Third Semester

Basic Electrical Engineering (DEC-301)

Basic Engineering and Science (BES) Core: Credit 4(3-0-2)

RATIONALE

This course will enable the students to understand the basic concepts and principles of d.c and a.c fundamental, a.c circuits, batteries, electromagnetic induction etc. Including constant voltage and current sources. A diploma holder may be involved in various jobs ranging from preventive maintenance of electrical installation to fault location etc. In addition, he may be working in testing laboratories where he uses measuring instruments.To carry out these and similar jobs effectively, knowledge of basic concepts, principles and their applications is very essential.

DETAILED CONTENTS

1.DC Circuits

1.1 Concept of electricity, various applications of electricity, advantages of electricity over other types of energy.

1.2 basic terms – voltage, current, potential difference, power, energy and their units.

1.3 Ohm's law and its practical applications, concepts of resistance,conductance, resistivity and their units,

1.4 Effect of temperature on resistance, temperature coefficient of resistance

1.5 Series and parallel combination of resistors, wattage consideration, simple problems

1.6 Kirchhoff's current law and Kirchhoff's voltage law and their applications to simple circuits. Conversion of circuits from Star to Delta and Delta to Star.

2. DC Circuit Theorems

Thevenin's theorem, Norton's theorem, super position theorem, maximum power transfer theorem, application of network theorem in solving d.c circuit problems.

3. Constant Voltage and Constant Current Sources

a) Concept of constant voltage source, symbol and graphical representation characteristics of ideal and practical sources.

b) Concept of constant current sources, symbol, characteristics and graphical representation of ideal and practical current sources.

4. Electro Magnetic Induction (8 hrs)

a)Concepts of magnetic field produced by flow of current, Magnetic circuit, concept of magneto motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.

b) Faraday's law and rules of electro-magnetic induction, principles of self and mutual induction, self and mutually induced e.m.f, simple numerical problems.

c) Concept of current growth, decay and time constant in an inductive (RL) circuit. d) Energy stored in an inductor, series and parallel combination of inductors.

5. Batteries

5.1 Basic idea about primary and secondary cells

5.2 Construction, working and applications of Lead-Acid battery and Nickel- Cadmium cells, Silver Oxide cells

5.3 Charging methods used for lead-acid battery(accumulator)

5.4 Care and maintenance of lead-acid battery

5.5 Series and parallel connections of batteries.

5.6 General idea of solar cells, solar panels and their applications

6. AC Fundamentals

6.1 Concept of alternating voltage and current

6.2 Difference between a.c and d.c

6.3 Concept of cycle, frequency, time period, amplitude, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.

6.4 Representation of sinusoidal quantities by phasor diagrams

6.5Equation of sinusoidal wave form (with derivation)

6.6Effect of alternating voltage applied to a pure resistance, pure inductance and pure capacitance.

7. AC Circuits

7.1 Inductive reactance and Capacitive reactance

7.2 Alternating voltage applied to resistance and inductance in series.

7.3 Alternating voltage applied to resistance and capacitance in series.

7.4 Impedance triangle and phase angle

7.5 Solutions and phasor diagrams for simple RLC circuits (series and parallel).

7.6 Introduction to series and parallel resonance and its conditions

7.7 Power in pure resistance, inductance and capacitance, power in combined RLC circuits. Power factor, active and reactive power and their significance, importance of power factor.

7.8 j-notation and its application in solving a series and parallel AC circuits

7.9 Definition of conductance, susceptance and admittance

LIST OF PRACTICALS

1. Familiarization of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter and multi-meter and other accessories

2. Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions.

3. To measure (very low) resistance of an ammeter and (very high) resistance of a voltmeter

4. To verify in d.c circuits:

a. hevenin’s theorem,

b. Norton’s theorem,

c. Super position theorem,

d. Maximum power transfer theorem,

5. To observe change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.

6. Verification of Kirchhoff's Current Law and Kirchhoff's Voltage Laws in a dc circuit]

7. To find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance

8. To find the voltage current relationship in a single phase R-L and R-C Series circuits, draw their impedance triangles and determine the power factor in each case .

9. To test a lead - acid storage battery and to charge it.

10. Measurement of power and power factor in a single phase R.L.C.circuit and to calculate active and reactive power.

11. Visit to a nearby Power Station(s).

RECOMMENDED BOOKS

1. Electrical Technology, Fifth Edition by Edward Hughes, Longman Publishers

2. Electrical Technology by BL Theraja, S Chand and Co, New Delhi

3.Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and Sons, New Delhi

4.Experiments in Basic Electrical Engineering by SK Bhattacharya, KM Rastogi; New Age International (P) Ltd.; Publishers New Delhi

5. Basic Electricity by BR Sharma; Satya Prakashan; New Delhi

6. Principles of Electrical Engineering by BR Gupta, S Chand and Co, New Delhi

7. Basic Electrical Engineering by PS Dhogal, Tata Mc Graw Hill, New Delhi

8. Basic Electrical Engineering by JB Gupta; SK Kataria and Sons, New Delhi

9.Experiments in Basic Electrical Engineering by GP Chhalhotra, Khanna Publishers, New Delhi

10.Basic Electrical Engineering by Mool Singh, Gilgotia Publications Pvt. Ltd.New Delhi

ANALOG ELECTRONICS (DEC-302)
Discipline core (DC) : Credit 4(3-0-2)

Objective: This subject will enable the student to have conceptual understanding of conductors, semiconductors and insulators, extrinsic and intrinsic semi-conductors, p-n junction, need of rectifiers in electronics , understanding of filters in rectifiers, tunnel diodes, LEDs, varactor diodes, LCD, understanding the working of transistors in various configuration; understanding of FETs and MOSFET etc.

COURSE OUTLINE:

1. Semi conductor Physics

1.1 Review of basic atomic structure and energy level, concept of insulator, conductors and semi conductors, atomic structure of Ge and Si, covalent bonds

1.2 Concept of intrinsic and extrinsic semiconductor, P and N impurities, doping of impurity

1.3 P and N type semiconductors and their conductivity. Effect of temperature on conductivity of intrinsic semiconductor.

1.4 Energy level diagram of conductors, insulators and semi conductors, minority and majority carriers

1.5 Basic idea of Hall Effect and its uses

2. Semi-Conductor Diode

2.1 PN junction diode, mechanism of current flow in PN junction, Drift and diffusion current, depletion layer, forward and reverse biased PN junction, potential barrier, concept of junction capacitance in forward and reverse bias condition

2.2 V-I characteristics, static and dynamic resistance and their calculation from diode characteristics

2.3 Diode as half wave, full wave and bridge rectifier. PIV, rectification efficiencies and ripple factor calculations, shunt capacitor filter, series inductor filter, LC filter and π filter

2.4 Type of diodes, characteristics and applications of Zener diode. Zener and avalanche breakdown, use of Zener diode as a voltage regulator

3. Introduction to Bipolar Transistor

Concept of bipolar transistor, structure, PNP and NPN transistor, their symbols and mechanism of current flow; current relations in transistor; concept of leakage current; CB, CE, CC configuration of the transistor, input and output characteristics in CB and CE configurations; input and output dynamic resistance in CB and CE configurations; current amplification factors. Comparison of CB, CE and CC Configurations, Power rating of Transistor

4. Transistor Biasing Circuits

Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Different types of biasing circuits, Load line Analysis , Concept of AC load Line, Stability Factor

5. Single Stage Transistor Amplifier

Classification of Amplifier Single stage transistor amplifier circuits, a.c load line and its use in calculation of currents and voltage gain of a single stage amplifier circuit. Explanation of phase reversal of output voltage with respect to input voltage.H-parameters and their significance. Calculation of current gain, voltage gain, input impedance and output impedance using h- parameter

6. FET, MOSFET & UJT

Construction, operation and characteristics of FET and its application

6.1 Construction, operation and characteristics of MOSFET in depletion and enhancement modes and its applications

6.2 C-MOS advantages and applications

6.3 Comparison of JFET, MOSFET and BJT FET amplifier circuit and its working principle. (No analysis)

6.4 Construction, operations and application of UJT.

LIST OF PRACTICALS

1. Familiarization, identification and testing of active and passive components.
2. Familiarization with operationsof different Electronicsinstruments likeanalog & digital Multi-meter, CRO, Signal generator, Regulated Power Supply
3. To plot V-I characteristics of PN junction diode
4. To plot V-I characteristics of a zener diode& observe its use as voltage regulator
5. To observe the wave shapeof following rectifier circuit·Half wave rectifier·Full wave rectifier·Bridge rectifier
6. To plot the wave shape of full wave rectifier with·Shunt capacitor filter·Series capacitor filter·π filter
7. To plot input and output characteristics and calculate parameter oftransistor in CE configuration
8. To plot input and output characteristics and calculate parameter of transistor in CB configuration

RECOMMENDED BOOKS

1. Basic Electronics and Linear circuit by NN Bhargava and Kulshreshta, Tata McGraw Hill, New Delhi.

2. Electronics Devices and circuits by D.C. Kulshereshtha; New Age Publishers, New Delhi.

3. Principle of Electrical and Electronics Engineering by VK Mehta; S Chand and Co. New Delhi.

DIGITAL ELECTRONICS (DEC-303)
Discipline core (DC): Credit 4(3-0-2)

Objective: This syllabus has been designed to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips. This subject aims to give a background in the broad field of digital systems design and microprocessors.

COURSE OUTLINE:

1. Introduction

1.1 Comparison between analog and digital signal

1.2 Applications and advantages of digital signals

2. Number System

2.1 Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa

2.2 Binary addition, subtraction, multiplication and division including binary points. 1's and 2's complement method of addition/subtraction, sign magnitude method of representation, floating point representation

3. Codes and Parity

3.1 Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code

3.2 Concept of parity, single and double parity and error detection code.

4. Logic Gates and Families

a) Concept of negative and positive logic

b) Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates

c) Logic family classification

i) Definition of SSI, MSI, LSI, VLSI

ii) TTL and C MOS families

iii) Characteristics of TTL and C MOS digital gates. Delay, speed, noise margin, logic levels, power dissipation, fan-in, fan-out, power supply requirement and Comparison between TTL and C MOS families, ECL & IIL

iv) Open collector and totem pole output circuits

v) Introduction to tri- state devices, tri state buffer and Inverter circuits

5. Logic Simplification

5.1 Postulates of Boolean algebra, De Morgan's Theorems. Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates

5.2 Karnaugh map (up to 4 variables) and simple applications in developing combinational logic circuits

5.3 Concept of POS & SOP.

6. Arithmetic circuits

6.1 Half adder and Full adder circuit, design and implementation.

6.2 Half and Full subtracter circuit, design and implementation.

6.3 4bit binary Adder and Subtractor IC (7483)

7. Decoders, Multiplexer and De Multiplexer

7.1 Four bit decoder circuits for 7 segment display and decoder/driver ICs.

7.2 Multiplexers and De-Multiplexers

7.3 Basic functions and block diagram of MUX and DEMUX. Different ICs

8. Latches and flip flops

8.1 Concept and types of latch with their working and applications

8.2 Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops.

8.3 Difference between a latch and a flip flop

8.4 Flip flop ICs

9. Counters

9.1 Introduction to Asynchronous and Synchronous counters 9.2 Binary counters 9.3 Divide by N ripple counters, Decade counter. 9.4 Up/down counter 9.5 Ring counter with timing diagram

9.6 Counter ICs

10. Shift Register

10.1 Introduction and basic concepts including shift left and shift right.

10.2 Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

10.3 Universal shift register

10.4 Buffer register, Tristate Buffer register

10.5 IC 7495

11. A/D and D/A Converters

a) Working principle of A/D and D/A converters

b) Brief idea about different techniques A/D conversion and study of

i) Stair step Ramp A/D converter

ii) Dual Slope A/D converter

c) Detail study of

i) Binary Weighted D/A converter

d) Applications of A/D and D/A converter

e) Sample and Hold Circuit

12. Memories

Memory organization, Classification of semi conductor memories. ROM, PROM, DROM, EPROM, EEPROM, RAM, CCD memories, Programmable logic devices, programmable logic array, programmable array logic

13 Arithmetic & Logic Unit

Basic idea about arithmetic logic unit w.r.t IC 74181 and applications, implementation of binary multiplication, division, subtraction and addition.

LIST OF PRACTICALS

1) Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR(EXNOR) gates
2) Realization of logic functions with the help of NAND or NOR gates
3) To design a half adder & full adder using XOR and NAND gates and verification of its operation
4) Realization of 4 bit adder/subtractor using IC
5) Verification of truth table for positive edge triggered, negative edge triggered, level triggered IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops)
6) Verification of truth table for encoder and decoder ICs, Mux and DeMux
7) To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation
8)Asynchronous Counter ICs Verification of truth table for any one universal shift register ICUse of IC 7490 or equivalent TTL (a) divide by 2 (b) divide by 10 CounterORUse of IC 7493 or equivalent TTL (a) divide by 2 (b) divide by 8 (c) divide by 16 counter
9.To design A/D and D/A convertor and verify their operations.

RECOMMENDED BOOKS

1 Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi.

2 Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi.

Principles of Communication (DEC-304)

Discipline core (DC): Credit 4(3-0-2)

RATIONALE

In the present age of information technology, the communication gains utmost importance whether it be voice or data or control signal. The students will be able to understand the working principle of various communication devices used in industry after going through the basic principles and concepts contained in this subject.

DETAILED CONTENTS

1. Introduction

a) Need for modulation and demodulation in communication system

b) Basic schemes of modern communication system

2. Amplitude Modulation

a) Definition, derivation of expression for an A.M., wave carrier and side band component modulation index, relative power distribution in carrier and side bands

b) Basic idea of DSB, DSB-SC, SSB-SC, ISB and VSB modulation and their comparison and area of application

3. Frequency Modulation

a) Expression for frequency modulated wave and frequency spectrum (without proof and analysis of Bessel function), modulation index, maximum frequency deviation and deviation rating

b) Effect of noise on FM carrier, Noise triangle. Need for pre-emphasis and de- emphasis

c) Narrow band and wide band FM

d) Comparison of FM and AM in communication system

4. Principles of AM Modulator

Working principles and typical applications of:

a) Collector modulator

b) Base modulator

c) Balanced modulator

5. Principles of FM Modulator

Working principle, applications of reactance modulator, varactor diode modulator, VCO and arm strong phase modulator, stabilization of carrier for using AFC (block diagram approach)

6. Demodulation of FM Wave

a) Basic principle of FM detection using single slope and dual slope detector

b) Principle of working of following FM demodulator

- Foster-seeley discriminator
- Ratio detector
- Quadrature detector
- Phase locked loop, PLL FM demodulator

7. Phase Modulation

Definition derivation of expression for PM wave modulation index.

Comparison with FM

8. Pulse Analog Modulation (PAM, PAW, PPM)

Sampling theorem (basic idea only), basic idea of pulse amplitude modulation (PAM), pulse width modulation (PWM) and pulse position modulation (only block diagram approach). Basic concept of TDM and FDM

9. Concept of Spread Spectrum, frequency hopping and direct sequence spread spectrum, CDMA and generation of spreading sequences Advantages of CDMA

LIST OF PRACTICALS

1. To obtain AM waveform from a modulator circuits
2. To measure modulation index of AM signal for different level of modulating signal
3. To obtain a FM wave from reactance tube modulator/voltage controlled oscillator circuit and obtain time constant and obtain its optimal value for least distortion
4. To obtain modulating signal from FM detector (foster seeley/ratio detector) circuits and plot the discriminator characteristics
5. a) To generate PAM signal by modulating with audio signal generator
   b) To demodulate PAM using low pass filter
6. a) To generate PWM signal by modulating with audio signal generator
   b) To demodulate PWM using comparator and low pass filter
7. To generate PPM signal by modulating with audio signal and generator

RECOMMENDED BOOKS

1. Electronics Communication by Kennedy, Tata McGraw Hill, New Delhi
2. Electronics Communication by KS Jamwal, Dhanpat Rai & Sons, New Delhi
3. Radio Engineering by GK Mittal, Khanna Publishers, New Delhi
4. Principles of Communication Engineering by DR Arora, Ishan Publications, Ambala
5. Communication Engineering by A Kumar
6. Principles of Communication Engineering by Manoj Kumar, Satya Prakashan, New Delhi
7. Principles of Communication Engineering by Anokh Singh, S.Chand & Co., New Delhi

Electronics Components and materials (DEC-305)

Discipline core (DC): Credit 4(3-0-2)

RATIONALE

Study of Electronic components and Materials is important from point of view of manufacturing, testing and maintenance of electronic devices and systems. Students should understand the procedure of identification, characteristics, specifications, merits, limitations, and applications of electronic components and materials.

DETAILED CONTENTS

1. Materials

1.1 Classification of materials

Conducting, semi-conducting and insulating materials through a brief reference to their atomic structure.

1.2 Conducting Materials

Resistors and factors affecting resistivity such as temperature, alloying and mechanical stressing. Classification of conducting materials into low resistivity and high resistivity materials.

1.3 Insulating Materials

Important relevant characteristics (electrical, mechanical and thermal) and applications of the following material: Mica, Glass, Copper, Sliver, PVC, Silicon, Rubber, Bakelite, Cotton, Ceramic, Polyester, Polythene and Varnish.

1.4 Magnetic Materials

Different Magnetic materials; (Dia, Para, Ferro) and their properties. Ferro magnetism, Domains, permeability, Hysteresis loop. Soft and hard magnetic materials, their examples and typical applications.

2. Components

2.1 Capacitors

a) Concept of capacitance and capacitors, units of capacitance, types of capacitors, constructional details and testing specifications

b) Capacity of parallel plate capacitors, spherical capacitors, cylindrical capacitor.

c) Energy stored in a capacitor.

d) Concept of di-electric and its effects on capacitance, di-electric constant, break down voltage.

e) Series and parallel combination of capacitor. Simple numerical problems of capacitor.

f) Charging and discharging of capacitor with different resistances in circuit, concept of current growth and decay, time constant in R-C circuits, simple problems.

2.2 Resistors: Carbon film, metal film, carbon composition, wound and variable types (presets and potentio-meters)

2.3 Transformer, inductors and RF coils: Methods of manufacture, testing, Need of shielding, application andtrouble shooting

2,4 Surface Mounted Devices (SMDs): Constructional detail and specifications.

2.5 Connectors, Relays, switches and cables: Different types of connectors, relays, switches and cables, their symbols, construction and characteristics.

2.7 Semi Conductors and Integrated Circuits

- Basic characteristics of Semiconductor materials, testing of diodes,

- transistors, FETs and SCRs.
- Various processes in IC manufacturing. Hybrid IC technology.
- Superconductivity and piezoelectric ceramic transducer elements

RECOMMENDED BOOKS

1. Electronic components and Materials by Grover and Jamwal; Dhanpat Rai and Sons, New Delhi
2. Basic Electronics and Linear Circuits by NN Bhargava and Kulshreshta; Tata McGraw Hill, New Delhi
3. Electronic components and Materials by SM Dhir, Tata McGraw Hill, New Delhi
4. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi
5. Electronic Engineering Materials by ML Gupta, Dhanpat Rai and Sons; New Delhi.

ELECTRONICS CIRCUITS (DEC-306)
Discipline Electives (DE): Credit 4(3-0-2)

Objective: Having attained basic knowledge of electronic devices like diodes, transistors, and elementary circuits, in second semester, this course will enable the students to learn about the use of transistors in analog circuits like power amplifier, multistage amplifier, oscillators, wave shaping circuits and in multivibrators etc. It also gives information about timer, operational amplifier, voltage regulator.

COURSE OUTLINE:

1. Multistage Amplifiers

1.1 Need for multistage amplifier

1.2 Gain of multistage amplifier

1.3 Different types of multistage amplifier, Coupling, Comparison between different types of coupling, RC coupled, transformer coupled, direct coupled, and their frequency response and bandwidth

2. Large Signal Amplifier

2.1 Difference between voltage and power amplifiers

2.2 Importance of impedance matching in amplifiers

2.3 Class A, Class B, Class AB, and Class C amplifiers, collector efficiency and Distortion in class A,B,C

2.4 Single ended power amplifiers, Graphical method of calculation (without derivation) of output power; heat dissipation curve and importance of heat sinks. Push-pull amplifier, and complementary symmetry push-pull amplifier.

3. Feedback in Amplifiers

3.1 Basic principles and types of feedback

3.2 Derivation of expression for gain of an amplifier employing feedback

3.3 Effect of feedback (negative) on gain, stability, distortion and bandwidth of an amplifier.

4. Sinusoidal Oscillators

4.1 Barkhausen criterion for oscillations

4.2 Tank Circuits

4.3 Use of positive feedback

4.4 Classification of oscillators

4.5Tuned collector, Hartley, Colpitts, phase shift, Wien's bridge, and crystal oscillator. Their working principles (no mathematical derivation but only simple numerical problems)

5. Tuned Voltage Amplifiers

5.1Series and parallel resonant circuits and bandwidth of resonant circuits

5.2 Single and double tuned voltage amplifiers and their frequency response characteristics

6. Wave Shaping Circuits

6.1 General idea about different wave shapers

7. Multivibrator Circuits

7.1 Working principle of transistor as switch

7.2 Concept of multi-vibrator: a stable, mono stable, and bi stable and their applications

7.3 Block diagram of IC555 and its working and application.

8. Operational Amplifiers

8.1 Characteristics of an ideal operational amplifier and its block diagram

8.2 Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current

8.3 Operational amplifier as an inverter, scale changer, adder, substractor, differentiator, and integrator

8.4 Concept of Schmitt trigger circuit and sample/hold circuit using operational amplifier and their application

LIST OF PRACTICALS

1.Plot the frequency response of two stage RC coupled amplifier and calculate the bandwidth and compare it with single stage amplifier

2.To measure the gain of push-pull amplifier at 1KHz

3.To measure the voltage gain of emitter follower circuit and plot its frequency response

4.Plot the frequency response curve of Hartley and Colpitts Oscillator

5.Plot the frequency response curve of phase shift and Wein bridge Oscillator

6.To observe the output waveforms of series and shunt clipping circuits
7.To observe the output for clamping circuits
8.Use of IC 555 as monostablemultivibrator and observe the output for different values of RC
9.Use of IC 555as astablemultivibrator and observe the output at different duty cycles
10.To use IC 741 (op-amplifier) as i)Inverter, ii) Adder, iii) Subtractor iv) Integrator

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hill, New Delhi
2. Electronic Principles by Sahdev, DhanpatRai and Sons, New Delhi.