Scheme of Teaching and Examination for
IV Semester DIPLOMA in ELECTRICAL & ELECTRONICS ENGINEERING

THEORY

Sl. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME		EXAMINATION - SCHEME					
			Periods per Week	Periods in one Session	Hours of Exam.	Terminal Exam. (A) Marks	Final Exam. (B) Marks	Total Marks (A+B)	Pass Marks Final Exam.	Pass Marks in the Subject
1.	Power System-I	20401	6	60	3	20	80	100	26	36
2.	Electrical Machine –I	20402	6	50	3	20	80	100	26	36
3.	Microprocessors its Apparition	20403	6	60	3	20	80	100	26	36
4.	Electrical & Electronics Engg. Drawing	39404	6	60	4	20	80	100	26	36
5.	Electrical Estimating & Costing	20405	6	50	4	20	80	100	26	36
	Total:-		30					500		

PRACTICAL

Sl. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME		EXAMINATION – SCHEME					
			Periods per Week	Periods in one Session (Year)	Hours of Exam.	Marks Internal Exam. (A)	Marks External Exam. (B)	Total Marks (A+B)	Pass Marks Final Exam.	Pass Marks in the Subject
6.	Electrical Engg. Lab.	20406	6	60	4	10	40	50	16	21
7.	Electronics & Microprocessor Lab	20407	6	60	4	10	40	50	16	21
	Total:-		12					100		

SESSIONAL

Sl. No.	SUBJECTS	SUBJECT CODE	TEACHING SCHEME		EXAMINATION - SCHEME			
			Periods per Week	Periods in One Session (Year)	Marks of Internal Examiner (X)	Marks of External Examiner (Y)	Total Marks (X+Y)	Pass Marks in the Subject
8.	Electrical Engg. Lab	20408	-	-	20	30	50	25
9.	Electronic & Microprocessor Lab	20409	-	-	20	30	50	25
10.	Electrical & Electronics Engg. Drawing	39410	-	-	20	30	50	25
	Total :-						150	

Total Periods per Week	42	Total Marks	750

POWER SYSTEM - I

Subject Code **20401**	Theory			No of Period in one session : 60		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	80
	06	-	-	Internal Exam.	:	20

Rationale:-

Electrical Diploma holders are required to work as technician and function as supervisors in various electric generating plants. They are also required to look after the transmission and distribution systems of electric energy. As such, they must have the knowledge of the technical aspects of the different types of generating plant and the transmission and distribution of electric energy.

Objectives

Generating plants and the transmission and distribution systems have been included in this paper. The study of proposed topics would enhance the quality and skill of the students. This will set them to face problems properly when placed with responsibility under real situations at respective State Electricity Boards, DVC, Electric Power Units of various large scale and small scale plants.

CURRICULUM
Sl.No. Topics   **Periods**

PART - I: GENERATION

1. Thermal Power Station   10
2. Hydro-Electric Station   10
3. Nuclear Power Station   08
4. Comparison of Various Plants   02

PART - II: TRANSMISSION & DISTRIBUTION

1. Constants of Overhead Lines   08
2. Performance of Transmission Lines   08
3. Overhead Line Insulator and Corona   05
4. Distribution Systems   05
5. Extra High Voltage Transmission   04
                                                           Total-   **60**

PART I - GENERATION
Topics Content
01.   Thermal Power Stations   **10**

01.01 Uses of thermal power plant, trends, selection of site.
01.02 Main parts and their working.

02.   Hydro-Electric Station   **10**

02.01 Introduction, selection of site, uses.
02.02 Classification of hydro-electric plants (Basic idea only)
02.03 General arrangement of operation and principle of working of a hydro-electric plant.
02.04 Layout of hydro-electric plant.

03. **Nuclear Power Station**   **08**

03.01 Introduction, advantages, site selection.
03.02 Elements of a nuclear power station
03.03 Main parts of a reactor and their functions (Basic idea only)

04. **Introduction of Non-conventional energy sources.**   **02**

PART II - TRANSMISSION & DISTRIBUTION
 Topics Content

1. **Constants of Overhead Lines**   **08**

01.01 Introduction, single line diagram of transmission and distribution system.
01.02 Inductance of single phase two-wire line, inductance of three phase lines, simple problems.
01.03 Capacitance of three phase lines, simple problems

02. **Performance of Transmission Lines**   **08**

02.01 Short lines, regulation and general network constants, simple problems.
02.02 Medium lines, Nominal Method, General network constants for localized capacitance,
        problems.
02.03 Feranti Effect.

03. **Overhead Line Insulator and Corona**   **05**

03.01 Type of insulators and their description. (Brief idea).
03.02 Methods of increasing string efficiency.
03.03 Phenomenon of corona, corona discharge, critical voltage, power loss due to corona
        simple problems.

04. **Distribution Systems**   **05**
04.01 Choice of transmission voltage, conductor size and Kelvin's law, problems.

05. **Extra High Voltage Transmission**   **04**

05.01 Brief idea of extra high voltage transmission system

 Recommended Books:-

Sl.No.	Title/Publisher	Author
1.	Electrical Power	
	(Generation, Transmission, Distribution, Protection and Utilization)	Soni, Gupta, Bhatnagar
2.	Electric Power	Uppal
3.	Electric Power (Hindi)	D.R. Nagpa

Reference Books:-

SL	Title/Publisher	Author
1.	Principles of Power System, S. Chand & Co., New Delhi.	V.K. Mehta

ELECTRICAL MACHINE - I

Subject Code 20402	Theory			No of Period in one session : 50		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	80
	05	-	-	Internal Exam.	:	20

Rationale:-

The students are well conversant with the electric and magnetic field and circuit, electro-magnetic induction, D.C. and A.C. circuits, based on related electric and magnetic theories. They also know about electrical components and materials. Now the Machine - I is being introduced for Part-II diploma in Electrical Engineering to impart the knowledge of D.C. machines, which play vital roles even in this era of electronics in different industries throughout the world.

The topics of requisites and construction of D.C. machines, generators, motors, converters, special motors and electro plating have been included in the content, which will give full insight of electrical equipments in their practical life.

Topics have been divided into sub-topics in order to facilitate the students to understand the subject matters properly. Tentative no. of lectures have been allotted for each topic and sub-topic, so that the whole syllabus may be covered easily in the academic year.

Objectives:-
The thorough study of these topics will enable the students know fully about D.C. machines, their operation, maintenance and proper connection and hence will enable him to work as a good supervisor and also to efficiently monitor the works of operators under him. The topics of special motors used and that of electroplating will provide full insight of practical use of electrical equipments.

CURRICULUM

SL	Topics	Periods
1.	Requisites and Construction of D.C. Machines	15
2.	D.C. Generator	20
3.	D.C. Motor	15
	Total-	50

CONTENTS
Topics Content

01.   Requisites and Construction of D.C. Machines   15

01.01 Armature winding: Pole-pitch, conductor coil and winding elements, coil span, coil-pitch, pitch of winding, back pitch, front pitch, resultant pitch, commutator pitch.
01.02 Single layer winding, lap and wave winding, use of lap and wave windings.

02.   D.C. Generator   20

02.01 Types of generator, E.M.F. equation of generator.
02.02 Losses and efficiency of a generator, condition for maximum efficiency.
02.03 Armature reaction: Demagnetizing and cross-magnetizing conductions, demagnetizing ampere-turns per pole, cross-magnetizing ampere-turn per pole.

02.04 Generator characteristics: No load curve of self-excited generator, How to find critical resistance, How to draw O.C.C. at different speeds, critical speed, voltage build-up of a shunt generator, condition for voltage build-up of a shunt generator, voltage regulation, no-load saturation curve.
02.05 Use of different types of generators, simple problems.

03   D.C. Motor:-   **15**

03.01 Significance of back E.M.F., voltage equation of a motor, armature torque, shaft torque.

03.02 Characteristics of series shunt and compound motors.

03.03 Losses and efficiencies of a motor.

03.04 Speed control of a D.C. motor: Speed control of a series motor, speed control of a shunt motor, merits and demerits of a rheostatic control method, series, parallel control, simple problems.

03.05 Testing of D.C. Motors: No-load test (Swin Burne's test) of D.C. shunt motor, back to back test (Nopkinson's test), retardation test of a series motor.

03.06 Necessity of a starter. Shunt motor starter: 3-point starter, 4-point starter.

Recommended Books:-

Sl.No. Title/Publisher   **Author**
1.   Theory of Direct Current Machinery, TMN editions   Alexander S. Langsdorf
2.   A Text-Book of Electrical Technology, Vol. II   B.L. Theraja
3.   Electrical Machinery, Khanna Publications   P.S. Pimbhra

MICROPROCESSOR & ITS APPLICATION

Subject Code 20403	Theory			No of Period in one session : 60		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	80
	06	-	-	Internal Exam.	:	20

Rationale:-

The role of Microprocessor in all industries is well established. They are used in instrumentation, transportation, military equipments like tanks, radars etc. communication, automatic testing products, lift control, speed control of motors, automatic control of generator's voltage, fuel control of furnaces etc. Microcomputers play a dominant role in all spheres of our life and outcome is the evolution of microprocessors itself.

Objectives

In this introductory paper the students will be exposed to the basic concept of microprocessors using 8085. The idea is to make the students aware of the terminologies, its components and elementary idea of Assembly Language Programming. They will be acquainted with the microprocessor.

Brief introduction given here about the recent trend and the microprocessor in common use these days, will enable the students the knowledge of Advanced Microprocessors in respect of Modern Control System.

CURRICULUM

Sl.No.	Topics	Periods
1.	Organization of Microprocessors	12
2.	Programming Technique	12
3.	Motorola 6800 and Assembly Language	12
4.	Interfacing	12
5.	Introduction to 8086	12
	Total	**60**

CONTENTS

Topics Content

01.   Organization of Microprocessors:-   **12**

01.01 Organization of microprocessors in general, Central Processing Unit (CPU), Arithmetic and Logic Unit (ALU), Resistors, Counters, data and address process, ROM and RAM, I.O. devices.

02.   Programming Technique:-   **12**

02.01 Architecture of 8085 programming technique used for 8085 for example, addition, subtraction, multiplication of numbers using 8085.

03.   Assembly Language of Intel 8085:-   **12**

03.01 Introduction to 8-bit microprocessor of Motorola 6800 and 2800.

04.   Interfacing:-   **12**

04.01 Interfacing.

05.   Introduction to 8086:-   **12**

05.01 Introduction to microprocessor, 8086, architecture, memory organization, address modes, data resistor memory, I.O. devices of 8086, interrupt instructions and applications, floppy disk drive and hard disk drive, description of keyboards in brief.

Reference Books:-

Sl.No.	Title/Publisher	Author
1.	Fundamentals of Microprocessors and Microcomputers	B. Ram
2.	Digital Computer Electronics - An Introduction to Microprocessors	A.P. Malvino
3.	Microcomputers/Microprocessors	Joh. L. Hilburn and P.M. Julich
4.	Microprocessor Architecture, Programming and Application	R.S. Goanker

ELECTRICAL AND ELECTRONICS ENGG. DRAWING

Subject Code 39404	Theory			No of Period in one session : 60		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	80
	3	0	0	Internal Exam.	:	20

RATIONAL & OBJECTIVE:-

For Electrical & Electronics Engineering students study of Drawing is essential in Ist/IInd semester Diploma in Electrical & Electronics Engineering Course, the students were acquainted with fundamental of Projections and simple drawing. At Semester IV stage level the students are required to prepare, understand, interpret drawing of electrical & electronics installation, electrical & electronics machine, equipments and electrical & electronics circuits. They should be able to draw free hand sketches of electrical machine parts, various electrical & electronics equipments and draw the various types of electronics components. Their symbols, block diagrams, circuit diagrams, Line diagrams & Logic diagrams neatly and properly.

PART-A

Sl.No. **Topics**
01.   Drawing from Sketeches
02.   Development of m/c windings & some free hand sketches

PART-B

03.   Symbols
04.   Construction Views of commonly used component and devices.
05.   Block Diagrams.
06.   Circuit Diagrams.
07.   Logic Diagrams.

CONTENTS:

PART-A

TOPIC: 01- DRAWING FROM SKETCHES:

To draw from sketches the fully dimensioned orthographic views of the following:-

01.01   Different views of Different types of nuts and bolts including foundation bolts with threads.
01.02   Pin insulators, Sackle type insulator, Disc insulator.
01.03   Sketches of C.T. , P.T. and Other Relays with feeders and Distributors.

TOPIC: 02- DEVELOPMENT OF MACHINE WINDINGS & SOME FREE HAND SKETCHES:

02.01   Different Industrial Electrical symbols.
02.02   D.C. Lap Winding/Single & Double layer.
02.03   D.C. wave winding/Single &Double layer.
02.04   Different types of poles & Towers with feeders and Distributors and Lightning Arrestors.
02.05   Battery Charging ckt. With Battery.

PART-B

TOPIC: 03- SYMBOLS:

03.01   Symbols of different components, equipments etc. and references of common types of active and passive devices.

TOPIC: 04-CONSTRUCTION VIEW OF COMMONLY USED COMPONENT & DEVICES:

04.01   Digital Ammeter.
04.02   Digital Voltmeter.
04.03   Digital Multi meter.
04.04   Relays.
04.05   Speakers.
04.06   Condenser.

TOPIC: 05-BLOCK DIAGRAMS:

05.01   Block Diagram of A.M. transmitter, receiver, F.M. transmitter, F.M. Receiver etc.
05.02   T.V. Receiver. T.V. Transmitter etc.

TOPIC: 06-CIRCUIT DIAGRAMS:

06.01   Different types of amplifiers.
06.02   Different types of multi vibrators.
06.03   A/D & D/A Converter.

TOPIC: 07-LOGIC DIAGRAMS:

07.01   Symbols & truth tables of different logic gates.
07.02   Flip flops.
07.03   Block diagram of Multiplexer and Demultiplexer.

BOOKS RECOMMENDED:
Text Books

1.   Electrical Engg. Drawing   Narang
2.   Electrical Engineering Drawing, Vol.I & Vol.II   Pal &Lal
3.   Electrical Engineering Drawing   J.T.T.I. Madras
4.   Power Electronics   Milliman & Halkias
5.   Fundamentals of Microprocessor and Microcomputers   B.Ram

Reference Books

1.   Electrical Engg. Drawing   Surjeet Singh.

ELECTRICAL ESTIMATING & COSTING

Subject Code 20405	Theory			No of Period in one session : 50		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	80
	04	-	-	Internal Exam.	:	20

Rationale

For any electrical project a proper layout requirements of equipments and items are essential features. The procurement of such items requires proper circuit diagram and relevant estimate.

Objectives

The students of electrical engineering diploma should have a sufficient knowledge of electrical circuit diagram and their estimates. The syllabus has been framed in the successive paragraph. This will provide the students to develop the skill with all confidence as per requirements of the industrial and commercial projects when they are placed in the field.

CURRICULUM

Sl.No.	Topics	Periods
1.	Common Block and Circuit Diagram	25
2.	Estimating and Costing	25
	Total-	**50**

CONTENTS
Topics

Content

01.   Common Block and Circuit Diagram   25

01.01 Block diagram showing the interconnection between Prime mover and generators.
01.02 Block diagram showing the interconnection Generators/supply and motors.
01.03 Open circuit test and load circuit test arrangement for D.C. Generator and Motor.
01.04 Parallel operation of D.C. Generators, circuit diagram showing necessary meters and bus-bars.
01.05 Different types of starters for D.C. motors and their circuit diagrams.

02.   Estimating and Costing   25

02.01 To draw the house wiring diagram for domestic use and estimation of the quantity and cost (CTS, clear, surface conduit and concealed wiring).
02.02 Power wiring diagram for small workshops having at least 5 motors and estimating cost for conduit type.
02.03 Power diagram for electrical substations (double feeder) including pole mounted type and estimating cost for it.
02.04 Layout and connection diagram for overhead lines connection from generator connection to distribution station and estimating cost of materials for the same.
02.05 Use of lighting arrestors etc. for pole mounted and other sub-stations etc. and estimating cost for it.

Recommended Books:-

Sl.No.	Title/Publisher	Author
1.	Electrical Estimating and Costing (Hindi Version)	Jaggi

ELECTRICAL ENGINEERING Lab.

Subject Code 20406	Practical			No of Period in one session : 60		
	No. of Periods Per Week			Full Marks	:	50
	L	T	P/S	Annual Exam.	:	40
	-	-	06	Internal Exam.	:	10

Rationale:-

In Electrical Machine - I, the students were imparted with the theoretical knowledge of the principles and working of different types of electrical machines, where they have been imparted with the theoretical knowledge at machines. After passing diploma, they will be required to work on the actual machines. Therefore it is essential for them to work on the actual machines.

Objective

Keeping in view, practical knowledge the syllabus of Electrical Engineering Lab. has been prepared so that it may bring boldness and confidence in the students regarding working electrical machines.

LIST OF PRACTICALS

Topics Content
01.   D.C. Generator

01.01   Determination of hysteresis loop of a generator.

01.02   Determination of external characteristic/percentage voltage of a shunt generator against percentage output load.

01.03   Determination of external characteristic/percentage voltage of a series generator against percentage output load.

01.04   Determination of family of external characteristic/percentage voltage curves of a compound generator performing load test as shunt, cumulative compound and differentially compounded generator.

01.05   Determination of efficiency of two similar generators coupled (Hopkinson's test / regenerative test).

01.06   Determination of external characteristic of a generator by performing open circuit and short circuit test.

01.07   Determination of armature resistance and field coil resistance by voltmeter and ammeter method with D.C. supply.

01.08   Determination of magnetization characteristics (O.C.C) of a D.C Shant generator.

01.09   Study of D.C. machine including development of armature winding

02.   D.C. Motor

02.01   Determination of percentage speed verses field current characteristic curve of a shunt or a compound motor.

02.02   Determination of percentage speed, percentage efficiency and percentage regulation curve against percentage output of a D.C. shunt motor by performing load test with mechanical breaking arrangement.

02.03   Determination of percentage speed, percentage efficiency and percentage regulation curve against percentage output of a D.C. motor by performing load test (if there is any coupled D.C. motor)

02.04   Determination of percentage speed, percentage efficiency and percentage regulation curve against percentage output of a D.C. series motor by performing load test with mechanical breaking arrangement.

02.05   Determination of percentage speed, percentage efficiency and percentage regulation curve against percentage output of a D.C. compound motor by performing load test with mechanical breaking arrangement.

02.06   Determination of percentage speed verses armature voltage curve at full excitation and half excitation. (like Warleonard control)

02.07   Determination of family of curves of percentage speed verses output of a shunt motor by putting different values of resistance is series with the armature and performing load test.

02.08   Study of a three point manual starter.

02.09   Study of a four point manual starter.

02.10   Study of a drum controller of a D.C. series motor.

02.11   Study of an automatic starter of a D.C. motor.

02.12   Study of speed control of a D.C. Shunt motor (Various methods)

ELECTRONICS & MICROPROCESSOR Lab.

Subject Code 20407	Practical			No of Period in one session : 120		
	No. of Periods Per Week			Full Marks	:	50
	L	T	P/S	Annual Exam.	:	40
	-	-	09	Internal Exam.	:	10

Rationale:-

The importance of the microprocessor based systems is well established. With the advent of microprocessor only the world of Digital Computer found its place in every sphere of our life. There are numerous application of this technology in the industries for control and efficient running of machineries. It is therefore essential that the students the students who read about this technology should also perform experiments to acquaint themselves with the actual working. The machine language which is the nearest programming language and is in close association of the Assembly Language to be introduced in this subject for practice. This subject will also enable the students to have an idea of memory management in Digital Computers.

Objectives

This will enable the students to have practical and physical concept of digital and electronics equipments. Thus it will make them a good supervisor for location and replacement of the faulty components.

LIST OF PRACTICALS

Sl.No Experiments

1. Study of logic trainer kit and verification of Truth Table in respect of following:
   a. AND gate
   b. OR gate
   c. NAND gate
   d. NOR gate
   e. EX-OR gate
2. Study of the Microprocessor Kit (8085 based).
3. Study of D-Flip Flop and T-Flip Flop.
4. Programming to add two 8-bit numbers: Sum 8-bit.
5. Programming for 8-unit subtraction.
6. Decimal addition of two 8-bit numbers, Sum 16-bit.
7. Programming practice for 1's and 2's complement of a number.
8. Shifting an 8-bit number (left shift and right shift).
9. Program to find the largest and smallest numbers from a series of numbers stored in memory.
10. Program to arrange a series of numbers in ascending and descending order.
11. Interfacing of A/D converter (ADC 0800).
12. Display of Alphabetic and Numeric characters in the data field using LED display.
13. Measurement of Frequency.
14. Measurement and monitoring of Temperature.
15. To draw the static characteristic of a junction diode.
16. To measure the amplification factor of a NPN or PNP transistor.
17. To connect a common emitter amplifier and measure the gain.
18. Assembling and testing of a burglar's alarm etc.

ELECTRICAL ENGINEERING Lab.

Subject Code 20408	Sessional			No of Period in one session : -		
	No. of Periods Per Week			Full Marks	:	50
	L	T	P/S	Annual Exam.	:	30
	-	-	-	Internal Exam.	:	20

Rationale:-

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LIST OF PRACTICALS

Topics Content

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02.08   Study of a three point manual starter.

02.09   Study of a four point manual starter.

02.10   Study of a drum controller of a D.C. series motor.

02.11   Study of an automatic starter of a D.C. motor.

02.12   Study of speed control of a D.C. Shunt motor (Various methods).

ELECTRONICS & MICROPROCESSOR Lab.

Subject Code 20409	Sessional			No of Period in one session :		
	No. of Periods Per Week			Full Marks	:	50
	L	T	P/S	Annual Exam.	:	30
	-	-	-	Internal Exam.	:	20

Rationale:-

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5. Programming for 8-unit subtraction.
6. Decimal addition of two 8-bit numbers, Sum 16-bit.
7. Programming practice for 1's and 2's complement of a number.
8. Shifting an 8-bit number (left shift and right shift).
9. Program to find the largest and smallest numbers from a series of numbers stored in memory.
10. Program to arrange a series of numbers in ascending and descending order.
11. Interfacing of A/D converter (ADC 0800).
12. Display of Alphabetic and Numeric characters in the data field using LED display.
13. Measurement of Frequency.
14. Measurement and monitoring of Temperature.
15. To draw the static characteristic of a junction diode.
16. To measure the amplification factor of a NPN or PNP transistor.
17. To connect a common emitter amplifier and measure the gain.
18. Assembling and testing of a burglar's alarm etc.

ELECTRICAL & ELECTRONICS ENGG. DRAWING

	Sessional			No of Period in one session : 60		
Subject Code 39410	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	Annual Exam.	:	60
	-	-	03	Internal Exam.	:	40

Contents:-

PART-A

Topic :- 01. Drawing from Sketches:-

01.01:- Different views of different types of nuts and bolts including foundation bolts with threads.
01.02 :- Pin Insulators, Shackle type Insulators & Discinsulator.
01.03 :- Sketches of C.T., P.T., and other Relays with feeders and Distributors.

Topic :- 02. Development of Machine windings & some free hand sketches:-

02.01 :- Different Electrical Symbols.
02.02 :- D.C. Lap and wave winding- single & Double layer.
02.03 :- Different types of poles & Towers with feeders and Distributors and Lightning Arrestors.
02.04 :- Battery charging Circuit with Battery.

Topic :- 03. Symbols & Construction View of common used Devices.

03.01 :- Symbols of different components & equipments used in electronics.
03.02 :- Digital Ammeter, Digital Voltmeter, Digital Multimeter.
03.03 :- Condenser, Relays, Speakers.

Topic :- 04.Block Diagrams:-

04.01 :- Block digram of A.M. transmitter & Receiver, F.M. transmitter & Receiver.
04.02 :- Block diagram of T.V. Transmitter & Receiver.

Topic :- 05.Circuit Diagrams:-

05.01 :- Different types of Amplifiers & Multivibrators.
05.02 :- A/D & D/A converter.

Topic :- 06.Logic Diagram:-

06.01 :- Symbols & truth tasle of different logic gates.
06.02 :- Flip-flops, Multiplexer and Demultiplexer
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Books Recommended:-

1. Operations Research. Sultan Chand & Sons, New Delhi, 1990   -Kanti Swaroop.P.K Gupta and Man Mohan

2. Operations Research. Sultan Chand & Sons, New Delhi, 1990   -Heera & Gupta

3. Operations Research. Macmillan Publishing Co. New York, 1982   -H.A.Taha

4. Computer based numerical algorithm, East West Press, 1975   -E.V Krishna Murthy & S.V. Sen

5. Computer oriented numerical method, Prentice Hall India, 1980   -V. Rajaraman