ELECTRONICS ENGINEERING
(For UTTARANCHAL)

VARIOUS SUBJECTS
IN
SECOND YEAR

3.1 ANALOG ELECTRONICS - I

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RATIONALE

This subject will enable the student io 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 configurations; understanding of FETs and MOSFET etc. for effective functioning in the field of electronic service industry. The teacher should give emphasis on understanding of concepts and explanation of various terms used in the subject. Practical exercises will reinforce various concepts. Industrial/field exposure must be given by organizing visit to local electronic industries.

DETAILED CONTENTS

1. Semi Conductor Physics: (12 hrs)

   Review of basic atomic structure and energy levels, concept of insulators, conductors and semi conductors, atomic structure of Ge and Si, covalent bonds

   Concept of intrinsic and extrinsic semi conductor, P and N impurities, doping of impurity.

   P and N type semiconductors and their conductivity. Effect of temperature on conductivity of intrinsic semi conductor.

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

2. Semi Conductor Diode: (12 hrs)

   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.

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

   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.

   Types of diodes, characteristics and applications of Zenor diodes. Zenor and avalanche breakdown.

3. Introduction to Bipolar Transistor: (12 hrs)

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;

Transistors as an amplifier in CE Configurations; d.c load line and calculation of current gain, voltage gain using d.c load line.

4. Transistor Biasing Circuits: (6 hrs)

Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Different types of biasing circuits.

5. Single Stage Transistor Amplifier: (10 hrs)

Single stage transistor amplifier circuit, 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. Field Effect Transistors (12 hrs)

Construction, operation and characteristics of FET and its application.

- Construction, operation and characteristics of MOSFET in depletion and enhancement modes and its applications.
- C MOS- advantages and applications
- Comparison of JFET, MOSFET and BJT.
- FET amplifier circuit and its working principle. (No analysis).

LIST OF PRACTICALS

1. Familiarization, identification and testing of Active and Passive components.

2. Familiarization with operation of following instruments:
Multi-meter, CRO, Signal generator, Regulated Power Supply by taking readings of relevant electrical quantities with their help.

3. To plot V-I characteristics of a pn junction diode

4. To plot V-I characteristics of a Zener diode
5. To observe the wave shape of following rectifier circuit
    a. Half wave rectifier
    b. Full wave rectifier
    c. Bridge rectifier
6. To plot the wave shape of full wave rectifier with
    a. Shunt capacitor filter
    b. Series inductor filter
    c. ∏Filter
7. To plot input and output characteristics and calculate parameters of transistors in CE configuration.
8. To plot input and output characteristics and calculate of parameters of transistors in CB configuration.
9. To plot V-I characteristics of FET amplifier.
10. To measure the Q-Point and note the variation of Q-Point.
    a. by increasing the base resistance in fixed bias circuit.
    b. by changing out of bias resistance in potential divider circuit.
11. To measure voltage gain, input, output impedance in single state CE amplifier circuit.

BOOKS RECOMMENDED

1. Basic Electronics and Linear Circuit by NN Bhargava and Kulshreshta, Tata McGrow Hill, New Delhi.
2. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
3. Electronic Components and Materials by SM Dhir, Tata McGraw Hill, New Delhi
4. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill.
5. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill, New Delhi
6. Electronics Devices and Circuits-I by Naresh Gupta, Jyotesh Malhotra and Harish C Saini, Eagle Prakashan, Jalandhar

7. Electronics Devices and Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Semi Conductor Physics	12	15
2.	Semi Conductor diode	12	20
3.	Introduction to Bipolar Transistor	12	20
4.	Transistor Biasing Circuits	06	10
5.	Single Stage Transistor amplifier	10	15
6.	Field Effect Transistors	12	20
Total		**64**	**100**

3.2 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 electronic 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

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Introduction	3	7
2.	Amplitude Modulation	8	20
3.	Frequency Modulation	7	15
4.	Principles of AM Modulator	4	5
5.	Principles of FM Modulator	6	10
6.	Demodulation of FM Wave	7	15
7.	Phase Modulation	3	8
8.	Pulse Analog Modulation (PAM, PAW, PPM)	5	10
9.	Concept of Spread Spectrum, frequency hopping and direct sequence spread spectrum, CDMA and generation of spreading sequences Advantages of CDMA	5	10
Total		**48**	**100**

3.3 NETWORK, FILTERS AND TRANSMISSION LINES

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RATIONALE

The study of network, filters and transmission lines leads to understanding of line communication, audio and video communication and micro wave communication. Particularly the study of network from principles of AC theory, introduces the students to parameters and characteristics of various networks, including filters. Also the study of transmission lines becomes important as its analogy is used in study of transmission of plane electromagnetic waves in bounded media.

DETAILED CONTENT

1. **Networks** (12 hrs)

   a) Two Port (Four Terminal) Network
      - Two port parameters (impedance, admittance, transmission, hybrid parameters)
      - Interconnection of two ports (series connection, parallel connection, cascade connection
      - Equivalent networks
      - T-network, Pi-networks, ladder networks
      - Symmetrical and asymmetrical networks

   b) Symmetrical Network
      - Concept and significance of characteristic impedance, propagation constant, attenuation constant (with expression in terms of Zo, Zoc for T-network, Pi-network

   c) Asymmetrical Network
      - Concept and significance of iterative impedance, image impedance, image transfer constant and insertion loss
      - Half section (L-section), symmetrical T and Pi section into half section

2. **Network Theorem** (08 hrs)

   A brief study of following:
   - Tellegen's Theorem
   - Superposition theorem
   - Substitution theorem
   - Thevenin and norton theorem
   - Reciprocity – maximum power transfer theorem
   - Attenuators: brief idea about attenuators and its types

3. **Filters** (16 hrs)

a) - Applications of filters in communication system
   - Concept of low pass, high pass, band pass, band stop, butter worth filter, constant filters, m-derived filters, K-filters

b) Proto-type Filter Section
   - Reactance vs attenuation constant and characteristic of a low pass filter and its impedance
   - Attenuation vs frequency, phase shift vs frequency characteristics Impedance vs frequency of T and Pi curve and their significance

c) M-derrived Filter Section
   - Need of M-derived filters
   - Expression for m in terms of fc (cut off frequency) fw (Frequency at which attenuation is infinity) for low pass and high pass filter

d) Active Filters
   - Basic concept and comparison with passive filters
   - Simple problems onlow pass and high pass filters (first and second order)

4. **Transmission Lines** (26 hrs)

a) Transmission lines and their implications, shapes of different types of transmission lines, (including 300 ohms antenna feeder cable, 75 ohm co-axial cable)

b) Distributed (or primary) constant of a transmission line, equivalent circuit of an infinite line, T and Pi type representation of a section of transmission line

c) Definition of characteristics impedance line: concept of short line termination in Zo; currents and voltage along at infinite line, propagation constant attenuation and phase shift constant of the line

d) Relationship of characteristics impedance, propagation constant attenuation constant and phase constant in terms of distributed constants of the lines.

e) Conditions for minimum distortion and minimum attenuation signal on the line; necessity and different methods of loading the communication lines (no derivation)

f) Concept of reflection and standing waves on a transmission lines; definition of reflection coefficient in terms of characteristic impedance and load impedance, definition of standing wave ratio (SWR). Relation between VSWR and voltage reflection coefficient maximum impedance and VSWR

g) Transmission line equation; expressions for voltage current and impedance at a point on the line for lines with and without losses

h) Input impedance of an open and short circuited line and its graphical representation

i) Transmission Line. at high frequency, effect of high frequencies on the losses of a transmission line; application of Transmission Line as a reactive component and impedance transformer (e.g. quarter wave transformer)

j) Principle of impedance matching using single stub; comparison of open and short circuited stubs

Note: No mathematical derivation

LIST OF PRACTICALS

1. Measurement of characteristics impedance of a symmetrical Pi and T networks
2. Image impedance of a given asymmetrical Pi and T networks
3. Determine experimentally the characteristics impedance of a prototype
   - Low pass filters
   - High pass filter and plot attenuation characteristics
4. To design and measure the attenuation of a symmetrical T/Pi type attenuation
5. To plot the impedance characteristics of a prototype band-pass filter and also plot the attenuation characteristics of band pass filter
6. - To plot the impedance characteristics of m-derived low pass filter
   - To plot the attenuation characteristics of a m-derived high pass filter
7. To assemble test the following butter worths active filter:
   - First order low pass and high pass
   - Second order low pass and high pass
8. Measurement of characteristics impedance propagation constant, VSWR for a given T.L. (transmission line)

RECOMMENDED BOOKS

1. Network Lines and Fields by John D Ryder; PHI, New Delhi
2. Network Filters and Transmission Lines by AK Chakarvorty; Dhanpat Rai & Co. Publication
3. Network Analysis by Van Valkenbury: PHI, New Delhi
4. Network Analysis by Soni and Gupta; Dhanpat Rai & Co. Publication , New Delhi
5. Network Theory and Filter Design by Vasudev K. Aatre

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Networks	12	20
2.	Network theorem	8	15
3.	Filters	16	25
4.	Transmission Lines	26	40
Total		**64**	**100**

3.4 DIGITAL ELECTRONICS - I

L	T	P
4	-	3

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** (02 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** (04 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** (06 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
10. Fundamentals of Digital Electronics by naresh Gupta, Jain Brothers , New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Introduction	02	05
2.	Number Systems	10	15
3.	Logic Gates	04	07
4.	Logic Simplification	08	10
5.	Arithmetic Circuits	04	07
6.	Multiplexer/Demultiplexer	04	08
7.	Decoders, Display Devices and Associated Circuits	04	08
8.	Encoders and Comparators	04	05
9.	Latches and Flip-Flops	08	10
10.	Counters	10	15
11.	Shift Registers	06	10
Total		**64**	**100**

3.5 ELECTRICAL MACHINES

L	T	P
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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 CONTENTS

1. Three Phase Supply (04 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 by one, two and three wattmeter methods

2. Transformer (08 hrs)

   Working principles of a transformer, constructional features, 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, harmonic and transient suppression, principles of isolation transformer, specifications of all types of transformers. Losses in a transformer, cooling of transformer, conservator

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. Three Phase Induction Motors (08 hrs)

   Principle, construction, concept of slip, torque and characteristics, effect of rotor resistance on torque (running and starting), rotor slip-torque current, output power, different methods of speed control. Starting methods, constructional details and working of Star-Delta and DOL starter, applications of submersible motors.

5. Synchronous Machines (08 hrs)

Working principle, constructional features of synchronous machines, synchronization of an alternator with busbar effect of change in load and excitation on performance of a synchronous motor. Starting of synchronous motors and their specific applications

6. Single Phase Motors and Fractional Kilowatt Motors (08 hrs)

a) Introduction
   - Principle of operation of single phase motors
   - Types of single phase induction motors and their constructional details (i.e. split phase, capacitor start, capacitor start and run, shaded pole and reluctance start)

b) Commutator type single-phase motors – a.c series motor and universal motors

7. Stepper Motor and Servo Motor (04 hrs)

Working principle, construction, working and their applications

(Note: No Mathematical derivation of any formula)

LIST OF PRACTICALS

1. To measure power and power factors in 3 Phase load by two wattmeter method
2. To determine effect of a single phase transformer from the data obtained through open circuit and short circuit test
3. To connect the primary and secondary windings of a three phase transformer and to verify line and phase current and voltage relationship respectively
4. To connect a dc shunt motor with supply through a 3 point starter and to run the motor at different speeds with the help of a field regulator
5. To run a 3 phase squirrel cage induction motor with the help of a star-delta starter. To change the direction of rotation of the motor.
6. To run a 3 phase alternator in synchronism with busbar and to measure its voltage and frequency
7. To run a synchronous motor with a.c supply and to measure speed to verify the relation N=12O f/ P
8. To make connections of starting and running winding of a single phase capacitor motor and to run it with the help a DOL starter and to measure its speed
9. Study construction of a stepper and servo motor and to write their complete specifications.

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

4. Electrical Engineering by JB Gupta, SK Kataria & Sons, New Delhi

5. Electrical Technology Vol. - I and II B.L. Thareja, S Chand and Co. New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
1.	Three phase Supply	4	10
2.	Transformer	8	20
3.	DC Motor	8	20
4.	Three Phase Induction Motors	8	15
5.	Synchronous Machines	8	15
6.	Single Phase Motors and Fractional Kilowatt Motors	8	15
7.	Stepper Motor and servo Motors	4	5
Total		**48**	**100**

3.6 GENERAL ENGINEERING

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4	-	2

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of General Engineering has been included to impart basic knowledge of civil, electrical and mechanical engineering to the students.

Note:

1. The students of Civil Engineering, will be studying Part A (Mechanical Engineering) and Part B (Electrical Engineering) only.

2. **The students of Electrical engineering, Electronics and Communication Engineering, Instrumentation and Control Engineering, Computer Engineering and Information Technology will be studying Part A (Mechanical Engineering) and Part C (Civil Engineering) only.**

3. The students of Mechanical Engineering will be studying Part B (Electrical Engineering) and Part C (Civil Engineering) only.

4. The students of remaining branches of engineering and technology will be studying all the three Parts A (Mechanical Engineering), Part B (Electrical Engineering) and Part C (Civil Engineering), unless specified otherwise

5. A time of 2 hours per week has been allotted to Mechanical Engineering, 2 hours per week to Electrical Engineering and 2 hour per week to Civil Engineering in the lecture hours, for teaching theory and a lump-sum time of 2 hours per week has been allotted for the Practical Work.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (8 hrs)

1.1 Belt Drives:
Types of belts, belt materials, cross and flat belt drives, advantages of V-belt drive over flat belt drive.

1.2 Gears Drives:
Types of gears (briefly), types of gear trains

2. Internal combustion Engines (10 hrs)

2.1 Classification of IC engines

2.2 Working principles of two stroke and four stroke engines

2.3 Working principles of petrol engine and diesel engines

2.4 Gas turbines (working principle only)

3. Refrigeration and Air Conditioning System (8 hrs)

3.1 Different types of refrigeration principles and refrigerants

3.2 Working of domestic refrigerator

3.3 Working of Window type AC system

4. Hydraulics: (6 hrs)

4.1 Classification of pumps (reciprocating and centrifugal)
4.2 Working principles of both reciprocating and centrifugal pumps
4.3 Turbine: Working principles of impulse turbine and reaction turbine and their applications

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Demonstration and study of main parts of 4 stroke petrol and diesel engines by actually dismantling them (The idea is to acquaint the students with the most common troubles occurring in the engines)
2. Demonstration and study of main parts of 2 stroke petrol engine by actually dismantling it. (The idea is to acquaint the students with the most common trouble occurring in the engines)
3. Demonstration and study of gas turbines through models
4. Demonstration and study of different hydraulic pumps
5. Demonstration and study of various drives for transmission of powers i.e. models of belts and gears.
6. Demonstration and study of air conditioning system in a building
7. Demonstration and study of domestic refrigeration system

PART B

ELECTRICAL ENGINEERING

Theory

1. Basic Quantities of Electricity: (4 hrs)

1.1 Definition of voltage, current, power and energy with their units

1.2 Name of the instruments used for measurement of electrical quantities such as voltmeter, ammeter, wattmeter, energy meter.
1.3 Connection of these instruments in electric circuit

2. Applications And Advantages of Electricity: (3 hrs)
2.1 Difference between AC and DC
2.2 Various applications of electricity
2.3 Advantages of electrical energy over other types of energy

3. Various Types of Power Plants: (3 hrs)

3.1 Elementary block diagram of thermal, hydro and nuclear power stations
3.2 Brief explanation of the principle of power generation in above power stations

4. Transmission and Distribution System (6 hrs)

4.1 Key diagram of 3 phase Electrical distribution system
4.2 Brief functions of accessories of distribution line
4.3 Distinction between 11 kV and 415 volt distribution system
4.4 Identification of three phase wires, neutral wires and the earth wire on a low voltage distribution system
4.5 Identification of the voltage between phases and between one phase and neutral
4.6 Distinction between three phase and single phase supply

5. Supply from the Poles to the Distribution Board: (4 hrs)
5.1 Arrangement of supply system from pole to the distribution board
5.2 Function of service line,energy meter, main switch,distribution board

6. Domestic Installation: (6 hrs)

6.1 Distinction between light and fan circuits and single phase power circuit, sub circuits
6.2 Various accessories and parts of installation, identification of wiring systems

6.3 Common safety measures and earthing

6.4 Introduction to BIS code of safety and wiring installation

7. Electric Motors and Pumps: (6 hrs)

7.1 Definition and various application of single and three phase motors
7.2 Conversion of horse power in watts or kilowatts
7.3 Type of pumps and their applications
7.4 Use of direct online starter and star delta starter

PRACTICAL EXERCISES IN ELECTRICAL ENGINEERING:

1. Use of Megger:
   Objective: To make the students familiar with different uses of megger

2. Connection of a three phase motor and starter with supply including fuses and reversing of direction of rotation.
   Objective: Students may be made familiar with the equipment needed to control a three-phase motor
   The students must experience that by changing any two phases, the direction of rotation is reversed.

3. Connection of a lamp, ceiling fan, socket outlet, geyser, desert cooler, voltage stabilizer etc.
   Objective: Students may be made familiar with the different types of equipment and circuits used in the domestic installations

4. Trouble shooting in a three-phase motor

   Note: The teacher may create anyone of the following faults
   (a) Loose connections
   (b) Blown fuse
   (c) Tripped overload protection
   (d) Incorrect direction of rotation
   (e) Single phasing
   (f) Burnt winding to be simulated by a loose connection or short circuiting behind a terminal box.

   Objective: The students must be able to detect the most common faults, which may occur in a three-phase motor, using meggar and a test lamp wherever necessary

4 Treatment of electric shock
Note: The teacher may give a demonstration how a victim of electric shock must be treated.

   Objective: Students must be trained to treat the persons suffering from an electric shock

6. Demonstration and study of Domestic installation components used in single phase and three phase wiring
7. Demonstration and study of distribution line components
8. Demonstration and study of a distribution Board

   Note: Students may be asked to study the distribution board in the institution and note down all accessories.

   Objective: Students must be made familiar with the distribution board

9. Connections and taking reading of an analog/digital energy meter(single phase and three phase).

Objective: Students may be asked to connect an energy meter to a load and calibrate the reading with a stop watch and counting the number of revolutions of the energy meter disk in case of an analog meter and reading in case of a digital meter.

Demonstration and the study of submersible motor pump set and its working

Objective: To tell use of the set in water supply and irrigation works

PART C

CIVIL ENGINEERING

Theory

1. Construction Materials (10 hrs)

Basics of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry.

2. Foundations (8 hrs)

i) Bearing capacity of soil and its importance
ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines

3. Basic concept of concrete (8 hrs)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete

4. RCC (6 hrs)

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

PRACTICAL EXERCISES IN CIVIL ENGINEERING

1. Testing of bricks
   a) Shape and size
   b) Soundness test
   c) Water absorption
   d) Crushing strength

2. Testing of concrete

   a) Slump test

   b) Compressive Strength of concrete cube

3. The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works

INSTRUCTIONAL STRATEGY

While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted in the laboratories and organized demonstrations for explaining various concepts and principles.

RECOMMENDED BOOKS

Mechanical Engineering

1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh
2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi
3. IC Engines and Automobile Engineering by Dr.MP Poonia, Standard Publishers, New Delhi
4. Refrigeration and Air Conditioning by RK Rajput; SK Kataria and sons; Ludhiana
5. Theory of Machines by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Electrical Engineering

1. Electrical Technology Part 1: Basic Electrical Engineering by Theraja, BL; S Chand and Company, New Delhi
2. Principles of Electrical Engineering by Gupta , S Chand and Company, New Delhi
3. Basic Electrical Engineering by Mehta VK; S Chand and Company, New Delhi
4. Basic Electricity and Measurements by Suryanarayan NV and N Delhi; Tata McGraw Hill, 1987, New Delhi
5. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and sons, New Delhi
6. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill, New Delhi
7. Basic Electricity by BR Sharma; Satya Parkashan, New Delhi

Civil Engineering

1. Textbook of Concrete Technology 2nd Edition by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi
2. Materials of Construction by Ghose; Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi

5. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vazirani and Chandola; Khanna Publishers, Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, Delhi
8. Soil Mechanics and foundation Engineering by SK Garg; Khanna Publishers, Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted (Hrs)	Marks Allocation
PART-A (MECHANICAL ENGINEERING)			
1.	Transmission of Power	8	12
2.	Internal combustion Engines	10	15
3.	Refrigeration and Air conditioning System	8	13
4.	Hydraulics	6	10
PAERT-B (ELECTRICAL ENGINEERING)			
1.	Basic Quantities of Electricity	4	5
2.	Application and Advantages of Electricity	3	5
3.	Various Types of Power Plant	3	5
4.	Transmission and Distribution System	6	10
5.	Supply from the Poles to the Distribution Board	4	5
6.	Domestic Installation	6	10
7.	Electric Motors and Pumps	6	10
PART-C (CIVIL ENGINEERING)			
1.	Constructional Materials	10	15
2.	Foundations	8	12
3.	Basic concept of concrete	8	13
4.	RCC	6	10

Note:

Total time and marks will be sum of any two sections. Total time will be 64 hours and total marks will be 100 in this case.