

**CHOICE BASED CREDIT
SYSTEM
B. SC. WITH ELECTRONICS**

***Effective from
academic session-2016***

Semester- I
ELECTRONICS-DSC 1A: NETWORK ANALYSIS AND ANALOG ELECTRONICS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Unit- I: Circuit Analysis

Concept of Voltage and Current Sources. Kirchhoff's Current Law, Kirchhoff's Voltage Law. Mesh Analysis. Node Analysis. Star and Delta networks, Star-Delta Conversion. Principal of Duality. Superposition Theorem. Thevenin's Theorem. Norton's Theorem. Reciprocity Theorem. Maximum Power Transfer Theorem. Two Port Networks: h, y and z parameters and their conversion. **(12 Lectures)**

Unit-II Semiconductor Devices - I

Junction Diode and its applications: PN junction diode (Ideal and practical)- I-V characteristics, dc load line analysis, Quiescent (Q) point. Zener diode, Rectifiers- Half wave rectifier, Full wave rectifiers (center tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Zener diode as voltage regulator, Introduction to Tunnel diode, metal contact diode **(15 Lectures)**

Unit-II Semiconductor Devices - II

Bipolar Junction Transistor: Review of the characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β . Relations between α and β . dc load line and Q point. Unipolar Devices: JFET. Construction, working and I-V characteristics (output and transfer), Pinch-off voltage. **(15 Lectures)**

Unit-III Amplifiers and Oscillators

Transistor biasing and Stabilization Circuits-Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two port network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains. Class A, B and C Amplifiers. **Cascaded Amplifiers:** Two stage RC Coupled Amplifier and its Frequency Response. Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative only). Barkhausen criterion for sustained oscillations. Phase shift and Colpitt's oscillator. Determination of Frequency and Condition of oscillation. **(18 Lectures)**

Reference Books:

- Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004)
- Electrical Circuits, M. Nahvi & J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)
- Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
- Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.
- Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.
- Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, Tata McGraw Hill
- Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline

ELECTRONICS LAB: DSC 1A LAB: NETWORK ANALYSIS AND ANALOG
ELECTRONICS LAB
60 Lectures

AT LEAST 06 EXPERIMENTS FROM THE FOLLOWING BESIDES #1

1. To familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.
2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of (a) Superposition Theorem and (b) Reciprocity Theorem.
5. Verification of the Maximum Power Transfer Theorem.
6. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.
7. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR).
8. Study the effect of (a) C- filter and (b) Zener regulator on the output of FWR.
9. Study of the I-V Characteristics of UJT and design relaxation oscillator.
10. Study of the output and transfer I-V characteristics of common source JFET.
11. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.
12. Design of a Single Stage CE amplifier of given gain.
13. Study of the RC Phase Shift Oscillator.
14. Study the Colpitt's oscillator.

Reference Books:

- Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)
- Networks, Lines and Fields, J.D.Ryder, Prentice Hall of India.
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- Allen Mottershead, Electronic Devices and Circuits, Goodyear Publishing Corporation.

Semester- II
ELECTRONICS-DSC 1B: LINEAR AND DIGITAL INTEGRATED CIRCUITS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Unit- I Linear Integrated Circuits and its Applications

Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR. Slew Rate and concept of Virtual Ground. Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Wein bridge oscillator, Comparator and Zero-crossing detector, and Active low pass and high pass Butterworth filter (1st order only). **(15 Lectures)**

Unit-II Number System and logic Gates

Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal arithmetic; addition, subtraction by 2's complement method, multiplication. Logic Gates and Boolean algebra: Truth Tables of OR, AND, NOT,

NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra. (15 Lectures)

Unit- III Combinational Logic Analysis and Design

Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP). Arithmetic Circuits: Binary Addition. Half and Full Adder. Half and Full Subtractor, 4- bit binary Adder/Subtractor. Multiplexers, De-multiplexers, Decoders, Encoders. (15 Lectures)

Unit- IV Sequential Circuits

Introduction to 555 timer. SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop. **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. (15 Lectures)

Reference Books:

- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J. Tocci, N.S. Widmer, 2001, PHI Learning.
- Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

ELECTRONICS LAB-DSC 1B LAB: LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB 60 Lectures

At least 04 experiments each from section A, B and C

Section-A: Op-Amp. Circuits (Hardware)

1. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
2. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response
(b) To design non-inverting amplifier using Op-amp (741,351) & study frequency response
3. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode
(b) To study the zero-crossing detector and comparator.
4. To design a precision Differential amplifier of given I/O specification using Op-amp.
5. To investigate the use of an op-amp as an Integrator.
6. To investigate the use of an op-amp as a Differentiator.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. To design a circuit to simulate the solution of simultaneous equation and 1st/2nd order differential equation.
9. Design a Butterworth Low Pass active Filter (1st order) & study Frequency Response
10. Design a Butterworth High Pass active Filter (1st order) & study Frequency Response
11. Design a digital to analog converter (DAC) of given specifications.

Section-B: Digital circuits (Hardware)

1. (a) To design a combinational logic system for a specified Truth Table.

- (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.
- (c) To minimize a given logic circuit.
- 2. Half Adder and Full Adder.
- 3. Half Subtractor and Full Subtractor.
- 4. 4 bit binary adder and adder-subtractor using Full adder IC.
- 5. To design a seven segment decoder.
- 6. To design an Astable Multivibrator of given specification using IC 555 Timer.
- 7. To design a Monostable Multivibrator of given specification using IC 555 Timer.
- 8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
- 9. To build JK Master-slave flip-flop using Flip-Flop ICs
- 10. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
- 11. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

Section-C: SPICE/MULTISIM simulations for electronic circuits and devices

- 1. To verify the Thevenin and Norton Theorems.
- 2. Design and analyze the series and parallel LCR circuits
- 3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
- 4. Design and Verification of op-amp as integrator and differentiator
- 5. Design the 1st order active low pass and high pass filters of given cutoff frequency
- 6. Design a Wein's Bridge oscillator of given frequency.
- 7. Design clocked SR and JK Flip-Flop's using NAND Gates
- 8. Design 4-bit asynchronous counter using Flip-Flop ICs
- 9. Design the CE amplifier of a given gain and its frequency response.

Reference Books

- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall
- R.L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw-Hill (1994)
- Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

Semester – III
ELECTRONICS- DSC 1C: COMMUNICATION ELECTRONICS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Unit- I Analog Modulation:

Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super-heterodyne receiver **(15 Lectures)**

Unit- II Analog Pulse Modulation:

Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM, PWM and PPM, Multiplexing. TDMA, FDMA. **(15 Lectures)**

Unit- III Digital Pulse Modulation:

Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of PCM, DPCM and Delta modulation, introduction to digital pass band modulation schemes. **(15 Lectures)**

Unit- IV Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies. **(15 Lectures)**

Reference Books:

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Modern Digital and Analog Communication Systems, B.P. Lathi, 4th Edition, 2011, Oxford University Press.
- Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
- Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- Communication Systems, S. Haykin, 2006, Wiley India
- Electronic Communication system, Blake, Cengage, 5th edition.
- Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

ELECTRONICS LAB-DSC 1C LAB: COMMUNICATION
ELECTRONICS LAB
60 Lectures

AT LEAST 03 AND 05 EXPERIMENTS RESPECTIVELY FROM FOLLOWING

USING HARDWARE AND SIMULATIONS.

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Reference Books:

- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Electronic Communication system

Semester- IV

ELECTRONICS-DSC 1D: MICROPROCESSOR AND MICROCONTROLLER

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Unit- I Microcomputer Organization and 8085 Architecture:

Input / Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. Main features of 8085. Block diagram. Pin-out diagram of 8085. Data and address buses. Registers. ALU. Stack memory. Program counter. **(13 Lectures)**

Unit- II 8085 Programming:

Instruction classification, Instructions set (Data transfer including stacks. Arithmetic, logical, branch, and control instructions). Subroutines, delay loops. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI. Hardware and software interrupts. **(17 Lectures)**

Unit- III 8051 Microcontroller Architecture:

Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. **(15 Lectures)**

Unit- IV 8051 Programming and Introduction to Embedded system:

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 (using assembly language), I/O programming: Bit manipulation, Embedded systems and general purpose computer systems. Architecture of embedded system. Classifications, applications and purpose of embedded systems. **(15 Lectures)**

Reference Books:

- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- Microprocessor and Microcontrollers, N. Senthil Kumar, 2010, Oxford University Press
- 8051 microcontrollers, Satish Shah, 2010, Oxford University Press.
- Embedded Systems: Design & applications, S.F. Barrett, 2008, Pearson Education India
- Introduction to embedded system, K.V. Shibu, 1st edition, 2009, McGraw Hill
- Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011,

ELECTRONICS LAB-DSC 1D LAB: MICROPROCESSOR AND MICROCONTROLLER LAB

60 Lectures

At least 06 experiments each from Section-A and Section-B

Section-A: Programs using 8085 Microprocessor

1. Addition and subtraction of numbers using direct addressing mode
2. Addition and subtraction of numbers using indirect addressing mode
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Handling of 16-bit Numbers.
6. Use of CALL and RETURN Instruction.
7. Block data handling.
8. Other programs (e.g. Parity Check, using interrupts, etc.).

Section-B: Experiments using 8051 microcontroller:

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's
5. Program to glow the first four LEDs then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED display.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement & display on LCD

Reference Books:

- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- 8051 microcontrollers, Satish Shah, 2010, oxford University Press.
- Embedded Microcomputer systems: Real time interfacing, J.W. Valcano 2011, Cengage Learning.

SEMESTER V
ELECTRONICS-DSC: ELECTRONIC INSTRUMENTATION
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Unit- I Measurements:

Accuracy and precision. Significant figures. Error and uncertainty analysis. Shielding and grounding. Electromagnetic Interference. **Basic Measurement Instruments:** DC measurement-ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating). Digital Multimeter; Block diagram principle of measurement of I, V, C. Accuracy and resolution of measurement. **(15 Lectures)**

Unit- II Bridges

Measurement of Impedance- A.C. bridges, Measurement of Self Inductance (Anderson's bridge), Measurement of Capacitance (De Sauty's bridge), Measurement of frequency (Wien's bridge). **(15 Lectures)**

Unit- III Power supply:

Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators (78XX and 79XX), Line and load regulation, Short circuit protection. Idea of switched mode power supply (SMPS) and uninterrupted power supply (UPS). **(15 Lectures)**

Unit- IV Oscilloscope: and Signal Generators

Block Diagram, CRT, Vertical Deflection, Horizontal Deflection. Screens for CRT, Oscilloscope probes, measurement of voltage, frequency and phase by Oscilloscope. Digital Storage Oscilloscopes. LCD display for instruments. Signal Generators: Function generator, Pulse Generator. **(15 Lectures)**

Reference Books:

- W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
- E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
- David A. Bell, Electronic Devices and Circuits, Oxford University Press (2015).
- Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Butterworth Heinmann-2008).
- S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
- Introduction to measurements and instrumentation, 4th Edn., Ghosh, PHI Learning

PRACTICALS -DSE LAB: ELECTRONIC INSTRUMENTATION LAB
60 Lectures

AT LEAST 05 EXPERIMENTS FROM THE FOLLOWING

1. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
2. Measurement of Capacitance by De Sauty's bridge
3. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of

Strain using half and full bridge.)

4. To determine the Characteristics of LVDT.
5. To determine the Characteristics of Thermistors and RTD.
6. Measurement of temperature by Thermocouples.
7. Design a regulated power supply of given rating (5 V or 9V).
8. To design and study the Sample and Hold Circuit.
9. To plot the frequency response of a microphone.

Reference Books:

- W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
- David A. Bell, Electronic Instrumentation & Measurements, Prentice Hall (2013)
- S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
- Basic Electronics:A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1990, Mc-Graw Hill

ELECTRONICS- DSE: PHOTONIC DEVICES AND POWER ELECTRONICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

UNIT-I: Photonic Devices

Classification of photonic devices. Interaction of radiation and matter, Radiative transition and optical absorption. Light Emitting Diodes- Construction, materials and operation. Semiconductor Laser- Condition for amplification, laser cavity, heterostructure and quantum well devices. Charge carrier and photon confinement, line shape function. Threshold current. Laser diode. **(15 Lectures)**

Unit- II Photo Detectors

Photodetectors: Photoconductor. Photodiodes (p-i-n, avalanche) and Photo transistors, quantum efficiency and responsivity. Photomultiplier tube. **Solar Cell:** Construction, working and characteristics **LCD Displays:** Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays. **(15 Lectures)**

Unit-III: Power Electronics

Power Devices: Need for semiconductor power devices, Power MOSFET (Qualitative). Introduction to family of thyristors. Silicon Controlled Rectifier (SCR)- structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Gate-triggering circuits. Diac and Triac- Basic structure, working and V-I characteristics. **(15 Lectures)**

Unit- IV Applications of SCR:

Phase controlled rectification, AC voltage control using SCR and Triac as a switch. Power Inverters- Need for commutating circuits and their various types, dc link inverters, Parallel capacitor commutated invertors, Series Invertor, limitations and its improved versions, bridge inverters. **(15 Lectures)**

Reference Books:

- J. Wilson & J.F.B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
- S.O. Kasap, Optoelectronics & Photonics, Pearson Education (2009)

- AK Ghatak & K Thyagarajan, Introduction to fiber optics, Cambridge Univ. Press (1998)
- Power Electronics, P.C. Sen, Tata McGraw Hill
- Power Electronics, M.D. Singh & K.B. Khanchandani, Tata McGraw Hill
- Power Electronics Circuits, Devices & Applications, 3rd Edn., M.H. Rashid, Pearson Education
- Optoelectronic Devices and Systems, Gupta, 2nd edn., PHI learning.
- Electronic Devices and Circuits, David A. Bell, 2015, Oxford University Press.

**PRACTICALS -DSE-1 LAB: PHOTONIC DEVICES AND POWER
ELECTRONICS LAB
60 Lectures**

AT LEAST 06 EXPERIMENTS FROM THE FOLLOWING

1. To determine wavelength of sodium light using Michelson's Interferometer.
2. Diffraction experiments using a laser.
3. Study of Electro-optic Effect.
4. To determine characteristics of (a) LEDs, (b) Photo voltaic cell and (c) Photo diode.
5. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination intensity, and (ii) Linear Displacement of source.
6. To measure the numerical aperture of an optical fiber.
7. Output and transfer characteristics of a power MOSFET.
8. Study of I-V characteristics of SCR
9. SCR as a half wave and full wave rectifiers with R and RL loads.
10. AC voltage controller using TRIAC with UJT triggering.
11. Study of I-V characteristics of DIAC
12. Study of I-V characteristics of TRIAC

Reference Books:

- AK Ghatak & K Thyagarajan, Introduction to fiber optics, Cambridge Univ. Press (1998)
- Power Electronics, M.D. Singh & K.B. Khanchandani, Tata McGraw Hill
- Power Electronics Circuits, Devices & Applications, 3rd Edn., M.H.Rashid, Pearson Education
- A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand.

ELECTRONICS-DSE: ANTENNA THEORY AND WIRELESS NETWORKS

(Credits: Theory-05, Tutorial-01)

Theory: 75 Lectures

ANTENNA THEORY:

Unit- I Introduction:

Antenna as an element of wireless communication system, Antenna radiation mechanism, Types of Antennas, Fundamentals of EMFT: Maxwell's equations and their applications to antennas. **Antenna Parameters:** Radiation pattern (polarization patterns, Field and Phase patterns), Field regions around antenna, Radiation intensity, Beam width, Gain, Directivity, Polarization, Bandwidth, Efficiency and Antenna temperature. **(15 Lectures)**

Unit- II Antenna as a Transmitter/Receiver:

Effective Height and Aperture, Power delivered to antenna, Input impedance. Radiation from an infinitesimal small current element, Radiation from an elementary dipole (Hertzian dipole), Reactive, Induction and Radiation fields, Power density and radiation resistance for small current element and half wave dipole antenna. **(15 Lectures)**

UNIT- III Radiating wire Structures (Qualitative idea only):

Monopole, Dipole, Folded dipole, Loop antenna and Biconical broadband Antenna. Basics of Patch Antenna and its design. Examples of Patch antenna like bowtie, sectoral, fractal, Horn Antenna etc. **(15 Lectures)**

Unit- IV Propagation of Radio Waves: Different modes of propagation: Ground waves, Space waves, Space Wave propagation over flat and curved earth, Optical and Radio Horizons, Surface Waves and Troposphere waves, Ionosphere, Wave propagation in the Ionosphere. Critical Frequency, Maximum usable frequency (MUF), Skips distance. Virtual height. Radio noise of terrestrial and extraterrestrial origin. Elementary idea of propagation of waves used in Terrestrial mobile communications. History of wireless communication. **(15 Lectures)**

Reference Books:

- Ballanis, Antenna Theory, John Wiley & Sons, (2003) 2nd Ed.
- Jordan and Balmain, E. C., Electro Magnetic Waves and Radiating Systems, PHI, 1968 Reprint (2003) 3rd Ed.
- Andrea Goldsmith, Wirelerss communications, (2015) Cambridge University Press
- D. Tse and P. Viswanathan, Fundamentals of Wireless Communication, (2014) Cambridge University Press.
- Wireless communication and Networks, Upena Dala, 2015, Oxford University Press.
- Antenna and Wave propogation, Yadava, PHI Learning
- Haykin S. & Moher M., Modern Wireless Communication Pearson, (2005) 3rd Ed.
- Lee, William C.Y., Mobile Communication Design and Fundamentals, (199) 4th Ed.

ELECTRONICS-DSE: DIGITAL SIGNAL PROCESSING

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Unit – I Discrete-Time Signals and Systems:

Classification of Signals, Transformations of the Independent Variable, Periodic and Aperiodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties. Impulse Response, Convolution Sum; Graphical Method; Analytical Method, Properties of Convolution; Commutative; Associative; Distributive; Shift; Sum Property System Response to Periodic Inputs, Relationship Between LTI System Properties and the Impulse Response; Causality; Stability; Invertibility, Unit Step Response. **(15 Lectures)**

Unit-II Discrete-Time Fourier Transform:

Fourier Transform Representation of Aperiodic Discrete-Time Signals, Periodicity of DTFT, Properties; Linearity; Time Shifting; Frequency Shifting; Differencing in Time Domain; Differentiation in Frequency Domain; Convolution Property. **The z-Transform:** Bilateral (Two-Sided) z-Transform, Inverse z-Transform, Relationship Between z-Transform and Discrete-Time Fourier Transform, z-plane, Region-of-Convergence; Properties of ROC, Properties; Time Reversal; Differentiation in the z-Domain. Analysis and Characterization of LTI Systems; Transfer Function and Difference-Equation System. Solving Difference Equations. **(15 Lectures)**

Unit- III Discrete Fourier Transform:

Frequency Domain Sampling (Sampling of DTFT), The Discrete Fourier Transform (DFT) and its Inverse, DFT as a Linear transformation, Properties; Periodicity; Linearity; Circular Time Shifting; Circular Frequency Shifting; Circular Time Reversal; Multiplication Property; Parseval's Relation, Linear Convolution Using the DFT (Linear Convolution Using Circular Convolution), Circular Convolution as Linear Convolution with aliasing. **(15 Lectures)**

Unit- IV Fast Fourier Transform:

Direct Computation of the DFT, Symmetry and Periodicity Properties of the Twiddle factor (W_N), Radix-2 FFT Algorithms; Decimation-In-Time (DIT) FFT Algorithm; Decimation-In-Frequency (DIF) FFT Algorithm, Inverse DFT Using FFT Algorithms. DFT as linear transformation tool **(15 Lectures)**

Reference Books:

- Digital Signal Processing, Tarun Kumar Rawat, 2015, Oxford University Press, India
- Digital Signal Processing, S. K. Mitra, McGraw Hill, India.
- Principles of Signal Processing and Linear Systems, B.P. Lathi, 2009, 1st Edn. Oxford University Press.
- Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L.Harris, 2005, Cengage Learning.
- Fundamentals of signals and systems, P.D. Cha and J.I. Molinder, 2007, Cambridge University Press.
- Digital Signal Processing Principles Algorithm & Applications, J.G. Proakis and D.G. Manolakis, 2007, 4th Edn., Prentice Hall.

PRACTICAL-DSE LAB: DIGITAL SIGNAL PROCESSING LAB

60 Lectures

At least 06 experiments from the following using Scilab. Introduction to Numerical

computation software Scilab be introduced in the lab.

1. Write a program to generate and plot the following sequences: (a) Unit sample sequence $\delta(n)$, (b) unit step sequence $u(n)$, (c) ramp sequence $r(n)$, (d) real valued exponential sequence $x(n) = 0.8^n u(n)$ for $0 \leq n \leq 50$.

2. Write a program to compute the convolution sum of a rectangle signal (or gate function) with itself for $N = 5$

$$x(n) = \text{rect}(n/2N) = \Pi(n/2N) = \begin{cases} 1 & -N \leq n \leq N \\ 0 & \text{otherwise} \end{cases}$$

3. An LTI system is specified by the difference equation

$$y(n] = 0.8y(n-1) + x(n]$$

(a) Determine $H(e^{j\omega})$

(b) Calculate and plot the steady state response $y_{ss}(n)$

$$\text{to } x(n) = \cos(0.5\pi n) u(n)$$

4. Given a casual system

$$y(n] = 0.9y(n-1) + x(n]$$

(a) Find $H(z)$ and sketch its pole-zero plot

(b) Plot the frequency response $|H(e^{j\omega})|$ and $\angle H(e^{j\omega})$

5. Design a digital filter to eliminate the lower frequency sinusoid of $x(t) = \sin 7t + \sin 200t$. The sampling frequency is $f_s = 500 \text{ Hz}$. Plot its pole zero diagram, magnitude response, input and output of the filter.

6. Let $x(n]$ be a 4-point sequence:

$$x(n] = \{1,1,1,1\} = \begin{cases} 1 & 0 \leq n \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

Compute the DTFT $X(e^{j\omega})$ and plot its magnitude

(a) Compute and plot the 4 point DFT of $x(n]$

(b) Compute and plot the 8 point DFT of $x(n]$ (by appending 4 zeros)

(c) Compute and plot the 16 point DFT of $x(n]$ (by appending 12 zeros)

7. Let $x(n)$ and $h(n)$ be the two 4-point sequences,

$$x(n) = \{1, 2, 2, 1\}$$

↑

$$h(n) = \{1, -1, -1, 1\}$$

↑

Write a program to compute their linear convolution using circular convolution.

8. Using a rectangular window, design a FIR low-pass filter with a pass-band gain of unity, cut off frequency of 1000 Hz and working at a sampling frequency of 5 KHz. Take the length of the impulse response as 17.

9. Design an FIR filter to meet the following specifications:

passband edge $F_p = 2 \text{ KHz}$

stopband edge $F_s = 5 \text{ KHz}$

Passband attenuation $A_p = 2 \text{ dB}$

Stopband attenuation $A_s = 42 \text{ dB}$

Sampling frequency $F_s = 20 \text{ KHz}$

10. The frequency response of a linear phase digital differentiator is given by

$$H_d(e^{j\omega}) = j\omega e^{-j\tau\omega} \quad \left| \omega \right| \leq \pi$$

Using a Hamming window of length $M = 21$, design a digital FIR differentiator.

Plot the amplitude response.

Reference Books:

- Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, India.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
- Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L. Harris, 2005, Cengage Learning.
- Getting started with MATLAB, Rudra Pratap, 2010, Oxford University Press.
- Modern Digital Signal Processing includes Signals and Systems, Udayashankara, 2nd Edn., PHI Learning.
- Digital Signal Processing, S. K. Mitra, McGraw Hill, India.
- Fundamentals of signals and systems, P.D.Cha and J.I Molinder, 2007, Cambridge University Press.

ELECTRONICS-DSE: VERILOG & FPGA BASED SYSTEM DESIGN

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Unit- I Digital logic design flow.

Review of combinational circuits. Combinational building blocks: multiplexors, demultiplexers, decoders, encoders and adder circuits. Review of sequential circuit elements: flip-flop, latch and register. **(15 lectures)**

Unit- II Finite State Machines:

Mealy and Moore. Other sequential circuits: shift registers and counters. FSM (Finite State Machine with Data path): design and analysis. Microprogrammed control. Memory basics and timing. Programmable Logic devices. **(15 lectures)**

Unit- III Programmable logic devices.

PAL, PLA and GAL. CPLD and FPGA architectures. Placement and routing. Logic cell structure, Programmable interconnects, Logic blocks and I/O Ports. Clock distribution in FPGA. Timing issues in FPGA design. Boundary scan. **(15 lectures)**

Unit- IV Verilog HDL:

Introduction to HDL. Verilog primitive operators and structural Verilog Behavioral Verilog. Design verification. Modeling of combinational and sequential circuits (including FSM and FSM) with Verilog Design examples in Verilog. **(15 lectures)**

Reference Books:

1. LizyKurien and Charles Roth. Principles of Digital Systems Design and VHDL. Cengage Publishing. ISBN-13: 978-8131505748
2. Palnitkar, Samir, Verilog HDL. Pearson Education; Second edition (2003).
3. Ming-Bo Lin. Digital System Designs and Practices: Using Verilog HDL and FPGAs. Wiley India Pvt Ltd. ISBN-13: 978-8126536948
4. Zainalabedin Navabi. Verilog Digital System Design. TMH; 2nd edition. ISBN-13: 978-0070252219
5. Wayne Wolf. FPGA Based System Design. Pearson Education.
6. S. K. Mitra, Digital Signal processing, McGraw Hill, 1998
7. VLSI design, Debaprasad Das, 2nd Edition, 2015, Oxford University Press.
8. D.J. Laja and S. Sapatnekar, Designing Digital Computer Systems with Verilog, Cambridge University Press, 2015.

PRACTICALS-DSE LAB: VERILOG AND FPGA LAB

60 Lectures

AT LEAST 08 EXPERIMENTS FROM FOLLOWING.

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Design and simulation of a 4 bit Adder.
5. Multiplexer (4x1) and Demultiplexer using logic gates.
6. Decoder and Encoder using logic gates.
7. Clocked D, JK and T Flip flops (with Reset inputs)
8. 3-bit Ripple counter
9. To design and study switching circuits (LED blink shift)
10. To design traffic light controller.
11. To interface a keyboard
12. To interface a LCD using FPGA
13. To interface multiplexed seven segment display.
14. To interface a stepper motor and DC motor.
15. To interface ADC 0804.

Reference Books

- W.Wolf, FPGA- based System Design, Pearson, 2004
- U. Meyer Baese, Digital Signal Processing with FPGAs, Springer, 2004
- S. Palnitkar, Verilog HDL– A Guide to Digital Design & Synthesis, Pearson, 2003
- Verilog HDL primer- J. Bhasker. BSP, 2003 II edition

Skill Enhancement Course (any four) (Credit: 02 each)- SEC1 to SEC4

PHYSICS WORKSHOP SKILL

(Credits: 02)

30 Lectures

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode

Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **(4 Lectures)**

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine

processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothing of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet. **(10 Lectures)**

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay. **(10 Lectures)**

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment. **(6 Lectures)**

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

COMPUTATIONAL PHYSICS

(Credits: 02)

Theory: 30 Lectures

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics and Science.

- *Highlights the use of computational methods to solve physical problems*
- *Use of computer language as a tool in solving physics/science problems*
- *Course will consist of hands on training on the Problem solving on Computers.*

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of $\sin(x)$ as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal. **(4 Lectures)**

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program,

Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. **(5 Lectures)**

Control Statements: Types of Logic(Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic **IF**, Block **IF**, Nested Block **IF**, **SELECT CASE** and **ELSE IF** Ladder statements), Looping Statements (**DO-CONTINUE**, **DO-ENDDO**, **DOWHILE**, Implied and Nested **DO** Loops), Jumping Statements (Unconditional **GOTO**, Computed **GOTO**, Assigned **GOTO**) Subscripted Variables (Arrays: Types of Arrays, **DIMENSION** Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), **RETURN**, **CALL**, **COMMON** and **EQUIVALENCE** Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using $\exp(x)$ series evaluated at $x=1$

(6 Lectures)

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors. **(6 Lectures)**

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.

10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

(9 Lectures)

Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
- "LaTeX—A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, etal. New Age International Publishers, New Delhi(1999)
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007

ELECTRICAL CIRCUITS AND NETWORK SKILLS

(Credits: 02)

Theory: 30 Lectures

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

Unit I

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. **(3 Lectures)**

Electrical Circuits: Basic electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. **(4 Lectures)**

Unit II

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **(4 Lectures)**

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **(3 Lectures)**

Unit III

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **(4 Lectures)**

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources **(3 Lectures)**

Unit IV

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device. **(4 Lectures)**

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, and solder. Preparation of extension board. **(5 Lectures)**

Reference Books:

- Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn

RENEWABLE ENERGY AND ENERGY HARVESTING

(Credits: 02)

Theory:30 Lectures

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Unit I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **(3 Lectures)**

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(6 Lectures)**

Unit II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **(3 Lectures)**

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. **(3 Lectures)**

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **(2 Lectures)**

Unit III

Geothermal Energy: Geothermal Resources, Geothermal Technologies. **(2 Lectures)**

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. **(2 Lectures)**

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power **(4 Lectures)**

Unit IV

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications **(2 Lectures)**

Carbon captured technologies, cell, batteries, power consumption **(2 Lectures)**

Environmental issues and Renewable sources of energy, sustainability. **(1 Lecture)**

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

- Non-conventional energy sources, B.H. Khan, McGraw Hill
- Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
- Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.
- Renewable Energy Sources and Emerging Technologies, Kothari et.al., 2nd Edition, PHI Learning.
- Solar Energy: Resource Assesment Handbook, P Jayakumar, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- http://en.wikipedia.org/wiki/Renewable_energy

TECHNICAL DRAWING

(Credits: 02)

Theory: 30 Lectures

Unit I: Introduction: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola: hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism. 2D geometrical construction. Representation of 3D objects. Principles of projections. **(6 Lectures)**

Unit II: Projections: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids.: Orthographic projection. Interpenetration and intersection of solids. Isometric and oblique parallel projection of solids. **(8 Lectures)**

Unit III: CAD Drawing - I

Introduction to CAD and Auto CAD, precision drawing and drawing aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user interface. Create, retrieve, edit, and use symbol libraries. Use inquiry commands to extract drawing data). Control entity properties. Demonstrating basic skills to produce 2-D and 3-D drawings. 3D modeling with Auto CAD (surfaces and solids), **(8 Lectures)**

Unit III: CAD Drawing - II

3D modeling with sketch up, annotating in Auto CAD with text and hatching, layers, templates and design center, advanced plotting (layouts, viewports), office standards, dimensioning, internet and collaboration, Blocks, drafting symbols, attributes, extracting data. basic printing, editing tools, Plot/Print drawing to appropriate scale. **(8 Lectures)**

Reference Books:

- Engineering Drawing, N.S. Parthasarathy and Vele Murali, 1st Edition, 2015, Oxford University Press
- Computer Aided Electrical Drawing, Yogesh et.al. PHI Learning
- Engineering Graphic, K. Venugopal, and V. Raja Prabhu, New Age International
- AutoCAD 2014 & AutoCAD 2014/Donnie Gladfelter/Sybex/ISBN:978-1-118-57510-9
- Architectural Design with Sketchup/Alexander Schreyer/John Wiley & Sons/ISBN:

APPLIED OPTICS

(Credits: 02)

THEORY: 30 Lectures

Theory includes only qualitative explanation. Minimum five experiments should be performed covering minimum three sections.

(i) Sources and Detectors (9 Periods)

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Experiments on Lasers:

- a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
- b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
- c. To find the polarization angle of laser light using polarizer and analyzer
- d. Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

- a. V-I characteristics of LED
- b. Study the characteristics of solid state laser
- c. Study the characteristics of LDR

- d. Photovoltaic Cell
- e. Characteristics of IR sensor

Fourier Optics (6 Periods)

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens

Experiments on Fourier Optics:

a. Fourier optic and image processing

1. Optical image addition/subtraction
2. Optical image differentiation
3. Fourier optical filtering
4. Construction of an optical 4f system

b. Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science.

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.

(iii) Holography (6 Periods)

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition

Experiments on Holography and interferometry:

1. Recording and reconstructing holograms
2. Constructing a Michelson interferometer or a Fabry Perot interferometer
3. Measuring the refractive index of air
4. Constructing a Sagnac interferometer
5. Constructing a Mach-Zehnder interferometer
6. White light Hologram

(iv) Photonics: Fibre Optics (9 Periods)

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating

Experiments on Photonics: Fibre Optics

- a. To measure the numerical aperture of an optical fibre
- b. To study the variation of the bending loss in a multimode fibre
- c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern
- d. To measure the near field intensity profile of a fibre and study its refractive index profile
- e. To determine the power loss at a splice between two multimode fibre

Reference Books:

- LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
- Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
- Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University Press
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd

WEATHER FORECASTING

(Credits: 02)

Theory: 30 Lectures

The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques

Unit I: Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics. **(9 Periods)**

Unit II:

Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws. **(4 Periods)**

Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. **(3 Periods)**

Unit III: Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **(6 Periods)**

Unit IV: Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. **(8 Periods)**

Demonstrations and Experiments:

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:
 - (a) To calculate the sunniest time of the year.
 - (b) To study the variation of rainfall amount and intensity by wind direction.
 - (c) To observe the sunniest/driest day of the week.
 - (d) To examine the maximum and minimum temperature throughout the year.
 - (e) To evaluate the relative humidity of the day.
 - (f) To examine the rainfall amount month wise.
3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis.
4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)

Reference books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agro meteorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur
5. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.