



Rashtrasant Tukadoji Maharaj Nagpur University

Formerly Known as Nagpur University



SCHEME OF EXAMINATION FOR

B.E. SEVENTH SEMESTER (ELECTRONICS & COMMUNICATION / ELECTRONICS & TELECOMMUNICATION ENGINEERING)

Sub Code	Board	SUBJECT	Work Load				Credit				Marks				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
											Internal	Unive rsity	Internal	Unive rsity	
BEECE701T/ BEETE701T	Electronics	DSP Processor & Architecture	4	0	1	5	4	0	1	5	20	80	0	0	100
BEECE701P/ BEETE701P	Electronics	DSP Processor & Architecture	0	2	0	2	0	1	0	1	0	0	25	25	50
BEECE702T/ BEETE702T	Electronics	Television & Video Engineering	4	0	1	5	4	0	1	5	20	80	0	0	100
BEECE702P/ BEETE702P	Electronics	Television & Video Engineering	0	2	0	2	0	1	0	1	0	0	25	25	50
BEECE703T/ BEETE703T	Electronics	Optical Communication	4	0	0	4	4	0	0	4	20	80	0	0	100
BEECE704T/ BEETE704T	Electronics	Advanced Digital System Design	4	0	1	5	4	0	1	5	20	80	0	0	100
BEECE704P/ BEETE704P	Electronics	Advanced Digital System Design	0	2	0	2	0	1	0	1	0	0	25	25	50
BEECE705T/ BEETE705T	Electronics	Elective-I	3	0	1	4	3	0	1	4	20	80	0	0	100
BEECE706P/ BEETE706P	Electronics	Project Seminar	0	2	0	2	0	2	0	2	0	0	50	0	50
Total			19	8	4	31	19	5	4	28	100	400	125	75	700

Elective-I – 1. Fuzzy Logic & Neural Network 2. Microelectromechanical Systems and System On Chip 3. Data Compression & Encryption
4. VLSI Signal Processing

B. E. Seventh Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

DSP PROCESSOR & ARCHITECTURE

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE701T/ BEETE701T/ BEENE701T

[4 – 0 – 1 – 5]

Objectives:

1. To study Programmable DSP Processors.
 2. To provide an understanding of the fundamentals of DSP techniques.
 3. To study implementation & applications of DSP techniques.
 4. To study multi-rate filters.
 5. To understand architecture of DSP processor..
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Outcome: By the end of the course, the students shall be able

1. to describe the detailed architecture, addressing mode, instruction sets of TMS320C5X
 2. to write program of DSP processor.
 3. to design & implement DSP algorithm using code composer studio
 4. to design decimation filter and interpolation filter.
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UNIT 1 : FUNDAMENTALS OF PROGRAMMABLE DSPs (10)

Multiplier and Multiplier accumulator, Modified Bus Structures and Memory access in P-DSPs, Multiple access memory, Multi-ported memory, VLIW architecture, Pipelining, Special Addressing modes in P- DSPs, On chip Peripherals, Computational accuracy in DSP processor, Von Neumann and Harvard Architecture, MAC

UNIT 2 : ARCHITECTURE OF TMS320C5X (08)

Architecture, Bus Structure & memory, CPU, addressing modes, AL syntax.

UNIT 3 : Programming TMS320C5X (10)

Assembly language Instructions, Simple ALP – Pipeline structure, Operation Block Diagram of DSP starter kit, Application Programs for processing real time signals.

UNIT 4 : PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: (12)

Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of S320C54XX Processors, Program Control, On-chip peripheral, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors, Block diagrams of internal Hardware, buses, internal memory organization.

UNIT 5: ADVANCED PROCESSORS**(07)**

Code Composer studio - Architecture of TMS320C6X - architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

UNIT 6: IMPLEMENTATION OF BASIC DSP ALGORITHMS:**(08)**

Study of time complexity of DFT and FFT algorithm, Use of FFT for filtering long data sequence, Interpolation filter, Decimation filter , wavelet filter .

Text- Books:

1. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and TMH, 2004.
2. Avtar Singh, S.Srinivasan DSP Implementation using DSP microprocessor with Examples from TMS32C54XX -Thamson 2004.
3. E.C.Ifeachor and B.W Jervis, Digital Signal Processing - A Practical approach, Pearson Publication
4. Salivahanan. Ganapriya, Digital signal processing, TMH , Second Edition

Reference Books:

1. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. , S. Chand & Co, 2000.
2. Digital signal processing-Jonathen Stein John Wiley 2005.
3. S.K. Mitra, Digital Signal Processing, Tata McGraw-Hill Publication, 2001.
4. B. Venkataramani, M. Bhaskar, Digital Signal Processors, McGraw Hill

B. E. Seventh Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

DSP PROCESSOR AND ARCHITECTURE

Duration: 2 Hrs.

College Assessment: 25 Marks

University Assessment: 25Marks

Subject Code: BEENE701P/ BEECE701P/ BEETE701P

[0 – 2 – 0– 2]

Objectives:

1. The DSP algorithms are better implemented on DSP processors having specially tailored architectures.
2. It enables the designers to understand different processors and apply them in system design

Outcome: The students shall be able to

1. Understand the architecture of TMS and Motorola Processors.
2. Implement different processing algorithms on DSP processors.
3. Design different types of filters and study their characteristics.

Any Eight practicals are to be conducted

LIST OF EXPERIMENTS

1. To study architecture of *TMS320C54XX* & Motorola DSP563XX
2. To generate basic signals using *TMS320C54XX* .
3. Write an ALP using instruction of TMS processors to add two numbers.
4. Write ALP to subtract two numbers.
5. Write an ALP to multiply two numbers of unsigned 32 bit data.
6. Write an ALP to divide 16 –bit data by an eight bit data.
7. Implementation of FFT using code Composer studio.
8. To implement Interpolation filter by Matlab.
9. To implement Decimation filter by Matlab.
10. To design FIR filter using MATLAB and find finite word length effect & cross verify using DSP processor.
11. To design IIR filter using MATLAB and find finite word length effect & cross verify using DSP Processor.

B. E. Seventh Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

TELEVISION AND VIDEO ENGINEERING

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE702T/ BEETE702T

[4 – 0 – 1 – 5]

Objectives:

1. To make students understand /explain the analysis and synthesis of T.V. system
 2. To study various colour TV system with greater emphasis on PAL T.V.system.
 3. To study Advance Technology of TV Engineering –Digital T.V., HDTV.
 4. To study various video recording system, display system and its application.
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Outcome: By the end of the course, the students shall be able to

1. analyze and understand colour T.V. System
 2. understand fundamental techniques of Different T.V. standards.
 3. understand Advanced T.V. Technology.
 4. understand different video recording, display and its consumer application.
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Unit 1: Fundamentals of Television and Display

(10)

Television basics: Elements of TV system, low level TV transmission, TV receiver block diagram , Production of luminance & colour difference signal , Composite video signal, and channel bandwidth etc., Color TV systems, colour fundamentals, mixing of colors , color perception, chromaticity diagram.

Unit 2: TV Standards

(08)

NTSC, PAL, SECAM systems, colour TV transmitter, colour TV receivers, remote control, antennas for transmission and TV pattern generation.

Unit 3: Digital TV

(10)

Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG1, MPEG2, MPEG4.

Unit 4: HDTV

(10)

HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, CCTV, CATV, direct to home TV, set top box with recording facility, 3D TV systems.

Unit 5: Video Recorders**(10)**

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G mobile System, Digital Video Recorders, Video Projectors, HD Video projectors, Video Intercom systems.

Unit 6: Consumer Applications**(07)**

Colour TV Digital cameras, Camcorders, Handycams, and Digicams, Display devices: LED, LCD, CD/DVD player, Blue Ray DVD Player, Dish TV.

Text Books

1. Television and video Engineering, A. M. Dhake, Tata McGraw Hill Publication.
2. Video Demisified, Kelth jack, Penram International Publication.
3. Audio Video Systems, R.G. Gupta, Technical Education.

Reference Books

1. S. P. Bali, "Color TV Theory and Practice", McGraw Hill Publications.
 2. Bernard Grob, Charles E, "Basic TV and Video Systems" McGraw Hill Publications.
 3. Gulathi, "Monochrome & Color TV", New Age International Publications .
 4. R.G. Gupta, "Television Engineering & Video Systems", McGraw Hill Publications
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B. E. Seventh Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

TELEVISION AND VIDEO ENGINEERING

Duration: 2 Hrs.

College Assessment: 25 Marks

University Assessment: 25Marks

Subject Code: BEECE702P/ BEETE702P

[0 – 2 – 0– 2]

Objectives:

- 1. To perform practical at a comprehensive coverage of Television Systems with all the new developments in Television Engineering**
- 2. To study and observe the RF based Transmission and Receptions in Audio and Video Mode**
- 3. To develop necessary expertise in handling hardware projects related television subject.**
- 4. To train students in operating and maintenance of all the sophisticated and latest equipment and machinery related to this subject.**

Outcome: By the end of the course, the students shall be able to

- 1. Study and classify the concept of troubleshoot and repair**
- 2. Develop an understanding of electronics, mechanical and environmental factors involved in maintaining television equipment.**
- 3. Analyze and synthesize TV Pictures, Composite Video Signal, TV Receiver Picture Tubes**

Any EIGHT practicals are to be conducted

LIST OF EXPERIMENTS

- 1. To study & understand TV Receiver block diagram & analyze and synthesize TV Pictures.**
- 2. To study & understand the color composite video signal.**
- 3. To study & understand the RF tuner section & measure the voltage at different test points.**
- 4. To study & understand the VIF & SIF section & measure the voltage at different test points.**
- 5. To study & understand the chroma section & measure the voltage at different test points.**
- 6. To study & understand the vertical & horizontal section & measure the voltage at different test points.**
- 7. To study & understand the EHT section.**
- 8. To study & understand power supply section of colour TV system.**
- 9. To study & understand the different patterns with the help of pattern generator.**
- 10. Case study of live broadcasting (e.g. Cricket match/football match).**
- 11. To study & understand HDTV standards.**
- 12. To study & understand various faults and trouble shooting of colour T.V.**
- 13. To study & understand different TV receiver picture tube.**
- 14. To study & understand Digital TV satellite System.**

B. E. Seventh Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

OPTICAL COMMUNICATION

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE703T/ BEETE703T/ BEENE703T

[4 – 0 – 0 – 4]

Objectives:

1. To understand optical fiber technology to sophisticated modern telecommunication systems.
 2. To understand the fundamental behavior of the individual optical components, describes their interactions with other devices in an optical fiber.
 3. To measure & analyze different measurements, parameters & properties of optical fiber.
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Outcome: By the end of the course, the students shall be able to

1. learn the basic elements of optical fiber.
 2. understand the different kinds of losses, signal distortion in optical wave guides & other signal degradation factors.
 3. classify various optical source materials, LED structures, LASER diodes.
 4. learn the fiber optic receivers such as PIN, APD diodes, receiver operation & performance.
 5. understand the operational principal of WDM, SONET, measurement of attenuation, dispersion, refractive index profile in optical fibers.
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UNIT I : OVERVIEW OF OPTICAL FIBER COMMUNICATION

(05)

Introduction, advantages, disadvantages and applications of optical fiber communication, Ray theory, classification of Optical Fibers

UNIT II: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

(10)

Fiber manufacturing & Fiber materials, manufacturing methods, Attenuation, Absorption, scattering losses, bending loss, dispersion, Intra modal dispersion, Inter modal dispersion.

UNIT III: OPTICAL SOURCES AND COUPLERS & CONNECTORS OF FIBER

(08)

Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers.

Optical sources: LED's, LASER diodes.

UNIT IV: OPTICAL DETECTORS AND RECEIVER

(06)

*Photo detectors, Photo detector noise, Response time, comparison of photo detectors
Optical Receiver Operation, receiver sensitivity, quantum limit, coherent detection, burst mode receiver operation, Analog receivers*

UNIT V: ANALOG AND DIGITAL LINKS**(08)**

Analog links – overview of analog links, CNR, multichannel transmission techniques, Digital links – point-to-point links, System considerations, link power budget, rise time budget, transmission distance for single mode links.

UNIT VI : WDM CONCEPTS AND COMPONENTS**(08)**

Operational Principles of WDM, basic applications and types of optical amplifiers, semiconductor optical amplifiers, EDFA. Measurement of Attenuation and dispersion. Study of various application of optical fiber communication.

TEXT BOOKS:

1. "Optical Fiber Communication", Gerd Keiser, 3rd Ed., McGraw Hill,
2. "Optical Fiber Communications", John M. Senior, Pearson Education. 3rd Impression, 2007.

REFERENCE BOOK:

1. Fiber Optic Communication - Joseph C Palais: 4th Edition, Pearson Education.
 2. "TextBook on Optical Fiber Communication & its Application", S.C. Gupta, PHI Publications
 3. "Optical Communication & Networks", M.N. Bandopadhyay, PHI Publications
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B. E. Seventh Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

Advanced Digital System Design

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code BEECE704T/ BEETE704T/BEENE704T

[4 – 0 – 1 – 5]

Objectives:

- 1. To motivate the students to learn basic foundation course in VHDL.**
 - 2. To address the challenges in Hardware design by discussing the role of digital components in system design**
 - 3. To concentrate on HDL based digital design ,HDL terminology, architecture and design of combinational and sequential circuit.**
 - 4. To learn about modeling of system tested with test benches & synthesis also implementation on FPGA/CPLD.**
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Outcome: By the end of the course, the students shall be able to

- 1. Design of combinational & sequential circuit.**
 - 2. Develop skilled VLSI front end designers**
 - 3. Implementation of digital system.**
 - 4. Experimentation on Hardware /Software co-design.**
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UNIT I

(08)

INTRODUCTION TO DIGITAL SYSTEM DESIGN: Device technologies, System representation, Levels of abstraction, Development tasks and EDA software, Development flow, Hardware description language, VHDL in development flow, Basic VHDL concepts.

UNIT II

(10)

BASIC LANGUAGE CONSTRUCTS OF VHDL: Skeleton/syntax of VHDL program, elements and program format, Objects, Data type and operators, Concurrent Signal Assignment, Combinational versus sequential circuits, Signal assignment statements, conditional signal assignment, Selected signal assignment, Conditional versus selected signal assignment statements.

UNIT III:

(08)

SUBPROGRAM:

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

UNIT IV:**(10)**

FINITE STATE MACHINE: Overview of FSM, FSM representation, Moore machine versus Mealy machine, VHDL representation of an FSM, State assignment, Some FSM design examples – sequence detector, FSM based binary counter.

Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment-transition table and problems in transition table.

UNIT V:**(09)**

HDL SYNTHESIS: The Synthesis Concept, Timing Analysis of Logic Circuits, Efficient Coding Styles, Combinatorial Logic Synthesis, Partitioning for Synthesis, Pipelining Resource sharing, Optimizing arithmetic expressions. Power Analysis of FPGA based system.

UNIT VI:**(10)**

Programmable Logic Devices:-Introduction to place & route process, Architecture of CPLD (Xilinx / Altera), FPGA XILINX 4000 Series ,Overview of PLDs, CPLD, FPGA, Design Examples: ALU, barrel shifter, 4*4 Keyboard Scanner, multiplier.

TEXT BOOKS:

1. VHDL, 4th Edition Douglas Perry –TMH
2. Fundamentals of Digital Logic with VHDL design –Stephen Brown, Zvonko Vranesic–TMH.
3. Digital Design Principles – Fletcher.
4. VHDL Synthesis –J Bhasker.
5. VHDL Primer–J Bhasker –Pearson Education.

REFERENCE BOOKS:

1. Digital System Design Using VHDL –Charles H. Roth, McGraw Hill Publications.
2. Digital System Design–John Wakerley, McGraw Hill Publications.
3. VHDL –Zainalabedin Navabbi, McGraw Hill publication
4. VHDL– D. Smith,
5. Digital Design with VHDL - Dr.S.S.Limaye, McGraw Hill Publications .

B. E. Seventh Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

Advanced Digital System Design

Duration: 2 Hrs.

College Assessment: 25 Marks

University Assessment: 25Marks

Subject Code: BEENE704P/ BEECE704P/ BEETE704P

[0 – 2 – 0– 2]

Objectives:

1. To acquire knowledge of computer-aided design tools for design of complex digital logic circuits.
2. To analyze the results of logic and timing simulations and to use these simulation results to debug digital systems

Outcome:

The student shall be able

1. to model, simulate, verify the digital model with hardware description language.
2. to design and prototype with programmable logic devices
3. to learn the modular design style to create large digital logic circuits.
4. to create and simulate basic circuit modules (or macros) using VHDL.

Any EIGHT practicals are to be conducted

LIST OF EXPERIMENTS

12. Design of basic logic gates using VHDL.
13. Design of full adder/subtractor using VHDL.
14. Design of Multiplexer/ Demultiplexer using VHDL.
15. Design of Priority encoder using VHDL.
16. Design of BCD-to-Seven segment encoder.
17. Design of n-bit up-down counter.
18. Design of n-bit shift register using VHDL.
19. Design of sequence detector using Mealy FSM.
20. Design of sequence detector using Moore FSM.
21. Design of 4-bit ALU using VHDL.
22. Design & Implementation of 4-bit barrel shifter using FPGA / CPLD.
23. Design & Implementation of 4-bit multiplier using FPGA / CPLD.
24. Design & Implementation of 4 X 4 keyboard scanner using FPGA / CPLD.
25. Design of Asynchronous sequential circuit using VHDL.
26. Design & implement Mini project on FPGA/CPLD.

All above practicals needs to perform test Bench verification & Synthesis Report.

B. E. Seventh Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

ELECTIVE 1 - FUZZY LOGIC & NEURAL NETWORK

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE705T/ BEETE705T

[3 – 0 – 1 – 4]

Objectives:

1. To provide the student with the basic understanding of neural networks and fuzzy logic fundamentals , Program the related algorithms and design the required and related systems
 2. To make the students well acquainted with Soft computing techniques, especially Fuzzy logic, Neural networks and Genetic algorithm
 3. To make the students able to identify the complex problems in conventional structures, obtain intelligent acceptable solutions for these problems using soft computing techniques and take the necessary corrective action in the light of ongoing events
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Outcome: By the end of the course ,the students shall be able to

1. Understand the adequate knowledge about feedback neural networks.
 2. Understand the concept fuzzy logic control to real time systems.
 3. provide adequate knowledge about fuzzy set theory.
 4. provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic
 5. study and understand defuzzification techniques.
 6. Understand and design genetic fuzzy controller.
 7. gain comprehensive knowledge of adaptive fuzzy system.
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UNIT I : INTRODUCTION:

(10)

Fundamentals and Models of Artificial Neural Systems, Neural computation: Examples and applications, Biological neurons and their artificial models, Models of artificial networks, Neural processing, Learning and adaptation, Neural network learning rules, Overview of neural networks, Single Layer Perception , multilayer perception & its limitation.

UNIT II: MULTILAYER FEED FORWARD NETWORKS

(08)

Linearly non separable pattern classification, Delta learning rule for multi-perceptron layer, generalized delta learning rule, feed forward recall and error back propagation training, learning factors.

UNIT III: SINGLE LAYER FEEDBACK NETWORKS: (07)

Basic concepts and dynamical systems, Mathematical foundations of discrete-time and gradient-type Hopfield networks

Application of Neural Networks: control system application like washing machine, refrigerator, signal processing application like ECG, EMG, EEG.

UNIT IV : INTRODUCTION TO FUZZY LOGIC (08)

Uncertainty and imprecision, Classical sets and Fuzzy sets, Classical relation and fuzzy relations, Operations on crisp and fuzzy relations. Fuzzy tolerance and equivalence

UNIT V: FUZZYFICATION AND DEFUZZIFICATION (07)

*Membership functions, Membership assignment, lambda cuts, Defuzzification methods, **Fuzzy Arithmetic:** Fuzzy numbers, vectors, extension principle, crisp functions, mapping, fuzzy transforms, interval analysis, fuzzy logic controller design.*

UNIT VI: APPLICATIONS OF FUZZY LOGIC (05)

Specific application in the field of control system and Image processing and signal processing, Design of genetic fuzzy controller.

TEXT BOOKS:

1. J. M. Zurada, Introduction to Artificial Neural Networks, Jaico Publishing house.
- 2 T. M. Ross, Fuzzy logic, Mc-Graw Hill Inc.
3. Kosoko, Neural Networks and Fuzzy Systems, PHI Publications

REFERENCE BOOKS:

1. Artificial Neural Network – Simon Haykin, Pearson Education, 2nd Ed.
2. Fundamental of Neural Networks – Laurene Fausett, Pearson, 1st Ed.

3. Neural Fuzzy Systems, C.T Lin & C S George Lee, Prentice Hall.
4. Fuzzy Logic with Engineering Applications, Timothy J. Ross, 2nd edition, McGraw Hill.
5. Fuzzy Sets & Fuzzy Logic- Theory & Applications, George J. Klir, Bo Yuan , Prentice Hall Publications
6. Neural Network, Fuzzy Logic & Genetic Algorithm, S. Rajasekaran, G.A. Vijayalakshmi Pai, PHI Publications.
7. Neural Networks – A classroom approach, Satish Kumar, McGraw Hill
8. Neural Network Design - Martin T. Hagan, Cenage Learning

B. E. Seventh Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

ELECTIVE 1 - MICROELECTROMECHANICAL SYSTEMS AND SYSTEM ON CHIP

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE705T/ BEETE705T

[3 – 0 – 1 – 4]

Objectives:

1. To understand Standard microfabrication techniques and the issues surrounding them.
2. To understand Major classes, components, and applications of MEMS devices/systems and to demonstrate an understanding of the fundamental principles behind the operation of these devices/systems
3. To understand microfabrication techniques and applications to the design and Manufacturing of an MEMS device or a microsystem

Outcome: By the end of the course, the students shall be able to

1. Understand working principles of currently available microsensors, actuators used in Microsystems.
2. Apply scaling laws that are used extensively in the conceptual design of micro devices and systems.
3. Understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
4. Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process
5. Consider recent advancements in the field of MEMS and devices

UNIT 1: Introduction to MEMS

(06)

Benefits of Miniaturization, Types of MEMS: Optical MEMS, Bio- MEMS, RF- MEMS, Microfluidics, Success Stories, Pressure sensor, Accelerometer, Micro-mirror TV Projector

UNIT 2 : Microfabrication and Micromachining

(08)

Integrated Circuit Processes, Bulk Micromachining, Surface LIGA process , *wet & dry etching processes* , Device fabrication using Surface Micromachining example, Microcantilever fabrication

Unit 3: Transducers

(10)

Chemical and Biological Transducers: basic concepts of cellular biology, chemical sensors, molecule-based biosensors, cell-based biosensors, chemical actuators, biological transducers and electrophoresis: optical transducers, thermal transducers, magnetic transducers, RF transducers.

UNIT 4: RF MEMS Devices

(08)

Capacitor, Inductor, Switches, and antennas, RF MEMS components in communications, space and defense applications

UNIT 5: Micro System Packaging**(06)**

Overview of mechanical packaging of microelectronics micro-system packaging.

UNIT 6: Introduction to system-on-chip**(07)**

Design of system on chip, Microsystems technology and applications, core architecture for digital media and the associated compilation techniques

TEXT BOOKS:

1. "Micro and Smart Systems", Ananthasuresh, G. K., Vinoy, K. J., Gopalakrishnan, S., Bhat, K. N., and Aatre V.K., Wiley-India, NewDelhi, 2010.
2. "Micromachined Transducers Sourcebook", Kovacs, Gregory T. A, McGraw-Hill Publications

REFERENCE BOOKS:

1. VLSI Technology, Sze S.M. (ed), McGraw Hill Publications
2. RFMEMS and Their Applications: Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, 2002.
3. "MEMS Practical Guide to Design, analysis and Applications", Jan G Korvinik and Oliver Paul William Andrew, Inc Springer.
4. "MEMs & Microsystem Design and Manufacture", Tai-Ran Hsu, McGraw Hill Publication
5. "MEMs", Nitaigour Premchand Mahalik, McGraw Hill Publications

B.E. Seventh Semester
(Electronics & Communication/ Electronics & Telecommunication Engg)

ELECTIVE 1 - DATA COMPRESSION & ENCRYPTION

Duration: 3 Hrs.
College Assessment: 20 Marks
University Assessment: 80 Marks

Subject Code: BEECE705T/ BEETE705T

[3 – 0 – 1 – 4]

Objectives:

- 1. To understand the different text compression technique.**
- 2. To study the various audio compression scheme.**
- 3. To verify different video compression & image compression methods.**
- 4. To have the knowledge of various encryption technique.**
- 5. To acquire the information about different authentication technique.**

Outcome: By the end of the course, the students shall be able to

- 1. implement various text, audio, video, compression technique.**
- 2. provide various authentication using digital communication.**
- 3. gain the knowledge of encryption techniques application to digital communication.**

Unit 1 : TEXT COMPRESSION (08)

Shannon Fano Coding, Huffman coding, Arithmetic coding and dictionary techniques- LZW, family algorithms, Entropy measures of performance and Quality measures.

Unit 2 : AUDIO COMPRESSION (08)

Digital Audio, Lossy sound compression, μ -law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

Unit 3 : IMAGE AND VIDEO COMPRESSION (08)

Lossless techniques of image compression, gray codes, Two dimensional image transforms, JPEG, JPEG 2000, Predictive Techniques PCM and DPCM. Video compression and MPEG industry standard.

Unit 4 : CONVENTIONAL ENCRYPTION (08)

Introduction, Types of attacks, Steganography, Data Encryption Standards, Block Cipher Principle, S-box design, triple DES with two three keys.

Unit 5: PUBLIC KEY ENCRYPTION AND NUMBER THEORY**(08)**

Euler's theorems, Chinese remainder theorem, Principles of public key cryptography, RSA algorithm, Diffie-Hellman Key Exchange. Elliptic curve cryptology, message authentication and Hash functions, Hash and Mac algorithms, Digital signatures.

Unit 6: SYSTEM SECURITY & CASE STUDIES**(05)**

Intruders, Viruses, Worms, firewall design, antivirus techniques, digital Immune systems, Certificate based & Biometric authentication, Secure Electronic Payment System.

Text Books

1. Data Compression – David Salomon, Springer Publication, 4th Edition.
2. Introduction to Data Compression – Khalid Sayood, Morgan Kaufmann Series, 3rd Edition
3. Cryptography and Network Security – William Stallings, Pearson Education Asia Publication,
4. Cryptography and Network Security – Behrouz Forouzan, McGraw-Hill, 1st Edition.

Reference Books:

1. The Data Compression Book – Mark Nelson, BPB publication, 2nd Edition
2. Applied Cryptography – Bruce Schneier, John Willey & Sons Inc. Publication, 2nd Edition
3. Cryptography & Network Security – Atul Kahate, Tata McGraw Hill, 2nd Edition
4. Cryptography and Network Security – Behrouz A. Forouzan , Special Indian Addition, SIE
5. Network Security & Cryptography – Bernard Menezes, Cenage Learning

B. E. Seventh Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

ELECTIVE 1 - VLSI SIGNAL PROCESSING

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE705T/ BEETE705T

[3 – 0 – 1 – 4]

Objectives:

- 1. To learn pipelining & parallel processing techniques.**
 - 2. To understand folding & unfolding techniques in multirate system**
 - 3. To address folding techniques used to design time multiplexed architecture.**
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Outcome: By the end of the course, the students shall be able to

- 1. Learn various methodologies to optimize power delay and area of VLSI design.**
 - 2. Build Real Time processing system.**
 - 3. Design of algorithm structure for DSP algorithms based on algorithm transformation.**
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Unit I: Pipelining and Parallel Processing

(08)

Introduction, pipelining of FIR Digital filters Parallel processing, Pipelining and parallel processing for low power.

Unit II: Retiming

(06)

Introduction, Definition and properties, solving system of inequalities, retiming techniques.

Unit III: Unfolding

(08)

Introduction, algorithms for unfolding, Properties of unfolding, Critical path, unfolding and retiming Application of unfolding.

Unit IV: Folding

(08)

Introduction Folding Transformation, Register minimization in folded architectures, Folding in Multirate systems.

Unit V: Fast Convolution

(08)

Introduction, Cook- Toom algorithm, Winograd algorithm.

Unit VI:

(07)

Iterated convolution, Cyclic Convolution, Design of Fast Convolution Algorithm by Inspection.

Text 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. Keshab. Parthi, "VLSI Digital signal processing system Design and implementation" Wiley-Inter science, 1999.
4. kung. S.Y., H.J. While house T.Kailath "VLSI and Modern singal processing", prentice hall, 1985.
5. Jose E. France, Yannis Tsividls "Design of Analog Digital VLSI circuits for telecommunications and signal processing" prentice Hall, 19994.



Rashtrasant Tukadoji Maharaj Nagpur University

Formerly Known as Nagpur University



SCHEME OF EXAMINATION FOR

B.E. EIGHTH SEMESTER (ELECTRONICS & COMMUNICATION / ELECTRONICS & TELECOMMUNICATION ENGINEERING)

Sub Code	Board	SUBJECT	Work Load				Credit				Marks				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
											Internal	University	Internal	University	
BEECE801T/ BEETE801T	Electronics	Microwave & Radar Engineering	4	0	0	4	4	0	0	4	20	80	0	0	100
BEECE801P/ BEETE801P	Electronics	Microwave & Radar Engineering	0	2	0	2	0	1	0	1	0	0	25	25	50
BEECE802T/ BEETE802T	Electronics	Computer Communication Network	4	0	1	5	4	0	1	5	20	80	0	0	100
BEECE802P/ BEETE802P	Electronics	Computer Communication Network	0	2	0	2	0	1	0	1	0	0	25	25	50
BEECE803T/ BEETE803T	Electronics	Wireless & Mobile Communication	4	0	0	4	4	0	0	4	20	80	0	0	100
BEECE804T/ BEETE804T	Electronics	Elective-II	3	0	1	4	3	0	1	4	20	80	0	0	100
BEECE805T/ BEETE805T	Electronics	Elective-III	3	0	1	4	3	0	1	4	20	80	0	0	100
BEECE806P/ BEETE806P	Electronics	Project	0	6	0	6	0	6	0	6	0	0	75	75	150
Total			18	10	3	31	18	8	3	29	100	400	125	125	750

Elective-II – 1. Wireless Sensor Network 2. Embedded System 3. Digital Image Processing 4. Artificial Intelligence

Elective-III – 1. Random Signal Theory 2. Robotics & Automation 3. Satellite Communication 4. CMOS VLSI Design

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

MICROWAVE & RADAR ENGINEERING

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE801T/ BEETE801T

[4 – 0 – 0 – 4]

Objectives

1. To understand the principles of the advanced microwave engineering
2. To design of passive and active microwave components and microwave circuits including: micro strip line, guided wave device
3. To study Klystron amplifier and oscillator.
4. To learn working principle of Radar system.
5. To understand the radio wave propagation and interference in mobile communications..
6. To get knowledge and relate different components in Radar and use them in projects.

Outcome: At the end of the course the student should be able to:

1. Understand the use of active and passive microwave devices
2. Analyze Different UHF components with the help of scattering parameter.
3. Understand micro strip lines MIC design
4. Understand the use of different Klystrons.
5. Analyze the different power distribution Tees.
6. Analyze Scattering Matrix of different UHF components.
7. Do research with capabilities in the design, development and manufacture of radar systems used in a wide spectrum of applications.
3. Able for Acquisition of technical competence in specialized areas of Radar engineering.
4. Able to identify, formulate and model problems and find Radar engineering solutions based on a system approach

Unit 1: Microwave Tubes

(08)

High frequency limitations of conventional tubes, Two Cavity and multi cavity Klystrons, Reflex Klystrons, slow-wave structure: TWT, BWO, Magnetron oscillator and its types.

Unit 2: Microwave Components

(10)

Introduction to rectangular waveguide & waveguide excitation ,Principles of S-parameters, S-parameters for multi-ports (2-port, 3-port, 4-port etc.) properties of S-matrix, waveguide Tees (E, H, E-H planes), Directional Couplers, matched terminations, Microwave attenuators, Slotted line, Ferrite devices, Circulators, Isolators, gyrators.

Unit 3: Solid State Microwave Devices

(06)

Parametric amplifiers, PIN diodes, Transferred Electron devices: Gunn diode, Avalanche diode, Transit Time devices like IMPATT, TRAPATT diodes.

Unit 4: Microwave measurement**(08)**

Introduction to microwave measurements, definition and measurement methods of frequency, power, attenuation, VSWR, impedance, insertion loss, dielectric constant, Q of a cavity resonator, phase shift.

Unit 5: Radar Fundamentals**(06)**

Basic principles and fundamentals of Radar , block diagram of basic radar, classification, radar performance factors, radar range equation, factors influencing maximum range, effects of noise, Pulsed radar systems.

Unit 6:**(07)**

Antennas and scanning, display methods, moving target indication, radar beacons, CW Doppler radar, FM CW phased array radars, applications of radar

Text Books

1. S.Y. Liao, "Microwave Devices and Circuits", Prentice Hall India.
2. Skolnik, "Principles of Radar Engineering", McGraw Hill Publications
3. David M. Pozar, "Microwave Engineering", John Willey & Sons.

Reference Book

1. G.S.Raghuwanshi "Microwave Engineering", Cengage India Publications .
2. R.S. Rao, "Microwave Engineering", PHI Publications
3. Annapurna Das, Sisir Das, "Microwave Engineering", McGraw Hill Publications

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

MICROWAVE AND RADAR ENGINEERING

Duration: 2 Hrs.

College Assessment: 25 Marks

University Assessment: 25Marks

Subject Code: BEECE801P/ BEETE801P

[0 – 2 – 0– 2]

Objectives: The objective of this course is to understand the practical concept of microwave engineering

2. To Understand different Power distribution Waveguide and Scattering Matrix.
3. To know about Microwave and its Application.
4. To Study different Microwave Filters.

Outcome:

At the end of the course the students shall be able to:

1. Describe working of microwave bench.
 2. Measure power & VSWR of microwave component.
 3. Analyze the S-parameter of microwave component.
-

Any EIGHT practicals are to be conducted

LIST OF EXPERIMENTS

1. Study the characteristics of Klystron Tube and to determine its electronic tuning range.
2. To study the V-I characteristics of Gunn Diode.
3. To study the following characteristics of Gunn Diode.
 - (a) Output power and frequency as a function of voltage.
 - (b) Square wave modulation through PIN diode.
4. Study the function of Magic Tee by measuring the following parameters.
 - (a) Measurement of VSWR at different ports and
 - (b) Measurement of isolation and coupling coefficient.
5. Study the function of Isolator / Circulator by measuring the following parameters.
 - (a) Input VSWR measurement of Isolator / Circulator.
 - (b) Measurement of insertion loss and isolation.
6. Study the function of Attenuator (Fixed and Variable type) by measuring the following parameters.
 - (a) Input VSWR measurement.
 - (b) Measurement of insertion loss and attenuation.
7. Study the function of Multi Hole Directional Coupler by measuring the following parameters.
 - (a) To measure main line and auxiliary line VSWR.
 - (b) To measure the coupling factor and directivity.
8. Study of a network analyzer and measurements using it.
9. Verification of port characteristics of Microwave Tees (E, H, E-H planes)

10. Verification of port characteristics of Directional Coupler, study of Coupling factor, Insertion loss and Directivity.
11. To plot the radiation pattern of Horn Antenna and calculate its Antenna Gain and Beam width.
12. To plot the radiation pattern of Dish Antenna and calculate its Antenna Gain and Beam width.
13. Simulation of detection of target (i.e. to find distance and position of the target)
14. Simulation of Doppler effect (for moving target).
15. Study of different tracking Radar System (Mono pulse / conical scan / pulse swapping Radar)
16. Study of different types of Antenna (Cassegrain antenna / Parabolic Antenna)
17. Study of Servo-mechanism for Antennas of Radar System.
18. Study of Pulse Radar System.
19. Study of FMCW Radar System.
20. Study of MTI Radar System.

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B. E. Eighth Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

COMPUTER COMMUNICATION NETWORK

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE802T/ BEETE802T/ BEENE802T

[4 – 0 – 1 – 5]

Objectives:

- 1. To explain the basic concept of computer communication network.**
- 2. To explain the computer network layer.**
- 3 To explain IP addressing scheme.**
- 4. To explain network process.**
- 5. To study Hardware aspect of network communication.**
- 6. To make selection of IEEE IAN standards.**
- 7. To explain network security & administration.**

Outcome: By the end of course, the students shall be able to

- 1. Understand the requirement of theoretical & practical aspect of computer network.**
- 2. Understand the network traffic in computer network.**
- 3. Describe various protocols used in network.**
- 4. Describe the concept of computer network security.**
- 5. Understand the different wired & wireless LAN stds.& Routers.**

Unit 1: Introduction to Computer Networks

(06)

Uses of computer Network, Network Software-design Issues for layers, Service primitives and relationship of services to Protocols, Reference models-OSI & TCP/IP, network architectures introduction, Example of networks-X.25, Frame Relay & ATM, Protocols and Standards.

Unit 2: Physical Layer

(10)

Physical layer-Data rate limits, Transmission media-guided and Unguided, Switching systems-Circuit switching, Datagram Switching & Virtual circuit switching, Structure of circuit and packet switch, cable modem and DSL technologies, SONET basics, selection of IEEE std 802.11 ,a,b,c,g.

Unit 3: Data link layer

(10)

Data link layer: Framing, Flow & Error control Protocols, HDLC, PPP, Multiple access techniques-random access, controlled access & Channelization, Ethernet types-bridged, Switched, Full duplex, Fast & gigabit Ethernet, Introduction to Data link layer in 802.11 LAN, Connecting devices like passive hubs, repeaters, Active hubs, Bridges, Two-layer Switches, Routers, three layer switches, Gateway etc., Backbone networks, Virtual LANs, Simple Router architecture, Sliding window protocol.

Unit 4: Transport Layer and Network Layer**(10)**

Transport layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, congestion control and Quality of Service.

Network Layer: IPv4 address, IPv6 address, Address mapping-ARP, RARP & DHCP, IPv4 datagram detail format, IPv6 datagram detail format, ICMP, IGMP, Network layer issues like Delivery, forwarding, intra-domain and Inter-domain routing, Routing algorithms like Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Path vector routing etc., Addressing types-Physical, Logical & port address.

Unit 5: Application Layer**(10)**

Application layer protocols and applications like Ping, FTP, telnet, http (www), SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, NFS, RPC, X-server, E-mail, Introduction to streaming Audio/Video, P2P file sharing, Introduction to socket programming.

Unit 6: Basics of Network Security and Network administration.**(09)**

Network security: Introduction to Cryptography, Secret key algorithm, public key algorithm, Hash Functions, basic ITU-T Recommendation - X.805 Security Architecture, Basics of Security Requirements/Services/Dimensions, Basics of Security attacks, Basics of Security mechanisms / solutions.

Network Administration: UTP Cabling for PC to PC communication, Network tester, network monitoring, Protocol Analyzer, Network Simulation, internet access through Dialup/DSL/Leased Line/Mobile handset.

Text Books

1. Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw Hill
2. Andrew Tenenbaum, "Computer Networks", 4th Edition, Pearson Education.
3. Kurose & Ross, "Computer Networking- A top Down Approach featuring the Internet", 3rd edition, Pearson Education.
4. William Stallings, "computer Networks and Cryptography", 3rd edition, Pearson Education

Reference Books

1. Behrouz A. Forouzan, "TCP/IP protocol Suit", 3rd edition, Tata McGraw Hill Publications
2. Stevens, "TCP/IP illustrated Volume - I & II", Pearson education.
3. Feibel Werner, "Encyclopaedia of networking", Pearson education.
4. Frank J. Derfler, "Practical Networking", 2nd edition, QUE international Publishing.
5. Atul Kahate, "Cryptography and Network Security", 2nd edition, TATA McGraw Hill
6. Kenneth Mansfield, "Computer Networking from LANs to WANs: Hardware, software & Security", CENGAGE learning.
7. Nurul Sarkar, "Computer Networking & Hardware concepts", Information Science Publisher, USA.

B. E. Eighth Semester

(Electronics /Electronics & Communication/ Electronics & Telecommunication Engg)

COMPUTER COMMUNICATION NETWORK

Duration: 2 Hrs.

College Assessment: 25 Marks

University Assessment: 25Marks

Subject Code: BEECE802P/ BEETE802P/ BEENE802P

[0 – 2 – 0– 2]

Objectives:

The objective of this course is to provide students with understanding of

1. Various physical equipments used for networking
 2. Various types of protocols working on various layers of OSI reference model
 3. Connecting computers in Local Area Network
-

Outcomes: At the end of the course the student should be able to

1. understand and select various cables and connectors used for networking
 2. Establish peer to peer computers as well as Local Area Network connectivity
 3. Effectively use available networking tools in Computer Communication Network
-

Any EIGHT practicals are to be conducted

LIST OF EXPERIMENTS

1. To study network simulator & get familiar with NS2
2. To create network Topology in NS2.
3. To demonstrate data transmission using Ping protocol, tracet, IP configuration & hub.
4. To study the fundamental of socket programming.
5. To understand IP address of the system, dhcp, network address translation.
6. To understand the domain name server.
7. To Study Protocol analyzer.
8. To configure router
9. To Study of FTP ,HTFT protocol.
10. To perform PC to PC communication using RS-232 port.
11. To understand Wireless TCP and UDP protocols
12. To demonstrate Network security cryptography

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

WIRELESS & MOBILE COMMUNICATION

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE803T/ BEETE803T

[4 – 0 – 0 – 4]

Objectives:

1. To impart the fundamental concept of mobile communication system.
 2. To give the student the idea about cellular communication theory & technology
 3. To introduce various technology and protocol involved in mobile communication
 4. To provide the student with an understanding the cellular concept.
-

Outcome: By the end of the course, the students shall be able to:

1. Design a model of cellular system communication and analyze their operation and performance.
 2. Quantify the causes and effects of path loss and signal fading on received signal characteristics.
 3. to construct and analyze the GSM system
-

Unit 1: The cellular concept

(06)

Evolution of mobile radio communication. Cellular telephone system, frequency reuse, channel assignment and handoff strategies, interference and system capacity, trunking and grade of service, improving capacity in cellular system.

Unit 2:- The mobile radio environment

(08)

Causes of propagation path loss, causes of fading-long and short term, definition of sample average, statistical average, probability distribution, level crossing rate and average duration of fade, delay spread, coherence bandwidth, inter-symbol interference.

Unit 3:- Equalization, diversity and channel coding

(08)

Fundamentals of equalization, space polarization, frequency and time diversity techniques, space diversity, polarization diversity, frequency and time diversity, fundamentals of channel coding.

Unit 4:- GSM

(08)

Global system for mobile: services and features, GSM system architecture, GSM radio subsystem, GSM channel type, GSM frame structure, signal processing in GSM, introduction to CDMA digital cellular standard, Third generation wireless networks, 3G technology.

Unit 5:-Introduction to wireless networking**(08)**

Difference between wireless and fixed telephone networks, development of wireless network, traffic routing in wireless networks.

Mobile IP and wireless access protocol, mobile IP, operation of mobile IP, collocated address, Registration, Tunneling, WAP Architecture, overview, WML scripts,WAP service, WAP session protocol.

Unit 6: Wireless LAN Technology**(07)**

Infrared LANs, Spread spectrum LANs, Narrow band microwave LANs, IEEE 802 protocol, Architecture, IEEE802 architecture and services, 802.11 medium access control, 802.11 physical layer.

Wireless Application Protocol: architecture, WDP,WTLS, WTP, WSP, WAE,WML scripts.

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, PHI, 2nd Edn.
2. Wireless Communication and Networking – William Stallings, PHI, 2003.
3. Mobile Communications- Jochen Schiller, Pearson Education, 2004.

REFERENCES:

1. Wireless Digital Communications – KamiloFeher, PHI, 1999.
2. Principles of Wireless Networks – KavehPahLaven and P. Krishna Murthy, Pearson Education, 2002.
3. Fourouzan, Data communications and Networking, third edition, Tata McGraw-Hill Publication,2004.
4. Mobile Cellular Telecommunications-William C Y Lee, 2 edition, Mc. Graw Hill Publication.

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 2- WIRELESS SENSOR NETWORK

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE804T/ BEETE804T

[3 – 0 – 1 – 4]

Objectives:

1. Introduce wireless sensor network architectures and communications protocols provide an understanding of mutual relationships and dependencies between different protocols and architectural decisions by offering an in-depth investigation of relevant protocol mechanisms.
2. Introduce sensor network platforms, operating systems and programming tools for sensor networks.
3. Introduce design spaces for sensor networks
4. Study wireless sensor network solutions with practical implementation examples and case studies.
5. Introduction to wireless sensor networks: Challenges for WSNs, enabling technologies.
6. Single node architecture: Hardware components, energy consumption of sensor nodes, operating systems and execution environments.

Outcome: By the end of this course, the students shall be able to

1. Demonstrate advanced knowledge and understanding of the engineering principle of sensor design, signal processing, established digital communications techniques, embedded hardware and software, sensor network architecture, sensor networking principles and protocols.
2. Demonstrate a computing science approach, in terms of software techniques, for wireless sensor networking with emphasis on tiny sensors, sensor specific programming languages, RFID technology, embedded architectures, software program design and associated hardware, data fusion.
3. Demonstrate knowledge of the associated business, legislative, safety and commercial issues; future technological advances and the way these will impact on the engineering product enterprise process.

Unit – I

(08)

Introduction and Overview of Wireless Sensor Networks, Commercial and Scientific Applications of Wireless Sensor Networks, Basic Wireless Sensor Technology, Sensor Taxonomy, wireless network environment, wireless network trends.

Unit – II

(08)

Radio technology primer, Available wireless technologies, Wireless Sensors Networks Protocols, Physical Layer, Fundamentals of Medium Access Control Protocols for Wireless Sensor Networks, MAC protocols for WSN, Case Study, IEEE 802.15 4LR WPAN, Standard case study.

Unit – III

(08)

Sensors Network Protocols, Data dissemination and gathering, Routing Challenges and design issues in wireless sensor network, Routing strategies in WSN.

Unit – IV**(08)**

Protocols, Transport Control Protocols for Wireless Sensors Networks, Traditional transport control protocol, transport protocol design issues, examples of existing transport control protocol, performance of TCP.

Unit – V**(06)**

Middleware for Sensor Networks, WSN middleware principles, Middleware architecture, existing middleware.

Unit – VI**(07)**

Network Management for Wireless Sensor Networks, Requirements, Design issues, Examples of management Architecture, Performance and Traffic Management Issues.

Text Books:

1. Morgan Kaufmann F. Zhao and L. Guibas, 'Wireless Sensor Networks', San Francisco, 2004.
2. C. S. Raghavendra, Krishna M. Sivalingam, Taieb F. Znati, 'Wireless sensor networks', Edition: 2, Published by Springer, 2004 ISBN 1402078838, 9781402078835

Reference Books:

1. "Wireless Sensor Networks: Technology, Protocols, and Applications", Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Interscience Publication, 2007
2. "Computer Networks", Andrew Tanenbaum, 4th ed, Pearson Education, 2007

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 2- EMBEDDED SYSTEMS

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE804T/ BEETE804T

[3 – 0 – 1 – 4]

Objectives:

1. To give sufficient background for understanding embedded systems design.
 2. To give knowledge of RISC processor.
 3. To understand connections of various peripherals with microcontroller based system
 4. To study of embedded system design aspects.
-

Outcome: By the end of the course, the students shall be able to

1. design embedded based system .
 2. design embedded system based on RTOS and communication protocols.
-

UNIT I: EMBEDDED SYSTEM INTRODUCTION

(08)

History, Design challenges, Optimizing design metrics, Time to market, NRE and UNIT cost design metrics, Application of embedded systems and recent trends in embedded systems.

UNIT II: EMBEDDED SYSTEM ARCHITECTURE

(08)

Hardware and software architecture, Processor selection for Embedded System, Memory Architecture and IO devices , Interrupt Service Mechanism ,Context switching, Device Drivers.

UNIT III: ARM PROCESSOR

(10)

Architecture and Programming: RISC and CISC, ARM organization, ARM Programmers model, operating modes, Exception Handling, Nomenclature, Core Extensions, ARM Assembly Language Programming, Introduction to ARM instruction set

UNIT IV: PROTOCOLS

(06)

Bluetooth, IEEE 802.11 and IEEE 802.16, GPRS, MODBUS CAN, I2C and USB

UNIT V: REAL TIME OPERATING SYSTEM CONCEPTS

(08)

Architecture of the kernel , Task scheduler , ISR , Semaphores , Mailbox , Message queues , Pipes, Events , Timers , Memory Management.

UNIT VI: CASE STUDY OF EMBEDDED SYSTEM:

(05)

Based on Communication, Automation, Security, Automobile Fields

Text Books:

- 1) Raj Kamal, "Embedded Systems ", TMH Publications.
- 2) Frank Vahid, "Embedded System Design", Wiley Publications, New edition 2001.
- 3) Sloss endrew & Dominic Symes, "ARM system Developers Guide", Morgan Kaufmann , 2004 .

Reference Books :

- 1) Dr. K.V.K.K. Prasad , "Embedded / Real Time Systems", Dreamtech Publications
- 2) Iyer, Gupta , "Embedded Real systems programming", TMH Publications.
- 3) Steve Heath, "Embedded System Design", Neuwans Publications
- 4) Jonathan,W. Valvano, " Embedded Microcomputer System Realtime Interfacing", Cenage Publications, 3rd Edition.

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 2- DIGITAL IMAGE PROCESSING

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE804T/ BEETE804T

[3 – 0 – 1 – 4]

Objectives:

1. Provide the student with the fundamentals of digital image processing.
2. Introduce the students to some advanced topics in digital image processing.
3. Give the students a useful skill base that would allow them to carry out further study in the field of Image processing.

Outcome: By the end of the course, students shall be able to

1. have an appreciation of the fundamentals of Digital image processing including the topics of filtering, transforms and morphology, and image analysis and compression.
2. implement basic image processing algorithms in MATLAB.
3. have the skill base necessary to further explore advanced topics of Digital Image Processing.
4. make a positive professional contribution in the field of Digital Image Processing

Unit 1: Digital Image Fundamentals

(06)

Components of Image Processing System. , Image Sensing and Acquisition, Image Sampling & Quantization, Spatial and Gray Level Resolution, Basic Relationships between Pixels. Statistical parameters, Measures and their significance, Mean, standard deviation, variance, SNR, PSNR etc.

Unit 2: Image Enhancement

(10)

Enhancement in Spatial Domain: basic gray level transformations, histogram processing, equalization, Arithmetic and logical operations between images, Basics of spatial filtering, smoothing and sharpening spatial filters, Image Enhancement in frequency Domain: smoothing and sharpening frequency domain filters, Fundamental of color image processing: color models, RGB, CMY, YIQ, HIS, Pseudo Color Image processing: Intensity filtering, gray level to color transformation, Basics of full color image processing.

Unit 3: Image Transforms

(08)

2D-DFT, FFT, DCT, the KL Transform, Walsh/Hadamard Transform, Haar Transform, slant Transform , Basics of wavelet transform.

Unit 4: Image Coding and Compression

(08)

Image Coding Fundamentals, Image Compression Model, fundamentals- redundancy: coding, interpixel, psychovisual, fidelity criteria, Basic compression methods Error Free Compression - variable length, bit plane, LZW arithmetic Lossless Predictive, Lossy Compression- Lossy Predictive. Fundamentals of JPEG, MPEG, fractals.

Unit 5: Image Analysis

(08)

Segmentation: Point, line, Hough Transform, Edge detection, Boundary detection and

Thersholding, Region Based segmentation.

Representation & Description :Boundary representation by chain codes, signature & skeleton Boundary descriptors, shape number, Fourier descriptors ,Basics of Regional descriptor, boundary representation by chain codes and B splines, Hough Transform, Morphological Image Processing: Dilation, Erosion, Opening, Closing on Binary Images.

Unit 6: Image restoration and reconstruction

(05)

Image Degradation Mode, Noise Models, and Restoration in Presence c Noise in spatial Domain. Inverse Filtering, wiener filtering, Introduction to Image reconstruction from projections applications of Image Processing.

Text Books

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education,
2. Arthur Weeks Jr., "Fundamentals of Digital Intake Processing", PHI.
3. S Jayaraman, "Digital Image Processing", Tata McGraw Hill Publications.
4. A. K. Jain, "Fundamentals of Digital Image Processing"; Pearson Education

Reference Book

1. Pratt William, "Digital Image Processing", John Wiley & Sons
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning, 2001
3. Milan Sonka, Vaclav halvac , "Image Processing analysis & Machine Vision", Cenage Learning

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 2- ARTIFICIAL INTELLIGENCE

Duration: 3 Hr.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE804T/ BEETE804T

[3 – 0 – 1 – 4]

Objectives:

1. To introduce the fundamental concepts of artificial intelligence;
2. To equip students with the knowledge and skills in logic programming using Prolog;
3. To explore the different paradigms in knowledge representation and reasoning;
4. To explain the contemporary techniques in machine learning;
5. To evaluate the effectiveness of hybridization of different artificial intelligence techniques.

Outcome: By the end of the course students shall be able to:

1. understand the history, development and various applications of artificial intelligence;
2. familiarize with propositional and predicate logic and their roles in logic programming;
3. understand the programming language Prolog and write programs in declarative programming style; .
4. learn the knowledge representation and reasoning techniques in rule-based systems, case-based systems, and model-based systems;
5. understand how uncertainty is being tackled in the knowledge representation and reasoning process, in particular, techniques based on probability theory and possibility theory (fuzzy logic);
6. master the skills and techniques in machine learning, such as decision tree induction, artificial neural networks, and genetic algorithm;
7. apply and integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.

Unit 1: Foundation

(08)

Intelligent Agents, Agents and environments, Good behavior, The nature of environments, structure of agents, Problem Solving, problem solving agents, example problems, searching for solutions, uniformed search strategies, avoiding repeated states, searching with partial information.

Unit 2: Searching

(08)

Search and exploration, Informed search strategies, heuristic function, local search algorithms and optimistic problems, local search in continuous spaces, online search agents and unknown environments, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP, Structure of problems, Adversarial Search, Games: Optimal decisions in games, Alpha- Beta Pruning, imperfect real-time decision, games that include an element of chance.

Unit 3: Knowledge Representation**(08)**

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining, Resolution, Knowledge representation, Ontological Engineering, Categories and objects, Actions - Simulation and events, Mental events and mental objects.

Unit 4: Learning**(08)**

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks - Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.

Unit 5: Perception and Expert System**(06)**

Visual perception -Waltz's algorithm, Introduction to Expert System, Architecture and functionality, Example Expert system

Unit 6: Natural Language Understanding**(07)**

Why NL, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models.

Text Book

1. Stuart Russell, Peter Norvig, "Artificial Intelligence, A Modern Approach", 2nd Edition, Pearson Education / Prentice Hall of India, 2004.

Reference Books

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw- Hill,
3. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education / PHI, 2002.
4. Eugene charniak, "Introduction to Artificial Intelligence", Pearson Education.
5. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publications

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 3- RANDOM SIGNAL THEORY

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE805T/ BEETE805T

[3 – 0 – 1 – 4]

Objectives:

1. To Learn the Random Variables and Random Processes
 2. To Design the systems which involves randomness using mathematical analysis and computer simulations.
-

Outcome: At the end of the course, students shall be able to

1. Apply theory of probability in identifying and solving relevant problems.
 2. Define and differentiate random variables and vector through the use of cumulative distribution function (CDF), probability density function (PDF), probability mass function (PMF) as well as joint, marginal and conditional CDF, PDF and PMF.
 3. Show probability and expectation computations using important discrete and continuous random variable types.
 4. Define and specify random processes and determine whether a given process is stationary or wide sense stationary.
-

Unit I: RANDOM VARIABLES

(08)

Introduction: Random input signals, random experiments and events.

Random Variables: Concept of random variable, distribution functions, density functions, mean values and moments, density functions related to Gaussian-Rayleigh distribution, Maxwell distribution, Chi-square distribution, normal distribution, uniform distribution, exponential distribution, Conditional probability distribution and density functions.

Unit II :

(09)

Several random variables : Two random variables, joint conditional probability, statistical independence, correlation between random variables, density function of sum of two random variables, probability density function of two random variables, the characteristic function.

Elements of statistics: curve fitting and linear regression, correlation between two sets of data.

Unit III: RANDOM PROCESSES

(08)

Random Processes: Continuous and discrete, deterministic and non-deterministic, stationary and non-stationary, ergodic and non-ergodic.

Correlation functions : Introduction, autocorrelation function of a binary process, properties of auto correlation functions, examples of auto-correlation functions, cross-correlation functions, properties of cross correlation functions, examples and applications of cross-correlation functions.

Unit IV: SPECTAL DENSITY

(08)

Introduction, relation of spectral density to the fourier transform, properties of spectral density, mean square values from spectral density, relation of spectral density to the auto-correlation function, White noise, Cross spectral density, examples and applications of spectral density.

Unit V: RESPONSE OF LINEAR SYSTEMS TO RANDOM INPUT

(06)

Analysis in the time domain, mean and mean square value of system output auto-correlation function of system output, cross-correlation between input and output, spectral density at the system output.

Unit VI: OPTIMUM LINEAR SYSTEMS

(06)

Criteria of optimality, restrictions on the optimum system, optimization by parameter adjustment systems that maximizes signal to noise ratio, systems that minimize mean square error.

Text Books :

1. G.R. Cooper and C.D. Mcgillem : Probabilistic Methods of Signal and System Analysis, Third Ed, Oxford University Press.
2. M. Lefebvre : Applied Probability and Statistics, Springer, McMillan India Ltd.
3. A. Papoulis, S.U. Pillai : Probability, Random Variable and Stochastic Process , TMH.
4. Peyton J. Peebles (Jr), "Problems and Solutions in Probability, Random Variables and Random Signal Principles", McGraw Hill Publications.
5. P Ramesh Babu, "Probability Theory and Random Processes", McGraw Hill Publications

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 3- ROBOTICS & AUTOMATION

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE805T/ BEETE805T

[3 – 0 – 1 – 4]

Objectives:

1. The course has been so designed to give the students an overall view of the mechanical components.
2. The mathematics associated with the same. Actuators and sensors necessary for the functioning of the robot.

Outcome: By the end of the course, the students shall be able to

1. Explore 8051 microcontroller architecture
 2. Effectively utilize instruction set for assembly language programming
 3. Interface different on & off chip peripherals with 8051 using C language
 4. Basics of 8051 can be used for robotic applications
-

UNIT1:

(10)

Definition of a Robot, A brief introduction to Robot Technology, Sensory perception, Intelligence, End Effectors, Sensory feedback, Robot Vision / Computer Vision and its fundamental components, Tactile Sensing, Range finding and real world navigation Speech synthesis and recognition.

Robot control fundamentals : *The Artificial intelligence view point, comparison of human brain and computer in the context of intelligent behavior, problem representation in A.I., system problem solving technique in A.I.*

UNIT 2:

(08)

Definition of knowledge, Domain and logic : Elements of logic, propositional calculus, predicate calculus, pros and cons of logic, production system and their basis elements, about Expert system comparison of various methods of knowledge representation.

UNIT 3:

(08)

Elements of speech, Time Domain Analysis / Synthesis of speech and waveform digitization, frequency Domain Analysis / Synthesis of speech phoneme Speech Synthesis, various type of speech recognition Systems and their basics ideas, Isolated word Recognition, Connected Speech understanding.

UNIT4:

(06)

Elements of vision, Image Transformation, Image Analysis, Image Understanding of Machine perception, Industrial Vision System.

UNIT 5:**(06)**

Triangulation Method, Time of Flight (TOF), Ranging Method, Robot Position and Proximity Sensing, Tactile- Sensing System, Sensing Joint Forces and their importance in Robot programming, sensing touch and slip

UNIT 6 :**(07)**

Various Robot Programming Languages and their characteristics, characteristics of Robot Task Level language, comparison of Robot programming language, features of the high level languages used in conventional programming language, featuring with the high level language used in conventional programming.

TEXT BOOKS :

1. Staugard A.C. : "Robotic and AI", Prentice Hall, Engle Wood Cliff N.J. 1987.
2. Lee C.S.G., Fu K. S., Gonzalez R.C. : "Robotic-Control, Sensing and Intelligence", Mc- Graw Hill, Singapore, 1987.

REFERENCE BOOKS :-

1. Klafferetal : "Robotics", Prantice Hall Publications
2. Parent M. and Laugreau C. : "Robot Technology (Vol.4 : Logic and Programming)", Kogan Page, London, 1985.
3. Aleksander I. ,Farreny H. and Ghallab M. : "Robot Technology" (Vol-1)., Decision and Intelligence "Kogan Page", 1986.
4. S.R. Deb, " Robotics Technology & Flexible Automation", McGraw Hill Publication
5. S.K. shaha, "Introduction to Robotics", McGraw Hill Publication

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 3- SATELLITE COMMUNICATION

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE805T/ BEETE805T

[3 – 0 – 1 – 4]

Objectives:

1. To learn working principle of satellite communication system.
 3. To understand the orbital aspects and components of a satellite communication system.
 4. To analyze the link budget of a satellite communication system and study of satellite orbits and launching.
 5. To get knowledge and relate different components in satellite communication and use them in projects.
-

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

1. Do research with capabilities in the design, development and manufacture of satellite communication systems used in a wide spectrum of applications.
 2. Experience real world experience from household appliances to sophisticated satellite communication, from electronic ignition to neural networks and signal processing chips & to integrate academic discipline with project-based engineering applications, classroom learning theory
 3. Able for Acquisition of technical competence in specialized areas of Satellite Communication engineering.
 4. Able to identify, formulate and model problems and find Satellite Communication engineering solutions based on a system approach.
-

UNIT I:

(08)

Introduction: Origin of Satellite communication, Current state of satellite communication. Orbital aspect of satellite communication: Orbital mechanism, equation of orbit, locating satellite in orbit, orbital elements, and orbital perturbation. Space craft subsystem: Attitude and orbit control system, Telemetry tracking and command power system, and communication subsystem.

UNIT II:

(08)

Satellite link design: System noise temperature and T / T ratio, down link design, domestic satellite system, uplink design, design of satellite link for specified (C / N).

UNIT III:

(08)

Multiple access techniques: FDMA, FDM / FM / FDMA, effects of intermodulation, companded FDM / FM / FDMA, TDMA, TDMA frame structure and design, TDMA synchronization and timing, code division multiple access, SS transmission and reception; Applicability of CDMA to commercial system, multiple access on board processing SCPS system, digital speech interpolation system, DAMA.

UNIT IV:**(08)**

Propagation on satellite: Earth's path – propagation effects, atmospheric absorption, Scintillation effects, Land and Sea multipath, Rain and ice effects, Rain drop distribution, calculation of attenuation. Rain effects on Antenna noise temperature.

UNIT V:**(08)**

Encoding and forward error correction: Error detection and correction, channel capacity, error detecting codes, linear block codes, error correction with linear block codes, performance of block error correction codes, convolution codes, cyclic codes, BCH and codes, error detection on satellite links.

UNIT VI:**(05)**

Earth Station technology: Earth Station design; antennas tracking, LNA, HPA, RF multiplexing, factors affecting orbit utilization, tracking, equipment for earth station.

Text BOOKS:

1. "Satellite Communication" by T. Pratt. Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2003.
2. "Satellite Communication", D. C. Agrawal, Khanna Publishers
3. "Satellite Communication", Dennis Roddy, 4th Edition, McGraw- Hill International edition, 2006.
4. "Satellite Communication", T. T. Hai., Mc.Graw Hill Publications

REFERENCES BOOKS:

1. **Satellite Communication Systems Engineering**, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.
2. Satellite Communication, Mark R Chartrand, Cenage Learning

B. E. Eighth Semester

(Electronics & Communication/ Electronics & Telecommunication Engg)

Elective 3- CMOS VLSI DESIGN

Duration: 3 Hrs.

College Assessment: 20 Marks

University Assessment: 80 Marks

Subject Code: BEECE805T/ BEETE805T

[3 – 0 – 1 – 4]

Objectives:

- 1. Motivating students to learn basics of CMOS VLSI design.**
 - 2. To learn CMOS device parameters and characteristics.**
 - 3. To detect faults and errors in the design.**
 - 4. To learn physical design of logic gates.**
 - 5. To Study CMOS processing technology.**
-

Outcome: By the end of course, the students shall be able to

- 1. Design PMOS and NMOS transistor.**
 - 2. Implementation different combinational logic circuits.**
 - 3. Design layout for various circuits.**
 - 4. Design CMOS transistor.**
 - 5. Experiment on CMOS logic design.**
 - 6. Detect and correct errors in VLSI Design.**
-

UNIT 1: MOS TRANSISTORS

(08)

nMOS enhancement and pMOS enhancement transistor, threshold voltage, body effect, MOS effect, MOS device equations, small signal model for MOS transistor.

UNIT 2: CMOS INVERTER

(08)

Principle of operation, dc characteristics, transient characteristics, β_n/β_p ration, noise margin, static load MOS inverter, transmission gate, introduction to Bi-CMOS inverter.

UNIT 3: STUDY OF CMOS LOGIC

(08)

Study of combinational logic, gates, compound gates, multiplexers, and memory elements using CMOS technology.

UNIT 4: CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION

(06)

Resistance and capacitance estimation, switching characteristics, power dissipation, charge sharing.

UNIT 5: VLSI DESIGN

(06)

VLSI processing integration, layout design rules, and stick diagram representation latch up, CMOS circuits and logic design: transistor sizing, fan-in, fan-out and physical design of simple logic gates, CMOS logic structures and clocking strategies.

UNIT 6: DESIGN FAULTS

(09)

Types of fault, stuck open, short, stuck at 1, 0 faults, Fault coverage, Need of Design for Testability (DFT), Controllability, predictability, testability, Built In Self Test (BIST), Partial and full scan check, Need of boundary scan check, JTAG, Test Access Port (TAP) controller.

Text Books:

1. "Principal of CMOS VLSI design", Neil H. E. Weste, K. Eshraghian, Addison Wesley VLSI Series.
2. "Digital Interrogated circuits, A Design Perspective" , J. M. Rabaey, A. Chandrakasan, and B. Nikolic., PHI Publications .
3. "CMOS VLSI Design" , Pucknell & K. Eshraghain, PHI Publications

REFERENCES BOOKS:

1. "VLSI Technology", S.M. Sze, McGraw Hill Publications
2. "VLSI Design Technologies for Analog & Digital Circuits", Randall L Gei , McGraw Hill Publications