Vidyasagar University

Curriculum for B.Sc. (Honours) in Electronics [Choice Based Credit System]

Semester-VI

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC- 13		**C13T:**Communication Electronics	Core Course-13	4	0	0	6	75
		- **Lab**		0	0	4		
CC- 14		**C14T**: Photonics	Core Course-14	4	0	0	6	75
		- **Lab**		0	0	4		
DSE-3		**TBD**	Discipline Specific Electives -3	4	0	0	6	75
				0	0	4		
DSE-4		**TBD**	Discipline Specific Electives - 4				4/5 2/1	75
Semester Total							**24**	**300**

L= Lecture, **T**= Tutorial, **P** = Practical, **CC -** Core Course, **TBD -** To be decided, **DSE:** Discipline Specific Elective.

Semester-VI

List of Core Course (CC)

CC-13: Communication Electronics

CC-14: Photonics

Discipline Specific Electives (DSE)

DSE-3: Modern Communication Systems
Or
DSE-3: Digital Signal Processing
Or
DSE-3: Computer Networks

DSE-4: Basic VLSI Design
Or
DSE-4: Nano Electronics
Or
DSE-4: Embedded Systems
Or
DSE-4: Biomedical Instrumentation

SEMESTER –VI

Core Courses (CC)

CC-13: Communication Electronics — Credits 06

C13T: Communication Electronics — Credits 04

Course Contents:

Electronic Communication

Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation, concept of channels and base-band signals. Concept of Noise, Types of Noise, Signal to noise ratio, Noise Figure, Noise Temperature, Friss formula. Need for modulation.

Amplitude Modulation

Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Linear and Non Linear Methods), Amplitude Demodulation (diode detector), Concept of Double side band suppressed carrier, Single side band suppressed carrier (Chopper, Balanced Modulation), other forms of AM (Pilot Carrier Modulation, Vestigial Side Band modulation, Independent Side Band Modulation). Block diagram of AM Transmitter and Receiver (Super heterodyne receiver – advantages over TRF , utility of heterodyning, different stages)
Angle modulation: Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL). Block diagram of FM Transmitter and Receiver
Comparison between AM, FM and PM.
Pulse Analog Modulation & Pulse Code Modulation
Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM.
Pulse Code Modulation: Need for digital transmission, Quantizing, Uniform and Non- uniform Quantization, Quantization Noise, Companding, Coding, Decoding, and Regeneration.

Digital Carrier Modulation techniques

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK)

Suggested Readings:

1. Frenzel,Electronic communication systems- Kennedy, 3rd edition, McGraw international publications
2. Frenzel,Principles of Electronic communication systems, 3rd edition, McGraw Hill

3. S. Haykin, Communication Systems, Wiley India (2006)
4. Tomasi,Advanced electronic communications systems –6th edition, PHI.
5. S. Haykin, Communication Systems, Wiley India (2006)
6. Kundu,Analog and Digital Communications, Pearson Education (2009)
7. Couch,Digital & Analog Communication Systems, 8e

C13P: Communication Electronics Lab **Credits 02**

List of Practical:

1. Study of Amplitude Modulation.
2. Study of Amplitude Demodulation.
3. Study of Frequency Modulation.
4. Study of Frequency Demodulation.
5. Study of Pulse Amplitude Modulation.
6. AM Transmitter/Receiver.
7. FM Transmitter/Receiver.
8. Study of TDM, FDM.
9. Study of Pulse Width Modulation.
10. Study of Pulse Position Modulation.
11. Study of Pulse Code Modulation.
12. Study of Amplitude Shift Keying.
13. Study of Phase Shift Keying.
14. Study of Frequency Shift Keying.

CC-14: Photonics **Credits 06**

C14T: Photonics **Credits 04**

Course Contents:

Light as an Electromagnetic Wave:
Light as an Electromagnetic Wave: Plane waves in homogeneous media, concept of spherical waves. Reflection and transmission at an interface, total internal reflection, Brewster's Law, Stoke's law
Interaction of electromagnetic waves with dielectrics: origin of refractive index, dispersion.

Interference: Necessary conditions (Concept of coherence)techniques using division of wave front and Division of Amplitude

Diffraction: Fresnel and Fraunhoffer approximations. Fraun hoffer Diffraction by a single slit, rectangular aperture, double slit, Resolving power of microscopes and telescopes; Diffraction grating: Resolving power and Dispersive power

Polarization:

Linear, circular and elliptical polarization, polarizer-analyzer and Malus' law; Double refraction by crystals, Interference of polarized light, Wave propagation in uniaxial media. Half wave and quarter wave plates. Faraday rotation and electro-optic effect
LED, Laser, Photodetectors and LCD displays

Light Emitting Diodes:

Construction, materials and operation, concept of quantum efficiency
Lasers: Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode.

Photodetectors:

Bolometer, Photomultiplier tube, Charge Coupled Device. Photo transistors and Photodiodes (p-i-n, avalanche), quantum efficiency and responsivity.
LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays.

Guided Waves and the Optical Fibre

TE and TM modes in symmetric slab waveguides, effective index, field distributions, Dispersion relation and Group Velocity. Step index optical fibre, total internal reflection, concept of linearly polarized waves in the step index circular dielectric waveguides, single mode and multimode fibres, attenuation and dispersion in optical fibre.
Basic idea of OEIC(Optoelectronic Communication system)

Suggested Readings:

1. Ajoy Ghatak, Optics, Tata McGraw Hill, New Delhi (2005)
2. E. Hecht, Optics, Pearson Education Ltd. (2002)
3. J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
4. S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education (2009)
5. Ghatak A.K. and Thyagarajan K., "Introduction to fiber optics," Cambridge Univ. Press. (1998).
6. Kushal Roy, Advanced Optical Fibre Communications (HB) Scitech

C14P: Photonics Lab Credits 02

List of Practical:

1. To verify the law of Malus for plane polarized light.
2. To determine wavelength of sodium light using Michelson's Interferometer.
3. To determine wavelength of sodium light using Newton's Rings.
4. To determine the resolving power and Dispersive power of Diffraction Grating.
5. Diffraction experiments using a laser.
6. Study of Faraday rotation.
7. Study of Electro-optic Effect.
8. To determine the specific rotation of scan sugar using polarimeter.
9. To determine characteristics of LEDs and Photo- detector.
10. To measure the numerical aperture of an optical fiber.

Discipline Specific Electives (DSE)

DSE-3: Modern Communication Systems — Credits 06

DSE3T: Modern Communication Systems — Credits 04

Course Contents:

Advanced Digital Modulation Technique:

DPCM, DM, ADM. Binary Line Coding Technique, Multilevel coding, QAM (Modulation and Demodulation)

Optical Communication

Block Diagram of optical communication system, optical power budgeting.

Switching systems and Traffic Engineering:

Basic overview of different electro-mechanical switching system, Digital Switching system (time and space division).
Traffic Engineering: Blocking network, blocking probability, grade of service, traffic load, Erlang formula , congestion control strategies.

Cellular Communication:

Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA

technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts. Concept of WLL.

Satellite Communication and LAN:

Satellite communication: Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station. Satellite access, TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna), GPS-services like SPS & PPS.
Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX. Concept of Li-Fi

Suggested Readings:

1. W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 3rd Edition
2. Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3rd Edition
3. Modern digital and analog Communication systems- B. P. Lathi, 4rd Edition 2009 Oxford University press.
4. ThiagarajanVishwanathan, Telecommunication Switching Systems and Networks, Prentice Hall of India.
5. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2nd Edition, Pearson Education Asia.

DSE3P: Modern Communication Systems Lab Credits 02

List of Practical:

1. Modulation of LED and detection through Photo detector.
2. Calculation of the transmission losses in an optical communication system.
3. Study of 16 QAM modulation and Detection with generation of Constellation Diagram.
4. Study of DPCM and demodulation.
5. Study of DM, ADM.
6. Study of architecture of Mobile phone.-Real Time study of GSM 07.05 & 07.07 commands in various categories.
7. Study of Satellite Communication System..
8. Study of Optical Fiber Communication System.
9. Studies on satellite communication system – to set up active and passive satellite communication link, to set up an FM / FDM satellite link, to measure the path loss and propagation delay in a satellite link, to communicate voice signal through satellite link.

10. Use different combinations of uplink and downlink frequencies to check the communication link, to transmit and receive various waveforms from a function generator through a satellite link.
11. Studies on Blue tooth system – to understand concept of Blue tooth technology, to study RF module, RS- 232C serial communication, Blue tooth protocol, different types of Blue tooth network.
12. Studies on wireless LAN.

Or

DSE-3: Digital Signal Processing — Credits 06

DSE3T: Digital Signal Processing — Credits 04

Course Contents:

Discrete Time systems:

Discrete sequences, linear coefficient difference equation, Representation of DTS, LSI Systems. Stability and causality, frequency domain representations and Fourier transform of DT sequences.

Network Synthesis:

Concept of pole-zero, properties of pole-zeroes Synthesis of two terminal reactive networks, Foster's Reactance Theorem, Network realization of reactance function, Canonic Networks, Continued fraction Networks (Cauer Networks), numerical.
Synthesis of Two terminal R-C & R-L networks, Positive Real Functions, numerical.

Discrete Fourier Transform:

DFT assumptions and Inverse DFT. Matrix relations, relationship with FT and its inverse, circular convolution, DFT theorems, DCT. Computation of DFT. FFT Algorithms and processing gain, Discrimination, interpolation and extrapolation. Gibbs phenomena. FFT of real functions interleaving and resolution improvement. Word length effects.

Digital Filters:

Analog filter review-Concept of Filters in signal processing,filter parameters ,Concept of LP, HP, BP, Notch Filter ,types of filters – Butterworth, Chebyshev.
System function for IIR and FIR filters, network representation. Canonical and decomposition networks. IIR filter realization methods and their limitations. FIR filter realization techniques. Discrete correlation and convolution; Properties and limitations

Suggested Readings:

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
3. Anand Kumar, Digital Signal Processing, 2nd edn. PHI
4. Udayashankara, Modern Digital Signal Processing includes Signals and Systems, MATLAB Programs, DSP Architecture with Assembly and C Programs, 3rd edn. PHI
5. Ramesh Babu, Digital Signal Processing - 6th Edn. Scitech

DSE3P: Digital Signal Processing Lab Credits 02

List of Practical:

1. Generation of unit sample sequence, unit step, ramp function, discrete time sequence, real sinusoidal sequence.
2. Generate and plot sequences over an interval.
3. Given x[n], write program to find X[z].
4. Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform.
5. Design of a Butterworth analog filter for low pass and high pass.
6. Design of digital filters.

Or

DSE-3: Computer Networks Credits 06

DSET3: Computer Networks Credits 04

Course Contents:

Data Communication and Switching:

Data Communications: Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media- guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity.
Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching

Data Link Layer and Medium Access Sub layer

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack, Error Detection and Correction codes (Parity, Checksum, CRC and Hamming)

Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for Ethernet LAN and WLAN, introduction to high-speed LANs (Gigabit Ethernet, Jumbo Frames), Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

Network layer:

Design issues, Routing algorithms, Congestion control algorithms,
Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6, ICMPV6.

Transport Layer and Application Layer:

Transport Layer: Process to Process Delivery: UDP; TCP
Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.
Introductory Concepts of Security: Authentication and Encryption.

Suggested Readings:

1. S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5th Edition
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4thEdition
3. Douglas Comer, "Internetworking with TCP/IP", Pearson
4. Jim Kurose, "Computer Networking: A Top-down Approach Featuring the Internet" Pearson.
5. Gupta, Data Communications and Computer Networks, 2nd edn.
6. Peterson Davie, Computer Networks – A Systems Approach, Harcourt Butler
7. Kundu, Fundamentals of Computer Networks, 2 Ed, PHI

DSE3P: Computer Networks Lab Credits 02

List of Practical:

1. Setting up off LAN
   (i) Identification of networking components:
      (a) Newtork Cables (CAT 5,6).
      (b) Network Jack and Crimping Process.
      (c) Understading the NIC.
   (ii) Setting up of Local LAN (in windows and LINUX) using switch in a client server mode.
   (iii) Creating workgroups in the same LAN.

(iv) Setting up a system as a Gateway (this should have at least two NIC interfaces) and making two LANs with the Gateway machine as the router (this should be done in LINUX).

2. Introduction to Discrete Event Simulation - Discrete Event Simulation Tools – ns2/ns3, Omnet^{++}
3. Using Free Open Source Software tools for network simulation of telnet and ftp between N sources – N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
4. Using Free Open Source Software tools for network simulation for http, ftp and DBMS access in networks.
5. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance - multiple VLANs and single router.
6. Using Free Open Source Software tools for network simulation to study the performance of wireless networks.

DSE- 4: Basic VLSI Design — Credits 06

DSE4T: Basic VLSI Design — Credits 04

Course Contents:

Metal Oxide Semiconductor (MOS):

Introduction to basic principle of MOS transistor, large signal MOS models (long channel) for digital design. MOS SPICE model, MOS device layout: Transistor layout, Inverter layout, CMOS digital circuit layout; Effects of scaling on MOS behaviour.

MOS Inverter

Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, Dynamic behavior, Propagation Delay and Power Consumption.

Combinational MOS Logic Design

Static MOS design, Pass Transistor logic, complex logic circuits. Sequential MOS Logic Design - Static latches, Flip flops & Registers, Dynamic Latches & Registers, CMOS Schmitt trigger, Monostable sequential Circuits, Astable Circuits. Concept of BICMOS circuits

Memory Design

ROM & RAM cells design. Dynamic MOS design- Dynamic logic families and performances. Interconnect & Clock Distribution- Interconnect delays, Cross Talks, Clock Distribution.

Suggested Readings:

1. Kang &Leblebigi "CMOS Digital IC Circuit Analysis & Design"- McGraw Hill, 2003.
2. Rabey, "Digital Integrated Circuits Design", Pearson Education, Second Edition, 2003.
3. Weste and Eshraghian, "Principles of CMOS VLSI design" Addison-Wesley, 2002.
4. Basic VLSI design: Douglas A Pucknell, Kamran Eshraghian, PHI, 3rd edition.
5. Angsuman Sarkar et.al.VLSI Design and EDA Tools 2nd Ed , Scitech
6. Ken Martin Digital Integrated Circuit Design

DSE4P: Basic VLSI Design Lab Credits 02

List of Practical:

1. To plot the output characteristics &transfer characteristics of an n-channel and p- channel MOSFET.
2. To design and plot the static (VTC) and dynamic characteristics of a digital CMOS inverter.
3. To design and plot the output characteristics of a 3-inverter ring oscillator.
4. To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology.
5. To design and plot the characteristics of a 4×1 digital multiplexer using pass transistor logic
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.
7. To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers.

Or

DSE- 4: Nano Electronics Credits 06

DSE4T: Nano Electronics Credits 04

Course Contents:

Introduction to Nano Electronics

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

Introduction to Physics of Solid State: Size dependence of properties, bonding in atoms and giant molecular solids, Electronic conduction, Systems confined to one, two or three dimension and their effect on property

Quantum Theory for Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials.
Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling,Coulomb Blockade, Density of States for confinement in one,two and three dimension, Infrared detectors; Quantum dot laser Superconductivity.Balliistic transport

Growth Techniques of Nanomaterials

Synthetic aspects: bottom up and top down approaches, Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowireguage

Methods of Measuring Properties and Characterization techniques:

Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) including energy dispersive X-ray (EDX) analysis, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED)
Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy

Application of Nano electronics

Carbon nanotubes, nano cuboids, graphene, carbon quantum dots: Fabrication, structure. Electrical, mechanical, and vibrational properties and applications. Use of nano particles forbiological application, drug delivery and bio-imaging, Impact of nanotechnology on the environment.

Suggested Readings:

1. Hanson, Fundamentals of Nanoelectronics Pearson
2. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
3. Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.

4. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
5. Chattopadhyay & Banerjee Introduction to Nanoscience and Nanotechnology PHI.
6. Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.
7. Bio-Inspired Nanomaterials and Nanotechnology, Edited byYong Zhou, Nova Publishers.
8. Quantum dot heterostructures, Wiley, 1999.
9. Modern magnetic materials: principles and applications, John Wiley & Sons, 2000.
10. Nano: The Essentials: Understanding Nanoscience andNanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
11. Nanobiotechnology, concepts, applications and perspectives, Wiley-VCH, 2004.

DSE4P: Nanoelectronics Lab — Credits 02

List of Practical:

1. Synthesis of at least two different sizes of Nickel Oxide/ Copper Oxide/ Zinc Oxide Nano Particles Using Sol-Gel Method
2. Polymer synthesis by suspension method / emulsion method
3. Electrical Charactrisation of nanomaterials.
4. Magnetoresistance of thin films and nanocomposite, I-V characteristics and transientresponse.
5. Particle size determination by X-ray diffraction (XRD) and XRD analysis of the given XRD spectra
6. Determination of the particle size of the given materials using He-Ne LASER.
7. Selective area electron diffraction: Software based structural analysis based on TEM based experimental data from published literature. (Note: Later experiment may be performed in the lab based on availability of TEM facility).
8. Surface area and pore volume measurements of nano particles (a standard sample and a new sample (if available)).
9. UV-VIS Spectroscopic characterization of metallic, semiconducting and insulating nano particles

Or

DSE-4: Embedded Systems — Credits 06

DSE4T: Embedded Systems — Credits 04

Course Contents:

Introduction to Embedded Systems:

Overview of Embedded Systems, Features, Requirements and Applications.
Range of embedded systems : CPU size and complexity; memory size; I/O handling variations; use of OS-es with single or multitasking
Recent Trends in the Embedded System Design, Common architectures for the Embedded System Design, Embedded Software design issues. Introduction to microcontrollers, Overview of Harvard architecture and Von Neumann architecture, RISC and CISC microcontrollers

AVR RISC Microcontrollers:

Introduction to AVR RISC Microcontrollers, Architecture overview, status register, general purpose register file, memories, Instruction set, Data Transfer Instructions, Arithmetic and Logic Instructions, Branch Instructions, Bit and Bit-test Instructions, MCU Control Instructions. Simple programs in Assembly Language / C Language. Use of Cross-Compiler.

Interrupts and Timer:
Introduction to System Clock, Reset sources, Introduction to interrupts, External interrupts, IO Ports, 8-bit and 16-bit Timers, introduction to different modes, Input Capture and Compare Match.

Peripherals:
Analog Comparator, Analog-to-Digital Converter, Serial Peripheral Interface (SPI, The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART), Two Wire Interface (TWI) / I2C bus, USB Concepts.

Suggested Readings:

1. AVR Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, PHI
2. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002
3. Programming and Customizing the AVR Microcontroller by D V Gadre, McGraw- Hill
4. Atmel AVR Microcontroller Primer: Programming and Interfacing by Steven F. Barrett, Daniel J. Pack, Morgan & Claypool Publishers
5. An Embedded Software Primer by David E Simon, Addison Wesley
6. AVR Microcontroller Datasheet, Atmel Corporation, www.atmel.com
7. Chattopadhyay, Embedded System Design, 2nd edn.
8. Kenneth J.Ayala, The 8051 Microcontroller, Third Edition, Thomson.
9. Lewis Fundamentals of Embedded Software with the ARM Cortex-M3,Pearson.

DSE4P: Embedded Systems Lab Credits 02

List of Practical:

- **Lab is based on AVR (as covered in the theory course) but same experiments can be done with any other 16/32 bit Microcontroller like PIC.**

AVR trainer kit based Experiments

1. Display custom characters on LCD using AVR Microcontroller
2. Interfacing AVR microcontroller with PC using USART
3. Interfacing SD Card with AVR Microcontroller
4. Phase Correct PWM (Pulse Width Modulation) Mode of AVR microcontroller Timer
5. Waveform Generation using AVR Microcontroller (Atmega16) Timers
6. Interfacing Servo Motor with AVR Microcontroller
7. Using I2C / TWI (Two Wire Interface) in AVR ATmega32
8. Designing Audio Tone Generator using AVR Microcontroller
9. Speed and Direction Control of Stepper Motor using AVR Microcontroller
10. Designing Watchdog System Monitor

Or

DSE-4: Biomedical Instrumentation — Credits 06

DSE4T: Biomedical Instrumentation — Credits 04

Course Contents:

Biomedical signals & Physiological transducers

Source of biomedical signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG & EEG .Physiological transducers: Pressure, Temperature, photoelectric & ultrasound Transducers. Measurement in Respiratory system: Physiology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators & Respirators , Humidifiers , Nebulizers Aspirators, Biomedical recorders: ECG, EEG & EMG. MEMS based biosensors

Patient Monitoring systems & Audiometers:

Cardiac monitor, Bedside patient monitor, measurement of heart rate, blood pressure, temperature, respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity. Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyzers.

Modern Imaging systems

Introduction, Basic principle & Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR), ultrasonic imaging system. Eco-Cardiograph,

Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, surgical diathermy machine.

Patient's safety & Computer Applications in Biomedical field & Physiotherapy

Patients safety & Computer Applications in Biomedical field: Precaution, safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Use of microprocessors in medical instruments, Microcontrollers, PC based medical instruments, Computerized Critical care units, Planning & designing a computerized critical care unit.
Physiotherapy: Software Diathermy, microwave diathermy, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.

Suggested Readings:

1. Joseph J. Carr & John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson.
2. Shakti Chatterjee, "Textbook of Biomedical Instrumentation System", Cengage Learning
3. Ananda Natarajan Biomedical Instrumentation and Measurements, 2nd ed. • PHI
4. Bertil Jacobson & John G. Webster - Medicine and Clinical Engineering, PHI
5. Prof. S.K.VenkataRam-Bio-Medical Electronics and Instrumentation, Galgotia Publications
6. John G.Webster- Medical Instrumentation-Application and Design Wiley Student Edition)
7. L.Cromwell et al- Biomedical Instrumentation and Measurements PHI

DSE4P: Biomedical Instrumentation Lab Credits 02

List of Practical:

1. Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator
3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator
4. Study of pulse rate monitor with alarm system
5. Determination pulmonary function using spirometer (using mechanical system).
6. Measurement of respiration rate using thermistor /other electrodes.
7. Study of Respiration Rate monitor/ apnea monitor
8. Study on ultrasound transducers based on medical system
9. Study of a Pacemaker.
10. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.