

V SEMESTER

MANAGEMENT & ENTREPRENEURSHIP

Subject Code	: 10AL51	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

MANAGEMENT

UNIT - 1

MANAGEMENT: Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of Management - Management as a Science, Art or Profession Management & Administration - Roles of Management, Levels of Management, Development of Management Thought-Early Management Approaches-Modern Management Approaches.

UNIT - 2

PLANNING: Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning only) - Decision making - Importance of planning - steps in planning & planning premises - Hierarchy of plans.

UNIT - 3

ORGANISING AND STAFFING: Nature and purpose of organization - Principles of organization - Types of organization - Departmentation - Committees – Centralisation Vs Decentralisation of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of Staffing - Process of Selection & Recruitment (in brief).

UNIT - 4

DIRECTING & CONTROLLING: Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance – Coordination, meaning and importance and Techniques of Co-ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control.

ENTREPRENEURSHIP

UNIT - 5

ENTREPRENEUR: Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur - an emerging Class. Concept of Entrepreneurship - Evolution of

Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

UNIT - 6

SMALL SCALE INDUSTRY: Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI - Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT Supporting Agencies of Government for S.S.I Meaning; Nature of Support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only).

UNIT - 7

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC.

UNIT - 8

PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of Business Opportunities - Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

TEXT BOOKS:

1. **Principles of Management** - P. C. Tripathi, P. N. Reddy; Tata McGraw Hill.
2. **Dynamics of Entrepreneurial Development & Management** - Vasant Desai Himalaya Publishing House.
3. **Entrepreneurship Development** - Small Business Enterprises - Poornima M Charantimath - Pearson Education – 2006.

REFERENCE BOOKS:

1. **Management Fundamentals** - Concepts, Application, Skill Development Robert Lusier – Thomson.
2. **Entrepreneurship Development** - S S Khanka - S Chand & Co.
3. **Management** - Stephen Robbins - Pearson Education /PHI -17th Edition, 2003.

DIGITAL SIGNAL PROCESSING

Subject Code	: 10EC52	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms.

UNIT - 2

Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.

UNIT - 3

Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).

UNIT - 4

Radix-2 FFT algorithm for the computation of DFT and IDFT—decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform

UNIT - 5

IIR filter design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations.

UNIT - 6

FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique

UNIT - 7

Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (backward difference and bilinear transformation) method, Matched z transforms, Verification for stability and linearity during mapping

UNIT - 8

Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form I and direct form II systems, cascade, lattice and parallel realization.

TEXT BOOK:

1. **Digital signal processing – Principles Algorithms & Applications**, Proakis & Monalakis, Pearson education, 4th Edition, New Delhi, 2007.

REFERENCE BOOKS:

1. **Discrete Time Signal Processing**, Oppenheim & Schaffer, PHI, 2003.
2. **Digital Signal Processing**, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010.
3. **Digital Signal Processing**, Lee Tan: Elsivier publications, 2007

ANALOG COMMUNICATION

Subject Code	: 10EC53	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

RANDOM PROCESS: Random variables: Several random variables. Statistical averages: Function of Random variables, moments, Mean, Correlation and Covariance function: Principles of autocorrelation function, cross – correlation functions. Central limit theorem, Properties of Gaussian process.

UNIT - 2

AMPLITUDE MODULATION: Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

UNIT - 3

SINGLE SIDE-BAND MODULATION (SSB): Quadrature carrier multiplexing, Hilbert transform, properties of Hilbert transform, Pre-envelope, Canonical representation of band pass signals, Single side-band

modulation, Frequency-Domain description of SSB wave, Time-Domain description. Phase discrimination method for generating an SSB modulated wave, Time-Domain description. Phase discrimination method for generating an SSB modulated wave. Demodulation of SSB waves.

UNIT - 4

VESTIGIAL SIDE-BAND MODULATION (VSB): Frequency – Domain description, Generation of VSB modulated wave, Time - Domain description, Envelop detection of VSB wave plus carrier, Comparison of amplitude modulation techniques, Frequency translation, Frequency division multiplexing, Application: Radio broadcasting, AM radio.

UNIT - 5

ANGLE MODULATION (FM)-I: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM.

UNIT - 6

ANGLE MODULATION (FM)-II: Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.

UNIT - 7

NOISE: Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Narrow bandwidth, Noise Figure, Equivalent noise temperature, cascade connection of two-port networks.

UNIT - 8

NOISE IN CONTINUOUS WAVE MODULATION SYSTEMS: Introduction, Receiver model, Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM,.

TEXT BOOKS:

1. **Communication Systems**, Simon Haykins, 3rd Edition, John Wiley, 1996.
2. **An Introduction to Analog and Digital Communication**, Simon Haykins, John Wiley, 2003.

REFERENCE BOOKS:

1. **Modern digital and analog Communication systems** B. P. Lathi, 3rd ed 2005 Oxford University press.

2. **Communication Systems**, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
3. **Communication Systems**: Singh and Sapre: Analog and digital TMH 2nd, Ed 2007.

TRANSMISSION LINES & WAVEGUIDES

Subject Code	: 10TC54	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT 1

Transmission – Line Theory

The transmission Line general solution, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0 , Open and short circuited Lines, Reflection loss, Insertion loss, T and PI sections equivalent to Lines, Constant K LPF & HPF

UNIT 2,3 & 4 .

The Line at radio frequencies

Constants for the Line of zero dissipation, Standing waves; nodes; standing wave ratio, Input impedance of open and short circuited Lines, The quarter wave Line; impedance matching, single stub impedance matching on a Line, The smith circle diagram, Application of the Smith chart, Double stub impedance, Open and Short circuit impedances when considering dissipation, Quarter and Half wave Lines of small dissipation,

UNIT 5

Microwave network theory and passive devices. Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi port networks.

UNIT 6

Microwave waveguides and components: Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits, directional couplers, circulators and isolators.

UNIT 7

Microwave diodes,

Transfer electron devices: Introduction, GUNN effect diodes – GaAs diode, RWH theory, Modes of operation,

Avalanche transit time devices: READ diode, IMPATT diode,

BARITT diode, Parametric amplifiers

Other diodes: PIN diodes, Schottky barrier diodes.

Text Books:

1. Network Lines and Fields - John D Ryder, 2e, PHI, 2003
2. Microwave Devices and circuits- Liao / Pearson Education
Microwave Engineering – Annapurna Das, Sisir K Das TMH
Publication, 2001

DIGITAL SWITCHING SYSTEMS

Subject Code	: 10EC55	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

Developments of telecommunications, Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM, TDM, PDH and SDH, Transmission performance.

UNIT - 2

EVOLUTION OF SWITCHING SYSTEMS: Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronic switching, Digital switching systems.

DIGITAL SWITCHING SYSTEMS: Fundamentals : Purpose of analysis, Basic central office linkages, Outside plant versus inside plant, Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, Basic call processing.

UNIT - 3

TELECOMMUNICATIONS TRAFFIC: Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems.

UNIT - 4

SWITCHING SYSTEMS: Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems.

UNIT - 5

TIME DIVISION SWITCHING: Introduction, space and time switching, Time switching networks, Synchronisation.

UNIT - 6

SWITCHING SYSTEM SOFTWARE: Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1 control, Software architecture for level 2 control, Software architecture for level 3 control, Digital switching system software classification, Call models, Connect sequence, Software linkages during call, Call features, Feature flow diagram, Feature interaction.

UNIT - 7

MAINTENANCE OF DIGITAL SWITCHING SYSTEM: Introduction, Scope, Software maintenance, Interface of a typical digital switching system central office, System outage and its impact on digital switching system reliability, Impact of software patches on digital switching system maintainability, Embedded patcher concept, Growth of digital switching system central office, Generic program upgrade, A methodology for proper maintenance of digital switching system, Effect of firmware deployment on digital switching system, Firmware-software coupling, Switching system maintainability metrics, Upgrade process success rate, Number of patches applied per year, Diagnostic resolution rate, Reported critical and major faults corrected, A strategy improving software quality, Program for software process improvement, Software processes improvement, Software processes, Metrics, Defect analysis, Defect analysis.

UNIT - 8

A GENERIC DIGITAL SWITCHING SYSTEM MODEL: Introduction, Scope, Hardware architecture, Software architecture, Recovery strategy, Simple call through a digital system, Common characteristics of digital switching systems. Analysis report. Reliability analysis.

TEXT BOOKS:

1. **Telecommunication and Switching, Traffic and Networks** - J E Flood: Pearson Education, 2002.
2. **Digital Switching Systems**, Syed R. Ali, TMH Ed 2002.

REFERENCE BOOK:

1. **Digital Telephony** - John C Bellamy: Wiley India 3rd Ed, 2000.

FUNDAMENTALS OF CMOS VLSI

Subject Code	: 10EC56	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

BASIC MOS TECHNOLOGY: Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. Thermal aspects of processing. BiCMOS technology. Production of E-beam masks.

MOS TRANSISTOR THEORY: Introduction, MOS Device Design Equations, The Complementary CMOS Inverter – DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, Tristate Inverter.

UNIT - 2

CIRCUIT DESIGN PROCESSES: MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams. Tutorial exercises.

Basic Physical Design of Simple logic gates.

UNIT - 3

CMOS LOGIC STRUCTURES: CMOS Complementary Logic, Bi CMOS Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic Cascaded Voltage Switch Logic (CVSL).

UNIT - 4

BASIC CIRCUIT CONCEPTS: Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.

SCALING OF MOS CIRCUITS: Scaling models and factors. Limits on scaling. Limits due to current density and noise.

UNIT - 5

CMOS SUBSYSTEM DESIGN: Architectural issues. Switch logic. Gate logic. Design examples – combinational logic. Clocked circuits. Other system considerations.

Clocking Strategies

UNIT - 6

CMOS SUBSYSTEM DESIGN PROCESSES: General considerations. Process illustration. ALU subsystem. Adders. Multipliers.

UNIT - 7

MEMORY, REGISTERS AND CLOCK: Timing considerations. Memory elements. Memory cell arrays.

UNIT - 8

TESTABILITY: Performance parameters. Layout issues. I/O pads. Real estate. System delays. Ground rules for design. Test and testability.

TEXT BOOKS:

1. **CMOS VLSI Design – A Circuits and Systems Perspective. 3rd Edition.** N.H. Weste and David Harris. Addison-Wesley, 2005. (Refer to <http://www.cmosvlsi.com>)
2. **Principles of CMOS VLSI Design: A Systems Perspective,** Neil H. E. Weste, K. Eshragian, and ??? 3rd edition, Pearson Education (Asia) Pvt. Ltd., 200?. (Shift to the latest edition.)
3. **Basic VLSI Design** - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.

REFERENCE BOOKS:

1. R. Jacob Baker. CMOS Circuit Design, Layout and Simulation. John Wiley.
2. **Fundamentals of Semiconductor Devices,** M. K. Achuthan and K. N. Bhat, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
3. **CMOS Digital Integrated Circuits: Analysis and Design,** Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
4. **Analysis and Design of Digital Integrated Circuits** - D.A Hodges, H.G Jackson and R.A Saleh. 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

DIGITAL SIGNAL PROCESSING LABORATORY

Subject Code	: 10ECL57	IA Marks	: 25
No. of Practical Hrs/Week:	03	Exam Hours	: 03
Total no. of Practical Hrs. :	42	Exam Marks	: 50

A LIST OF EXPERIMENTS USING MATLAB / SCILAB / OCTAVE / WAB

1. Verification of Sampling theorem.
2. Impulse response of a given system
3. Linear convolution of two given sequences.
4. Circular convolution of two given sequences
5. Autocorrelation of a given sequence and verification of its properties.
6. Cross correlation of given sequences and verification of its properties.
7. Solving a given difference equation.
8. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
9. Linear convolution of two sequences using DFT and IDFT.
10. Circular convolution of two given sequences using DFT and IDFT
11. Design and implementation of FIR filter to meet given specifications.
12. Design and implementation of IIR filter to meet given specifications.

B. LIST OF EXPERIMENTS USING DSP PROCESSOR

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N- Point DFT of a given sequence
4. Realization of an FIR filter (any type) to meet given specifications .The input can be a signal from function generator / speech signal.
5. Audio applications such as to plot time and frequency (Spectrum) display of Microphone output plus a cosine using DSP. Read a wav file and match with their respective spectrograms
6. Noise: Add noise above 3kHz and then remove; Interference suppression using 400 Hz tone.
7. Impulse response of first order and second order system

REFERENCE BOOKS:

1. **Digital signal processing using MATLAB** - Sanjeet Mitra, TMH, 2001
2. **Digital signal processing using MATLAB** - J. G. Proakis & Ingale, MGH, 2000
3. **Digital Signal Processors**, B. Venkataramani and Bhaskar, TMH,2002

ANALOG COMMUNICATION LAB + LIC LAB

Subject Code	: 10ECL58	IA Marks	: 25
No. of Practical Hrs/Week	: 03	Exam Hours	: 03
Total no. of Practical Hrs.	: 42	Exam Marks	: 50

EXPERIMENTS USING DESCERTE COMPONENTS and LABVIEW - 2009 CAN BE USED FOR VERIFICATION AND TESTING.

1. Second order active LPF and HPF
2. Second order active BPF and BE
3. Schmitt Trigger Design and test a Schmitt trigger circuit for the given values of UTP and LTP
4. Frequency synthesis using PLL.
5. Design and test R-2R DAC using op-amp
6. Design and test the following circuits using IC 555
 - a. Astable multivibrator for given frequency and duty cycle
 - b. Monostable multivibrator for given pulse width W
7. Class C Single tuned amplifier
8. Amplitude modulation using transistor/FET (Generation and detection)
9. Pulse amplitude modulation and detection
10. PWM and PPM
11. Frequency modulation using 8038/2206
12. Precision rectifiers – both Full Wave and Half Wave.

VI SEMESTER

DIGITAL COMMUNICATION

Subject Code	: 10EC/TE61	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

Basic signal processing operations in digital communication. Sampling Principles: Sampling Theorem, Quadrature sampling of Band pass signal, Practical aspects of sampling and signal recovery.

UNIT - 2

PAM, TDM. Waveform Coding Techniques, PCM, Quantization noise and SNR, robust quantization.

UNIT - 3

DPCM, DM, applications. Base-Band Shaping for Data Transmission, Discrete PAM signals, power spectra of discrete PAM signals.

UNIT - 4

ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission.

UNIT - 5

DIGITAL MODULATION TECHNIQUES: Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation techniques.

UNIT - 6

Detection and estimation, Model of DCS, Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input.

UNIT - 7

Detection of known signals in noise, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise.

UNIT - 8

Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency

hop spread spectrum, applications.

TEXT BOOK:

1. **Digital communications**, Simon Haykin, John Wiley, 2003.

REFERENCE BOOKS:

1. **Digital and analog communication systems & An introduction to Analog and Digital Communication**, K. Sam Shanmugam, John Wiley, 1996. 2. Simon Haykin, John Wiley, 2003
2. **Digital communications** - Bernard Sklar: Pearson education 2007

MICROPROCESSORS

Subject Code	: 10EC/TE62	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

8086 PROCESSORS: Historical background, The microprocessor-based personal computer system, 8086 CPU Architecture, Machine language instructions, Instruction execution timing, The 8086

UNIT - 2

INSTRUCTION SET OF 8086: Assembler instruction format, data transfer and arithmetic, branch type, loop, NOP & HALT, flag manipulation, logical and shift and rotate instructions. Illustration of these instructions with example programs, Directives and operators

UNIT - 3

BYTE AND STRING MANIPULATION: String instructions, REP Prefix, Table translation, Number format conversions, Procedures, Macros, Programming using keyboard and video display

UNIT - 4

8086 INTERRUPTS: 8086 Interrupts and interrupt responses, Hardware interrupt applications, Software interrupt applications, Interrupt examples

UNIT - 5

8086 INTERFACING: Interfacing microprocessor to keyboard (keyboard types, keyboard circuit connections and interfacing, software keyboard interfacing, keyboard interfacing with hardware), Interfacing to alphanumeric

displays (interfacing LED displays to microcomputer), Interfacing a microcomputer to a stepper motor

UNIT - 6

8086 BASED MULTIPROCESSING SYSTEMS: Coprocessor configurations, The 8087 numeric data processor: data types, processor architecture, instruction set and examples

UNIT - 7

SYSTEM BUS STRUCTURE: Basic 8086 configurations: minimum mode, maximum mode, Bus Interface: peripheral component interconnect (PCI) bus, the parallel printer interface (LPT), the universal serial bus (USB)

UNIT - 8

80386, 80486 AND PENTIUM PROCESSORS: Introduction to the 80386 microprocessor, Special 80386 registers, Introduction to the 80486 microprocessor, Introduction to the Pentium microprocessor.

TEXT BOOKS:

1. **Microcomputer systems-The 8086 / 8088 Family** – Y.C. Liu and G. A. Gibson, 2E PHI -2003
2. **The Intel Microprocessor, Architecture, Programming and Interfacing**-Barry B. Brey, 6e, Pearson Education / PHI, 2003

REFERENCE BOOKS:

1. **Microprocessor and Interfacing- Programming & Hardware**, Douglas hall, 2nd, TMH, 2006.
2. **Advanced Microprocessors and Peripherals** - A.K. Ray and K.M. Bhurchandi, TMH, 2nd, 2006.
3. **8088 and 8086 Microprocessors - Programming, Interfacing, Software, Hardware & Applications** - Triebel and Avtar Singh, 4e, Pearson Education, 2003

ANTENNAS AND PROPAGATION

Subject Code	: 10EC/TE63	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

ANTENNA BASICS: Introduction, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, diversity and gain, antenna

apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna field zones.

UNIT - 2

POINT SOURCES AND ARRAYS: Introduction, point sources, power patterns, power theorem, radiation intensity, field patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, examples of pattern synthesis by pattern multiplication, non-isotropic point sources, broad side array with non uni polar amplitude distribution, broad side versus end fire array, direction of maxima fire arrays of n isotropic point sources of equal amplitude and spacing.

UNIT - 3

ELECTRIC DIPOLES AND THIN LINEAR ANTENNAS: Introduction, short electric dipole, fields of a short dipole, radiation resistance of short dipole, radiation resistances of $\lambda/2$ Antenna, thin linear antenna, micro strip arrays, low side lobe arrays, long wire antenna, folded dipole antennas.

UNIT - 4 & 5

LOOP, SLOT, PATCH AND HORN ANTENNA: Introduction, small loop, comparison of far fields of small loop and short dipole, loop antenna general case, far field patterns of circular loop, radiation resistance, directivity, slot antenna, Balmain's principle and complementary antennas, impedance of complementary and slot antennas, patch antennas, horn antennas, rectangular horn antennas.

UNIT - 6

ANTENNA TYPES: Helical Antenna, Yagi-Uda array, corner reflectors, parabolic reflectors, log periodic antenna, lens antenna, antenna for special applications – sleeve antenna, turnstile antenna, omni directional antennas, antennas for satellite antennas for ground penetrating radars, embedded antennas, ultra wide band antennas, plasma antenna.

UNIT - 7 & 8

RADIO WAVE PROPAGATION: Introduction, Ground wave propagation, free space propagation, ground reflection, surface wave, diffraction.

TROPOSPHERE WAVE PROPAGATION: Troposcopic scatter, Ionosphere propagation, electrical properties of the ionosphere, effects of earth's magnetic field.

TEXT BOOKS:

1. **Antennas and Wave Propagation**, John D. Krauss, 4th, McGraw-Hill International edition, 2010.
2. **Antennas and Wave Propagation** - Harish and Sachidananda: Oxford Press 2007

REFERENCE BOOKS:

1. **Antenna Theory Analysis and Design** - C A Balanis, 2nd ED, John Wiley, 1997
2. **Antennas and Propagation for Wireless Communication Systems** - Sineon R Saunders, John Wiley, 2003.
3. **Antennas and wave propagation** - G S N Raju: Pearson Education 2005.

MICROWAVES AND RADAR

Subject Code	: 10EC/TE64	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

MICROWAVE TRANSMISSION LINES: Introduction, transmission lines equations and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance and line admittance. Smith chart, impedance matching using single stubs, Microwave coaxial connectors.

UNIT - 2

MICROWAVE WAVEGUIDES AND COMPONENTS: Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits, directional couplers, circulators and isolators.

UNIT - 3

MICROWAVE DIODES,

Transfer electron devices: Introduction, GUNN effect diodes – GaAs diode, RWH theory, Modes of operation, Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, Parametric amplifiers
Other diodes: PIN diodes, Schottky barrier diodes.

UNIT - 4

Microwave network theory and passive devices. Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi port networks.

UNIT - 5

Microwave passive devices, Coaxial connectors and adapters, Phase shifters, Attenuators, Waveguide Tees, Magic tees.

UNIT - 6

STRIP LINES: Introduction, Microstrip lines, Parallellè strip lines, Coplanar strip lines, Shielded strip Lines.

UNIT - 7

AN INTRODUCTION TO RADAR: Basic Radar, The simple form of the Radar equation, Radar block diagram, Radar frequencies, application of Radar, the origins of Radar.

UNIT - 8

MTI AND PULSE DOPPLER RADAR: Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, pulse Doppler Radar.

TEXT BOOKS:

3. **Microwave Devices and circuits-** Liao / Pearson Education.
4. **Introduction to Radar systems-**Merrill I Skolnik, 3rd Ed, TMH, 2001.
5. **Microwave Engineering** – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010.

REFERENCE BOOK:

1. **Microwave Engineering** – David M Pozar, John Wiley, 2e, 2004.

INFORMATION THEORY AND CODING

Subject Code	: 10EC/TE65	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

INFORMATION THEORY: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source.

UNIT - 2

SOURCE CODING: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.

UNIT - 3

FUNDAMENTAL LIMITS ON PERFORMANCE: Source coding theorem, Huffman coding, Discrete memory less Channels, Mutual information, Channel Capacity.

UNIT - 4

Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.

UNIT - 5

INTRODUCTION TO ERROR CONTROL CODING: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

UNIT - 6

Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an $(n-k)$ bit shift register, Syndrome calculation. BCH codes.

UNIT - 7

RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes.

UNIT - 8

Convolution Codes, Time domain approach. Transform domain approach

TEXT BOOKS:

1. **Digital and analog communication systems**, K. Sam Shanmugam, John Wiley, 1996.
2. **Digital communication**, Simon Haykin, John Wiley, 2003.

REFERENCE BOOKS:

1. **ITC and Cryptography**, Ranjan Bose, TMH, II edition, 2007

2. **Digital Communications** - Glover and Grant; Pearson Ed. 2nd Ed 2008

MICROWAVE & ANTENNA LAB

Subject Code	: 10TEL67	IA Marks	: 25
No. of Practical Hrs/Week:	03	Exam Hours	: 03
Total no. of Practical Hrs.:	42	Exam Marks	: 50

LIST OF EXPERIMENTS USING DESCERTE COMPONENTS and LABVIEW – 2009 can be used for verification and testing.

LIST OF EXPERIMENTS

1. Measurement of Microwave power
2. Three point method of obtaining equivalent circuit parameters.
3. Measurement of impedance using slotted line Assembly.
4. Measurement of dielectric strength.
5. Calibration of crystal detector.
6. Calibration of Variable waveguide attenuator.
7. Study of Circulator/Isolator.
8. Study of Directional coupler. Extraction of S-parameter.
9. Study of E-plane H-plane & Magic tee. Extraction of S-parameter.
10. Measurement of phase shift for a ferrite phase shifter.
11. Field intensity measurement of a Horn antenna.
12. Field intensity measurement of a Parabolic dish

MICROPROCESSOR LAB

Subject Code	: 10TEL68	IA Marks	: 25
No. of Practical Hrs/Week:	03	Exam Hours	: 03
Total no. of Practical Hrs.:	42	Exam Marks	: 50

I) Programs involving

- 1) Data transfer instructions like:
 - i] Byte and word data transfer in different addressing modes.
 - ii] Block move (with and without overlap)
 - iii] Block interchange
- 2) Arithmetic & logical operations like:

- i] Addition and Subtraction of multi precision nos.
- ii] Multiplication and Division of signed and unsigned Hexadecimal nos.
- iii] ASCII adjustment instructions
- iv] Code conversions
- v] Arithmetic programs to find square cube, LCM, GCD, factorial

3) Bit manipulation instructions like checking:

- i] Whether given data is positive or negative
- ii] Whether given data is odd or even
- iii] Logical 1's and 0's in a given data
- iv] 2 out 5 code
- v] Bit wise and nibble wise palindrome

4) Branch/Loop instructions like:

- i] Arrays: addition/subtraction of N nos.
Finding largest and smallest nos.
Ascending and descending order
- ii] Near and Far Conditional and Unconditional jumps, Calls and Returns

5) Programs on String manipulation like string transfer, string reversing, searching for a string, etc.

6) Programs involving Software interrupts

Programs to use DOS interrupt INT 21h Function calls for Reading a Character from keyboard, Buffered Keyboard input, Display of character/ String on console

II) Experiments on interfacing 8086 with the following interfacing modules through DIO (Digital Input/Output-PCI bus compatible) card

- a) Matrix keyboard interfacing
- b) Seven segment display interface
- c) Logical controller interface
- d) Stepper motor interface

III) Other Interfacing Programs

- a) Interfacing a printer to an X86 microcomputer
- b) PC to PC Communication

ELECTIVE – GROUP A
PROGRAMMING IN C++

Subject Code	: 10EC761	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

C++, AN OVERVIEW: Getting started, the C++ program, Preprocessor Directives, The Built-In Array Data Type, Dynamic Memory Allocation and Pointers, An Object – based Design, An Object-Oriented Design, An Exception – based Design, An array.

UNIT - 2

THE BASIC LANGUAGE: Literal Constant, Variables, Pointer Type, String Types, const Qualifier, Reference Types, the bool type, Enumeration types, Array types. The vector container type.

UNIT - 3

OPERATORS: Arithmetic Operators, Equality, Relational and Logical operators, Assignment operators, Increment and Decrement operator, The conditional Operator, Bitwise operator, bitset operations. Statements: if, switch, for Loop, while, break, goto, continue statements.

UNIT - 4

FUNCTIONS: Prototype, Argument passing, Recursion and linear function.

UNIT - 5

EXCEPTION HANDLING: Throwing an Exception, Catching an exception, Exception Specification and Exceptions and Design Issues.

UNIT - 6

CLASSES: Definition, Class Objects, Class Initialization, Class constructor, The class destructor, Class Object Arrays and Vectors.

UNIT - 7

Overload Operators, Operators ++ and --, Operators new and delete.

UNIT - 8

Multiple Inheritances, public, private & protected inheritance, Class scope under Inheritance.

TEXT BOOK:

1. **C++ Primer**, S. B. Lippman & J. Lajoie, 3rd Edition, Addison Wesley, 2000.

REFERENCE BOOKS:

1. **C++ Program Design: An Introduction to Programming and Object- Oriented Design**. Cohoon and Davidson, 3rd Edn. TMH publication. 2004.
2. **Object Oriented Programming using C++**, R. Lafore, Galgotia Publications, 2004.

SATELLITE COMMUNICATIONS

Subject Code	: 10EC662	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation, INTEL Sat.

UNIT - 2

ORBITS: Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits, Geostationary orbit: Introduction, antenna, look angles, polar mix antenna, limits of visibility, earth eclipse of satellite, sun transit outage, leandiag orbits.

UNIT - 3

PROPAGATION IMPAIRMENTS AND SPACE LINK: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.

SPACE LINK: Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR.

UNIT - 4

SPACE SEGMENT: Introduction, power supply units, altitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem.

UNIT - 5 & 6

EARTH SEGEMENT: Introduction, receive only home TV system, out door unit, indoor unit, MATV, CATV, Tx – Rx earth station.

INTERFERENCE AND SATELLITE ACCESS: Introduction, interference between satellite circuits, satellite access, single access, pre-assigned FDMA, SCPC (spade system), TDMA, pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA.

UNIT - 7 & 8

DBS, SATELLITE MOBILE AND SPECIALIZED SERVICES: Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, USAT, RadarSat, GPS, orb communication and iridium.

TEXT BOOK:

1. **Satellite Communications**, Dennis Roddy, 4th Edition, McGraw-Hill International edition, 2006.

REFERENCES BOOKS:

1. **Satellite Communications**, Timothy Pratt, Charles Bostian and Jeremy Allnut, 2nd Edition, John Wiley & Sons, 2003.
2. **Satellite Communication Systems Engineering**, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.

RANDOM PROCESSES

Subject Code	: 10EC663	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

INTRODUCTION TO PROBABILITY THEORY: Experiments, sample space, Events, Axioms, Assigning probabilities, Joint and conditional probabilities, Baye's Theorem, Independence, Discrete Random Variables, Engg Example.

UNIT - 2

Random Variables, Distributions, Density Functions: CDF, PDF, Gaussian random variable, Uniform Exponential, Laplace, Gamma, Erlang, Chi-Square, Raleigh, Rician and Cauchy types of random variables

UNIT - 3

OPERATIONS ON A SINGLE R V: Expected value, EV of Random variables, EV of functions of Random variables, Central Moments, Conditional expected values.

UNIT - 4

Characteristic functions, Probability generating functions, Moment generating functions, Engg applications, Scalar quantization, entropy and source coding.

UNIT - 5

Pairs of Random variables, Joint CDF, joint PDF, Joint probability mass functions, Conditional Distribution, density and mass functions, EV involving pairs of Random variables, Independent Random variables, Complex Random variables, Engg Application.

UNIT - 6

MULTIPLE RANDOM VARIABLES: Joint and conditional PMF, CDF, PDF, EV involving multiple Random variables, Gaussian Random variable in multiple dimension, Engg application, linear prediction.

UNIT - 7

RANDOM PROCESS: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, Properties of ACF.

UNIT - 8

EXAMPLE PROCESSES: Markov processes, Gaussian Processes, Poisson Processes, Engg application, Computer networks, Telephone networks.

TEXT BOOK:

1. **Probability and random processes: application to Signal processing and communication** - S L Miller and D C Childers: Academic Press / Elsevier 2004

REFERENCE BOOKS:

1. **Probability, Random variables and stochastic processes** - A. Papoullis and S U Pillai: McGraw Hill 2002
2. **Probability, Random variables and Random signal principles** - Peyton Z Peebles: TMH 4th Edition 2007
3. **Probability, random processes and applications** - H Stark and Woods: PHI 2001

Adaptive Signal Processing

Subject Code	: 10EC664	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT 1

Adaptive Systems: Definition and characteristics, Areas of application, General properties, Open-and closed-loop adaptation, Applications of closed-loop adaptation, Example of an adaptive system.

UNIT 2

The Adaptive Linear Combiner: General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components.

UNIT 3

Properties Of The Quadratic Performance Surface: Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values, a second example.

UNIT 4

Searching The Performance Surface: Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves.

UNIT 5

Gradient Estimation And Its Effects On Adaptation: Gradient component estimation by derivate measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution, excess mean-square error and time constants, mis adjustment, comparative performance of Newton's and steepest-descent methods, Total mis adjustment and other practical considerations.

UNIT 6

The LMS Algorithm: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, misadjustment, performance.

UNIT 7

Adaptive Modeling And System Identification: General description, Adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, Adaptive modeling in FIR digital filter synthesis.

UNIT 8

Adaptive Interfacing Canceling: The concept of adaptive noise canceling, stationary noise-canceling solutions, effects of signal components in the reference input, The adaptive interference canceller as a notch filter, The adaptive interface canceller as a high-pass filter, Effects of finite length and causality, multiple-reference noise canceling.

Text Book:

1. Bernard Widrow and Samuel D. Stearns, Adaptive Signal Processing, Pearson Education Asia, 2001.

Reference Books:

1. Simon Haykin, Adaptive filter Theory , 4e, Pearson Education Asia, 2002
2. Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, Theory and Design of Adaptive Filters, Pearson education/,PHI 2002.

MODERN CONTROL THEORY

Subject Code : **10EC665**

No. of Lecture Hrs/Week : 04

Total no. of Lecture Hrs. : 52

IA Marks : 25

Exam Hours : 03

Exam Marks : 100

UNIT 1:

Linear Spaces and Linear Operators.

Introduction, Fields, Vectors and Vector Spaces, Linear Combinations and Bases, Linear Transformations and Matrices, Scalar Product and Norms, Solution of Linear Algebraic Equations, Eigen values, Eigen vectors and a Canonical-Form, Functions of a Square Matrix.

UNIT 2:

State Variable Descriptions. Introduction, The Concept of State, State Equations for Dynamic Systems, Time-Invariance and Linearity, Non uniqueness and State Model, State diagrams.

UNIT 3:

Physical Systems and State Assignment:

Introduction, Linear Continuous-Time Models, Linear Discrete-Time Models, Nonlinear Models, Local Linearization of Nonlinear Models, Plant Models of some Illustrative Control Systems.

UNIT 4:

Solutions of State Equations: Introduction, Existence and Uniqueness of Solutions to Continuous –Time State Equations, Solution of Nonlinear Continuous-Time Equations, Solution of Linear Time-Varying Continuous – Time State Equations, Solution of Linear Time- Invariant continuous-Time State Equations, Solution of Linear Discrete-Time State Equations, State Equations of Sampled –Data Systems.

UNIT 5

Controllability and Observability: Introduction, General Concept of Controllability, General Concept of Observability, Controllability Tests for Continuous-Time Systems, Observability Tests for Continuous- Time Systems, Controllability and Observability of Discrete-Time Systems, Controllability and Observability of State Model in Jordan Canonical Form, Loss of Controllability and Observability due to Sampling, Controllability and Observability, Canonical Forms of State Model.

UNIT 6:

Relationship between State Variable and Input-Output Descriptions: Introduction, Input-output Maps from State Models, Output Controllability, Reducibility, State models from Input-Output Maps.

UNIT 7:

Stability : Introduction, Stability Concepts and Definitions, Stability of Linear Time-Invariant Systems, Equilibrium Stability of Nonlinear Continuous-Time Autonomous Systems, The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems, Aids to Finding Lyapunov Functions for Nonlinear Continuous-Time Autonomous Systems, Use of Lyapunov Functions to Estimate Transients, The Direct Method of Lyapunov and the Discrete-Time Autonomous Systems.

UNIT 8:

Model Control: Introduction, Controllable and Observable Companion Forms, The effect of State Feedback on Controllability and Observability, Pole Placement by State Feedback, Full-Order Observers, Reduced-Order Observers, Deadbeat Control by State Feedback, Deadbeat Observers.

Text Book:

1. M. Gopal : Modern Control System Theory –; 2nd Edition; New Age Int (P) Ltd. 2007

Reference Books:

1. Richard Dorf & Robert Bishop Modern Control System –, Pearson Education/ PHI.
2. K. Ogata Modern Control Engineering- - Pearson Education / PHI

DIGITAL SYSTEMS DESIGN USING VHDL

Subject Code	: 10EC666	IA Marks	: 25
No. of Lecture Hrs/Week	: 04	Exam Hours	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

UNIT - 1

INTRODUCTION: VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL model for a counter.

UNIT - 2

DESIGNING WITH PROGRAMMABLE LOGIC DEVICES: Read-only memories, Programmable logic arrays (PLAs), Programmable array logic

(PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner.

UNIT - 3

DESIGN OF NETWORKS FOR ARITHMETIC OPERATIONS: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider.

UNIT - 4

DIGITAL DESIGN WITH SM CHARTS: State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines.

UNIT - 5

DESIGNING WITH PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC DEVICES: Xilinx 3000 series FPGAs, Designing with FPGAs, Xilinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series COLDs.

UNIT - 6

FLOATING - POINT ARITHMETIC: Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations.

UNIT - 7

ADDITIONAL TOPICS IN VHDL: Attributes, Transport and Inertial delays, Operator overloading, Multi-valued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and Text IO.

UNIT - 8

VHDL MODELS FOR MEMORIES AND BUSES: Static RAM, A simplified 486 bus model, Interfacing memory to a microprocessor bus.

TEXT BOOK:

1. **Digital Systems Design using VHDL**, Charles H. Roth. Jr., Thomson Learning, Inc, 9th reprint, 2006.

REFERENCE BOOKS:

1. **Fundamentals of Digital Logic Design with VHDL**, Stephen Brwon & Zvonko Vranesic, Tata McGrw-Hill, New Delhi, 2nd Ed., 2007
2. **Digital System Design with VHDL**, Mark Zwolinski, 2 Ed, Pearson Education., 2004
3. **Digital Electronics and Design with VHDL** - Volnei A Pedroni, Elsvier Science, 2009.