3.1 BASICS OF CONTROL SYSTEM

L T P
4 - 3

RATIONALE

It is pre-requisite for the students to know the various total plant controls in the process industry. An automatic control system saves manpower, reduces cost of production, increases the accuracy of the finished product and helps in mass production. The knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation.

DETAILED CONTENTS

1. Introduction (16 hrs)

   Basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, basic elements of a servo mechanism, Examples of automatic control systems, use of equivalent systems for system analysis, linear systems, non-linear systems, control system examples from chemical systems, mechanical systems, electrical systems, introduction to laplace transform.

2. Transfer function (12 hrs)

   Transfer function analysis of ac and dc servomotors synchros, stepper motor, ampledyne. ac position control system, magnetic amplifier.

3. Control system representation (12 hrs)

   Transfer function, block diagram, reduction of block diagram, problems on block diagram, Mason's formula signal flow graph

4. Time Response Analysis (12 hrs)

   Standard test signals, time response of first and second-order system, time constant, time response of second order system, time response specifications, steady-state errors and error constants, problems in first and second order system.

5. Stability (12 hrs)

   Routh Hurwitz Criterion, Root Locus, Bode Plotting using semi log graph paper

LIST OF PRACTICALS

1. Study of characteristic of servomotor
2. Characteristics and speed control of a stepper motor
3. To demonstrate the synchro characteristic and use a synchro pair as error detector
4. Measurement of speed control of motor with tachometric feed back.
5. Study of a DC speed control system
6. Simulation of a position control system with PC
7. Study of ON-OFF controller

INSRUCTIONAL STRATEGY

Since the knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation, the subject teacher is required to make the subject interesting and provide information about practical applications. The students may be given exposure in process industry and shown various controls.

RECOMMENDED BOOKS

1) Control Systems by Nagrath and Gopal
2) Control Systems Engineering by Bhattacharya, Pearson Education, Sector 62, Noida
3) Control Systems: Theory and Applications by Ghosh, Pearson Education, Sector 62, Noida
4) Control Systems by KUO
5) Control Systems by Ogata

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Introduction	16	25
2.	Transfer function	12	15
3.	Control System Representation	12	20
4.	Time Response Analysis	12	20
5.	Stability	12	20
Total		**64**	**100**

3.2 ELECTRICAL AND ELECTRONICS MATERIALS AND COMPONENTS

L	T	P
4	-	-

RATIONALE

A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above-mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

DETAILED CONTENTS

1. **Materials** **(32 hrs)**

1.1 Classification of materials (04 hrs)

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

1.2 Conducting Materials (08 hrs)

- Resistors and factors affecting resistivity such as temperature, alloying and mechanical stressing. Classification of conducting materials as low resistivity and high resistivity materials.
- Applications of Copper, Aluminium , Steel, low resistivity copper alloys such as brass, bronze, copper, graphite etc in the field of electrical engineering.
- Superconductivity and piezoelectric ceramic materials

1.3 Insulating Materials (06 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 (06 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.

1.5. Special Materials (04 hrs)

Thermocouple, bimetals, lead soldering and fuse material, mention their applications

1.6. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (04 hrs)

2. Components (32 hrs)

2.1 Capacitors (08 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) (04 hrs)

2.3 Transformer, inductors and RF coils: (04 hrs)

Methods of manufacture, testing, Need of shielding, application and trouble shooting

2.4 Surface Mounted Devices (SMDs): (04 hrs)

Constructional detail and specifications.

2.5 Connectors, Relays, switches and cables: (04 hrs)

Different types of connectors, relays, switches and cables, their symbols, construction and characteristics.

2.6 Semi Conductors and Integrated Circuits (ICs) - Characteristics and testing (08 hrs)

- Basic characteristics of semiconductor materials, testing of diodes, transistors, FETs and SCRs.
- Various processes in IC manufacturing. Hybrid IC technology

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc .and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

1. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, NewDelhi
2. Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
3. Electrical Engineering Materials by Sahdev, Unique International Publications
4. Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi
5. Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi
6. Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi
7. Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City
8. Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
Materials			
11	Classification of Materials	4	5
1.2	Conducting Materials	8	15
1.3	Insulating Materials	6	10
1.4	Magnetic Materials	6	10
1.5	Special Materials	4	5
1.6	Introduction to various Engineering Materials	4	5
Components			
2.1	Capacitors	8	15
2.2	Resistors	4	5
2.3	Transformers, Inductors	4	5
2.4	SMDs	4	5
2.5	Connectors, Relays	4	5
2.6	Semiconductors & ICs	8	15
	Total	**64**	**100**

3.3 TEST AND MEASURING INSTRUMENTS

L T P
3 - 3

RATIONALE

Instrumentation and control engineering diploma holders are normally placed in process and manufacturing industries and service sector. They are required to operate and maintain various electrical and electronic systems. This course provides a starting background to the students of diploma programme in Instrumentation and Control acquainting him/her with various electrical and electronic instruments for their principle, operation, testing, calibration and applications. The detailed content of this course has been tailored as per industrial needs. Proper understanding of the measuring techniques, construction and working principles of various instruments will help the students in proper handling, operation and maintenance of industrial plants, control circuits and panels etc. This course will help the diploma students to pursue higher studies as well.

DETAILED CONTENTS

1. Introduction to Test and Measurements (4 hrs)

   Classification, Absolute and secondary instruments, Indicating recording and integrating instruments

   1.1 Review of units, dimensions and standards
   1.2 Symbolic representation of circuits

2 Measurement of Resistance, Inductance and Capacitance (10 hrs)

   2.1 Measurement of resistance: Ohmmeters, Meggers, Wheatstone Bridge, Kelvin Bridge, Potentiometer method, Impedance Measurement:

   2.2 Measurement of inductance and capacitance: AC bridge method, Wagner earth devices, Detectors – classification and types, Vibration galvanometers

3. Ammeter, Voltmeter and Multimeter (10 hrs)

   Zero error Moving Iron, Permanent Magnet Moving Coil Meters, Range Extension, Thermal type, electrostatic inductor, rectifier instruments, Electronic voltmeter, Digital Voltmeter (DVM)- ramp type and integrating type digital voltmeters, D' Arsonoval Galvanometer, dynamo galvanometer equation of motion, damped, under damped and critical damped

   Multimeter: Principle of measurement, Measurement of d.c voltage and a.c voltage, a.c and d.c sensitivity, Shunt and multiplier for range extension

4. Power and Energy Measurements (4 hrs)

Watt meters – types, definition, classification, 2 Wattmeter and 3 Wattmeter methods, Energy Measurement, Energy meters – types, definition, principle, Maximum demand indicators

5. Frequency and Phase difference Measurement (4 hrs)

Stroboscopes, synchro-scopes, Power factor meters, Digital frequency meters, phase sequence indicators

6. Illumination Instrument (4 hrs)

Definition, Flicker, illumination photo meter

7. Cathode ray Oscilloscope (6 hrs)

Block diagram, Construction of Circuit, Deflection sensitivity, Various controls, X–Y Section, delay line, Horizontal sweep section, synchronization of sweep and triggered sweep, Measurement of voltage, current, phase angle, frequency, CRO probes, dual trace beam, high frequency beam, Digital Storage Oscilloscope (DSO)

8. Construction, principle and operation of the following Meters and Instruments (6 hrs)

Q-meter, transistor tester, LCR Bridge, function generator, Tong tester, flux meter, spectrum analyzer

LIST OF PRACTICALS

1. To identify and study of indicating, integrating and recording instruments.
2. Extension of range of a given voltmeter and an ammeter.
3. Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
4. Study the constructional details, working and calibration of an ammeter (moving coil and moving iron type)
5. To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
6. Study the constructional details, working of a meggar and measurement of insulation resistance of a given motor.
7. To measure the value of earth resistance using earth tester.
8. To measure unknown resistance with wheat-stone bridge.

9. Connecting appropriate instruments at the supply of an installation to measure supply voltage, current, frequency, power, maximum demand, Phase sequence, energy consumed (Instruments to be used are Maximum demand Indicator, phase sequence indicator, energy meter, power factor meter, wattmeter, voltmeter, ammeter and frequency meter)
10. To measure frequency, power, power factor in a single-phase circuit, using digital frequency meter, wattmeter and power factor meter and to verify results with calculations.
11. Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
12. Use of LCR meter for measuring inductance, capacitance, Q-factor and resistance.
13. Measurement of voltage, frequency, time period, phase and rise time and fall time using CRO.
14. Measurement of voltage, frequency, time and phase using Digital Storage Oscilloscope(DSO).
15. Measurement of illumination at different places using a photometer.

INSTRUCTIONAL STRATEGIES

While teaching this course the teacher should give demonstration in working and calibration of the instruments pertaining to relevant topics in the class. A visit to power plant or industry can also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals

RECOMMENDED BOOKS

1. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney; Dhanpat Rai and Sons, New Delhi
2. Electrical Measurements and Measuring Instruments by EW Golding and Widdis; Wheeler Publishing House, New Delhi
3. Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International Publications, Jalandhar
4. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
5. Electrical Measurements by MU Reissland; Wiley Eastern Ltd., New Delhi
6. Electronic Measurement by Ternam Pettat
7. Electronics Test and Instrumentation by Rajiv Sapra, Ishan Publications, Ambala
8. Electronic, Instrumentation Fundamentals by Malvino
9. Electrical Measurement by DR Nagpal
10. Electric Instruments by D. Cooper, Prentice Hall of India, New Delhi
11. Basic Electrical Measurements by Melville B. Staut.

12. Electronics Instrumentation by JB Gupta, Satya Prakashan, New Delhi
13. Modern Electronic Instrumentation and Measurement Techniques by Cooper,
14. Electronics Instrumentation by Umesh Sinha

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time allotted(hrs)	Marks Allocation
1.	4	7
2.	10	20
3.	10	20
4.	4	8
5.	4	7
6.	4	8
7.	6	15
8.	6	15
Total	48	100

3.4 PRINCIPLES OF INSTRUMENTATION

L	T	P
3	-	3

RATIONALE

This syllabus has been designed to impart the knowledge of basic principles involved in instrumentation systems. The student will learn the various characteristics of instruments, means of transduction and displaying variables besides instrument selection criteria. The concepts will help the students in forming a solid foundation for higher learning.

DETAILED CONTENTS

1. Basics of Instrumentation Systems (08 hrs)

   - Scope and necessity of instruments
   - Measurement, its significance and types
   - Building blocks of instrumentation systems
   - Various testing signals
   - Important process variables and their units

2. Performance Characteristics of Instruments (16 hrs)

   - Static characteristics of instruments-accuracy, precision, linearity, resolution, sensitivity, hysteresis, drift, dead time, loading effects.
   - Dynamic inputs and dynamic characteristics-time constant, response time, natural frequency, damping coefficient.
   - Reliability, serviceability, cost effectiveness, and availability
   - Static and dynamic response (step response)
   - Order of Instruments
   - Environmental Effects
   - Calibration tools

3. Display and recording devices (18 hrs)

   - Operating mechanism in indicating and recording devices
   - Various indicating, integrating and recording methods and their combination
   - Merits and demerits of circular chart and strip chart recorder

- Basics of printing devices
- Scanning, data logging and field buses
- Bar graph LCD, Seven segment display, X-Y recorder, scanners
- Design experiments for display system

4. Errors (06 hrs)

- Calibration of instruments
- Sources of errors
- Classification of errors
- Grounding/earthing
- Precautions

LIST OF PRACTICALS

1. To find the constant of 1st order instrument
2. To find the constant of 2nd order instrument
3. To find the response of 1st order instrument with step, sinusoidal and ramp input
4. To find the response of 2nd order instrument with step, sinusoidal and ramp input
5. To assemble seven segment display using LEDs
6. To make fourteen segments display using LCD and verify it
7. To make the DOT Matrix display and its verification
8. Make any word using LCD and LED
9. To study circular and strip chart recorder

INSTRUCTIONAL STRATEGY

This being a first branch specific subject, the teacher should lay emphasis on giving an overview of the field of instrumentation and control. In addition, for exposure the students should be taken to various process industries or where control system and electronic instrumentation is being used. The teacher shall demonstrate the instruments and their functioning.

LIST OF RECOMMENDED BOOKS

1. Mechanical and Industrial Measurement by RK Jain, Khanna Publishers,New Delhi
2. Electrical and Electronic Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co., New Delhi
3. Elements of Electronic Instrumentation and measurement by Carr, Pearson Education , Sector 62, Noida

4. Electronic Instrumentation and measurement by Kishore, Pearson Education , Sector 62, Noida
5. Electrical and Electronic Measurement and Instrumentation by JB Gupta; S.K Kataria and Sons Publishers, New Delhi
6. Measurement Systems by Doeblin.
7. Industrial Instrumentation by Donald P Eickrman
8. Advanced Instrumentation and Control by MF Kureshi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	**Topic**	**Time Allotted (hrs)**	**Marks Allocation**
1.	Basics of Instrumentation Systems	8	15
2.	Performance Characteristics of Instruments	16	35
3.	Display and Recording Devices	18	40
4.	Errors	6	10
Total		**48**	**100**

3.5 ELECTRICAL MACHINES

L	T	P
3	-	3

RATIONALE

This subject deals with various types of electrical machines being employed in industry, 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 students will study three phase supply, transformer, a.c. and d.c. motors. The practicals will enable students to perform various tests necessary for installation and commissioning of such machines.

DETAILED CONTENT

1. Three Phase Supply (06 hrs)

   a) Advantages of 3 phase system over single phase system
   b) Star delta connections
   c) Relation between phase voltage and line voltage, phase current and line current in a 3 phase system
   d) Power and power factor(p.f.) in 3 phase system and their measurements, importance of p.f. (simple problems)

2. Transformer (08 hrs)

   Principle of transformer, construction, voltage and current transformation. Methods of connection in 3 phase transformers, current and voltage relationship, auto transformer and its uses, instrument 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)

   Principle, significance of back emf, types of motors and their construction, 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 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)

Principle, construction and working, effect of load and excitation on synchronous motor. Starting of motor and their applications

6. Single Phase Motors (06 hrs)

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

a) Induction motor
b) 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

The students to perform following experiments in the lab:

1. DC machines

   1.1 Speed control of dc shunt motor (i) Armature control method (ii) Field control method
   1.2 Study of dc series motor with starter (to operate the motor on no load for a moment)

2. Transformers (single phase)

   Open circuit and short circuit test for determining parameter of a transformer

3. Determining the regulation and efficiency from the data obtained from open circuit and short circuit test

4. Three-phase transformers

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

5. To measure power and power factors in 3 - phase load using two wattmeter method.
6. To connect a dc shunt motor with supply through 3 - phase starter and to run the motor at different speech with the help of a field regulator.
7. To run a 3 - phase squirrel cage Induction motor with the help of a star delta starter.
8. To change the direction of rotation of induction motor.

9. To run a synchronous motor with a.c. supply and to measure speed to verify the relation

$$N = \frac{120\,f}{p}$$

INSTRUCTIONAL STRATEGY

For conceptual understanding a field/industrial visit (preferably Transformer Factory) may be organised to give live exposure to students. For this the teacher should visit first to understand the assembly line-up which could be followed by a visit of the students, where the teacher can give an idea of the working of the factory without much seeking assistance of the factory staff. In addition, emphasis may be given on field applications and simple numerical problems.

RECOMMENDED BOOKS

1) Electrical Machine by SK Bhattacharya, Tata McGraw Hill Education Pvt Ltd, New Delhi
2) Electrical Machines by Nagrath and Kothari, Tata McGraw Hill Education Pvt Ltd, New Delhi
3) Experiments in Basic Electrical Engineering: by S.K. Bhattacharya, KM Rastogi: New Age International (P) Ltd. Publishers, New Delhi
4) Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
5) Electrical Engineering by JB Gupta, SK Kataria & Sons, New Delhi
6) Electrical Machines by DR Arora, Ishan Publications, Ambala City.
7) Electrical Technology Vol. - I and II B.L. Thareja, S Chand and Co. New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Three phase Supply	6	12
2.	Transformers	8	20
3.	DC Motor	8	15
4.	3 Phase Induction Motors	8	20
5.	Synchronous Motors	6	10
6.	Single Phase Motors	6	13
7.	Stepper Motor and Servo Motor	6	10
Total		**48**	**100**

3.6 FUNDAMENTALS OF DIGITAL ELECTRONICS

L T P
3 - 3

RATIONALE

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.

DETAILED CONTENTS

1. Introduction (02 hrs)

   a) Distinction between analog and digital signal.
   b) Applications and advantages of digital signals.

2. Number System (03 hrs)

   a) Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa.
   b) 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 (03 hrs)

   a) Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code.

   b) Concept of parity, single and double parity and error detection

   c) Alpha numeric codes: ASCII and EBCDIC.

4. Logic Gates and Families (06 hrs)

   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:

   - Definition of SSI, MSI, LSI, VLSI
   - TTL and C MOS families and their sub classification

- Characteristics of TTL and C MOS digital gates. Delay, speed, noise margin, logic levels, power dissipation, fan-in, power supply requirement and comparison between TTL and C MOS families

5. Logic Simplification (04 hrs)

a) 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

b) Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits

6. Arithmetic circuits (04 hrs)

a) Half adder and Full adder circuit, design and implementation.
b) Half and Full subtracter circuit, design and implementation.
c) 4 bit adder/subtracter.
d) Adder and Subtractor IC (7484)

7. Decoders, Multiplexeres and De Multiplexeres (04 hrs)

a) Four bit decoder circuits for 7 segment display and decoder/driver ICs.
b) Multiplexers and De-Multiplexers
c) Basic functions and block diagram of MUX and DEMUX. Different types and ICs

8. Latches and flip flops (05 hrs)

a) Concept and types of latch with their working and applications
b) Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops.
c) Difference between a latch and a flip flop
d) Flip flop ICs

9. Counters (06 hrs)

a) Introduction to Asynchronous and Synchronous counters
b) Binary counters
c) Divide by N ripple counters, Decade counter.
d) Pre settable and programmable counters
e) Up/down counter
f) Ring counter with timing diagram
g) Counter ICs

10. Shift Register (05 hrs)

Introduction and basic concepts including shift left and shift right.

a) Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

b) Universal shift register

c) Buffer register, Tristate Buffer register

d) IC 7495

11. A/D and D/A Converters (06 hrs)

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

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

- Stair step Ramp A/D converter
- Dual Slope A/D converter
- Successive Approximation A/D Converter

c) Detail study of :

- Binary Weighted D/A converter
- R/2R ladder D/A converter

d) Performance characteristics of A/D and D/A converter.

e) Applications of A/D and D/A converter.

LIST OF PRACTICALS

1. Basic logic operations, AND, OR, NOT functions

2. Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR(EXNOR) gates

3. - Realisation of logic functions with the help of NAND or NOR gates
   - Design of a NOR gate latch and verification of its operation

4. To design a half adder using XOR and NAND gates and verification of its operation
   Construction of a full adder circuit using XOR and NAND gates and verify its operation

5. 4 bit adder, 2's complement subtractor circuit using an 4 bit adder IC and an XOR IC and verify the operation of the circuit.

6. To design a NOR Gate Latch and verification of its operation

7 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).

8. Verification of truth table for encoder and decoder ICs, Mux and DeMux

9. To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation.

10. To design a 4 bit ring counter and verify its operation.

11. Asynchronous Counter ICs

    Verification of truth table for any one universal shift register IC
    Use of IC 7490 or equivalent TTL (a) divide by 2 (b) divide by 10 Counter
    OR
    Use of IC 7493 or equivalent TTL (a) divide by 2 (b) divide by 8 (c) divide by 16 counter

Note: Above experiments may preferably be done on Bread Boards.

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

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
3. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd,
4. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar
5. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd,
6. Digital Fundamentals by Thomas Floyds, Universal Book Stall
7. Digital Electronics by RP Jain, Tata McGraw Hill Education Pvt Ltd, New Delhi
8. Digital Electronics by KS Jamwal, Dhanpat Rai and Co., New Delhi
9. Digital Electronics by Rajiv Sapra, Ishan Publication, Ambala
10. Digital Electronics by BR Gupta, Dhanpat Rai & Co., New Delhi
11. Digital Systems: Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi

12. Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi

13. Fundamentals of Digital Electronics by Naresh Gupta, Jain Brothers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1.	Introduction	2	5
2.	Number System	3	5
3.	Codes and Parity	3	5
4.	Logic Gates and Families	6	15
5.	Logic Simplification	4	10
6.	Arithmetic Circuits	4	10
7.	Decoders, Multiplexers and Demultiplexers	4	10
8.	Latches and Flip flops	5	10
9	Counters	6	10
10.	Shift Registers	5	10
11.	A/D and D/A Converter	6	10
Total		**48**	**100**