3.1 ANALOG ELECTRONICS - II

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4 - 3

RATIONALE

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, ICs and their applications for effective functioning in the field of electronic service industry.

DETAILED CONTENTS

1. **Multistage Amplifiers** (08 hrs)

   a) Need for multistage amplifier
   b) Gain of multistage amplifier
   c) Different types of multistage amplifier like RC coupled, transformer coupled, direct coupled, and their frequency response and bandwidth

2. **Large Signal Amplifier** (08 hrs)

   a) Difference between voltage and power amplifiers
   b) Importance of impedance matching in amplifiers
   c) Class A, Class B, Class AB, and Class C amplifiers
   d) Single ended power amplifiers, push-pull amplifier, and complementary symmetry push-pull amplifier

3. **Feedback in Amplifiers** (08 hrs)

   a) Basic principles and types of feedback
   b) Derivation of expression for gain of an amplifier employing feedback
   c) Effect of feedback (negative) on gain, stability, distortion and bandwidth of an amplifier
   d) RC coupled amplifier with emitter bypass capacitor
   e) Emitter follower amplifier and its applications

4. **Sinusoidal Oscillators** (08 hrs)

a) Use of positive feedback
b) Barkhausen criterion for oscillations
c) Different oscillator circuits-tuned collector, Hartley Colpitts, phase shift, Wien's bridge, and crystal oscillator. Their working principles and simple numerical problems
d) Series and parallel resonant circuits and bandwidth of resonant circuits
e) Single and double tuned voltage amplifiers and their frequency response characteristics

6. **Wave Shaping Circuits** (04 hrs)

a) General idea about different wave shapers
b) RC and RL integrating and differentiating circuits with their applications
c) Diode clipping and clamping circuits and simple numerical problem on the circuits

7. **Multivibration Circuits** (08 hrs)

a) working principle of transistor as switch
b) Concept of multi-vibrator: astable, monostable, and bistable and their applications
c) Block diagram of IC555 and its working
d) IC555 as monostable and astable multi-vibrator

8. **Operational Amplifiers** (06 hrs)

a) Characteristics of an ideal operational amplifier and its block diagram
b) Definition of differential voltage gain, CMMR, PSRR, slew rate and input offset current
c) Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, and integrator
d) Concept of Schmitt trigger circuit and sample/hold circuit using operational amplifier and their applications

9. **Regulated DC Power Supplies** (06 hrs)

a) Concept of DC power supply. Line and load regulation

b) Concept of fixed voltage, IC regulators (like 7805, 7905), and variable voltage regulator like (IC 723)
c) Idea of SMPS

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. To observe the output waveform of a Bistable multivibrator
9. Use of IC 555 as monostable multivibrator and observe the output for different values of RC
10. Use of IC 555 as astable multivibrator and observe the output at different duty cycles
11. To use IC 741 (op-amplifier) as
    i) Inverter
    ii) Adder
    iii) Subtracter
    iv) Integrator
12. To realize positive and negative fixed voltage AC power supply using three terminal voltage regulator IC (7805, 7812, 7905)

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hills, New Delhi
2. Electronics Principles by Malvino, Tata McGraw Hills, New Delhi
3. Electronic Devices and Circuits by Millman and Halkias, McGraw Hills, New Delhi

4. Basic Electronics by Grob, Tata McGraw Hills, New Delhi
5. Art of Electronics by Horowitz
6. Electronic Principles by Sahdev, Dhanpat Rai and Sons, New Delhi.
7. Electronic Circuit Theory by Boylstead
8. Electronic Devices and Circuits by BL Theraja, S Chand and Co Ltd. New Delhi
9. Operational Amplifiers and Linear Integrated Circuits by Ramakant A. Gaykwad
10. Electronics Devices and Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi
11. Electronics Devices and Circuits-II by Naresh Gupta, Jyotesh Malhotra and Harish C. Saini, Eagle Prakashan, Jalandhar

3.2 ELECTRONIC COMPONENTS AND MATERIALS (ECM)

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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** **(32 hrs)**

1.1 Classification of materials (4 hrs)
Conducting, semi-conducting and insulating materials through a brief reference to their atomic structure.

1.2 Conducting Materials (10 hrs)
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 (10 hrs)
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 (8 hrs)
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** **(32 hrs)**

2.1 Capacitors (8 hrs)

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) (3 hrs)

2.3 Transformer, inductors and RF coils: (4 hrs)
Methods of manufacture, testing, Need of shielding, application and trouble shooting

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

2.5 Connectors, Relays, switches and cables: (5 hrs)
Different types of connectors, relays, switches and cables, their symbols, construction and characteristics.

2.7 Semi Conductors and Integrated Circuits (8 hrs)

- 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.

3.3 PRINCIPLES OF COMMUNICATION

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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** (03 hrs)

   a) Need for modulation and demodulation in communication system
   b) Basic schemes of modern communication system

2. **Amplitude Modulation** (08 hrs)

   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** (07 hrs)

   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** (04 hrs)

   Working principles and typical applications of:

a) Collector modulator
b) Base modulator
c) Balanced modulator

5. **Principles of FM Modulator** (06 hrs)

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

6. **Demodulation of FM Wave** (07 hrs)

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** (03 hrs)

Definition derivation of expression for PM wave modulation index. Comparison with FM

8. **Pulse Analog Modulation (PAM, PAW, PPM)** (05 hrs)

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 (05 hrs)

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

3.4 DIGITAL ELECTRONICS - I

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RATIONALE

The objective of this subject is to enable the students to know the basic concepts of digital electronics and gain familiarity with the available IC chips. The students will learn about number systems, logic gates, various codes, parities, Boolean algebra, mux and demux, filp-flop, counters, shift registers. This will form a broad base for studying digital system design, advanced microprocessors and further studies.

DETAILED CONTENT

1. **Introduction** (01 hrs)

   a) Define digital and analog signals and systems, difference between analog and digital signals
   b) Need of digitization and applications of digital systems

2. **Number Systems** (10 hrs)

   a) Decimal, binary, octal, hexadecimal number systems
   b) Conversion of number from one number system to another including decimal points
   c) Binary addition, subtraction, multiplication, division, 1's and 2's complement method of subtraction
   d) BCD code numbers and their limitations, addition of BCD coded numbers, conversion of BCD to decimal and vice-versa
   e) Excess-3 code, gray code, binary to gray and gray to binary conversion
   f) Concept of parity, single and double parity, error detection and correction using parity

3. **Logic Gates** (04 hrs)

   a) Logic gates, positive and negative logic, pulse waveform, definition, symbols, truth tables, pulsed operation of NOT, OR, AND, NAND, NOR, EX-OR, EX-NOR gates
   b) NAND and NOR as universal logic gates

4. **Logic Simplification** (08 hrs)

   a) Rules and laws of Boolean algebra, logic expression, Demorgan's theorems, their proof
   b) Sum of products form (minterm), Product of sum form (maxterms), simplification of Boolean expressions with the help of Rules and laws of Boolean algebra
   c) Karnaugh mapping techniques upto 4 variables and their applications for simplification of Boolean expression

5. **Arithmetic Circuits** (03 hrs)

   a) Half adder, full adder circuits and their operation
   b) Parallel binary adder, 2-bit and 4-bit binary full adder, block diagram, working

6. **Multiplexer/Demultiplexer** (04 hrs)

   a) Basic functions, symbols and logic diagrams of 4-inputs and 8-inputs multiplexers,
   b) Function/utility of 16 and 32 inputs multiplexers,
   c) Realization of Boolean expression using multiplexer/demultiplexers

7. **Decoders, Display Devices and Associated Circuits** (04 hrs)

   a) Basic Binary decoder, 4-line to 16 line decoder circuit
   b) BCD to decimal decoder, BCD to 7-segment decoder/driver, LED/LCD display

8. **Encoders and Comparators** (04 hrs)

   a) Encoder, decimal to BCD encoder, decimal to BCD priority encoder, keyboard encoder
   b) Magnitude comparators, symbols and logic diagrams of 2-bit and 4-bit comparators

9. **Latches and Flip-Flops** (08 hrs)

   a) Latch, SR-latch, D-latch, Flip-flop, difference between latch and flip-flop
   b) S-R, D flip-flop their operation using waveform and truth tables, race around condition
   c) JK flip-flop, master slave and their operation using waveform and truth tables

10. **Counters** (10 hrs)

a) Asynchronous counter, 4-bit Asynchronous counter, Asynchronous decade counter

b) Asynchronous counter, 4-bit synchronous binary counter, Asynchronous decade counter

c) Up/down Asynchronous counters, divide by N counter MOD-3, MOD-5, MOD-7, MOD-12 counters

d) Ring counter, cascaded counter, counter applications

11. **Shift Registers** (08 hrs)

a) Shift registers functions, serial-in-serial out, serial-in-parallel-out, parallel-in-serial-out, parallel-in-parallel out

b) Universal shift register, shift register counter and applications of shift registers

LIST OF PRACTICALS

1. Study of logic breadboard with verification of truth table for AND, OR, NOT, NAND, EX-OR, NOR gate
2. Verification of NAND and NOR gate as universal gates
3. Construction of half-adder and full adder circuits using EX-OR and NAND gate and verification of their operation
4. Verify the operation of
   a) multiplexer using an IC
   b) de-multiplexer using an IC
5. a) Verify the operation of BCD to decimal decoder using an IC
   b) Verify the operation of BCD to 7 segment decoder using an IC
6. Verify operation of SR, JK, D-flip-flop master slave JK filp-flop using IC
7. Verify operation of SISO, PISO, SIPO, PIPO shift register. (universal shift register)
8. Study of ring counter, Up/down counter
9. Construct and verify the operation of an asynchronous binary decade counter using JK flip-flop
10. Verification of truth tables and study the operation of tristate buffer IC 74126 or similar IC and construction of 4/8 bit bi-directional bus by using an IC
11. Testing of digital ICs using IC tester

RECOMMENDED BOOKS

1. Digital Electronics and Applications by Malvino Leach, Tata McGral Hill, New Delhi
2. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi
3. Digital Fundamentals by Thomas Floyds, Universal Book Stall
4. Digital Electronics by RP Jain, Tata McGraw Hill, New Delhi
5. Digital Electronics by KS Jamwal, Dhanpat Rai & Co., New Delhi
6. Digital Electronics by Rajiv Sapra, Ishan Publication, Ambala
7. Digital Electronics by BR Gupta, Dhanpat Rai & Co., New Delhi
8. Digital Systems: Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi
9. Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi

3.5 ELECTRICAL MACHINES

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RATIONALE

This is a subject dealing with various types of electrical machines being employed in industries, power stations, domestic and commercial appliances etc. It is envisaged that after studying the subject, students will gain competence in operation, repair and maintenance of such machines and give suggestions for improvement in their performance. The practicals will enable students to perform various tests necessary for installation and commissioning of such machines.

DETAILED CONTENT

1. **Three Phase Supply** (03 hrs)

   a) Advantages of 3 phase system over single phase system
   b) Star delta connections
   c) Relation between phase voltage and line voltage, also between phase current and line current in a 3 phase system
   d) Power and power factor in 3 phase system and their measurements

2. **Transformer** (05 hrs)

   Principles of transformer, construction, voltage and current transformation. Methods of connection 3 phase transformers, current and voltage relationship, auto transformer and its uses, instruments transformer, voltage regulation and its significance, need for isolation, electrical and transients suppression, principles of isolation transformer, specifications of all types of transformers. Losses in a transformer

3. **DC Motor** (08 hrs)

   Principles, significance of back emf, types of motors and their constructions, motor characteristics for shunt and series, speed control of DC motors and factors controlling the speed. Starting methods, Construction and working of 3 point starter, applications (simple problems)

4. **3 Phase Induction Motors** (08 hrs)

   Principles, construction, concept of slip, torque and characteristics, effect of

motor resistance on torque (running and starting), rotor current, output power, different methods of speed control. Starting methods and constructional and working of 3 point starter, applications (simple problems)

5. **Synchronous Motors** (06 hrs)

Principles, constructions and working, effect of load and excitation on synchronous motor. Starting of motor and their applications

6. **Single Phase Motors** (06 hrs)

Principles, construction, working speed control, starting and applications of the following motors:

a) Induction motor
c) Universal motor

7. **Stepper Motor and Servo Motor** (06 hrs)

Types, construction, working and their applications

(**Note**: No derivation of any formula)

LIST OF PRACTICALS

1. Introduction to electrical machines

Measurement of the angular displacement of rotor of the three phase synchronous machine with respect to the stator on application of DC to the field winding and simultaneously to each phase-winding in sequence

OR

Measurement of the angular displacement of the rotor of a slip-ring induction motor on application of DC to stator winding in sequence and simultaneously to each phase of rotor winding

2. DC machines

2.1 Speed control of dc shunt motor (i) Armature control method (ii) Field control method

2.2 Study of dc series motor with starter (to operate the motor on no load for a moment)

3. Transformers (single phase)

3.1 To perform open circuit and short circuit test for determining parameter of a transformer

3.2 To determine the regulation and efficiency from the data obtained from open circuit and short circuit test

4. Three-phase transformers

4.1 Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations

4.2 Finding the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions

RECOMMENDED BOOKS

1. Electrical Machine by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

3.6 ELECTRONIC INSTRUMENTS AND MEASUREMENT

L T P
4 - 3

RATIONALE

In the real world of work the technician is required to handle wide variety of instruments while testing, trouble shooting, calibration etc. the study of this subject will help students to gain the knowledge of working principles and operation of different instruments. During practical sessions, he will acquire the requisite skills.

DETAILED CONTENTS

1. **Basics of Measurements** (04 hrs)

   Measurement, method of measurement, types of instruments

   Specifications of instruments: Accuracy, precision, sensitivity, resolution, range, errors in measurement, sources of errors, limiting errors loading effect, requirements, importance and applications of standards, calibration

2. **Multimeter** (08 hrs)

   Principles of measurement of DC voltage, DC current, AC voltage, AC current, moving coil and moving iron type instruments (voltmeter and Ammeter)

   Block diagram of multimeter and measurement of voltage, current and resistance using multimeter

   Specifications of multimeter and their applications

   Limitations with regard to frequency and input impedance

3. **Electronic Voltmeter** (06 hrs)

   Advantages over conventional multimeter for volt measurement with respect to input impedance and sensitivity

   Principles of voltage, current and resistance measurement (block diagram only)
   Specifications of electronics voltmeter

4. **AC Milli Voltmeter** (04 hrs)

Types of AC milli voltmeters and their block diagram description

Typical specifications and their significance

5. **Cathode Ray Oscilloscope** (05 hrs)

Construction and working of different blocks used in CRT

Time base operation and need for blanking during flyback, synchronization

Block diagram description of a basic CRO and triggered sweep oscilloscope, front panel controls

Specifications of CRO and their explanation

Measurement of current, voltage, frequency, time period and phase using CRO

CRO probes, special features of dual beam, dual trace,delay sweep

Digital storage oscilloscope: block diagram and working principle

6. **Signal Generators and Analysis Instruments** (06 hrs)

Explanation of block diagram specifications of low frequency and RF generators, pulse generator, function generator

Distortion factor meter; wave analyser and spectrum analyser

7. **Impedance Bridges and Q Meters** (12 hrs)

Wheat stone bridge

AC bridges: Maxwell's induction bridge, Hay's bridge, De-Sauty's bridge, Schering bridge and Anderson bridge

Block diagram description of laboratory type RLC bridge, specifications of RLC bridge

Block diagram and working principle of Q meter

8. **Digital Instruments** (08 hrs)

Comparison of analog and digital instruments

Working principle of ramp, dual slope and integration type digital voltmeter

Block diagram and working of a digital multimeter

Measurement of time interval, time period and frequency using universal counter/frequency counter

Working principle of logic probe, logic pulser, logic analyzer, logic comparator, signature analyzer and logic analyzer

LIST OF PRACTICALS

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance
2. To observe the limitations of a multimeter for measuring high frequency voltage
3. Measurement of voltage, frequency, time period and phase using CRO
4. Measurement of rise time and fall time using CRO
5. Measurement of Q of a coil and its dependence on frequency
6. Measurement of voltage, frequency, time and phase using DSO
7. Measurement of resistance and inductance of coil using RLC meter
8. Measurement of distortion of RF signal generator using distortion factor meter
9. Use of logic pulser and logic probe
10. Measurement of time period, frequency, average period using universal counter/ frequency counter
11. Study of operation and features of a logic analyser

RECOMMENDED BOOKS

1. Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai & Sons, Delhi
2. Electronics Instrumentation by Cooper, Prentice Hall of India
3. Electronics Test and Instrumentation by Rajiv Sapra, Ishan Publications, Ambala
4. Electronics Instrumentation by JB Gupta, Satya Prakashan, New Delhi