BABU BANARASI DAS UNIVERSITY
LUCKNOW

SCHOOL OF ENGINEERING

Syllabus for

B.Tech Third & Final Year

in

Electronics and Communication Engineering

(Effective from the Academic Session 2013-14)

FIFTH SEMESTER

Sl. No.	Code No	Name of Subjects	Periods/ Week			Evaluation Scheme				Subject Total	Credits
			L	T	P/ S	Sessional Exam.			ESE		
						CT	TA	Total			
Theory											
01.	BHU – 505	Engineering and Managerial Economics	3	1	0	30	20	50	100	150	4
02.	BEC – 501	Analog Communication System	3	1	0	30	20	50	100	150	4
03.	BEC – 502	Control System	2	1	0	15	10	25	50	75	3
04.	BEC – 503	Computer Architecture & Organization	3	1	0	30	20	50	100	150	4
05.	BEC – 504	Microprocessors	2	1	0	30	20	50	100	150	4
06.	BEC – 505	Antennas and Wave Propagation	3	1	0	15	10	25	50	75	3
		Practical / Sessional									
07.	BEC – 551	Communication Laboratory -1	0	0	2	10	10	20	30	50	1
08.	BEC – 552	Control System Laboratory	0	0	2	10	10	20	30	50	1
09.	BEC– 553	Computer Organization Laboratory	0	0	2	10	10	20	30	50	1
10.	BEC –554	Microprocessor Laboratory	0	0	2	10	10	20	30	50	1
11.	GP – 501	General Proficiency	-	-	-	-	-	-	-	50	1
		Total	16	6	8	Total				1000	27

SIXTH SEMESTER

Sl. No.	Code	Name of Subjects	Periods/ Week			Evaluation Scheme				Subject Total	Credits
			L	T	P/ S	Sessional Exam.			ESE		
						CT	TA	Total			
Theory											
01.	BHU – 601	Industrial Management	3	1	0	30	20	50	100	150	4
02.	BEC – 601	Digital Signal Processing	3	1	0	30	20	50	100	150	4
03.	BEC – 602	Microwave Engineering	2	1	0	15	10	25	50	75	3
04.	BEC – 603	Digital Communication System	3	1	0	30	20	50	100	150	4
05.	BEC – 604	VLSI Technology	2	1	0	15	10	25	50	75	3
06.	BEC-011- BEC-015, BEE-601	Professional Elective – I	2	1	0	15	10	25	50	150	4
Practical / Sessional											
07.	BEC– 651	Digital Signal Processing Laboratory	0	0	2	10	10	20	30	50	1
08.	BEC – 652	Microwave Lab	0	0	2	10	10	20	30	50	1
09.	BEC –653	Communication Laboratory -2	0	0	2	10	10	20	30	50	1
10.	BEC – 658	Seminar	0	0	2	10	10	20	30	50	1
11.	GP – 601	General Proficiency	-	-	-	-	-	-	-	50	1
Total			15	6	8	Total				1000	27
Industrial Training for 4-6 weeks after sixth semester											

Professional Elective – I		
1.	BEC-011	Microcontrollers
2.	BEC-012	Digital System Design using VHDL
3.	BEC-013	Introduction to RADAR systems
4.	BEC-014	MATLAB Programming for Engineers
5.	BEC-015	Artificial Neural Network

6.	BEE-601	Power Electronics

SEVENTH SEMESTER

Sl. No.	Code No	Name of Subjects	Periods/ Week			Evaluation Scheme				Subject Total	Credits
			L	T	P/S	Sessional Exam.			ESE		
						CT	TA	Total			
		Theory									
01.	OE01-06	Open Elective – I	3	0	0	30	20	50	100	150	3
02.		Professional Elective – II	3	1	0	30	20	50	100	150	4
03.		Professional Elective – III	3	1	0	30	20	50	100	150	4
04.	BEC – 701	Electronic Switching	3	1	0	30	20	50	100	150	4
05.	BEC – 702	Computer Networks and Mobile Communication	3	1	0	30	20	50	100	150	4
		Practical / Sessional									
06.	BEC – 751	CAD of Electronics Lab	0	0	2	10	10	20	30	50	1
07.	BEC – 752	Electronics Circuit Design Lab	0	0	2	-	-	50	-	50	1
08.	BEC – 757	Industrial Training Evaluation	0	0	2	-	-	50	-	50	1
09.	BEC – 759	Mini-Project	0	0	2	-	-	50	-	50	1
10.	GP – 701	General Proficiency	-	-	-	-	-	-	-	50	1
		Total	15	4	8			Total		1000	24

Professional Elective – II

1.	BEC-021	Satellite Communication
2.	BEC-022	Digital Image Processing
3.	BEC-023	VLSI Design
4.	BEC-024	Optoelectronics
5.	BEC-025	Bio-Medical Instrumentation
6.	BEC-026	Microwave Integrated Circuit Design
7.	MEC-003	Digital Communication Techniques
8.	MEC-032	CDMA and OFDM for Wireless Communication
9.	MEC-020	Statistical Signal Processing
10.	MEC-022	Mobile Satellite Communication
11.	MEC-024	Global Positioning Systems
12.	MCS-060	TCP/IP Concepts and Programming
13.	MCS-062	Internet Routing Design

Professional Elective – III

1.	BEC-031	Advance Semiconductor Devices
2.	BEC-032	Analog Signal Processing
3.	BEC-033	Modern Processor Architecture
4.	BEC-034	Error Control Coding
5.	BEC-035	Advance Communication Systems
6.	BEC-036	Embedded Systems
7.	BEC-037	Microcontrollers and Embedded Systems

EIGHTH SEMESTER

Sl. No.	Code No	Name of Subjects	Periods/ Week		Evaluation Scheme					Subject Total	Credits
			L	T	P/S	Sessional Exam.			ESE		
						CT	TA	Total			
Theory											
01.	OE021-25	Open Elective – II	3	0	0	30	20	50	100	150	3
02.		Professional Elective – IV	3	1	0	30	20	50	100	150	4
03.	BEC – 801	Optical Communication	4	0	0	30	20	50	100	150	4
Practical / Sessional											
04.	BEC-858	Seminar								50	1
05.	BEC – 859	Project	0	0	12	-	-	150	250	450	12
06.	GP – 801	General Proficiency	-	-	-	-	-	-	-	50	1
	Total		10	1	14	Total				1000	25

Professional Elective – IV		
1.	BEC-041	Optical Networks
2.	BEC-042	Speech Processing
3.	BEC-043	Filter Designing
4.	BEC-044	Television Engineering
5.	BEC-045	Spread Spectrum Communication
6.	BEC-046	Special Topics in Communication Engineering
7.	BEC-047	Cellular Mobile Communication
8.	MEC006	Advanced Digital Signal Processing
9.	MEC-023	Smart Antennas
10.	MEC-027	Advanced Optical Communication
11.	MEC-025	Multimedia Communication Systems
12.	MCS -066	Multimedia Networking
13.	MCS -068	Advance Network Security
14.	MCS061	Wireless Network Security and Privacy

Open Elective –I			Department
1	OE-01	Entrepreneurship Development Program	Humanities
2	OE-02	Graph Theory	Mathematics
3	OE-03	Operations Research	Mathematics
4	OE-04	E-Commerce	Computer Science
5	OE-05	Energy Management	Electrical Engineering
6	OE-06	Quality Management	Mechanical Engineering

Open Elective –II			Department
1	OE-21	Disaster Management, Guidelines & Control	Civil Engineering
2	OE-22	Human Computer Interaction	Computer Science
3	OE-23	Nano Technology	Electronics & Communication
4	OE-24	Non-Conventional Energy Resources	Electrical Engineering
5	OE-25	Product Development	Mechanical Engineering

FIFTH

SEMESTER

ANALOG COMMUNICATION SYSTEMS (BEC – 501)

Unit-1

Introduction: Overview of Communication system, Communication channels Need for modulation, Baseband and Pass band signals, Amplitude Modulation: Double side band with Carrier (DSB-C), Double side band without Carrier, Single Side Band Modulation, DSB-SC, DSB-C, SSB Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator, Radio Transmitter and Receiver.

Unit-2

Angle Modulation, Tone Modulated FM Signal, Arbitrary Modulated FM Signal, FM Modulators and Demodulators, Approximately Compatible SSB Systems, Stereophonic FM Broadcasting, Examples Based on MATLAB.

Unit-3

Pulse Modulation Digital Transmission of Analog Signals: Sampling Theorem and its applications, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation. Their generation and Demodulation, Digital Representation of Analog Signals, Pulse Code Modulation (PCM), PCM System, Issues in digital transmission: Frequency Division Multiplexing, Time Division Multiplexing ,Line Coding and their Power Spectral density, T1 Digital System, TDM Hierarchy.

Unit-4

Differential Pulse Code Modulation, Delta Modulation. Adaptive Delta Modulation, Voice Coders, Sources of Noises, Frequency domain representation of Noise, Super position of Noises, Linear filtering of Noises ,Mathematical Representation of Noise.

Unit-5

Noise in Amplitude Modulation: Analysis ,Signal to Noise Ratio, Figure of Merit ,Noise in Frequency Modulation: Pre emphasis ,De Emphasis and SNR Improvement, Phase Locked Loops Analog and Digital.

References:

1. Simon Haykin," Communication Systems" John Wiley & Sons 4th Edition
2. Principles of Communication Systems, Taub & Schilling, TMH.
3. Modern Digital and Analog Communication Systems, B. P. Lathi, OUP
4. Communication System, Hykin, Wheeler
5. Electronic Communication System, Kenndy, TMH
6. Electronic Communication, Roody & Coolen, PHI
7. Digital Communications: Fundamental And Applications, Sklar, Pearson
8. Digital Communications, Prokias, MGH
9. Electronic Communication System Fundamentals through Advance, Wayne Tomasi, Pearson Education.
10. Communication Systems: Analog and Digital, R Singh, S. Sapre, Mc Graw Hill.

CONTROL SYSTEM ENGINEERING (BEC – 502)

Unit-1

Mathematical models of physical systems, mechanical translational systems, mechanical rotational systems, electrical systems; Transfer function models of suitable mechanical, electrical, thermal and pneumatic systems; Open & Closed loop control systems; Block diagram and signal flow analysis; Basic Characteristics of feedback control systems.

Unit-2

Time Domain Analysis; Standard Test Signals; Time response of first, second order systems; Error analysis, static and dynamic error coefficients; Effect of adding poles and zeroes to the system; Response of P, PI, and PID controllers.

Unit-3

Definitions of stability; Routh Hurwitz Criterion; Root locus technique (concept and construction); Frequency Response Analysis, correlation between time and frequency response, polar and inverse polar plots; Nyquist stability criterion; Bode plots, calculation of transfer function from Bode plot; All pass and minimum phase systems.

Unit-4

Design through compensation techniques; Realization of lag, lead and lag-lead compensators; Design of closed loop control system using root locus and Bode plot Compensation.

Unit-5

Stable Variable Analysis, state space representation; State modes of linear systems; Solution of state equations: transfer matrices, diagonalization solution of state equations, controllability, observability & pole-zero cancellation.

Reference Book:

1. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley India Ltd, 2008.
2. Norman S. Nise, Control System Engineering 4th edition, Wiley Publishing Co., 2004.
3. J. Nagrath & M. Gopal, "*Control System Engineering*", New Age International,5th edition, 2007
4. B C Kuo, "Automatic Control Systems" Prentice Hall of India,7th edition, 2006
5. K. Ogata, "*Automatic Control System*", Pearson Education, 4th edition, 2007.
6. Samarajit Ghosh, "*Control System*" Prentice Hall of India, 2011 Edition.
7. R. Anandanatarajan, P. Ramesh Babu, "*Control System Engineering*", Scitech Publications, 2nd edition, 2008.
8. Ashfaq Husain, Haroon Ashfaq, "*Control System* "Dhanpat Rai & Co.,1st edition ,2011

COMPUTER ARCHITECTURE AND ORGANIZATION (BEC– 503)

Unit-1

Introduction to Computers

Basic of Computer, Von Neumann Architecture, Generation of Computer, Classification of Computers, Instruction Execution

Register Transfer and Micro operations

Register Transfer, Bus and Memory Transfers, Tree-State Bus Buffers, Memory Transfer, Micro-Operations, Register Transfer Micro-Operations, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations.

Unit-2

Computer Arithmetic

Addition And Subtraction With Signed-Magnitude, Multiplication Algorithm, Booth Multiplication Algorithm, Array Multiplier, Division Algorithm, Hardware Algorithm, Divide Overflow, Floating-Point Arithmetic Operations, Basic Considerations, Register Configuration, Addition And Subtraction, Decimal Arithmetic Operations, BCD Adder, BCD Subtraction.

Programming the Basic Computer

Machine language, Assembly language, Assembler, First pass, Second pass, Programming Arithmetic and Logic operations, Multiplication Program, Double-Precision Addition, Logic operations, Shift operations.

Unit-3

Organization of a Computer

Central Progressing Unit (CPU), Stack Organization, Register Stack, Memory Stack, Reverse Polish Notation. Instruction Formats, Three- Address Instructions, Two – Address Instructions, One- Address Instructions, Zero-Address Instructions, RISC Instructions, Addressing Modes Reduced Instruction Set Computer, CISC Characteristics RISC Characteristics.

Input-Output Organization

Modes Of Transfer, Priority Interrupt, DMA, Input-Output Processor (IOP), CPUIOP Communication.

Unit-4

Memory Organization

Memory Hierarchy, Main Memory, Auxiliary Memory, Cache Memory, Virtual Memory. Address Space and Memory Space, Associative Memory, Page Table, Page Replacement.

Parallel Processing and Vector Processing

Pipelining, Parallel Processing, Pipelining General Consideration, Arithmetic Pipeline Instruction Pipeline, Vector Operations, Matrix Multiplication, Memory Interleaving.

References:

1. John P Hayes "Computer Architecture and Organisation" McGraw Hilll 3rd Edition.
2. M Morris Mano, "Computer System Architecture" PHI 3rd Edition
3. Modern Digital Design, R.P. Jain, TMH.
4. Digital Logic Design, M. Morris Mano, PHI
5. Digital Technology, Virendra Kumar, New Age.
6. Digital Logic and State Machine Design, Comer, OUP
7. Modern Digital Design, R.S. Sandige, MGH.

MICROPROCESSORS (BEC – 504)

Unit-1

Introduction to 8085A CPU ,architecture-register organization, addressing modes and their features. Pin description and features and Reset Operation of 8085 Microprocessor. Software instruction set and Assembly Language Programming.

Unit-2

Instruction cycle, machine cycle, Timing diagram, Bus Idle Machine Cycle & INA Machine Cycle. Hardware Interfacing: 8085 Microprocessor based Buffered System, Interfacing of memory, peripheral chips (IO mapped IO & Memory mapped IO).

Unit-3

Interrupts of 8085 Microprocessor: Software Interrupts, Hardware Interrupts & Vectored Interrupts, Peripherals: 8255, 8155/ 8156, 8355 PPIs, 8251Usart and 8253/ 8254 Timer/ Counter. Synchronous, Asynchronous, Interrupt driven and DMA Modes of Date Transfer Techniques. Interfacing Techniques of A/D and D/A converters with 8085 Microprocessor and Programming.

Unit-4

Introduction to 8086 microprocessor, Internal Architecture of Intel 8086 Microprocessor Pin configuration of 8086 at minimum and maximum mode. Clock Generator for 8086 Microprocessor, Timing Diagram.

Unit-5

Addressing modes of 8086.Software instruction set and Simple Assembly level language Programming of 8086 Microprocessor.

References:

1) Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd, 1989 by Ramesh S. Gaonkar.
2) Advanced Microprocessors and Interfacing, B. Ram, TMH.
3) Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.
4) An introduction to micro computers Vol. 2 – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane
5) Advanced Microprocessors by Ray and Bhurchandi - TMH
6) Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
7) Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992
8) Assembly Language Programming the IBM PC by Alan R. Miller, SubexInc, 1987
9) Textbook On Microprocessor Based Laboratory Experiments And Projects, A. K. Mukhopadhyaya, Wheeler Publishing
10) Fundamentals Of Microprocessors And Microcomputers, B. Ram, DhanpatRai

ANTENNAS AND WAVE PROPAGATION (BEC –505)

Unit-1

Fundamental Parameters of Antennas

Definition ; Function and properties of antenna; Radiation pattern; Radiation power density; Radiation intensity;Gain, Directivity; Beam width; Bandwidth; Polarization; Antenna efficiency, Effective aperture; Antenna input impedance.

Retarded potential; Radiation fields of alternating current element; Radiated power and radiation resistance of current element; Radiation from monopole & half wave dipole; Radiation characteristics of dipoles.

Unit-2

Antenna Arrays:Two element array; Uniform linear arrays; Broad side and end fire arrays; Multiplication of patterns.

Antenna Measurements: Radiation pattern measurement; Introduction to phase measurement; Gain measurement; Directivity measurement; Polrization measurement; Impedence measurement; Measurement of antenna efficiency.

Unit-3

HF, VHF, UHF and Microwave Antennas

Rhombic Antenna Design relation and advantages & disadvantages.

Loop Antenna Salient features and EMF equation of loop antenna.

Yagi-UDA Antenna Salient features & design parameters.

Helical Antennas Normal and Axial modes; Corner reflector and parabolic reflector antennas.

Horn and Micro-strip Antenna: Salient features & applications.

Unit-4

Wave Propagation

Propagation characteristics of EM wave ; Factors involved in the propagation of radio waves; Modes of propagation, ground wave, ground wave field strength; Reflection of radio wave by the surface of earth, wave Tilt of the ground wave; Space wave or Troposphere wave propagation, field strength due to space wave, atmospheric effect in space wave propagation; Duct propagation; Radio horizon; Line of sight (LOS); Ionospheric wave propagation, characteristics of ionosphere, refractive index of ionosphere; Phase and group velocities; Virtual height; MUF, Critical frequency; Skip distance; Sky wave field strength; Fading and Diversity technique.

Reference Books

1. C A. Balanis , "*Antenna Theory* ", John Wiley ,Second Edition,2009.
2. John D. Kraus, Ronald J. Mashefka, " *Antenna for All Applications*", Tata McGraw-Hill, Second Edition, Reprint 2007.
3. G.S.N. Raju, "*Antenna &Wave Propagation*", Pearson Education India, Reprint 2005.
4. K.D. Prasad,"*Antennas and Wave Propagation*" , Satya Prakashan,Third Edition, Reprint 2005.
5. Jordan and Balman, "*Electromagnetic Waves and Radiating Systems*", PHI.

COMMUNICATION LABORATORY-1 (BEC – 551)

List of Experiments:

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2. To study amplitude demodulation by linear diode detector
3. To study frequency modulation and determine its modulation factor
4. To study PLL 565 as frequency demodulator.
5. To study sampling and reconstruction of Pulse Amplitude modulation system.
6. To study the Sensitivity, Selectivity, and Fidelity characteristics of super heterodyne receiver.
7. To study Pulse Amplitude Modulation
    a. using switching method
    b. by sample and hold circuit
8. To demodulate the obtained PAM signal by 2nd order LPF.
9. To study Pulse Width Modulation and Pulse Position Modulation.
10. To plot the radiation pattern of a Dipole, Yagi-uda and calculate its beam width.
11. To plot the radiation pattern of Horn, Parabolic & helical antenna. Also calculate beam width & element current.
12. Design and implement an FM radio receiver in 88-108 MHz.

CONTROL SYSTEM ENGINEERING LABORATORY (BEC – 552)

List of Experiments:

1. DC SPEED CONTROL SYSTEM
   (a) To study D.C. speed control system on open loop and close loop.
   (b) To study of Transient performance, another time signal is added at the input of control Circuit.
   (c) To study how eddy current breaking is being disturbance rejected by close and open loop.
2. DC MOTOR POSITION CONTROL
   (a) To study of potentiometer displacement constant on D.C. motor position control.
   (b) To study of D. C. position control through continuous command.
   (c) To study of D.C. position control through step command.
   (d) To study of D.C. position control through Dynamic response.
3. AC MOTOR POSITION CONTROL
   (a) To study of A.C. motor position control through continuous command.
   (b) To study of error detector on A.C. motor position control through step command.
   (c) To study of A.C. position control through dynamic response.
4. MAGNETIC AMPLIFIER
   (a) To study Input / Output characteristic of a magnetic amplifier in mode (i) Saturable Reactor, (ii) Self Saturable Reactor.
5. SYNCHRO TRANSMITTER / RECEIVER
   (a) To study of Synchro Transmitter in term of Position v/s Phase and voltage magnitude with respect to Rotor Voltage Magnitude/Phase.
   (b) To study of remote position indication system using Synchro-transmitter/receiver.
6. PID CONTROLLER
   (a) To observe open loop performance of building block and calibration of PID Controls.
   (b) To study P, PI and PID controller with type 0 system with delay.
   (c) To study P, PI and PID controller with type 1 system.
7. LEAD LAG COMPENSATOR
   (a) To study the open loop response on compensator.
   (b) Close loop transient response.
8. LINEAR SYSTEM SIMULATOR
   (a) Open loop response (i) Error detector with gain, (ii) Time constant, (iii) Integrator
   (b) Close loop system
9. (I) First order system (II) Second order system (III) Third order systemIntroduction to MATLAB (Control System Toolbox), Implement at least any two experiment in MATLAB.
   a. Different Toolboxes in MATLAB, Introduction to Control Systems Toolbox.
   b. Determine transpose, inverse values of given matrix.
   c. Plot the pole-zero configuration in s-plane for the given transfer function.
   d. Determine the transfer function for given closed loop system in block diagram representation.
   e. Plot unit step response of given transfer function and find peak overshoot, peak time.

f. Plot unit step response and to find rise time and delay time.
g. Plot locus of given transfer function, locate closed loop poles for different values of k.
h. Plot root locus of given transfer function and to find out S, Wd, Wn at given root & to discuss stability.
i. Plot bode plot of given transfer function.
j. Plot bode plot of given transfer function and find gain and phase margins
k. Plot Nyquist plot for given transfer function and to compare their relative stability
l. Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

COMPUTER ORGANIZATION LABORATORY (BEC – 553)

List of Experiments:

1. Bread Board Implementation of Flip-Flops.
2. Experiments with clocked Flip-Flop.
3. Design of Counters.
4. Bread Board implementation of counters & shift registers.
5. Implementation of Arithmetic algorithms.
6. Bread Board implementation of Adder/Subtractor (Half, Full)
7. Bread Board implementation of Binary Adder.
8. Bread Board implementation of Seven Segment Display.

MICROPROCESSORS LABORATORY (BEC – 554)

List of Experiments:

1. Addition of 8 bit numbers series.
2. Addition of two 16 bit numbers.
3. Subtraction of two 8 bit numbers.
4. Multiplication and division.
5. Addition of two 8 byte long binary numbers.
6. To find the maximum number in a given string.
7. Binary to gray code conversion.
8. To sort a string of a one byte numbers in descending order.
9. Interfacing with ADC/DAC.

10. Interfacing with 8253.
11. Interfacing with 8255 in I/O mode.
12. Verification of interrupts.

SIXTH SEMESTER

DIGITAL SIGNAL PROCESSING (BEC – 601)

UNIT- 1

DISCRETE TIME SYSTEM ANALYSIS AND Z-TRANSFORM

Z-transform–properties-inverse z-transform.

Discrete Fourier Transform

The Discrete Fourier Transform frequency-domain sampling and reconstruction of discrete-Time Signals; Discrete Fourier Transform (DFT); The DFT as a linear transformation; Relationship of the DFT to Other transforms; Properties of the DFT, periodicity, linearity, and symmetry properties; Multiplication of two DFTs and circular convolution; Additional DFT properties.

UNIT- 2

Efficient Computation of DFT

Efficient computation of the DFT: FFT algorithms; Direct computation of the DFT; Radix-2 FFT algorithms; Efficient computation of the DFT of two real sequences computations; Efficient computation of the DFT of a 2N point real sequences; Gortezel algorithm; Chirp Z-transform algorithm.

UNIT-3

Realization of Filter Structures

IIR Filter Structure

Direct forms (I & II), cascade and parallel realizations, signal flow graph, transposed structure, **FIR Filter Structures**- Direct form structure, frequency sampling structure, lattice structure, Linear phase FIR structure .

UNIT- 4

Design of IIR Filters from Analog Filters: IIR filter design by approximation of derivatives; IIR filter design by impulse invariance; IIR filter design by the Bilinear transformation; Matched-z transformation; Characteristics of commonly used analog filters; Application of above technique to the design of Butterworth and Chebyshev filters.

UNIT -5

Design of FIR Filter : Symmetric and anti-symmetric FIR Filters; Design of linear-phase FIR Filters using windows; Design of linear-phase FIR filters by the frequency sampling method; Equiripple filter design Differentiators. Design of Hilbert transformers.

References:

1. S. Salivahanan et al, Digital Signal Processing, TMH.
2. J.G. Proakis& D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications., PHI/Pearson
3. L.R. Rabiner & B.Gold, Theory and Application of Digital Signal Processing., PHI
4. Chen, Digital Signal Processing, OUP
5. Meyer-Basse U, Digital Signal Processing with FPGA, Spriger India
6. Ingle, Digital Signal Processing using MATLAB, Vikas
7. Babu R, Digital Signal Processing , Scitech
8. S.K.Mitra, Digital Signal Processing - A Computer based approach, TMH
9. Xavier, Digital Signal Processing, S. Chand
10. Emmanual C. Ifeachoret. al., Digital Signal Processing: A Practical approach, Pearson Education, 2nd edition.
11. Pradhan, Digital Signal Processing Applications, Jaico

MICROWAVE ENGINEERING (BEC –602)

Unit-1

Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant TE10 mode, Field Distribution, Power, Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Micro strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.

Unit-2

Scattering Matrix , Passive microwave devices: Microwave Hybrid Circuits. , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.

Unit-3

Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications.

Unit-4

Microwave Measurements: General set up of a microwave test bench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements, Impedance and Refection coefficient, VSWR, Insertion and attenuation loss measurements, measurement of antenna characteristics, microwave link design.

References:

1. Microwave Circuits and Passive Devices – M.L. Sisodia and G.S.Raghuvanshi, Wiley Eastern Ltd., New Age International Publishers Ltd., 1995.
2. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
3. Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th ed., 1955.
4. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition,1994.

5. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBSPublishers and Distributors, New Delhi, 2004.
6. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999.
7. Elements of Microwave Engineering – R. Chatterjee, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.

DIGITAL COMMUNICATION SYSTEM (BEC – 603)

UNIT- I

Digital Data transmission, Line coding review, Pulse shaping, Scrambling, Digital receivers, Eye diagram, Digital carrier system, Method of generation and detection of coherent & non-coherent binary ASK, FSK & PSK, Differential phase shift keying, quadrature modulation techniques. (QPSK and MSK),M-ary Digital carrier Modulation.

UNIT- II

Concept of Probability, Random variable, Statistical averages, Correlation, Sum of Random Variables, Central Limit Theorem, Random Process, Classification of Random Processes, Power spectral density, Multiple random Processes.

UNIT- III

Performance Analysis of Digital communication system: Optimum linear Detector for Binary polar signaling, General Binary Signaling, Coherent Receivers for Digital Carrier Modulations, Signal Space Analysis of Optimum Detection, Vector Decomposition of White Noise Random processes, General Expression for Error Probability of optimum receivers.

UNIT- IV

Spread spectrum Communications: Frequency Hopping Spread Spectrum(FHSS) systems, Direct Sequence Spread Spectrum, Code Division Multiple Access of DSSS, Multiuser Detection, OFDM Communications.

UNIT- V

Measure of Information, Source Encoding, Error Free Communication over a Noisy Channel capacity of a discrete and Continuous Memory less channel Error Correcting codes: Hamming sphere, hamming distance and Hamming bound, relation between minimum distance and error detecting and correcting capability , Linear block codes, encoding & syndrome decoding; Cyclic codes, encoder and decoders for systematic cycle codes; convolution codes, code tree
& Trellis diagram, Viterbi and sequential decoding, burst error correction, Turbo codes.

References Books

1. R.P.Singh & S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.
2. Simon Haykin , "*Digital Communication*" , John Wiley , Fourth Edition, Reprint 2009.
3. B.P Lathi, "*Modern Digital & Analog Communication Systems*", Oxford University Press, Fourth Edition, 2010.
4. Taub & Schilling, "*Principles of Communication Systems*", TMH.
5. Sklar, "*Digital Communications: Fundamental And Applications*", Pearson.
6. Prokias , "*Digital Communications*",TMH .
7. Wayne Tomasi,"*Electronic Communication System Fundamentals through Advance"*, Pearson Education.

VLSI Technology (BEC-604)

Unit-1

Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor –Phase Epitaxy, Molecular Beam Epitaxy, Silicon on

Insulators, Epitaxial Evaluation.

Unit-2

Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.

Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon , Silicon Dioxide, Silicon Nitride.

Unit-3

Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Sheet Resistance and its easurement. Ion-Implantation: Ion-Implantation Technique, Range Theory, Implantation Equipment.

Unit-4

Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies.

References:

1. S. M. Sze , "VLSI Technology", Tata Mc Graw –Hill, Second Edition,1988.
2. Douglas A. Pucknell , Kamran Eshraghian, " Basic VLSI Design", Prentice-Hall of India, Third Edition.
3. Neil H.E. Weste, Kamran Eshraghian, " Principles of CMOS VLSI Design A systems Perspective", Pearson Education, Third Edition,2009.
4. John P. Uyemura , "CMOS Logic Circuit Design", Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, Reprint 2002.

5. Plummer , “Silicon VLSI Technology”,Pearson Education, First Edition,2001.
6. R. Jacob Baker, “ CMOS Circuit Design, Layout, and Simulation”, IEEE Press, New York, Second Edition,2005.
7. Sung-Mo Kang, Yusuf Leblebici, “ CMOS Digital Integrated Circuits Analysis and Design”, Tata Mc-Graw-Hill, Third Edition,2007.

DIGITAL SIGNAL PROCESSING LABORATORY (BEC– 651)

LIST OF EXPERIMENTS:

1. With the help of Fourier series, make a square wave from sine wave and cosine waves. Find out coefficient values.
2. Evaluate 4 point DFT of and IDFT of x(n) = 1, $0 \leq n \leq 3$; 0 elsewhere.
3. Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter.
4. Design FIR filter using Fourier series expansion method.
5. Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal.
6. Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results.
7. Implement the filter functions.
8. Generate DTMF sequence 1234567890*# and observe its spectrogram.
9. Generate an Amplitude Modulation having side low frequencies 1200 Hz and 800 Hz. Observe and verify the theoretical FFT characteristics with the observed ones.
10. Generate Frequency Modulation having carrier frequencies 1 KHz and modulating frequency 200 Hz with the modulation index of 0.7. Observe and verify the theoretical FFT characteristics with the observed ones.
11. Generate an FSK wave form for transmitting the digital data of the given bit sequence. Predict and verify the FFT for the same one.
12. To study the circular convolution.

MICROWAVE LAB (BEC – 652)

List of Experiments:

1. Study of Reflex Klystron Characteristics.

2. Measurement of guide wavelength and frequency of the signal in a rectangular Waveguide using slotted line carriage in a Micro wave Bench.
3. Measurement of impedance of an unknown load connected at the output end of the slotted line carriage in a Micro wave Bench.
4. Determine the S-parameter of any Three port Tee.
5. Determine the S-parameter of a Magic Tee.
6. Study various parameters of Isolator.
7. Measurement of attenuation of a attenuator and isolation, insertion loss, cross coupling of a circulator.
8. Determine coupling coefficient, Insertion loss, Directivity and Isolation coefficient of anty Multi-Hole directional coupler.
9. To study working of MIC Components like Micro strip Line, Filter, Directional Coupler, Wilkinson Power Divider, Ring resonator & coupler, antennas & amplifies.
10. Study of waveguide horn and its radiation pattern and determination of the beam width.
11. Study radiation pattern of any two types of linear antenna.

COMMUNICATION LABORATORY-2 (BEC – 653)

List of Experiments:

1. To construct a triangular wave with the help of Fundamental Frequency and its Harmonic component.
2. To construct a Square wave with the help of Fundamental Frequency and its Harmonic component.
3. Study Frequency Division Multiplexing (FDM) & Demultiplexing.
4. Study of Time Division Multiplexing (TDM) & Demultiplexing.
5. Study of Pulse code modulation (PCM) and its demodulation using Bread Board.
6. Study of delta modulation and demodulation and observe effect of slope overload.
7. Study of pulse data coding techniques for NRZ formats.
8. Study of Data decoding techniques for NRZ formats.
9. Study of Manchester coding and Decoding.
10. Study of Amplitude shift keying modulator and demodulator.
11. Study of Frequency shift keying modulator and demodulator.
12. Study of Phase shift keying modulator and demodulator
13. Study of single bit error detection and correction using Hamming code.

14. Measuring the input impedance and Attenuation of a given Transmission Line

SEVENTH SEMESTER

ELECTRONIC SWITCHING (BEC-701)

Unit-1

Evolution of Switching systems: Introduction: Message switching, circuits switching, functions of a switching system, register-translator-senders, distribution frames, crossbar switch, a general trunking, electronic switching, Reed electronic system, digital switching systems.

Unit-2

Digital switching: Switching functions, space division switching, Time division switching, two dimensional switching, Digital cross connect systems, digital switching in analog environment.

Unit-3

Telecom Traffic Engineering: Network traffic load and parameters, grade of service and blocking probability, modelling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, Delay systems.

Unit-4

Control of Switching Systems: Introduction, Call processing functions; common control, Reliability availability and security; Stored program control. Signalling: Introduction, Customer line signalling, AF junctions and trunk circuits, FDM carrier systems, PCM and inter register signalling, Common channel signalling principles, CCITT signalling system No. 6 and 7, Digital customer line signalling.

Unit-5

Packet Switching: Packets formats, statistical multiplexing, routing control, dynamic, virtual path circuit and fixed path routing, flow control, X.25 protocol, frame relay, TCP/IP, ATM cell, ATM service categories, ATM switching, ATM memory switch, space memory switch, memory-space, memory-space-memory switch, Banyan network switch.

References:

1. J.C. Bellamy, “Digital Telephony”, John Wiley, 3rd Ed.
2. Thiagarajan Viswanathan, “Telecommunication switching System and networks”, PHI.

3. J.E. Flood, “Telecommunication switching, Traffic and Networks”, Pearson education.

COMPUTER NETWORKS AND MOBILE COMMUNICATION (BEC-702)

Unit-1

Introduction to Networks & Data Communications, Internet and Intranet, Protocols & Standards, OSI Model, TCP / IP Protocol Suite, Transmission Media: Guided and unguided Media.

Unit-2

Data Link Layer: Flow and Error Control, Multiple Access Protocol: Random Access, Controlled Access, Channelization.
Network Layer : Design Issues. Routing Algorithms. Congestion control Algorithms. IPV4 Addresses, Internet Protocol, IP Addressing.

Unit-3

Transport Layer: Process to Process delivery: UDP and TCP. Congestion Control, Cryptography and Network Security.

Unit-4

Evolution of mobile radio communication fundamentals. Large scale path loss: propagation models, reflection, diffraction, scattering, practical link budget design using path loss model. Small scale fading & multipath propagation and measurements, impulse response model and parameters of multipath channels. Small scale Multipath Measurements, Parameters of Mobile Multipath Channels types of small scale fading.

Unit-5

Cellular concepts, Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems.

References:

1. Forouzan, “Data Communications and Networking”, MGH, 4th ed. 2007
2. Andreas F. Molisch, “Wireless Communications”, Wiley Student Edition.
3. Tanenbaum, “Computer Networks”, PHI.
4. W. Stallings, “Data and Computer Communication”, PHI.
5. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson, Second Edition.
6. T L Singal ,“Wireless Communications ”,McGraw Hill Publications.
7. R. Pandya, “ Mobile and personal communication system”, PHI.
8. Andrea Goldsmith, “Wireless Communications”, Cambridge University press.
9. Andreas F. Molisch, “Wireless Communications”, Wiley Student Edition.
10. S. Haykin & M. Moher, “Modern wireless communication”, Pearson, 2005.

CAD OF ELECTRONICS LAB (BEC-751)

1. (a) Transient Analysis of BJT inverter using step input.

   (b) DC Analysis (VTC) of BJT inverter with and without parameters.

2. (a) Transient Analysis of NMOS inverter using step input.

   (b) Transient Analysis of NMOS inverter using pulse input.

   (c) DC Analysis (VTC) of NMOS inverter with and without parameters.

3. (a) Analysis of CMOS inverter using step input.

   (b) Transient Analysis of CMOS inverter using step input with parameters.

   (c) Transient Analysis of CMOS inverter using pulse input.

   (d) Transient Analysis of CMOS inverter using pulse input with parameters.

   (e) DC Analysis (VTC) of CMOS inverter with and without parameters.

4. Transient & DC Analysis of NOR Gate inverter.

5. Transient & DC Analysis of NAND Gate.

6. Synthesis and simulation of Full Adder.

7. Synthesis and Simulation of Full Subtractor.

8. Synthesis and Simulation of 3 X 8 Decoder.

9. Synthesis and Simulation of 8 X 1 Multiplexer.

ELECTRONICS CIRCUIT DESIGN LAB (BEC-752)

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/ digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad

2. Universal OTA biquad

3. Amplitude control or stabilization applied to any sinusoidal oscillators

4. Op-amp/ OTA based function generator

5. Any application of log/antilog circuits

6. Any applications of analog multiplier/ divider

7. Any digital system design and its hardware implementation using TTL/ CMOS ICs

8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any other ICs

The above must include

1. Design the circuit.

2. Make a hardware and measure various parameters.

3. Simulation in Spice of the designed circuit.

4. Comparison of measured and simulated results.

5. A report is to be made for evaluation.

EIGHTH SEMESTER

OPTICAL COMMUNICATION (BEC-801)

Unit-1

Overview of optical fiber communication-The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides, Step Index fibers,
Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index. Fiber Material and its Fabrication Techniques

Unit-2

Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Attenuation Measurements Techniques, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion.

Pulse broadening. Overall fiber dispersion in Multi mode and Single mode fibers, Fiber dispersion measurement techniques, Non linear effects. Optical fiber Connectors: Joints, Couplers and Isolators.

Unit-3

Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser:
Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, resonant frequencies, reliability of LED & ILD

Unit-4

Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling. Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors.
Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers.

Unit-5

Link Design: Point to Point Links, Power Penalities, Error control,Multichannel Transmission Techniques, WDM concepts and component overview, OTDR and optical Power meter

References:

1. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition, 2004.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.
3. Gerd Keiser, “Optical Fiber Communications”, TMH, 4th Edition, 2008.
4. Joseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004.

SIXTH SEMESTER (Professional Elective-I)

MICROCONTROLLERS (BEC-011)

Unit-1

Introduction , Microcontrollers and Embedded processors, Overview of the 8051, Inside the 8051, Addressing modes

Unit-2

Introduction to 8051 assembly programming, Assembling and running an 8051 program, The program counter and ROM space in the 8051, 8051 data types and directives, 8051 flag bits and the PSW register, 8051 register banks and stack, 8051 I/O programming, I/O bit manipulation programming.

Unit-3

Programming the 8051 timers, Counter programming, Basics of serial communications, 8051 connection to RS-232, 8051 serial port programming assembly, 8051 interrupts, Programming timer interrupts, programming external hardware interrupts, programming the Serial communication interrupts, Interrupts priority in the 8051,

Unit-4

Interfacing with 8051: Memory address decoding 8031/ 51 interfacing with external ROM, 8051 data memory space, LCD, Keyboard, Parallel and Serial ADC, DAC interfacing, Sensor interfacing and Signal Conditioning, Stepper motor and DC motor,

Unit-5

Programming the 8255 and Interfacing, Introduction to Intel 8096 and MC68HC11 microcontroller.

References:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D., " The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson, 2nd Edition.
2. Chhabra Bhupendra Singh, "Microcontrollers & its Applications" Dhanpat Rai Publishing Company
3. Ayala Kenneth, "The 8051 Microcontroller", Cengage Learning, 3rd Edition
4. Shah Satish, " 8051 Microcontrollers MCS 51 Family and its variants", Oxford
5. Ghoshal Subrata, " 8051 Microcontroller Internals, Instructions, Programming and Interfacing" Pearson

DIGITAL SYSTEM DESIGN USING VHDL (BEC-012)

Unit-1

Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.

Unit-2

Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL.RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding Alternatives, Association methods, generic Parameters, Design Configuration

Unit-3

Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure, Packaging Utilities and Components, Sequential Statements. VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE– related issues, Predefined Attributes

Unit-4

VHDL Signal Model – Characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution

Unit-5

Hardware Cores and Models - Synthesis rules and styles, Memory and Queue Structures, Arithmetic Cores, Components with Separate Control and Data parts. Core Design Test and Testability - Issues Related to Design Test, Simple Test benches.

References:

1. Z. Navabi, “VHDL-Modular Design and Synthesis of cores and Systems”, TMH – 3rd Edition.
2. Douglas Perry, “VHDL- Programming by examples”, MGH
3. R.D.M. Hunter, T. T. Johnson, “Introduction to VHDL” Spriger Publication, 2010.
4. C. H. Roth, “Digital System Design using VHDL”, PWS Publishing

INTRODUCTION TO RADAR SYSTEMS (BEC-013)

Unit-1

Introduction to Radar: Basic Radar, The Simply Form of the Radar Equations, Radar Block Diagram, Radar Frequencies, Applications of Radar. The Radar Equation: Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar Cross-Section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses.

Unit-2

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line Cancelers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

Unit-3

Tracking Radar: Tracking with Radar, Mono pulse Tracking, Conical Scan and Sequential Lobing, Limitations to tracking Accuracy, Low-Angle Tracking, Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars.

Unit-4

Detection of Signals in Noise: Introduction, Detection Criteria, Detectors, Automatic Detection, Integrators, Constant-False-Alarm Rate Receivers.

Unit-5

Information from Radar Signals: Basic Radar Measurements, Theoretical Accuracy of Radar Measurements, Ambiguity Diagram, Pulse Compression, Target Recognition, Land Clutter, Sea Clutter, Weather Clutter

References:

1. Merrill I. Skolnik " Introduction to Radar Systems" Third Edition.
2. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

MATLAB PROGRAMMING FOR ENGINEERS (BEC-014)

UNIT-I

Introduction to MATLAB

The MATLAB Environment, Variables and Arrays, Initializing Variables in MATLAB, Displaying Output Data, Built-in- MATLAB Functions, Introduction to Plotting.

UNIT -II

Branching systems and Program Design

The Logical Data Type, branches, Additional Plotting Features, while Loop, for Loop, Logical Arrays and Vectorization,

UNIT- III

User-Defined Functions

Introduction to MATLAB Functions, Variable passing in MATLAB: The Pass-By-Value Scheme, Sharing Data Using Global Memory, Preserving Data between Call to a Function, Function Functions, Sub functions, Private Functions, and Nested Functions, Complex Data, String Function, Additional two-Dimentional Plots, Three-dimentional plots.

UNIT- IV

Arrays and input/output Functions

Sparse Arrays, cell Arrays, Structure Arrays, Function Handles, The textread function, More about the load and save Command, An Introduction to MATLAB File Processing, file Opening and Closing, Binary I/O Functions, Formatted I/o Functions, Comparing Formatted and Binary I/O Functions, File Positioning and Status Functions.

UNIT -V

Graphical User Interface:

The MATLAB Graphics system, Object Handles, Examination and Changing Object Properties, Using set to List Possible Property Values, User-Defined Data, finding objects, Selecting Objects with the mouse, Creating and Displaying GUI Components, Objects Properties, Panels and Buttons Groups, Dialog Boxes, Tips for Creating Efficient GUIs.

Reference Books

1. Amis Gilat, "MATLAB: An introduction with Application", John Wiley, Reprint 2007.
2. Stephen J. Chapman, "*MATLAB Programming for Engineers*", Cengage Learning, Third Edition,2008.

ARTIFICIAL NEURAL NETWORKS (BEC-015)

Unit-1

Introduction:
Introduction and history, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge representation, Artificial intelligence and neural networks.
Learning Process: Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation.

\Unit-2

Artificial neurons, Neural networks and architectures Introduction, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture. Geometry of Binary threshold neurons and their networks Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non-linear separable problems, capacity of TLN, XOR solution.

Unit-3

Perceptrons and LMS
Learning objective of TLN, pattern space & weight space, perceptron learning algorithm, perceptron convergence theorem, pocket algorithm, α – LMS learning, MSE error surface, steepest descent search, μ – LMS and application.
Back propagation and other learning algorithms, Multilayered architecture, back propagation learning algorithm, practical considerations, structure growing algorithms, applications of feed forward neural networks, reinforcement learning

Unit-4

Statistical Pattern Recognition
Bayes' theorem, classical decisions with Bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems.
RBF Networks, Regularization networks, generalized RBF networks, RBF network for solving XOR problem, comparison of RBF networks & multilayer perceptrons.
Stochastic Machines

Statistical mechanics, simulated annealing, Boltzmann machine.

Unit-5

Adaptive Resonance Theory

Building blocks of adaptive resonance, Adaptive Resonance Theory 1.

Self Organizing Feature MAP

Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, Mexican hat networks.

References:

1. Kumar Satish, "Neural Networks", TMH
2. Simon Haykin, "Neural Networks", PHI

SEVENTH SEMESTER (Elective-II)

SATELLITE COMMUNICATION (BEC-021)

Unit-1

Elements of Satellite Communication. Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.

Unit-2

Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna Satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.

Unit-3

Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc. Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary.

Unit-4

Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing accuracy, GPS Receiver Operation

Unit-5

Global Mobile Satellite Systems, Antenna System for mobile satellite applications, Evolution, Antenna Requirement and Technical Characteristics, Classification of Mobile Satellite Antenna(MSA), Low gain omni directional Antenna, Medium gain Directional Antenna, High gain
Directional Aperture Antenna, Wire Quadrifilar Helix Antenna(WQHA) for Hand held Terminals, Antenna Systems for Mobile Satellite Broadcasting.

References:

1. B. Pratt, A. Bostian, “Satellite Communications”, Wiley India.
2. D. Roddy, “Satellite Communications”, TMH, 4th Ed.
3. S. D. Ilcev, “Global Mobile Satellite Communication”, Springer
4. R. Pandya, “Mobile and Personal Communication Systems and Services ”, PHI.

DIGITAL IMAGE PROCESSING (BEC-022)

Unit-1

Introduction: Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model.

Unit-2

Image Transforms: One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar, and Slant & KL transforms.
Image Enhancement: Introduction, point operations, histogram modelling, spatial operations, Transform operations.

Unit-3

Image Restoration: Introduction, image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.

Unit-4

Image Compression: Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding

Unit-5

Image Segmentation: Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.

References:

1. Rafael C. Gonzalez Richard E Woods, "Digital Image Processing", Pearson, 3rd Ed. 2009.
2. Anil K Jain, "Fundamentals of Digital Image Processing", PHI.

VLSI DESIGN (BEC-023)

Unit-1

Introduction: Overview of VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality. MOSFET Fabrication: Fabrication process flow, NMOS and CMOS fabrication, layout design rules, stick diagram and mask layout design. MOS Transistor : MOS Structure, The MOS System under external bias, Operation of MOSFET, MOSFET - Current /Voltage Characteristics, Scaling and Small geometry effects and capacitances

Unit-2

MOS Inverters: Introduction, Resistive Load Inverter, Inverters with n-type MOSFET load, CMOS Inverter. MOS Inverters - Switching Characteristics: Introduction, Delay – Time Definitions, Calculation of Delay Times, and Inverter Design with Delay Constraints.

Unit-3

Combinational MOS Logic Circuits: Introduction, MOS logic circuits with depletion NMOS Loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates) Sequential MOS Logic Circuits: Introduction, behaviour bistable elements, SR latch circuits, clocked latch and FF circuits, CMOS D latch and edge triggered FF.

Unit-4

Dynamic logic circuits: Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, domino CMOS logic. Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.

Unit-5

Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits. Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques.

References:

1. Sung-Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis & Design", TMH, 3rd Edition.
2. D. A. Pucknell and K. Eshraghian, "Basic VLSI Design: Systems and Circuits", PHI, 3rd Ed., 1994.
3. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

OPTOELECTRONICS (BEC-024)

Unit-1

Introduction to Optical waveguide; Photo sources and detectors; Optical waveguide modes, theory of dielectric slab waveguides, symmetric and asymmetric slab wave guide,

Unit-2

Electro Optic Effects

Birefringence phenomenon; Electro optic Retardation, electro optic amplitude , phase modulator, electro optic intensity modulators; Beam deflection, Acousto –optics, acousto –optics modulators; Integrated optic spectrum analyzer; Non linear optics second harmonic generation; Parametric amplification,.

Unit-3

Fourier Optics

Phase transformation of thin lens; Fourier transforming property of Lens; Image forming property of Lens; Interferometer; Optical data storage; Speckle Phenomenon ; Laser Interferometer.

Unit-4

Optical Fiber Sensors

Multimode fiber Sensors, displacement , pressure ,stress, strain; Intensity modulated sensors; Active multimode fiber optics sensors; Micro-bend optical fiber sensor; Magnetic sensors; Single mode fiber optics sensors; Polarization modulated; Fiber optic Gyroscope.

Unit-5

Optical Computing

Analog linear optical processing; Halftone processing; Non linear processing; Analog arithmetic operation-addition, subtraction, multiplication, division, averaging, differentiation and integration; **Digital logic:** Modified signed digit number system; Residue Number system; Logarithmic number system.

Arithmetic Operations: Residue; Signed logarithmic arithmetic; Threshold logic; Threshold devices; Spatial light Modulators; Theta Modulation devices.

References:

1. Mohammad A.Karim ,Abdul As Awwal , "Optical Computing –An introduction", Wiley, Reprint 1992.
2. F.T.S. Yu, "Optical Information Processing", John Wiley, New York, Reprint 1983.
3. J. Wilson, J.F.B. Hawkes k, "*Opto Electronics: An Introduction*", PHI, Second Edition Reprint 2000.
4. I.P. Kaminov , "*A Introduction to Electro Optic Devices*",Academic Press New York, Reprint 1974.
5. A Yariv , " *Optical Electronics*",C.B.S. Collage Publishing, New York, Reprint 1985.

BIO-MEDICAL INSTRUMENTATION (BEC-025)

Unit-1

Basic Physiology: Cells and their structures- transport of ions through cell membrane- Resting and excited state-transmembrane potential-action potential-Bio Electric potentialnervous system-physiology of muscles-heart and blood circulations-respiratory systemurinary system.

Unit-2

Basic Transducer Principles and Electrodes: The transducer principles-active transducers-passive transducer for Bio-medical application-electrode theory-bio potentialelectrode- Bio chemical transducer.

Unit-3

Cardiovascular System: The heart and cardiovascular system-blood pressurecharacteristics of blood flow-heart sounds Electro cardiography - measurement of blood pressure-measurement of blood flow and cardiac o/p-plethysmography - measurement of heart sounds.

Unit-4

X-ray and Radioisotope Instrumentation: X-ray imaging, radiography fluoroscopyimage intensifier, angiography-medical use of radio isotopes, Beta radiations detectorsradiation therapy.

Unit-5

Bio-Telemetry: Introduction to bio-telemetry-physiological parameters adaptable to biotelemetry - the components of bio-telemetry systems-implantable units-applications of telemetry in patient care-application of computer in Bio-medical instrumentation. Anatomy of nervous system-measurement from the nervous system-EEG-EMG

References:

1. Khandpur, "Hand book on Bio-medical Instrumentation", Tata McGraw Hill Company
2. Ltd., 1989
3. Lesis Cromwell, Fred J.werbell and Erich A.Pfraffer "Bio-medical Instrumentation and
4. measurements", PHI Learning, 1990.
5. M.Arumugam, "Bio-medical Instrumentation" Anuratha Agencies Publishers, 1992.

MICROWAVE INTEGRATED CIRCUIT DESIGN (BEC-026)

Unit-1

Transmission Lines: Characteristics of conventional transmission structures, various planar transmission lines for MICs, comparison of various MIC transmission media. Design of stripline and microstrip transmission lines. Design of coupled striplines and microstrip lines. Stripline and microstrip discontinuity. Losses of microstrip lines and frequency effects. Review of scattering, ABCD, impedance and admittance matrices for two port networks.

Unit-2

Microwaves Integrated Circuits Components: Lumped elements for MIC**:** Design of lumped elements, design of inductors, capacitors and resistors. Resonators**:** Resonator parameters, resonant frequency, quality factor, rectangular microstrip resonator. Hybrids and couplers: Basics of hybrids and couplers, types of hybrids and couplers, design of hybrids, directional couplers using aperture coupled lines.

Unit-3

Active and Passive Microwave Devices: Microwave transistor, equivalent circuit .Basic operation principles of FET, MESFET model, power FETs. Introduction, equivalent circuit and figure of merit of schottky barrier junctions, varactor diodes, step recovery diodes and pin diodes.

Unit-4

Microwave Semiconductor Sources and Amplifiers: Oscillators**:** Introduction, concept of negative resistance, three port S-parameter characterization of transistors, oscillation and stability conditions, design of fixed

frequency oscillators. Amplifiers**:** Two port representation of transistor, stability consideration, amplifier characterization, Non-linear behavior, biasing networks, and linear amplifier design.

Unit-5

Fabrication of MMC's/MMIC's: Introduction, materials, mask layouts and mask fabrication, hybrid MIC, Mimics- design considerations, design procedures and MMIC fabrication. Hybrid versus Mimics.

References:

1. I. J. Bahl and P. Bhartia, "Microwave solid state circuit design", John Wiley and Sons, 1988.
2. G.D.Vendelin, A.M.Pavio and U.L.Rohde, "Microwave circuits design using linear and non- linear techniques", John Wiley and Sons, 1990.

SEVENTH SEMESTER (Elective-III)

ADVANCE SEMICONDUCTOR DEVICES (BEC-031)

Unit-1

Review of Fundamentals of Semiconductors: Semiconductor Materials and their properties Carrier Transport in Semiconductors Excess Carriers in Semiconductor

Unit-2

Junctions and Interfaces: Description of p-n junction, Action, The Abrupt Junction, Example of an Abrupt Junction, The linearly graded Junction. The Ideal Diode Model, Real Diodes, Temperature Dependence of I-V Characteristics, High Level Injection Effects, Example of Diodes. Description of Breakdown Mechanism, Zener and Avalanche Breakdown in p-n Junction

Unit-3

Majority Carrier Diodes: The Tunnel Diode, The Backward Diode, The Schottkey Barrier Diode, Ohmic Contacts Heterojunctions.

Unit-4

Microwave Diodes: The Varactor Diode, The p-i-n Diode, The IMPATT Diode, TRAPATT Diode, The BARITT Diode, Transferred Electron Devices

Optoelectronic Devices: The Solar Cell, Photo detectors, Light Emitting Diodes, Semiconductor Lasers.

Unit-5

Metal Semiconductor Field Effect Transistors: Basic Types of MESFETs, Models for I-V Characteristics of Short – Channel MESFETs, High Frequency Performance, MESFETs

Structures.

MOS Transistors and Charge Coupled Devices: Basic Structures and the Operating Principle, I-V Characteristics, Short-Channel Effects, MOSFET Structures, Charge Coupled Devices.

References:

1. M.S. Tyagi, "Introduction To Semiconductor Materials And Devices", John Willy-India Pvt. Ltd.
2. S. M. Sze, "Physics of Semiconductor Devices", 2nd Edition, John Willy-India Pvt. Ltd.
3. B. G. Streetman and S. Banerjee, "Solid state electronics devices", 5th Edition, PHI.

ANALOG SIGNAL PROCESSING (BEC-032)

Unit-1

Liner Analog Functions: Addition , Subtraction, Differentiation, Integration, Impedance Transformation and Conversion

Unit-2

AC/DC Signal Conversion: Signal Rectification, Peak and Valley Detection, rms to dc Conversion, Amplitude Demodulation

Unit-3

Other Nonlinear Analog Functions: Voltage Comparison, Voltage Limiting(Clipping), Logarithmic Amplifiers, Analog Multipliers, Analog Dividers

Unit-4

Continuous time op-amp RC filters: Second order LP, HP, BP, Notch and AP transfer functions, Kirwin-Huelsman-Newcomb biquad, Ackerberg-Mosberg Circuits, Tow-Thomas biquad, compensated integrators, Sallenkey Circuits, Generalized convertor, GIC biquads.

Unit-5

Transconductance-C filters: Transconductance cells, realization of resistors, integrators, amplifiers, summers and gyrators, first order and second order sections, Ladder design.

References:

1. Ramon Pallas-Areny, John G. Webster, "Analog Signal Processing", John Wiley& Sons
2. R. Schaumann and M. E. Valkenberg, "Design of Analog Circuits", Oxford University Press, 2001.

MODERN PROCESSOR ARCHITECTURE (BEC-033)

Unit-1

Processor Design: The Evolution of processors, Instruction set Processor design, Principles of Processor performance, Instruction level parallel processing

Pipelined processors: Pipelining fundamentals, pipelined processor design, deeply

pipelined processors

Unit-2

Memory and I/O systems: Computer system overview, Latency and bandwidth, memory hierarchy, virtual memory systems, memory hierarchy implementation, I/O systems

Unit-3

Superscalar Organization: Limitations if Scalar pipelines, Superscalar pipeline overview

Superscalar Techniques: Instruction Flow techniques, Register Data Flow Techniques, memory data flow Techniques

Unit-4

Case studies of Superscalar Processors: The PowerPC 620, Instruction fetching, dispatching, execution and completion Intel'sP6 Microarchitecture Basics of the P6 micro architecture, pipelining, the in order front end,out of order core, retirement, memory subsystem.

Unit-5

Advanced Instruction Flow techniques: Static and Dynamic Branch Prediction techniques, Hybrid branch predictors, Instruction Flow issues and techniques

Advanced Register Data Flow Techniques: Value Locality with and without speculation

Executing Multiple Threads: Synchronizing Shared memory threads, introduction to multiprocessor systems, explicitly multithreaded processors, implicitly multithreaded processors, executing the same thread

References:

1. John Paul Shen, Mikko H. Lipasti- Modern processor Design Fundamentals of Superscalar Processors, TMH
2. Daniel Tabak- Advanced Microprocessors, TMH

ERROR CONTROL CODING (BEC-034)

Unit-1

Compact Coding: Introduction of Block Codes, Linear Codes, Cyclic Codes, Dual Cyclic codes. Linear –feedback shift registers for encoding and decoding of cyclic codes. The polynomial-division register, Register for encoding, Register for error detection and correction, The Meggitt decoder.

Unit-2

Linear Algebra: Field, Vector Spaces, Linear codes as Vector Spaces, Dual codes.

Galios Field: Roots of equations, The Galios Field GF, Primitive field elements,Irreducible and primitive polynomials, Minimal polynomials.

Unit-3

Bose-Chaudhari-Hocquenghem Codes: Construction of BCH codes, Error syndrome in finite fields, Decoding of BCH codes,Reed Solomon Codes,The Berlekamp algorithm, The error evaluator polynomial.

Unit-4

Convolutional Codes: Convolutional code and its representation by code tree, trellis diagram and state diagram,Maximum Likelihood Decoding: Viterbi decoding algorithm.

Unit-5

Turbo codes: Introduction to Turbo codes and Iterative decoding with exchange of extrinsic information with MAP decoding algorithm.

References:

1. Introduction to Error /Control Codes by Salvatore Gravano
2. Error Correcting Codes by Todd. K. Moon

ADVANCE COMMUNICATION SYSTEMS (BEC-035)

Unit-1

Satellite Communication systems:
• Orbital Mechanics- Kepler's laws, Orbits, Orbital effects, Orbital perturbations
• Satellite sub systems- AOCS, TTC&M, Antennas, Transponders,
• Earth station technolgoy
• Link calculation
• Satellite systems- GEO systems, non-GEO communication systems
• Satellite Applications- Global Positioning System, Very Small Aperture Terminal

system, Direct to Home Satellite Systems

Unit-2

Cellular Communication Systems:
• 2G TDMA standard GSM- standards, architecture, radio aspects, security, call flow,
• 2G CDMA standard IS-95- Service aspects, key features, radio aspects, forward and reverse channel processing, challenges
• 3G mobile systems- IMT 2000 vision, radio aspects, UMTS, network aspects, CDMA 2000, W-CDMA

Unit-3

Mobile Data Communication Systems:
• Circuit switched data services- HSCSD
• Packet switched data services- GPRS, CDPD, EDGE

Unit-4

Radar Systems:
• The Radar Equation, Detection of Signal in Noise, Integration of Radar Pulses, Transmit Power, Pulse Repetition frequency, system losses, Antenna Parameters and Radar Equation consideration
• MTI and Pulse Doppler Radar, Doppler Filter Banks, Digital MTI Processing Detector, Pulse Doppler Radar,
• Tracking Radar, Monopulse Tracking, Conical Scale and Sequential Lobbing, Comparison of Trackers, Automatic tracking with Surveillance Radar

Unit-5

Recent Advances:
• Ultra wideband systems (UWB)
• Push To Talk (PTT) technology

• Mobile IP

References:

1. Introduction to wireless & Mobile systems- D.P.Agarwal, Qing-An zeng- Thomson P
2. Wireless communications, principles and practices, Theodore S. Rappaport Pearson Education.
3. Radar Systems by Skolnik

EMBEDDED SYSTEMS (BEC-036)

Unit-1

Introduction

Characteristics of Embedding Computing Applications; Concept of Real time Systems; Challenges in Embedded System Design; Common design metrics; Components of embedded systems; Examples of embedded systems; Hardware and Software Systems development tools

Unit-2

Embedded System Architecture

Bus Protocols and Organization-PCI, ISA, EISA, Vesa; CISC and RISC processor; Harvard and Von Neumann Architecture; Superscalar and VLIW architectures; Introduction to ARM Processor and PIC microcontroller; I/0 Sub-system- Busy-wait I/0, DMA, Interrupt driven I/0, Power saving strategies

Designing Embedded Computing Platform

Memory Devices and their Characteristics- EEPROM, Flash Memory, DRAM; I/O Devices- Watchdog Timers, Interrupt Controllers, DMA Controllers

Unit-3

Operating System

Basic Features of an Operating System; Processes and Threads; Process management; Memory management; Context Switching- Cooperative Multi-tasking, Pre-emptive Multi-tasking; Scheduling-Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling; Inter-process Communication- Signals, Shared Memory Communication, Message-Based Communication; Device Drivers-Introduction, function, architecture, types, implementations; Evaluating Operating System Performance-Response time Calculation, Interrupt latency; Resource access protocols-Priority

inheritance protocol, Priority ceiling protocol; Power Optimization Strategies for Processes; Introduction to Network OS and Mobile OS; Example Real Time OS Vx-works, RT-Linux

Unit-4

Networks for embedded systems
Distributed embedded architecture, I2C, CAN Bus; I/O Device Interfacing Protocols-GPIB, FIREWIRE, USB, IRDA

Unit-5

Embedded System Development
UML as Design tool- UML notation, Requirement Analysis and Use case Modeling, Static Modeling, Object and Class Structuring, Dynamic Modeling; Architectural Design- Hardware-Software Partitioning, Hardware-Software Integration; Design examples; Fault-tolerance Techniques; Reliability Evaluation Techniques

Laboratory work will be based on topics covered under the above syllabus.

References:

1. Rajkamal – Embedded systems Architecture, Programming and Design, (TMH).
2. Computers as components Principles of embedded computing system design by
   Wayne Wolf (Morgan Kaufmann).

MICROCONTROLLERS AND EMBEDDED SYSTEMS (BEC-037)

UNIT- I

Introduction to Microcontroller

Microcontrollers and Microprocessors; Embedded versus external memory devices 8 and 16-bit micro controllers; CISE & RISC processors; Harvard & Von-Neumann architecture commercial Microcontroller devices.

UNIT -II

8051 Microcontrollers

Architecture, pins description I/O ports and memory organizations; Interrupts; Timer and serial communication; Addressing mode; Instructions; Assembly language programming tools, simple programs.

UNIT- III

AVR & PIC Microcontrollers

Architecture; Pin description and features of 8096/95,98CXX, 89C20XX,; PIC micro-controllers; AVR microcontrollers.

UNIT- IV

Interfacing

LEDs,; Push Buttons; Relay and latch connections; Keyboard; 7-Segment display; LCD interfacing; ADC and DAC interfacing.

UNIT -V

Application

Applications of Microcontroller; Different waves generation; Frequency counter; Measurement applications; Automation and controller application.

Reference Books

1. Ajay V. Deshmukh, "*Microcontrollers; Theory and applications*", Tata McGraw-Hill, Fifth Edition.
2. Raj Kamal, "Embedded Systems Architecture Prgoramming and Design", Tata McGraw-Hill.
3. B.P. Singh & Renu Singh, "*Advanced Microprocessors and Microcontrollers*", New Age International Publishers, Reprint 2002.

EIGHTH SEMESTER (Elective-IV)

OPTICAL NETWORKS (BEC-041)

Unit-1

Introduction to Optical Networks- Principles and Challenges and its Generation, Characteristics of Optical Fiber in non linear region ,Optical Packet Switching, Transmission Basics, Multiplexers & Filters,

Unit-2

Optical Amplifiers ,Tunable Lasers, Switches, Wavelength Converters. Sub-Carrier Modulation and Multiplexing,Spectral efficiency,Crosstalk,Introduction of Soliton systems.

Unit-3

Majority Carrier Diodes: The Tunnel Diode, The Backward Diode, The Schottkey Barrier Diode, Ohmic Contacts Heterojunctions.

Unit-4

WDM Network Design Cost Trade-offs, Light path Topology Design, and Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability
Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Different Schemes, Interworking between Layers Access Networks Network Architecture Overview, Enhanced HFC, FTTC, PON evolution

Unit-5

Optical Switching OTDM, Synchronization, Header Processing, Buffering, Burst Switching. Deployment Considerations- SONET/SDH core Network

References:

1. R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practicalperspective", Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, "Optical Networks: Third Generation Transport Systems"/ Pearson Educations
3. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006.

SPEECH PROCESSING (BEC-042)

Unit-1

Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.

Unit-2

Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech & silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function.

Unit-3

Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.

Unit-4

Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder.

Unit-5

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.

References:

1. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition, 2006.
2. R. L. Rabiner & R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.

Filter Designing (BEC-043)

Unit-1

Review of op-amps circuits, Categorization of filters-Low-pass filter, High-pass filter, band-pass filter, band-reject filter, Gain equalizers, and Delay equalizers.

Unit-2

Approximation Theory: Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Basic of sensitivity, Frequency Transformations.

Unit-3

Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder

structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR. Active ladder filters. Active R filters.

Unit-4

Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.

Unit-5

Switched capacitor filters: The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation based SC filter design.

References:

1. Gobind Daryanani, "Principles of active network synthesis and design",John Wiley & Sons.
2. R. Schaumann, M. E. Van Valkenburg, "Design of analog filters", Oxford University Press.

Television Engineering (BEC-044)

Unit-1

Introduction: TV transmitter and receivers, synchronization. Television Pictures: Geometric form and aspect ratio, image continuity, interlaced scanning, picture resolution, Composite video signal: Horizontal and vertical sync, scanning sequence. Colour signal generation and Encoding**:** Perception of brightness and colours, additive colour mixing, video signals for colours, luminance signal, colour difference signals, encoding of colour difference signals, formation of chrominance signals.

Unit-2

TV Signal Transmission and Propagation: Picture signal transmission, positive and negative modulation, VSB transmission, sound signal transmission, standard channel BW, TV transmitter, TV signal propagation, interference, TV broadcast channels, TV transmission Antennas– Receiver Antennas.

Picture Tubes: Monochromatic Picture tube, Electrostatic focusing, Beam deflection, picture tube characteristics and specifications, Colour picture tubes – Delta Gun, PIL picture tubes, Sony Trinitron picture tube. TV standards: American 525 lines B&W TV system, NTSC color system, 625-line monochrome system, PAL colour system, SECAM colour system.

TV Cameras: Monochrome TV camera - Camera tube types, Vidicon, Image orthicon, Plumbicon, Silicon Diode Array Vidicon - Colour camera. CCD image sensors.

Unit-3

Monochrome Television Transmitter and Recevier: TV transmitter – Monochrome TV receiver – RF tuner – UHF, VHF tuner- Digital tuning techniques- AFT-IF subsystems - AGC – Noise cancellation- Video and sound inter carrier detection- vision IF subsystemvideo amplifiers requirements and configurations - DC re-insertion - Video amplifier

circuits- Sync separation – Typical sync processing circuits- Deflection current waveform – Deflection Oscillators – Frame deflection circuits – requirements- Line Deflection circuits – EHT generation.

Unit-3

Colour TV Transmitter and Receiver: NTSC colour TV system- NTSC colour receiver limitations of NTSC system – PAL colour TV system – Cancellation of phase errors- PAL –D colour system- PAL coder – Pal-D colour receiver- chromo signal amplifier- Separation of U and V signals- Colour burst separation – Burst phase Discriminator – ACC amplifier- Reference Oscillator- Ident and colour killer circuits- U and V demodulators- RO phase shift and 180$_o$PAL– Switch circuitry -Colour signal matrixing – merits and demerits of the PAL system – SECAM system – Coder and Decoder - merits and demerits of SECAM system.

Unit-5

Digital Television: DVB Systems and standards – HDTV – EDTV – 3DTV – Projection TV- DTH - Digital TV transmission and reception - systems and standards – Display devices – LCD and Plasma Display

References:

1. A.M. Dhake, “Television and Video Engineering”, McGraw Hill Publications. 2008.
2. R.R. Gulati, “Monochrome and Colour TV”, New Age International Publication, 2008.
3. S.P. Bali, “Colour Television Theory and Practice”, TMH, 2008.
4. R.R. Gulati, “Modern Television Practice – Principles, Technology and Service”, New Age International Publication, 2008.
5. B. Grob and C.E. Herndon, “Basic Television and Video Systems”, McGraw Hill, 2008.

Spread Spectrum Communication (BEC-045)

Unit-1

Introduction: Origins of SS communications – Advantages of Spectrum spreading – Types of techniques used for spread spectrum – Processing gain and other fundamental parameters – Jamming methods – Linear Feedback shift register sequence generation – Msequence and their statistical properties. Introduction to Non-linear sequences – Gold codes; Kasami sequences & chaotic sequences

Unit-2

Direct Sequence Spread Spectrum System: Coherent direct sequence systems – Model of a DS/BPSK system, Chernoff bound – Performance of encoded DS/BPSK – Constant power and pulse jammer. Coded DS/BPSK Performance for known and unknown channel states

Unit-3

Frequency Hopping SS System: Non-coherent FH system model – Uncoded FH/BFSK performance under constant power broadband jammer – Partial band noise jammer – Multitone jammer. Coded FH/BFSK performance for partial and multitone jammer. Performance of FH/MDPSK in the presence of partial band mutitone jamming

Unit-4

Synchronization of SS Receivers: Acquisition and tracking in DS SS receivers & FH SS receivers – Sequential estimation – Matched filter techniques of acquisition and tracking – Delay locked loop – Tau-Dither loop.

Unit-5

Applications: Space systems – Satellite communication. Anti jam military communication – Low probability of intercept communication – Mobile communications.

Reference:

1. R.C. Dixon, "Spread spectrum systems", John Wiley, 1984.
2. M.K. Simon, J.K.Omura, R.A. Schiltz and B.K.Levitt, "Spread spectrum communication", Vol-I, II & IV, Computer Science Press, USA, 1985.
3. G.R.Coopeand, CD.Mc.Gillem, "Modern communications and spread spectrum", McGraw Hill, 1986.

SPECIAL TOPICS IN COMMUNICATION ENGINEERING (BEC-046)

Unit-1

ISDN Overview: A conceptual view of ISDN- ISDN standards- service capabilities- Teleservice protocol architecture- facsimile- teletex message handling system. ISDN interfaces and function; transmission structure- user network interface configuration- ISDN protocol architecture- ISDN connection- terminal adaptation- addressing- internet working. ISDN physical layer: line coding techniques, basic user network interface- primary user

role- network interface.

Unit-2

ISDN Data Link Layer: Hap D, bearer channel link control using 465/ v 120, frame mode bearer service and protocol. ISDN network layer: ISDN call control, Frame relay connection control. Signaling system number Z: SS7 architecture, signaling- data link level-link level, network level- signaling connection control part- ISDN user part. ATM networking capabilities - ATM networking asynchronous technology problems address by

ATM, ATM solution, ATM cell and its structure.

Unit-3

ATM Network Concepts and Architecture: ATM's position in the OSI model- BISDN protocol reference model- ATM functions and layers. ATM signaling principals, ATM performances: merging voice, audio, data and video, ATM traffic control, ATM operation and maintenance, ATM reference configuration. ATM protocol stack: lower layers fiber based networks and its advantages- ATM physical layer media. ATM transmission convergence sub layer - ATM switching principles, OAM function and signaling.

Unit-4

Internet Concepts: The net and its features main Internet features, email news groups, telnet, gopher, browsing in WWW. Control modems: speed/ time continuum, communication software Internet finding tools, Archie, gopher commands: TCP/IP pictures, graphics and binary files via news groups: compression software: processing filessound

and images: animation. Internet resources- library card catalogues: establishing web services intranet- creating web home page.

Unit-5

Mobile Communication Systems: GSM – IS95 – Network aspects – Radio aspects – Security aspects – Low speed circuit switched data in digital cellular networks – High speed circuit switched data in GSM – Packet switched data in digital cellular networks – Data services over DECT, CT2 and PACS – GPRS – CDMA 1x, CDMA 3x, CDMA 2000 and WCDMA.

References:

1. R.G. Winch "Telecommunication transmission systems", McGraw Hill 1996.
2. W. Stallings, "ISDN and B.ISDN" Macmillan, 1995.
3. A.Glosshrenner, "Internet 101 Computing", McGraw Hill.
4. M. Y. Rhee, "Cryptography and secure communications", McGraw Hill 1994.
5. Raj Pandya, "Mobile and Personal communication system and services", PHI Learning, 2001.

CELLULAR MOBILE COMMUNICATION (BEC-047)

Unit-1

Introduction: The cellular concept – Frequency reuse – Interference and system capacity – Trunking and Grade of service – Improving coverage and capacity in cellular systems - Advanced Mobile Phone service - Global system for mobile communication - EIA/T IA IS- 136 Digital cellular system - EIA/T IA IS-95 Digital cellular system - cordless telephony and low tier TCS - Third generation wireless system

Unit-2

Mobility Management: Handoff - Roaming management - Handoff detection – channel Assignment techniques - Radio link transfer IS-41 Network signaling – Intersystem handoff and Authentication - PACS Network Signaling - cellular digital packet data

Unit-3

GSM: GSM Network signaling - GSM Mobility management GSM short message service - International roaming for GSM - GSM operation, Administration and maintenance - Mobile number Mobile number portability's, VoIP service for mobile networks.

Unit-4

Wireless Application Protocol: WAP model - WAP Gateway - WAP Protocol, WAP UAProf and caching - Wireless bearer for WAP - WAP developer tool kits – Mobile station application execution environment.

Unit-5

Special Topics: Third generation mobile services - Wireless local loop – Wireless enterprise networks - Bluetooth technology.

References:

1. Yi-Bing Lin and Imrich chlantae, "Wireless and Mobile Network Architecture", John Wiley 2006
2. Kauch Pahlavan and Prahant Krishna moorthy, "Principles of Wireless Networks", PHI Learning, 2007
3. T. S. Rappaport, "Wireless and Mobile Communication", Pearson Education, 2008.

COMMUNICATION ENGINEERING (BEC 506)

Unit-1

Amplitude Modulation:

Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, super heterodyne receiver, IF amplifiers, AGC circuits, Frequency Division multiplexing.

Unit-2

Angle Modulation:

Basic definitions, Narrow band and wideband frequency modulation, transmission bandwidth of FM signals

Generation and detection of frequency modulation.

Noise :

External noise, internal noise, Noise calculations, signal to noise ratio Noise in AM and FM systems

Unit-3

Pulse Modulation:

Introduction, sampling process Analog Pulse Modulation Systems-Pulse Amplitude Modulation, Pulse width modulation and Pulse Position Modulation.

Waveform coding Techniques:

Discretization in time and amplitude, Quantization process, quantization noise, Pulse code Modulation, Differential Pulse code Modulation, Delta Modulation and Adaptive Delta Modulation.

Unit-4

Digital Modulation Techniques:

Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, methods of generation of coherent and noncoherent, ASK,FSK and PSK, comparison of above digital techniques.

Unit-5

Time Division Multiplexing:

Fundamentals, Electronic Commutator, Bit/byte interleaving, TI carrier system, synchronization and signaling of TI, TDM and PCM hierarchy, synchronization techniques

Introduction to Information Theory:

Measure of information, Entropy & Information rate, channel capacity, Hartley Shannan law, Huffman coding, shannan Fano coding.

References:

1. Simon Haykin," Communication Systems" John Wiley & Sons 4th Edition
2. G.Kennedy and B. Davis,"Electronic Communication Systems" 4th Edition,
3. Tata McGraw Hill
4. Simon Haykin, "Digital Communications" John Wiley & Sons
5. B.P. Lthi, "Modern Analog & Digital Communication Systems" Oxford University Press.
6. Taub & Schilling, "Communication System: Analog and Digital" Tata Mc Graw Hill
7. R.P.Singh & S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.

COMMUNICATION ENGINEERING LAB (BEC 556)

1. To study amplitude modulation using a transistor and determine depth of modulation.
2. To study generation of DSB-SC signal using balanced modulator.
3. To study generation of SSB signal
4. To study envelope detector for demodulation of AM signal.
5. To study super heterodyne AM receiver and measurement of sensitivity, selectivity and fidelity.
6. To study frequency modulation using voltage controlled oscillator.
7. To detect FM signal using Phase Locked Loop.
8. To measure noise figure using a noise generator.
9. To study PAM, PWM and PPM.
10. To realize PCM signal using ADC and reconstruction using DAC and 4 bit/8bit system. Observe quantization noise in each case.
11. To study Delta Modulation and Adaptive Delta Modulation.
12. To study PSK-modulation system.
13. To study FSK-modulation system.
14. To study sampling through a Sample-Hold circuit and reconstruction of the sampled signal and observe the effect of sampling rate & the width of the sampling pulses.

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING (BEC 606)

Unit-1

Discrete Fourier Transform

The Discrete Fourier Transform frequency-domain sampling and reconstruction of discrete-Time Signals; Discrete Fourier Transform (DFT); The DFT as a linear transformation; Relationship of the DFT to Other transforms; Properties of the DFT, periodicity, linearity, and symmetry properties; Multiplication of two DFTs and circular convolution; Additional DFT properties.

Unit-2

Efficient Computation of DFT

Efficient computation of the DFT: FFT algorithms; Direct computation of the DFT; Radix-2 FFT algorithms; Efficient computation of the DFT of two real sequences computations; Efficient computation of the DFT of a 2N point real sequences; Gortezel algorithm; Chirp Z-transform algorithm.

Unit-3

Realization of Filter Structures

IIR Filter Structure

Direct forms (I & II), cascade and parallel realizations, signal flow graph, transposed structure, FIR Filter Structures- Direct form structure, frequency sampling structure, lattice structure, Linear phase FIR structure .

Unit-4

Design of FIR Filter

Symmetric and anti-symmetric FIR Filters; Design of linear-phase FIR Filters using windows; Design of linear-phase FIR filters by the frequency sampling method; Equiripple filter design Differentiators. Design of Hilbert transformers.

Unit-5

Design of IIR Filters from Analog Filters

IIR filter design by approximation of derivatives; IIR filter design by impulse invariance; IIR filter design by the Bilinear transformation; Matched-z transformation; Characteristics of commonly used analog filters; Application of above technique to the design of Butterworth and Chebyshev filters.

References:

1. J.G. Proakis, & D.G.Manolakis, , "Digital Signal Processing: Principles Algorithms and Applications", Prentice Hall ,Fourth Edition, 2009.
2. Sanjit K. Mitra, "Digital Signal Processing", Tata McGraw-Hill, Third Edition, 2008.
3. Oppenheim A.V. & Schafer, Ronald W., "Digital Signal Processing", Pearson Education, First Edition, 2002.
4. L.R. Rabiner, B.Gold, "Theory and applications of DSP", PHI,Seventh Edition ,2003.

VLSI DESIGN & TECHNOLOGY (BEC-038)

Unit-1

Introduction to an integrated circuit technology, Moore's law, ITRS recent trends in design, Crystal Growth Silicon wafer Preparation & characterization, Oxidation: Thermal oxidation, Oxide thickness measurement, Oxidation system.
Film Deposition: Epitaxial growth of Si, Apparatus for Epitaxy, Vacuum deposition & Sputtering apparatus, CVD Processes and its applications in IC Lab.

Unit-2

Diffusion of dopants
Diffusion Eqns. Dopant profiles, sheet resistance, diffusion furnace, liquid and gaseous dopants. Ion Implantation: Ion implantation techniques, dopants profiles, apparatus used Ion implantation.
Lithography: Mask making, photo resist & Etching Techniques, Introduction to Modern Lithography Techniques, Photolithography techniques for pattern transfer, Metallization,

Unit-3

Packaging
Packaging Hierarchy, Packaging Substrates, Plastic Packaging, Ceramic Packaging, Package Types, Die Attachment Techniques: Wire Bonding, Tape-Automated Bonding, Solder Bump Bonding. Introduction to Testing: Role of Testing, VLSI Testing Process and Automatic Test Equipment.

Unit-4

Basic MOS transistor theory, MOS transistor threshold voltage Vth, MOS trans- conductance (gm) and output conductance (gds) and MOS transistor figure of merit. The NMOS inverter, pull-up to pull-down ratio, CMOS inverter and its characteristics, latch-up in CMOS circuits, Body effect, sheet resistance, capacitances of layers, Gate delays, Delay estimation.

Unit-5

NMOS design style, CMOS design style, lambda based design rules, logical efforts, Scaling models and scaling factors, limitation of scaling, Limits of miniaturization. Stick diagrams,
NMOS, CMOS NAND Gates, NMOS, CMOS NOR gates, Combinational circuit design, Sequential circuit design.

References:

1. S. M. Sze , "VLSI Technology", Tata Mc Graw –Hill, Second Edition,1988.
2. Douglas A. Pucknell , Kamran Eshraghian, " Basic VLSI Design", Prentice-Hall of India, Third Edition.
3. Neil H.E. Weste, Kamran Eshraghian, " Principles of CMOS VLSI Design A systems Perspective", Pearson Education, Third Edition,2009.
4. John P. Uyemura , "CMOS Logic Circuit Design", Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, Reprint 2002.
5. Plummer , "Silicon VLSI Technology",Pearson Education, First Edition,2001.
6. R. Jacob Baker, " CMOS Circuit Design, Layout, and Simulation", IEEE Press, New York, Second Edition,2005.
7. Sung-Mo Kang, Yusuf Leblebici, " CMOS Digital Integrated Circuits Analysis and Design", Tata Mc-Graw-Hill, Third Edition,2007.

Open Electives

OE – 23 NANO-TECHNOLOGY

UNIT -1 :
Introduction:
Difinition of Nano-Science and Nano Technology, Applications of Nano-Technology. 1(4) Introduction to Physics of Solid State: Structure: Size dependence of properties; crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations. Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.
Localized Particles: Acceptors and deep taps; mobility; Excitons. 6

UNIT-2
Quantum Theory For Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Refelection and tunneling(Quantum leak). Penetration of

Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane(Nano sheet), Quantum confinerment effect in nano materials. 4Quantum Wells, Wires and Dots Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermigas;
Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared etectors; Quantum dot laser Superconductivity. 3 Properties of Individual Nano particlesMetal Nano clusters: Magic Numbers; Theoretical Modelling of Nanopraticles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure.
Semi conducting Nanoparticles: Optical Properties; Photofragmentation; Coulmbic explosion.
Rare Gas & Molecular Clusters: Inert gas clusters; Superfluid clusters molecular
clusters.

UNIT-3

Growth Techniques of Nanomaterials: Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique(p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapourdeposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid
–Solid (VLS) method of nanowires. 8

UNIT -4

Methods of Measuring Properties: Structure: Crystallography, particle size determination, surface structure,
Microscopy: Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Elecrtron Microscopy (TEM)Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic
resonance, Optical and Vibrational Spectroscopy, Luninscence. 8

UNIT-5

Buckey Ball: Nano structuresofcarbon(fullerene): Carbon nano-tubes: Fabrication , structure. electrical, mechanical, and vibrational
properties and applications. Nano diamond, Boron Nitride Nano-tubes, single elecron transistors, Moelcular machine, Nano-Biometrics, Nano Robots. 7

Text/Reference Books:

1. C.P.PooleJr F.J. Owens, “Introduction to Nanotechnology”. (5)
2. “Introduction to S.S. Physics” - (7th Edn.) Wiley 1996.
3. S. Sugano & H. Koizuoni, “Microcluster Physics” –Springor 1998
4. “Handboole of Nanostructured Materials & Nanotechnology” vol.-5. Academic Press
2000
5. A.K.Bandyopadhyay, “Nano Materials” New Age International.

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WE BELIEVE IN SHAPING GENERATIONS