

STUDY & EVALUATION SCHEME
THREE YEAR DIPLOMA COURSE IN
INSTRUMENTATION AND CONTROL ENGINEERING
(2014 Scheme)

SEMESTER - III

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Theory		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
3.1	*Digital Electronics	4	-	3	50	50	100	3	100	3	300
3.2	Industrial Instrumentation	4	-	3	50	50	100	3	100	3	300
3.3	Network Analysis	4	-	3	50	-	100	3			150
3.4	*Electronics Fabrication and Product Design	1	-	3	-	50	-	-	100	3	150
3.5	Programming in C	4	-	3	50	50	100	3	100	3	300
3.6	* Electronics Components and Materials	4	-	-	50	-	100	3	-	-	150
**	Student Centered activities	-	-	4							
	TOTAL	21	-	19	250	200	500		400		1350

*Common with Digital/Medical Electronics

**Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made

DIGITAL ELECTRONICS

L T P
4 - 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 & microprocessors.

DETAILED CONTENTS

- 1. Introduction (2%)**
 - (a) Basic difference between analog and digital signal.
 - (b) Applications and advantages of digital signals.
- 2. Number Systems (10%)**
 - (a) Binary, Octal and hexadecimal number system, conversion from one form to another.
 - (b) Concept of code, weighted and non weighted codes, BCD (8421 code only), excess -3 and grey code.
 - (c) Concept of parity, single and double parity and error detection.
 - (d) Alphanumeric codes (ASCII).
 - (e) Binary arithmetic (addition, subtraction, multiplication and division including binary points). BCD addition, 1's and 2's complement method of addition /subtraction.
- 3. Logic Gates (10%)**
 - (a) Concept of negative and positive logic.
 - (b) Definition, symbols and truth table of NOT, AND, OR, NAND, NOR, XNOR, gates, working of AND and OR gates using simple diode circuits, NAND and NOR as universal gates.
- 4. Logic Simplification (10%)**
 - (a) Postulates of Boolean algebra, De-Morgan's theorems, various identities, formulation of truth table and Boolean equation for simple problems, implementation of Boolean (Logic) equations with logic gates.
 - (b) Karnaugh map (up to 4 variables) and simple application in developing combinational logic circuits.
- 5. Logic Families (10%)**
 - (a) Logic family classification;
 - (i) Definition of SSI, MSI, LSI, VLSI
 - (ii) Comparison of TTL and MOS family characteristics with respect to delay, speed, noise margin, logic levels, power dissipation, fan-in, fan- out, power supply requirement.
 - (b) Logic Circuits: Open collector, wired-OR, totem pole output circuit operation (qualitative) for TTL NAND gate.
 - (c) Tri-state switch / Buffer.

- 6. Arithmetic Circuits (10%)**
(a) Half Adder and Full adder circuits, design and implementation.
(b) Half and full adder circuits, design and implementation.
(c) 4 bit adder/subtractor
- 7. Display Devices (5%)**
LED, LCD, seven segment displays, basic operation of common anode and common cathode types of displays.
- 8. Multiplexers, De-multiplexers and Decoders (10%)**
Basic functions and block diagram of MUX, DEMUX, Encoders and Decoders. Detailed functioning of 3X8 decoder/demux.
- 9. Latches and Flip-flops (10%)**
(a) Concept and types of latch with their working and applications.
(b) Operation using waveforms and truth tables of RS, JK, D, Master/Slave JK and T flip-flops.
(c) Use of D flip-flop as latch
(d) Flip-flop as basic memory cell
- 10. Counters (10%)**
(a) Asynchronous counters:
(i) Binary counters
(ii) Modulus of a counter, modified count of a counter, Mod-8 and Mod-10 counter (including design), difference between decade and mod-10 counter.
(iii) Presentable and programmable counters
(iv) Down counter, up/down counter.
(b) Synchronous counters (only introduction)
(c) Difference between asynchronous and synchronous counters
(d) Ring counter and Johnson counter with timing diagram.
- 11. Shift Register (10%)**
(a) Introduction and basic concepts including shift left and shift right.
(b) Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.
(c) Universal shift register.
(d) Buffer register, Tri-state buffer Register.
- 12. Applications (3%)**
Digital Clock and Calculator

List of Practicals (Digital Electronics)

1. Study of pin configuration of different ICs (e.g. DIP ICs etc.)
2. Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR, Ex-OR and Ex-Nor gates.
3. Logic functions using universal gates
 - (a) Realization of logic functions with the help of NAND or NOR gates.
 - (b) Construction of a NOR gate latch and verification of its operations.
4. Half-adder and full adder circuits
 - (a) Construction of half adder using Ex-OR and NAND gates and verification of its operations.
 - (b) Construction of a full adder using Ex-OR and NAND gates and verification of its operations.
5. 4 bit adder / subtractor circuit.
 - (a) Construction of a 4 bit adder 2's complement subtractor circuit using a 4 bit adder IC and an Ex-OR and verify the operation of the circuit.
6. IC Flip-flop
 - (a) Verification of truth table for some positive edge triggered, negative edge triggered, level triggered IC flip-flops (at least one IC each of D latch, D flip- flop, edge triggered JK and Master –Slave JK flip-flops)
7. Display Devices and their decoder / drivers
 - (a) Familiarization and use of different type of single LEDs, common anode and common cathode seven segment LED displays. Use of 7447, 7448 or equivalent decoder /driver ICs for seven segment displays.
8. Tri-state gate ICs
 - (a) Verification of truth tables and study the operation of tri-state buffer IC 74126 or equivalent
 - (b) Construction of a 4 / 8 bit bidirectional bus using an appropriate IC.
9. Decoder, Encoder, Multiplexer and De-multiplexer
 - (a) Verification of truth table for any one each of encoder and decoder ICs.
 - (b) Verification of truth tables for one/two each of multiplexer/de-multiplexer ICs.
 - (c) Shift Register
 - (d) Construction of a 4 bit serial in serial out / serial in parallel out right shift register using JK flip-flops and verification of its operation.
 - (e) Construction and testing of its operation of a 4 bit ring counter using Jk flip-flop.
10. Universal shift register IC
 - (a) Verification of truth table for any one universal shift register IC.
11. Asynchronous Counter ICs
 - (a) Use of 7490 equivalent TTL
 - (i) Divide by 2
 - (ii) Divide by 5
 - (iii) Divide by 10 counters

OR

- (a) Use of 7493 equivalent TTL
 - (i) Divide by 2
 - (ii) Divide by 8
 - (iii) Divide by 16 counters

Note : Use of simulation software such as OrCADP Spice MULTISIM, ELECTRONIC WORK BENCH etc. for performing some of the above on the computer also, which will enhance the understanding of the students beyond traditional laboratory experiments.

INDUSTRIAL INSTRUMENTATION

L	T	P
4	–	3

RATIONALE

Syllabus has been designed to give thorough insight in the measurement of different parameters in the field of instrumentation engineering. Different methods of measurement and their appropriate selection with limitation have also been taken up to bring the students to a level where they will be able to solve practical problems faced in the field. The relation between the final and primary process control components and functioning of various components have also been dealt with. Coverage is also given to various types of control valves and their applications. Application in industry have also been dealt with.

DETAILED CONTENTS

- 1. Basic Building blocks of any instrumentation system (5%)**
 - Scope and Necessity of instrumentation
 - Names of important process variables their units
 - Building blocks of instrumentation system
 - Various testing signal
 - Controlling system and controllers
 - Display system analog and digital
 - Typical specifications to be given regarding an instrument
- 2. Temperature (30%)**

Importance of temperature measurement in an industry, seebeck effect, Peltier's effect, Temperature scales and conversions.

Principles of working, materials of constructions, advantages and limitations of the following :

 - Vapour filled thermometer, gas filled thermometer, liquid filled thermometer, mercury in glass thermometer
 - Bimetallic thermometer
 - Pressure spring thermometers
 - Thermocouples
 - Resistance thermometers
 - Thermistors
 - Radiation pyrometers
 - Optical pyrometers
 - Location of sensor for measurement speed of response of sensor
 - Lead wire compensation
 - Installation of thermometers
- 3. Level (25%)**

Importance of level measurement; principle of working, material of construction, advantages and limitations of the following :

- Visual Level indicators
- Ordinary float type using strings and pulley
- Purge method
- Buoyancy method
- Resistance probes for level measurements
- Capacitance probe for level measurements
- Ultrasonic level measurements
- Gamma ray level measurements
- Level limit switches
- Level measurement in pressure vessels
- Solid level measurement techniques

4. Mechanical Flow (25%)

Mechanical flowmeter – Principle of working and constructional features, reciprocating piston, nutating discs, oscillating discs, helix oval gears.

Differential pressure meters – types, construction features, working and applications of orifice plate, venturi tube, Dall tube, flow nozzle pitot tube, differential pressure transmitter, shunt flow meter for liquid and gases, variable area flowmeter, rotameter, electro magnetic and ultrasonic flow meters mass flow meters, target flow meters and turbine flow meters

5. Pressure (15%)

Principle of measurement of absolute and gauge pressure, units of pressure and conversion – different type of manometer, principle of working of bellows, bourdon capsule and diaphragm pressure switches vacuum gauges.

LIST OF PRACTICALS (INDUSTRIAL INSTRUMENTATION)

1. To determine time constant and reading time of thermocouple and RTD (resistance temperature detector)
2. To find the temperature coefficient of a RTD and thermister
3. To calibrate an instrument using a thermocouple
4. To determine the time constant of thermal process like an oven
5. To study and use radiation pyrometer for measuring high temperatures.
6. To study and use an optical pyrometer for measuring high temperatures.
7. To study and verify the operation of a level limit switch
8. To measure level in tank using a purge method
9. To use a capacitance probe along with the measurement circuitry to transducer liquid level into a voltage

10. To disassemble and assemble a bourdon pressure gauge
11. To calibrate a Rotameter
12. To verify the working of different types of pressure gauge
13. To calibrate an instrument using RTD
14. To calibrate an instrument using thermister

NETWORK ANALYSIS

L	T	P
4	-	3

RATIONALE

The study of networks and filters taken off from principles of A.C theory and introduces the students to parameters and characteristics of various networks including filter and helps in understanding their basic use for various control system design circuitry.

DETAILED CONTENTS

- 1. Signal waveform and specification : (5%)**
Exponential, step, ramp and impulse functions, periodic waveforms, the sinusoidal average peak and effective values.
- 2. Network elements and their characterization : (10%)**
Terminal properties of R.C and L elements, V-I relationships for mathematically coupled coil, voltage and current, dependant and independent sources, source transformation.
- 3. Fundamentals of network analysis : (10%)**
Kirchoff's laws, analysis of series, parallel and series – parallel network, Topological considerations (Elementary ideas only) loop and nodal analysis dual consideration.
- 4. Transient response of simple circuits : (7%)**
RL, LC and RLC series, parallel and series – parallel circuit, time constant; initial conditions.
- 5. Steady state response of AC ckts. : (10%)**
Phasor representation of sinusoidal impedance concept, Active and reactive power, power factor, Q of inductor and capacitor, series and parallel response, Bandwidth and selectivity.
- 6. Network theorems and Transformations : (10%)**
Star mesh conversion, reciprocity, Thevenin's Norton's maximum power transfer and tellegen's theorems, their statements and application to the solution of network with DC and AC excitation.
- 7. Coupled circuits : (5%)**
Inductive coupling, coeff. of coupling. Frequency response of single and double tuned ckts.
- 8. Fourier series : (8%)**
Evaluation of Fourier coeff. of periodic non-sinusoidal waveforms.
- 9. Laplace transforms : (10%)**
The laplace transform and its properties, partial fractional expansions. The initial and final value theorem. Application of Laplace Transform to networks with step and pulse excitation of initial conditions. Convolution integral.

10. Networks :

(15%)

- (a) One short network : Series and parallel tuned circuits, expression for their impedance in terms of Q and component value (LCR) frequency and Q .
- (b) Two part (Four part Terminals) Network, : Basic concepts of the following terms.
- symmetrical and asymmetrical networks :
Balance and unbalanced networks; Pi network, ladder network :
lattice network :
 - Representation of a two part black box in terms of z, y and h parameters and mentioned of applications to transistor as a two part network.
- (c) Symmetrical network : concept and significance of the terms characteristic impedance, propagation constant, attenuation constant, phase shift constants.
- Expression for characteristics impedance, propagation constant, attenuation constant and phase shift constant in terms of z_0, z_{oc} for the following
 - T network
 - Pi network

11. Reliability of one port :

(10%)

Properties of driving point impedance functions of passive lumped networks, Brunes positive. Hurwitz polynomial, Necessary and sufficient conditions for positive realness, concept of stability and conditions for stability.

LIST OF PRACTICALS (NETWORK ANALYSIS)

1. To verify Thevenins theorem.
2. To verify Norton's theorem.
3. To verify superposition theorem.
4. To verify maximum power theorem.
5. To draw the phasor diagram of series RLC circuit and parallel RLC circuit.
6. To measure active , reactive and apparent power in a single phase A.C circuit.
7. Measurement of Q-factor.
8. To find the Z-parameter of a two- port network.
9. To draw the locus diagram of RL circuit for a proto -type low pass and high pass filter-
 - (a) Determine the characteristics impedance experimentally.
 - (b) Plot the attenuation characteristic.

ELECTRONIC FABRICATION & PRODUCT DESIGN

L	T	P
1	-	3

RATIONALE

The study of electronic manufacturing practices is a detailed study of design and fabrication of PCBs with a view to assemble desired instruments. The topics of production, testing and documentation have been included to give an overall picture of the process of manufacture of electronic devices and systems. Particularly, the students should be oriented to practice and draw on the skills acquired in various workshops attended by them earlier.

DETAILED CONTENTS

1. Introduction to PCB

- (a) Need of PCBs
- (b) Types of PCBs
- (c) Types of materials used for PCB, their characteristics and limitations
- (d) Brief summary of all the processes involved in fabrication of PCB from schematic diagram to final stage.
- (e) Use of active and passive components. Manuals for using mechanical parameters of components

2. Manual Design of PCB

- (a) Layout generation
- (b) Minimization of layout
- (c) Layout transfer
- (d) Etching of PCB
- (e) Drilling

3. Introduction to PCB design software

- (a) Familiarization and use of PCB software like ORCAD (minimum 9.1), Eagle, Pro E, PCB Express, Lab View (Any two) Electronics Workbench.
- (b) Practice in PCB designing of circuits of the following categories;
 - (i) Communication circuits
 - (ii) Digital circuits (counters, shift registers, multiplexers, de-multiplexer etc.)
 - (iii) Audio & Video
 - (iv) Microprocessor based circuits

4. Fabrication and testing

- (a) Fabrication of small analog and digital (minimum one each) circuits, CMOS ICs.
- (b) Final assembly, troubleshooting of the developed product and product
- (c) demonstration.
- (d) Criterion for selection and mounting of heat sinks.

5. Fabrication Techniques

- (a) Soldering methods, manual and demo on machine soldering
- (b) Comparison of soldering methods
- (c) Practice on PCB soldering/de soldering
- (d) Component forming and placement on the PCB
- (e) Tools and precautions to be observed during manual soldering.

PROGRAMMING IN 'C'

L	T	P
4	-	3

RATIONALE-

In order to enable the students to use computer effectively in problem solving, this course offers the model programming language along with exposure to various applications of computer. The knowledge of C language will be reinforced by the practical exercises.

DETAILED CONTENTS

UNIT-I

25%

Overview of C: History & Importance of C, Structure of a C Program.
Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant.
Input/output: Unformatted & formatted I/O function, Input functions (scanf(), getch(), getche(), getchar(), gets()), output functions (printf(), putchar(), puts()).

UNIT-II

25%

Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.

Unit- III

25%

Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement. **UNIT-III** Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement.
Functions : Definition, prototype, passing parameter.

UNIT-IV

25%

Storage classes in C: Auto, extern, register and static storage class, their scope, storage, & lifetime.
Arrays : Definition, types, initialization, processing an array.
User Define data types : Structure and Union.

List of practicals

1. Programming exercises on executing and editing C programs.
2. Programming exercises on defining variables and assigning values to variables.
3. Programming Exercises on arithmetical, relational operators.
4. Programming Exercises on arithmetic expression and their evaluation.
5. Programming Exercises on formatting input/out using printf and scanf.
6. Programming Exercises on if-statement.
7. Programming Exercises on if-else statement.

8. Programming Exercises on switch statement.
9. Programming Exercises on do-while statement.
10. Programming Exercises on for statement.
11. Programming Exercises on one dimensional array.
12. Programming Exercises on two dimensional array.
13. Programming Exercises on strings.
14. Programming Exercises on comparing two strings.
15. Programming Exercises on structure.

TEXT BOOKS

1. Gottfried, Byron S., Programming with C, Tata McGraw Hill
2. Balagurusamy, E., Computing Fundamentals and C Programming, Tata McGraw-Hill

REFERENCE BOOKS

1. Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley.
2. Yashwant Kanetker, Let us C, BPB
3. Rajaraman, V., Computer Programming in C, PHI
4. Yashwant Kanetker, Working with C, BPB

ELECTRONIC COMPONENTS & MATERIALS.

L T P
4 - -

RATIONALE:

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

DETAILED CONTENTS

1. Materials **(50%)**

Classification of materials into conducting, semi conducting and insulating materials through a brief reference to atomic Structure.

(a) Conducting materials:

- (i) Resistivity and factors affecting resistivity such as temperature, alloying and mechanical stressing.
- (ii) Classification of conducting materials into low resistivity and high resistivity materials. Some examples of each and their typical applications.

(b) Insulating Materials :

- (i) Electrical properties – volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) and dielectric constant.
- (ii) Thermal properties – heat resistance, classification according to temperature endurance, thermal conductivity.
- (iii) Plastics – classification into thermo plastic and thermo-setting categories; examples of each and their typical applications.
- (iv) Important relevant (electrical, mechanical and thermal) characteristics and applications of the following materials:

Mica	Epoxy Glass	Polythene
Ceramic	Asbestos	Polyester
Glass	Varnish	Phosphor- Bronze alloy
Cotton	Lacquer	Beryllium – copper alloy
Jute	Enamel	Soldering lead alloy
Teflon	Paper(dry and impregnated)	Copper
Acrylics	Rubber	Silver, gold
Silicon grease	Silicon rubber	
Bakelite	PVC	

(c) Magnetic Materials :

- (i) Different magnetic materials; (Dia, para, ferro) their properties

- (ii) Ferromagnetism, ferrimagnetisms, domains, permeability, Hysteresis loop (including coercive force and residual magnetism and magnetic saturation)
- (iii) Soft and hard magnetic materials, their examples and typical applications

2. Components

- (i) Capacitor Polyester, Metalized Polyester ceramic paper, mica and electrolytic types, constructional details and testing, specifications, temperature and frequency stability and other limitations. Mutual comparison.
- (ii) Resistors-carbon film, carbon composition wire wound and variable types (presets and potentiometers) constructional details and testing, specifications, temperature and frequency dependence and noise considerations. Mutual comparison.
- (iii) Transformers Inductors and RF Coils: Methods of manufacture of inductors, RF coils and small transformers (upto 1 KVA) and their testing. Properties of cores. Need and types of shielding.
- (iv) Surface Mounted Devices (SMD)
- (v) Connectors, Relays and Switches :
- (vi) Various types of switches, e.g. slide, rotary, push, toggle. Micro-switches etc. their symbols, specifications and applications
- (vii) Concept of 'make' and 'break' contacts in relays. Operating current, Holding current, various types of relays. Their symbols, specifications and applications.
- (viii) Various types of connectors. Their symbols specifications and applications.