS AND INSTRUCTION SET
07 Hours

Registers, Current Program Status Registers(CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM-Thumb Interworking, other branch instructions, Data Processing instructions, Stack instructions, Single -register load -store instruction, multiple -register load- store instruction, software interrupt instructions

UNIT – 3 EMBEDDED LINUX   07 Hours

Embedded Linux: System architecture, BIOS versus boot-loader, Booting the kernel, Kernel initialization, Space initialization, Boot loaders, Storage considerations

Linux kernel construction: Kernel build system, Obtaining a custom Linux kernel, File systems, Device drivers, Kernel configuration.

UNIT – 4 COMMUNICATION PROTOCOLS   07 Hours

Use of communication protocols in embedded systems, Serial communication basics, synchronous/asynchronous interfaces, UART Protocol, I2C protocol, SPI protocol, USB Protocol, SPI protocol, CAN Protocol, 1 Wire protocol

UNIT – 5   REAL TIME OPERATING SYSTEMS   07 Hours

RTOS fundamentals, Multitasking in small embedded systems, Memory management, Task management, Queue management, software timer management, interrupt management, resource management, event, Task notification

TEXT BOOKS:

1. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Pearson EducationPublication

2. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", WILEY Student EditionPublication

3. Andrew N. Sloss, "ARM system developer's guide", Morgan Kaufmannelsevier.com

4. Tammy Noergaard, "Embedded Systems Architecture", ElsevierPublication

5. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Pearson EducationPublication

6. "Real -Time System Design and analysis -Tools for the practioner " By Phillip A Laplante (WileyPublication)

REFERENCE BOOKS:

1. Mastering the Free RTOS   Real time Kernel A hands on tutoral guide by Richard Barry

2. The Free RTOS Reference manual API functions and configuration options

BTETPE504C Digital System Design   **4 Credits**

Course Objectives:

1. 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.

2. 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.

3. 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 Introduction to VHDL: **07 Hours**

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, and VHDL data types, concurrent and sequential statements.

UNIT –2 Subprograms: **07 Hours**

Subprograms – Functions, Procedures, attributes, generio, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration.

UNIT – 3 Combinational logic circuit design and VHDL implementation: 07 Hours

Combinational logic circuit design and VHDL implementation of following circuits – first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, multiplier, divider.

UNIT – 4 Synchronous sequential circuits design: **07 Hours**

Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT – 5 Asynchronous sequential circuit designs: **07 Hours**

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like meta stability, synchronizers, clock skew and timing considerations, Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD (Xilinx / Altera)

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.

6. Bhasker J, "VHDL Primer" Prentice-Hall of India Pvt. Ltd 3rdEdition.

BTETPE504D Automotive Electronics   **4 Credits**

Course Objectives:

1. To understand the concepts of Automotive Electronics and it"s evolution and trends automotive systems & subsystems overview.

2. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.

3. To understand, design and model various automotive control systems using Model based development technique.

4. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.

5. To describe various communication systems, wired and wireless protocols used in vehicle

6. To understand Safety standards, advances in towards autonomous vehicles.

7. To understand vehicle on board and off board diagnostics.

Course Outcomes:

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

1. Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in todays automotive industry.

2. Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.

3. Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the subsystems.

4. Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

UNIT – 1 Automotive Fundamentals Overview: **07 Hours**

Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System , Starter Battery –Operating principle

UNIT – 2 The Basics of Electronic Engine Control: **07 Hours**

Motivation for Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

UNIT – 3 Automotive Sensors and Actuators: **07 Hours**

Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor, Solenoid, Fuel Injector, EGR Actuator, Ignition System

UNIT – 4 Digital Engine Control Systems: **07 Hours**

Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, SystemDiagnostics

UNIT – 5 Vehicle Motion Control: **07 Hours**

Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System(ABS)

TEXT/REFERENCE BOOKS:

1. William B. Ribbens, ―Understanding Automotive Electronics‖, 6th Edition, Elsevier Publishing.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc.,2007.

BTETPE504E Mixed Signal Design   4 Credits

Course Objectives:
1. To introduce how to handle the practical situations where mixed signal analysis is required.
2. To analyze and handle the inter-conversions between signals.
3. To introduce the students how to design systems involving mixed signals.

Course Outcomes:

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

1. Understand the practical situations where mixed signal analysis is required.
2. Analyze and handle the inter-conversions between signals.
3. Design systems involving mixed signals.

UNIT – 1 Analog and discrete-time signal processing: **07 Hours**

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters. Basics of analog discrete-time filters and Z-transform.

UNIT – 2 Switched-capacitor filters: **07 Hours**

Switched-capacitor filters- Non idealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

UNIT – 3 Basics of data converters: **07 Hours**

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT – 4 Mixed-signal data transmission: 07 Hours

Mixed-signal layout, Interconnects and data transmission, Voltage-mode signaling and data transmission, Current-mode signaling and data transmission.

UNIT –5 PLLs: 07 Hours

Introduction to frequency synthesizers and synchronization, Basics of PLL, Analog PLLs, Digital PLLs, DLLs.

TEXT/REFERENCE BOOKS:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill,2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, and2008.
4. Rudy V. de Plassche, CMOS Integrated ADCs and DACs, Springer, Indian edition,2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill,1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or neweradditions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETPE504F Power Electronics **4Credits**

Course Objectives:

1. To introduce students to different power devices to study their construction, characteristics and turning on circuits.
2. To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
3. 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 asSCR
2. Analyze and design-controlled rectifier, DC to DC converters, DC to ACinverters.

3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT – 1 Characteristics of Semiconductor Power Devices: **07 Hours**

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: **07 Hours**

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: **07 Hours**

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 – 4Single-phaseinverters: **07 Hours**

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 and Applications: **07 Hours**

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.

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 ofIndia.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley andsons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand&Co.
4. V. R. Moorthi, "Power Electronics", Oxford UniversityPress.
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.

BTETOE505A Control System Engineering   4 Credits

Course Objectives:

1. To introduce the elements of control system and their modeling using various Techniques.
2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. To introduce the concept of root locus, Bode plots, Nyquist plots.
4. To introduce the state variable analysis method.
5. To introduce concepts of PID controllers and digital and control systems.
6. 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: **07 Hours**

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 and Stability Analysis: **07 Hours**

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.

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

UNIT – 3 Frequency-response analysis: **07 Hours**

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 – 4 Introduction to Controller Design: **07 Hours**

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 BodePlot.

UNIT – 5 State variable Analysis: **07 Hours**

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigen values 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, 7thEdition,1995.

3. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

4. Schaum"sOutlineSeries,"FeedbackandControlSystems"TataMcGraw-Hill,2007.

5. John J. D"Azzo& Constantine H. Houpis, "Linear Control System Analysis andDesign", Tata McGraw-Hill, Inc.,1995.

6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

BTETOE505B Artificial Intelligence and Machine Learning   4 Credits

Course Objectives:

1. Apply AI techniques to solve the given problems.

2. Implement trivial AI techniques on relatively largesystem

3. Explain uncertainty and Problem-solving techniques.

4. Compare various learning techniques.

Course Outcomes:

This course will enable students to

1. Identify the AI basedproblems.

2. Apply techniques to solve the AIproblems.

3. Define learning and explain various logicinferences.

4. Discuss different learning techniques.

UNIT –1Introduction: **07 Hours**

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behaviour: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

UNIT – 2SearchTechniques: **07 Hours**

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search,

Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyon Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT – 3 Game Playing: 07 Hours

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT – 4 Logic and inference: 07 Hours

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, **Backtracking** Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, PlanningGraphs.

UNIT –5 Learning: 07 Hours

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation-Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

TEXT/REFERENCE BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. IIIEdition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGrawHill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education,2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford UniversityPress-2015.

BTETOE505C Optimization Techniques   4 Credits

Course Objectives:

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

Course Outcomes:

After completion of this course students will be able to

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

UNIT – 1 Introduction and Basic Concepts: **07 Hours**

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: **07 Hours**

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: **07 Hours**

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: **07 Hours**

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 and Advanced Topics in Optimization: **07 Hours**

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

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.

BTETOE505D Project Management and Operation Research   4 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 those 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.
*   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

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

UNIT– 1   **07 Hours**

Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases and applications. Optimization models and their classifications

Linear Models: Formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP.   .

UNIT– 2   **07 Hours**

Replacement Models:

Replacement of items that deteriorates with time, Value of money changing with time and not changing with time, Optimum replacement policy , Individual and group replacement.

Introduction: Solution methods, Variations of the assignment problem, Traveling salesman problem

UNIT– 3   **07 Hours**

Transportation Problems: Introduction, Methods for finding initial solution, Test of optimality, Maximization and Minimization Transportation problems, Transshipment problems, Degeneracy.

Queuing Theory: Queuing models – queuing systems and structures – notation –parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

Game Theory: Introduction, Two-person zero-sum game, Minimum and Maximum principle, Saddle point, Methods for solving game problems with pure and mixed strategies

UNIT– 4   **07 Hours**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models, Processing 'n' jobs on 'm' machines. Processing of two jobs on machines with each having different processing order.

Inventory Models: Types of Inventory- EOQ –ERL- Deterministic inventory problems, Price breaks, stochastic inventory problems, Selective inventory control techniques..

UNIT– 5   **07 Hours**

Network Models: Introduction to PERT/CPM & its importance in project management. Concept & construction of network diagrams. Critical path & project duration, floats, network crashing, optimum project duration & cost, PERT activity, time estimate, probability of completion of a project on or before specified time.

TEXT/REFERENCE BOOKS:

1. Wayne. L. Winston, Operations research applications and algorithms, Thomson learning,4th edition 2007.

2. 2. Taha H.A, "Operation Research", Pearson Education sixth edition, 2003

3. 3. S. D. Sharma, "Introduction to Operations Research", Discovery Publishing House, New Delhi

4. 4. P. K. Gupta, D. S. Hira, "Operations Research", S Chand and Co. Ltd., ISBN 81-219-0281-9.

BTETOE505E Augmented, Virtual and Mixed Reality   **4 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: **07 Hours**

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, View port transform

UNIT – 2 Light and Optics: **07 Hours**

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

UNIT – 3 Visual Physiology &Visual Perception: **07 Hours**

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 anddisplays

UNIT – 4 Tracking Systems &Visual Rendering: **07 Hours**

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 imagewarp

UNIT – 5 Audio & Interfaces and Augmented Reality: **07 Hours**

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.

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.

BTETOE505F Open Source Technologies   **4 Credits**

Course Objectives:

1. Understand the difference between open source software and commercial software.
2. Familiarity with Linux operating system.
3. Understanding and development of web applications using open source web technologies

Course Outcomes:

Student will be able to

1. Define the development model of Open source software, and tell about the open-source licensing
2. Understand the difference between open source software and commercial software.

3. To get acquainted with Linux OS by understanding configuration and troubleshooting of Linux Operating System.

4. Identify, install and implementation of open source technologies.

UNIT– 1 Fundamentals of Open Source Technology 07 Hours

History of Open Source Software, Introduction – Need and Advantage of Open-Source Software, Open Source Movement- Open Source Licensing Certification, Comparing OSS with other Software-OSS Licenses.

UNIT– 2 Introduction to Open source operating system - Linux OS 07 Hours

Introduction & types of OS, Interfaces of OS: CLI, GUI, Brief history of Linux, Architecture of Linux, Features of Linux, Difference between Linux and other OS, Linux Distributions, Boot process & run levels, Major application areas of Linux..

UNIT– 3 Linux Basics Usage 07 Hours

User & password management & Logging into the system, GNOME and KDE desktop environment, Basic desktop operations, Text editors: vi and gedit, File system, File system architecture, File types, File attributes, File naming conventions, Shell as interpreter, Types of shell, Command line, Command syntax, Running commands and getting help, Basic commands, File-directory handling commands, Locating Files, File access permissions

UNIT– 4 Open Source Operating System (SHELL PROGRAMMING): 07 Hours

Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Handling signals, creating functions, working sed and gawk, working with web using shell script: Downloading web page, Converting Web page content to a text file, parsing data, working cURL.

UNIT– 5 Open Source Database And Application: 07 Hours
MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. **PHP – MySQL Application Development:** Connecting to MySQL with PHP, Inserting data with PHP, Retrieving data with PHP.

TEXT/REFERENCE BOOKS:

1. Linux the complete reference' by Richard Mathews, McGraw Hill Publication. Sixth Edition, 2008

2. Linux with Operating System Concepts' by Richard Fox, CRC Press Publication. Second Edition , 2006

3. PHP6 and MySQL Bible by Steve Suehring and Joyce Park Wiley-India, New Delhi 2009.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,

SEMESTER VI

BTETC601 Antennas and Wave Propagation   4Credits

Course Objectives:

1. To understand the applications of electromagnetic engineering.
2. To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
3. To analyze and understand the Uniform plane wave propagation in variousmedia.
4. To solve the electric field and magnetic fields for a given wireantenna.

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 – 1WavePropagation: 07 Hours

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 magneticfield. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and CoherenceTime.

UNIT – 2 Antenna Fundamentals andWireAntennas: 07 Hours

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.

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 – 3 Antenna Arrays: 07 Hours

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, non-uniform amplitude, array factor, binomial and DolphTchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, YagiUda Antenna Array.

UNIT – 4 Concepts of Smart Antennas: 07 Hours

Introduction, Smart Antenna Analogy, Cellular Radio System Evolution, benefits and drawbacks of smart antennas, fixed weight beam forming basics, Antenna beamforming

UNIT – 5 Antennas and Applications: 07 Hours

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", JohnWiley.
2. Mathew N O Sadiku, "Elements of Electromagnetics" 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, "Antenna & Wave Propagation", SatyaPrakashan, NewDelhi.
5. John D Kraus, "Antenna& Wave Propagation", 4th Edition, McGraw Hill,2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

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BTETC602 Digital Communication   4 Credits

Course Objectives:

1. To understand the building blocks of digital communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a digital communication system.
4. To analyze error performance of a digital communication system in presence of noise and other interferences.
5. 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: 07 Hours

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 threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speechsynthesis.

UNIT – 2 Baseband Digital Transmissions: 07 Hours

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

UNIT – 3 Random Processes: 07 Hours

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT – 4 Baseband Receivers: **07 Hours**

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT – 5 Passband Digital Transmission & Spread Spectrum Techniques: 07 Hours

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

Spread Spectrum Techniques: Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS:

1. Simon Haykin, "Digital Communication Systems", John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, "A First Course in Digital Communication", Cambridge University Press.
4. B P Lathi, Zhi Ding "Modern Analog and Digital Communication System", Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications" Second Edition, Pearson Education.
6. Taub, Schilling, "Principles of Communication System", Fourth Edition, McGrawHill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTETPE603A Microprocessors and Microcontrollers   **4 Credits**

Course Objectives:

1. Objective of this course is to introduce to the students the fundamentals of microprocessor and Microcontrollers.

2. After learning Microprocessors and Microcontrollers course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.

3. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.

4. The students will get acquainted with recent trends in microprocessor like pipelining, cache memory etc.

5. To understand the applications of Microprocessors and Microcontrollers.

6. To learn interfacing of real-world input and output devices.

7. The learner can microcontroller design-based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.

Course Outcomes:

1. Students get ability to conduct experiments based on interfacing of devices to   or interfacing to real world applications.

2. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.

3. Students can identify and formulate control and monitoring systems using microprocessors.

4. Learn use of hardware and software tools.

5. Develop interfacing to real world devices.

6. Graduates will be able to design real time controllers using microcontroller-based system.

7. Learn importance of microcontroller in designing embedded application.

UNIT– 1   **07Hours**

CISC and RISC Processor Architectures. Harvard and Von Neumann memory architectures. Introduction to 8085 Microprocessor based System: Architecture, Pin Description. Addressing modes. Instruction set and assembler directives. Timing Diagram.

UNIT– 2   **07 Hours**

Introduction to 8085 Assembly language programming. Programming examples using Data Transfer, Arithmetic, Logical, Branching and control instructions. Stacks and subroutine related programs. Serial data transfer. Interrupts.

UNIT– 3   **07 Hours**

Introduction to 8051 Microcontroller based System: Architecture, Pin Description, Internal Memory Organization. Addressing modes. Instruction set and assembler directives. Assembly Language Programming examples. I/O port structure and programming. Embedded C Programming with I/O port programming examples.

UNIT– 4   **07Hours**

Introduction to 8051 Timers. Timer programming in assembly and C. Introduction to 8051 serial communication. Serial Programming in assembly and C. Introduction to 8051 interrupts. Interrupt Programming in assembly andC.

UNIT– 5   **07Hours**

Interfacing of 8255, 8254, 8259 with 8085 microprocessor. External memory interfacing with 8085 microprocessor and 8051 microcontroller. Interfacing of LED, 7 Segment display, LCD, Keypad, ADC, DAC, DC Motor, Stepper Motor, Temperature sensors, Motion detectors, Relay, Buzzer, Opto-isolators with 8051microcontroller.

TEXT/REFERENCE BOOKS:

1. Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.

2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.

3. M. A. Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearsonedu.

4. Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing, Cengage Learning, Jan2011.

5. David Calcutt, 8051 microcontrollers: Applications based introduction,Elsevier.

6. Udayashankara V., MallikarjunaSwamy, 8051 microcontroller,TMH.

7. K. J. Ayala, 8051 microcontroller, Cenage (Thomson).

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BTETPE603B CMOS Design   **4 Credits**

Course Objectives:

1. Model the behavior of a MOS Transistor
2. Design combinational and sequential circuits using CMOS gates.
3. Analyze SRAM cell and memory arrays.
4. To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
5. 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. Identify the sources of power dissipation in a CMOS circuit.
3. Analyze SRAM cell and memory arrays
4. Use tools for VLSI IC design.

UNIT– 1   **07 Hours**

MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Fabrication, Packaging, and Testing, MOS transistor Theory, Long Channel I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics

UNIT– 2   **07 Hours**

CMOS Processing Technology, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Technology-Related CAD Issues, Manufacturing Issues, Circuit Simulation, A SPICE Tutorial, Device Models, Device Characterization, Circuit Characterization, Interconnect Simulation. Combinational Circuit Design, Circuit Families, Silicon-On-Insulator Circuit Design, Sub Threshold Circuit Design. Sequential Circuit Design, Circuit Design of Latches and Flip-Flops, Static Sequencing Element Methodology, Sequencing Dynamic Circuits, Synchronizers, Wave Pipelining

UNIT– 3   **07 Hours**

Power, Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures, Robustness, Variability, Reliability, Scaling, Statistical Analysis of Variability, Variation-Tolerant Design. Delay, Transient Response, RC

Delay Model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding, Shifters, Multiplication

UNIT– 4   **07 Hours**

Array Subsystems, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays, Robust Memory Design, Special-Purpose Subsystems.

UNIT– 5   **07 Hours**

Packaging and Cooling, Power Distribution, Clocks, PLLs and DLLs, I/O, High-Speed Links, Random Circuits, Design Methodology and Tools, Testing, Debugging, and Verification.

TEXT/REFERENCE BOOKS:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th 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.

BTETPE603C Nano Electronics   **4 Credits**

Course Objectives:

1. To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
2. 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.
3. This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas inVLSI.
4. 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.

5. 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 and Basics of Quantum Mechanics: 07 Hours

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

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 – 2 MOS Scaling theory: 07 Hours

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

UNIT – 3 Nano electronics Semiconductor devices: 07 Hours

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 – 4 Properties of Nano devices: 07 Hours

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

Work functionpinning.

UNIT – 5 Characterization techniques for Nano materials: 07 Hours

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 ElectronicMaterial 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.

BTETPE603D Advanced Digital Signal Processing   4 Credits

Course Objectives:

1. This Multirate Signal Processing course covers advanced techniques for the design of digital filters, which are essential components in almost every digital signal processing system, as well as cyclostationary signals, so important to the understanding of modulation systems.
2. The course then moves on to treat multi-rate systems and presents multi-rate processing of both deterministic and random signals, culminating in a full case study exercise.
3. To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
4. To analyze the effects of interpolation and decimation on random signals.
5. To design interpolation and decimation filters to a given specification.

Course Outcomes:

After successfully completing the course students will have:

1. Ability to understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.

2. Able to explain how the multirate implementation of ADC and DAC converters works.

3. Able to describe basic sampling rate conversion algorithms.

4. Able to draw and describe different kinds of interpolator and decimator.

5. Able to analyze how the interpolated FIR filter works.

6. Able to do sampling rate conversion.

UNIT – 1 Fundamentals of Multirate Systems: **07 Hours**

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems,Special filter and filter banks.

UNIT – 2 Maximally Decimaled Filter Banks: **07 Hours**

Introduction, Errors created in the QMF bank, A simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Trans multiplexer.

UNIT – 3 Paranitary Perfect Reconstruction Filter Banks: **07 Hours**

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel para unitary QMF lattice, M - channel FIR paraunitary filter banks, Transform coding and LOT.

UNIT – 4 Linear Phase and Cosine Modulated Filter Banks: **07 Hours**

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formalsynthesisoflinearphaseFIRPRQMFLattice.PseudoQMFbanks,Designofthe Pseudo QMF bank, Efficient poly phase structure, Cosine modulated perfect reconstruction system.

UNIT – 5 The Wavelet Transform and its Relation to Multirate Filter Banks: 07 Hours

Introduction, Background and outline, Short time Fourier transform, The Wavelet transform, DT orthogonal Wavelets, Continuous time orthonormal Wavelet basis.

Multidimensional, Multivariable and Lossless Systems: Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals. Review of discrete time multi-input multi-output LTI System, Para UNITary and lossless system.

TEXT/REFERENCE BOOKS:

1. P. P. Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, Multirate System and FilterBanks.

2. N. J. Fliege , John Wiley & Sons, Multirate Digital SignalProcessing.

3. RaghuveerRao, AjitBopardikar, Pearson Education Asia, Wavelet Transforms Introduction to Theory andApplication.

4. C. Sidney Burrus ,R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

BTETPE603E Information Theory and Coding   4Credits

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.

2. 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.

3. 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: 07 Hours

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: 07 Hours

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: **07 Hours**

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 and Markov sources: **07 Hours**

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

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 – 5 Speech Coding: **07 Hours**

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, Chaterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering(2nd Edition), TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Interscience.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2nd Edition), Pearson India.
7. N. Abramson, Information and Coding, McGraw Hill, 1963.
8. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

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BTETPE603F VLSI Signal Processing   **4 Credits**

Course Objectives:

1. Introduce students to the fundamentals of VLSI signal processing and expose them to examples of applications.
2. Design and optimize VLSI architectures for basic DSP algorithms.
3. Design and optimize VLSI architectures for basic DSP algorithms.

Course Outcomes:

1. Understand VLSI design methodology for signal processing systems.
2. Be familiar with VLSI algorithms and architectures for DSP.

UNIT– 1   07 Hours

Pipelining and Parallel Processing: Introduction, Pipelining of FIR Digital Filters, Parallel Processing. Pipelining and Parallel Processing for Low Power. Retiming: Introduction, Definition and Properties, Solving System of Inequalities, Retiming Techniques.

UNIT– 2   07 Hours

Unfolding: Introduction an Algorithms for Unfolding, Properties of Unfolding, Critical Path, Unfolding and Retiming Application of Unfolding.

UNIT– 3   07 Hours

Folding: Introduction to Folding Transformation, Register Minimization Techniques, Register Minimization in Folded Architectures, Folding in Multirate Systems.

UNIT– 4   07 Hours

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations Containing Delays.

UNIT– 5   07 Hours

Fast Convolution: Introduction, Cook, Toom Algorithm, Winogard Algorithm, Iterated Convolution, Cyclic Convolution Design of Fast Convolution Algorithm by Inspection

TEXT/REFERENCE BOOKS:

1. Keshab K. Parhi. VLSI Digital Signal Processing Systems, Wiley-Inter Sciences,1999.

2. Mohammed Ismail, Terri, Fiez, Analog VLSI Signal and Information Processing, McGraw Hill, 1994.

3. Kung. S.Y., H.J. While house T.Kailath, VLSI and Modern singal processing, Prentice Hall,1985.

4. Jose E. France, YannisTsividls, Design of Analog Digital VLSI Circuits for Telecommunications andSignal Processing"Prentice Hall, 1994.

BTETPE603G VLSI Design & Technology   **4 Credits**

Course Objectives:

1. To study HDL based design approach.

2. To learn digital CMOS logic design.

3. To nurture students with CMOS analog circuit designs.

4. To realize importance of testability in logic circuit design.

5. To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.

2. Understand chip level issues and need of testability.

3. Design analog & digital CMOS circuits for specified applications

UNIT – 1 VHDL Modeling: **07 Hours**

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM,Meta-stability.

UNIT – 2PLDArchitectures: **07 Hours**

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

UNIT – 3 SoC & Interconnect: **07 Hours**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

UNIT – 4 Digital CMOS Circuits: **07 Hours**

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logicalefforts.

UNIT – 5 Analog CMOS Design and Testability: **07 Hours**

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier and Operational amplifier.

Testability: Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS:

1. Charles H. Roth, "Digital systems design using VHDL",PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.
3. Allen Holberg, "Analog CMOS Design", Oxford University Press.
4. NeilH.   E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication.

BTETOE604A IoT and Industry4.0   **4 Credits**

Course Objectives:

1. Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS),

Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.

2. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Outcomes:

1. Understand the drivers and enablers of Industry4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0world
4. Appreciate the power of Cloud Computing in a networkedeconomy.
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

UNIT – 1 Introduction and Industry4.0:   **07 Hours**

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Cyber security in Industry4.0

UNIT – 2 Basics of Industrial IoT and Introduction: **07 Hours**

Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Referece Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

UNIT – 3 Industrial IoT-Layers: **07 Hours**

Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III., Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics -

Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

UNIT – 4 Industrial IoT: Big Data Analytics and Software Defined Networks: 07 Hours

Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT – 5 Industrial IoT-Application Domains: 07 Hours

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies:

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab

TEXT/REFERENCE BOOKS:

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist(Apress)
2. "Industrial Internet of Things: Cyber manufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat(Springer)
3. Research papers.

BTETOE604B Deep Learning   **4Credits**

Pre-Requisites: Machine Learning

Course Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolution neural networks.

Course Outcomes:

After successfully completing the course, students will be able to

1. Understand the fundamentals of neural networks as well as some advanced topics such as recurrent neural network.
2. Understand convolution neural networks.

UNIT –1 Basics: **07 Hours**

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

UNIT – 2 Feed forward Networks: **07 Hours**

Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, auto encoders.

UNIT – 3 Deep Neural Networks and Better Training of Neural Networks: 07 Hours

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training. Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT – 4 Recurrent Neural Networks and Convolutional Neural Networks: 07 Hours

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

Convolutional Neural Networks: LeNet, AlexNet.

UNIT – 5 Generative models, recent trends and Applications: **07 Hours**

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Recent trends: Variation Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

TEXT/REFERENCE BOOKS:

1. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

2. Neural Networks: A Systematic Introduction, Raúl Rojas,1996

3. Pattern Recognition and Machine Learning, Christopher Bishop,2007

BTETOE604C Computer Network   4 Credits

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.

2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).

3. To provide an opportunity to do network programming

4. To provide a WLAN measurement idea.

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 andtools.

UNIT – 1 Physical Layer: **07 Hours**

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: **07 Hours**

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, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT– 3 Wireless LANS & Virtual Circuit Networks and Network Layer: 07 Hours

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

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

UNIT – 4Transport Layer: 07 Hours
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 – 5ApplicationLayer:07 Hours

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, TataMcGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice HallIndia.
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.

BTETOE604D Industrial Drives and Control   4 Credits

Course Objectives:

To expose the students to the Engineering fundamentals of various Drives and its control, Dynamic operation and their Applications.

Course Outcomes:

At the end of the course, students will demonstrate the ability to gain an ability to design and conduct performance experiments, as well as to identify, formulate and solve drives related problems.

UNIT – 1 Electrical Drives: 07 Hours

Introduction &Dynamics Introduction, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives, Fundamental Torque equations, Speed Torque conventions and Multi-quadrant Operation, Equivalent values of Drive Parameter, Measurement of Moment of Inertia, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy-Loss in Transient Operations, Steady State Stability, Load Equalization.

UNIT – 2 Selection of Motor Power Rating and Control of Electrical Drives: 07 Hours

Thermal Model of Motor for Heating and Cooling, Classes of Motor Rating, Determination of Motor Rating. Control of Electrical Drives: Modes of Operation, Speed Control, Drive Classification, and Closed loop Control of Drives

UNIT – 3 DC Drives: 07 Hours

Review of Speed Torque relations for Shunt, Series and Separately excited Motors, Review of Starting, Braking (Regenerative, Dynamic, Plugging), Review of Speed control, Controlled rectifier fed DC drives (separately excited only): Single phase fully-controlled Rectifier, Single phase Half controlled Rectifier, Three phase fully-controlled Rectifier, Three phase Half-controlled Rectifier, Dual Converter Control, Chopper Control – Motoring and Braking of separately excited and Series Motor. (No numerical from thismodule).

UNIT – 4 AC Drives: 07 Hours

Induction Motor drives, Review of Speed-Torque relations, Review of Starting methods, Braking (Regenerative, Plugging and AC dynamic braking), Transient Analysis, Speed Control: Stator voltage control, Variable frequency control from voltage source, Static Rotor Resistance control, Slip Power Recovery - Static Scherbius Drive, Review of d-q model of Induction Motor, Principle of Vector Control, Block diagram of Direct Vector Control Scheme, Comparison of Scalar control and Vector control, Basic Principle of Direct Torque Control (block diagram) of induction motor. Introduction to Synchronous Motor Variable Speed drives.

UNIT – 5 Special Motor Drives: 07Hours

Stepper Motor drives- Types, Torque vs. Stepping rate characteristics, Drive circuits, Introduction to Switched reluctance motor drives and Brushless DC motor drives.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Electrical Drives by G. K. Dubey, NarosaPublication
2. A First Course on Electrical Drives by S. K. Pillai, New AgeInternational.
3. Electrical Drives: Concepts and Applications by VedamSubramanyam,T.M.H
4. Modern Power Electronics and AC Drives by B. K. Bose, Prentice HallPTR
5. Special Electrical Machines by E.G. Janardanan,PHI
6. Electric Motor Drives: Modeling, Analysis and Control by Krishnan. R,PHI
7. Power Electronics by Joseph Vithayathil, Tata McGrawHill
8. Power Semiconductor Controlled Drives by G. K. Dubey, Prentice HallInternational.

BTETOE604E Robotics Design 4Credits

Course Objectives:

1. To prepare students with basics of robotics
2. To familiarize students with kinematics & dynamics of robots
3. To familiarize students with path & Trajectory planning of robots
4. To familiarize students with robot vision

Course Outcomes:

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

1. Describe kinematics and dynamics of stationary and mobile robots
2. Describe trajectory planning for robots.
3. Implement trajectory generation and path planning various algorithms
4. Work in interdisciplinary projects.

UNIT – 1 Fundamentals of Robotics: **07 Hours**

Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications.

UNIT – 2 Forward & Inverse Kinematics of Robots: **07 Hours**

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Casestudies

UNIT – 3 Velocity Kinematics & Dynamics and Robot Motion Planning: **07 Hours**

Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. Dynamic Analysis of Forces: Lagrangian mechanics, Newton Euler formulation, Dynamic equations of robots, Transformation of forces and moment between coordinate frames.

Robot Motion Planning: Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug

UNIT – 4 Potential Functions and Visibility Graphs: **07 Hours**

Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods

UNIT – 5 Trajectory planning and Robot Vision: **07 Hours**

Trajectory planning: Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories. Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.

TEXT/REFERENCE BOOKS:

1. Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of India

2. Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition,2011

3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, "Principles of Robot Motion – Theory, Algorithms and Implementations", Prentice-Hall of India, 2005.

4. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, "Robot Modeling & Control ", Wiley India Pvt. Ltd.,2006

5. John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India,2009

6. Aaron Martinez & Enrique Fernandez, "Learning ROS for Robotics Programming", Shroff Publishers, First Edition,2013.

7. Mikell P. Groover et.al," Industrial Robots-Technology, Programming & applications", McGraw Hill, New York, 2008

BTETOE604F Patents and IPR   4Credits

Course Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

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

1. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
2. Understand that IPR protection provides an incentive to inventors for further research

work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT –1 Patents: 07 Hours

Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models

UNIT – 2 Patent Rights: 07 Hours

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – 3 Overview of Intellectual Property: 07 Hours

Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad,

UNIT – 4 New Developments in IPR: 07 Hours

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

UNIT – 5 Case studies: 07 Hours

Case studies related to patents and IPR

TEXT/REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition,2011

2. Mayall, "Industrial Design", McGraw Hill,1992

3. Niebel , "Product Design", McGraw Hill,1974.

4. Asimov, "Introduction to Design", Prentice Hall,1962.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.

6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,2008

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BTETOE604G Acoustic Engineering   **4 Credits**

Course Objectives:

1. The learner develops a basic understanding of audio production equipment and software.
2. The Learner develops a basic understanding sound and acoustics
3. Learners will become proficient with an industry standard DAW user interface and related peripheral technology
4. Learners will demonstrate project management skills.

Course Outcomes:

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

1. understanding of audio production
2. basic understanding sound and acoustics
3. learners will come to know about Radiation and diffraction of acoustic, Cavities and waveguides, Resonators and filters

UNIT – 1 Fundamentals of Acoustics: **07 Hours**

Equation of state, Equation of continuity , Euler''s equation , Linearized wave equation , Speed of sound in fluids , Harmonic plane waves , Energy density , Acoustic intensity , Specific acoustic impedance, Spherical waves , Decibel scales

UNIT – 2 Transmission and reflection: **07 Hours**

Transmission from one fluid to another - normal incidence , Transmission through a fluid layer - normal incidence , Transmission from one fluid to another - oblique incidence , Transmission through a fluid layer - oblique incidence , Reflection at a solid surface – normal incidence , Reflection at a solid surface – oblique incidence

UNIT – 3 Radiation and diffraction: **07 Hours**

Pulsating sphere , Acoustic reciprocity , Simple sources , Acoustic dipoles , Acoustic line source , Directivity and beam patterns , Plane circular piston , Near field and far field , Acoustic radiation impedance , Phased arrays

UNIT – 4 Cavities and waveguides: **07 Hours**

Resonance in pipes , Open-ended pipes , Standing waves , Absorption in pipes , Pipes with drivers

UNIT – 5 Resonators and filters: **07 Hours**

Helmoltz resonator, Acoustic impedance (radiation impedance and mechanical impedance),

Waves in a pipe , Acoustic filters

TEXT/REFERENCEBOOKS:

1. Kinsler and Frey, „Fundamentals of Acoustics", 4thedition

BTHM605 Employability & Skill Development   **3 Credits**

Course Objectives:

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successful in a profession.
4. 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: **07 Hours**

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   **07 Hours**

Interpersonal Skills: Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, negotiation, avoiding Stress.

Commercial Awareness: Professional etiquettes and manners, Global negotiating and Persuading, Integrity. Global trends and statistics about civil engineering businesses.

UNIT – 3 Grammar and Comprehension: **07 Hours**

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 – 4 Skills for interviews: **07 Hours**

 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 – 5 Problem Solving Techniques: **07 Hours**

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:

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