

PROPOSED SYLLABUS

FOR

PROFESSIONAL DIPLOMA IN COMPUTERISED INSTRUMENTATION (PDCI)

By



**KERALA STATE ELECTRONICS DEVELOPMENT CORPORATION
LTD.**

(A Government of Kerala under taking)

KELTRON HOUSE, VELLAYAMBALAM, THIRUVANANTHAPURAM

PROFESSIONAL DIPLOMA IN COMPUTERISED INSTRUMENTATION

WELCOME TO THE PDCI TRAINING PROGRAMME

OBJECTIVE OF THE COURSE

We proudly introduce our Professional Diploma in Computerised Instrumentation course package, for people aspiring to have careers as an instrument engineer.

Instrumentation is one of the main branches of engineering which deals with the measuring and controlling, the process variables, such as pressure, temperature, flow, level, density etc...

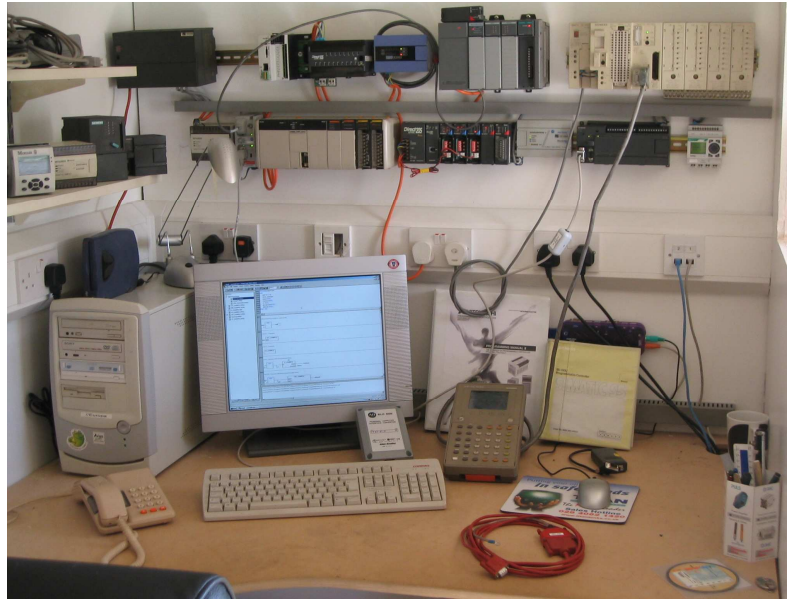
This course programme aims providing the students with a better understanding of control process and instrumentation technology. Elements modes and testing of measurement technique control modes, implementation and valve functions will be explained. Modern trends in digital measurements, electronic and pneumatic features inherent in the control process and DCS, PLC and SCADA . Syllabus is included in this course

By the end of this one year course, the students will be able to understand

1. The process control and instrumentation, theory, the instruments usage, it's calibration, installation, overhauling etc..
2. Understand the analog and digital signal condition
3. Determine the level, pH measure, pressure, temp., flow and inventory controls
4. Be familiar with type and uses of sensors, transducers, Transmitters, Receivers etc...
5. The function working principle and functions of PLC, DCS, SCADA etc.
6. The industrial process variables like pressure, temp., flow level etc..
7. The latest automation control system introduce in instrumentation course.

SCOPE OF THIS COURSE

Plenty of job opportunities are there in the fields like Petrochemical plants, Refineries, Ship yard, Steel plants, Cement plants, power stations etc... The Engineering students of electronic/electrical /telecommunication/ even the students having a very basic technical knowledge can go through our one year control instrumentation course; and they are surly to obtain a dissent job in the field of control instrumentation; As there is an acute shortage of control instrumentation engineers in this field.



IN GENERAL OPPURTUNITIES ARE IN THE FIELD OF..

- PETRO CHEMICAL INDUSTRY
- LARGE SCALE MANUFACTURING INDUSTRIES
- OIL REFINERIES AND CEMENT FACTORIES
- R&D ORGANIZATIONS
- SHIP YARD AND AIR PORTS ETC...

SCHEME OF EXAMINATION AND AWARD OF MARKS

The scheme of examinations shall consist of external end examinations and internal assessments based on periodical tests, assignments and attendance in theory subjects and sectional work in practical subjects

- a) The total marks (internal and external) for each year of diploma will be as follows

COURSE	FEES	DURATION	PRACTICAL /THEORY MARK	INTERNAL MARK	TOTAL MARK
PDCI	28000/- (3000+2500*10)	1 year	700	200	900

ELIGIBILITY: SSLC and Above

- b) The number of subjects in PDCI will be as follows.

Total of 6 subjects with practical session.

ABSTRACT

Sl.no	Subject Title	Subject Code	Marks
1	PROCESS CONTROL INSTRUMENTATION	PDCI T001	100+25
2	AUTOMATION IN INSTRUMENTATION	PDCI T002	100+25
3	ELECTRICAL ENGINEERING	PDCI T003	100+25
4	ELECTRONICS & COMPUTER SCIENCE	PDCI T004	100+25
5	ENGINEERING DRAWING	PDCI T005	100+25
6	PRACTICALS	PDCI T006	200+75

Award of internal assessment marks

- a) In respects of theory subjects the award of sectional mark will be based on tests, assignments and attendance in the proportion of 40% of tests, 40% of assignments and 20% for attendance. There will be a minimum of five tests and the best four of the five taken for the final sectional marks. In the case of assignments, there will be a minimum of two assignments which all the five taken in to account for the final sectional marks.
- b) The class teacher will maintain a record of all marks awarded in respect of internal assignment. The student can represent their grievance if any in respect of marks awarded to the head of the department for clarification.

SUBJECT TITLE : PROCESS CONTROL INSTRUMENTATION
SUBJECT CODE : PDCI T001

CONTENT DETAILS

MARKS: 100 + Internal 25

Familiarization

CHAPTER 1:- FAMILIARIZATION WORKSHOP TOOLS

- Vernier Calipers, Micro Meter, screw gauge, Steel rule, Measuring tape
- Common Screw Drivers (CSD), Philips Screw Drivers, Watch Makers Screw Driver
- Different type of Files
- Different type of Hacksaw
- Hammer of different sizes
- Vices of different types
- Different spanners, Allen key , pipe wrenches, Pliers, tweezers, Pointer extractor, Tube cutter, Tube bender, Spirit level indicator, crimping tools, wire stripper
- Drills of different types
- Teflon Tapes, Insulation tapes
- Different types of punches

CHAPTER 2:- FUNDAMENTALS OF PROCESS INSTRUMENTATION

- Definition : Process & Process Parameter and examples
- Control functions and its 3 stages – Measurement, Control, Correction
- Definitions of Process Control
- Process control in industry. Advantages and its major role in an industry
- Elements of Process Control – Controlled variable, Measured Variable, Set point, Deviation, Manipulated Variable, Disturbances
- Uses of Instruments in Process Control and examples
- Elements of the Feedback Control Loop – Sensor or Transducer, Transmitter, Controller, Final Control Element
- Other instruments that support a control loop – Recorders, Indicators, Alarms, Interlocks
- Characteristics of an instruments – Response Time, Accuracy, Precision or Repeatability, Sensitivity, Dead Band
- Transmitters and Transmission Signals
- Familiarization of different Control Loops
- Calibration – type of calibration, stages of calibration
- Range, Lower Range Value(LRV), Upper Range Value(URV). Span

CHAPTER 3:- PRESSURE MEASUREMENT

- Definition: Pressure.
- Familiarization of different pressure units and its conversion
- Type of Pressure – Static, Dynamic, Differential pressure
- Atmospheric Pressure, Absolute Pressure, Gauge Pressure, Vacuum
- Boyle's law, Charles' Law, Ideal Gas Law, Pascal's Law
- Pressure Elements-Manometers, Barometer, Impulse Line
- Pressure Sensors – Elastic pressure transducer (Diaphragm, Capsule, Bellow, Bourdon Tubes and its Technology)
- Bourdon Tube Pressure Gauges- Installation, Calibration & Maintenance
- Familiarization of Dead Weight Tester, Air Regulator, Pressure Switches, Differential Pressure switches and its installations
- Calibration of Pressure gauges with the help of Dead Weight Tester
- Different type of Electrical Pressure Transducers – Strain Gauges, Linear Variable Differential Transformer (LVDT), Capacitance type transducers, Potentiometric Transducers
- Piezoelectric, Oscillometric
- Type of Manifold Valve, Syphon and condensation pot
- Liquid Filled Gauges
- Pressure Transmitters

CHAPTER 4:-TEMPERATURE MEASUREMENTS

- Introduction – What is temperature?
- Temperature Scales – Fahrenheit, Celsius, Kelvin, Rankine and its comparison
- Temperature Conversion
- Methods of temperature measurement – mechanical, electrical, optical
- Effect of temperature on solids, liquids and gases.
- Liquid filled thermometer, industrial type mercury thermometer, gas filled thermometer, vapor filled thermometer, bi-metallic thermometers, comparison of thermometers
- Resistance Temperature Detector – Principle of operation, RTD elements, Wheatstone Bridge Principle
- Type of RTDs and its material and operating temperature
- RTD configuration – 2 wire RTD, 3 wire RTD, 4 wire RTD
- Familiarization of RTD reference table
- Variation of resistance with temperature - formula
- Thermocouple – laws of Thermocouple – Seebeck effect – Peltier effect – Thomson effect
- Type of Thermocouple – Material, Measuring range, compensating leads
- Familiarization of Thermocouple reference table

- Duplex Thermocouple, Thermopiles etc
- Thermowells – Types-material and its properties and selection
- Thermister – Characteristics – types – applications
- Pyrometers – What is Pyrometry?
- Radiation Pyrometer, Optical Pyrometer
- Temperature switches

CHAPTER 5 :-FLOW MEASUREMENT

- Introduction
- Physical properties of fluids – Pressure, Density, Viscosity, Velocity
- Fluid motion, classification of flow, laminar flow, turbulent flow and Transitional Flow. Reynolds number, Bernoulli's equation for ideal flow.
- Flow measuring devices – variable head or differential flow meters
- Primary elements
Orifice plate, ventury tubes, pitot tube, flow nozzles
- Secondary Element
Manometer, Bellometer, force balance meter
- Variable area flow meters
Rotameter, Cylinder and piston type flow meter.
- Mass flow meters
Turbine flow meter, Target Flow Meter, Magnetic Flow meter
- Flow switches

CHAPTER 5:- LEVEL MEASUREMENTS

- Introduction, direct and in indirect measurements
Direct level measurements, float type, level gauge, sight glass , open and closed tank level measurements, bubbler systems, conductivity method, rheostat method, capacitive methods, level gauge.
- Indirect level measurement
- Radar type and radiation type, transformer, transmitter, ultrasonic, electronic and pneumatic D/P type transmitter, level controller, level troll etc...

CHAPTER 6:- pH

- pH Measurement
- Definition of pH
- Electrodes

Glass Electrode, Reference Electrodes, Double Junction Reference Electrode, pH meter

- Temperature Compensation

CHAPTER 7:-VIBRATION MEASUREMENTS

- Definition, reason for generating the vibration, detection of vibration.
- Proximity Probe installation, monitoring etc...
- Normal vibration- Vibrator
- Proximity Transducer System

CHAPTER 8 :-TRANSMITTERS

- Introduction to telemetry system
- Type of telemetry system
- Transmitters definition
- Classification of Transmitters – Pneumatic & Electronic
- Type of Electronic Transmitter – Analog (Non-SMART), Digital (SMART)
- Principle, construction, operation and Calibration Procedure
- Electronic Transmitter(Non SMART)
- Calibration Setup for Non-Transmitter
- Measuring principle of a SMART Transmitter
- Difference between SMART & Conventional Transmitter
- Global standardization of SMART Transmitter
- Parameters of the Transmitter
- Communicators – different model

CHAPTER 9:-FINAL CONTROL ELEMENTS

- Introduction to final control elements
- Type of control valve and their classification
- Valve selection – flow characteristics
- Actuators – different types
- Valve Coefficient/Flow Coefficient
- Trim, noise, cavitation, lapping, control valve hysteresis
- Parts of a control valve
- Limit switches, air busters, current to pneumatic converters, electro-pneumatic positioner, Solenoid valve

CHAPTER 10 :-INDUSTRIAL SAFTY AND PRECAUTIONS

- Objective
- Personal Safety
- Personal Protective Equipments
- Electrical Safely
- List of Safety crimes
- House Keeping
- Gas Safety
- Fire Safety & fire safety equipments
- Discipline while operating machines
- Handling of tools and equipments
- Work permit system
- Health care and first aids

SUBJECT TITLE : AUTOMATION IN INSTRUMENTATION
SUBJECT CODE : PDCI T002

CONTENT DETAILS

MARKS: 100 + Internal 25

CHAPTER 1:-CONTROL ENGINEERING

- Opened and closed loops
- Analog and digital control devices
- Pneumatic Controllers
- Proportional Controller
- Proportional – plus- derivative Controllers.
- Pneumatic Auxiliary Devices Pneumatic computing elements
- Electric and electronic controllers, on off controller
- Three- Mode controller
- Supervisory Control concepts
- Feed back controllers
- Digital controllers

CHAPTER 2 :- PROGRAMMABLE LOGIC CONTROLLERS

- Principle of operation
- Typical area's of PLC Application
- PLC vs Other types of controllers
 - PLC vs Computer control
 - PLC vs Personal computers
 - PLC vs Dedicated controllers
- Advantage of using PLC
- Ladder logic concepts
- Devices, processors, programming devices
- PLC architecture and Programming
 - PLC architecture
 - Organization
 - Replacing relays
 - Ladder diagram
 - Function blocks
 - Simulations
 - Verifications
 - Installation

CHAPTER 3 :- SCADA

- Introduction to SCADA systems
- SCADA architecture
- Communication protocols
- Introduction to DCS

SUBJECT TITLE : ELECTRICAL ENGINEERING
SUBJECT CODE : PDCI T003

CONTENT DETAILS

MARKS: 100 + Internal 25

CHAPTER :-1 GENERATION AND DISTRIBUTION OF ELECTRICITY

- Hydro electric power station
- Thermal power station
- Nuclear power station.
- Advantages and disadvantages
- AC/DC Generators
- Motors
- Diesel Engines

CHAPTER 2:-BASIC ELECTRICITY

- Define voltage, current, resistance and it's units
- Resistance in series and parallel connection.
- Simple problems
- Ohms law and problems
- Factors affecting Resistances
- Conductance, inductance and capacitance, it's symbols and units
- Specification of resistance, colour coding
- Specific resistance , power Factor
- E.M.F, it's units
- Temp. Coefficient
- Kirchoff's laws
- Fixed and variable resistors, capacitor, inductors, transformers.
- MOTOR, GENERATOR, EARTHING SYSTEMS

CHAPTER 3:- MAGNETISM AND ELECTRO MAGNETISM

MAGNETISM

- Permanent, temporary magnets
- Para, Ferro and Dia magnetic materials and it's uses
- Magnetic field, Flux and Density. MMF
- Residual magnetism
- Retentively , Saturation , permeability
- Force between two magnetic poles

ELECTRO MAGNETISM

- Faradays laws, Lenz's law
- Induced e.m.f, self and mutual induction
- Core laws. methods to reduce these laws

CHAPTER 4:-CAPACITORS

- Definition of capacitors, it's units
- Different types and it's uses
- Factors affecting the capacitors.
- Capacitors in series and parallel combination, simple problems

CHAPTER 5:-ELECTRICAL MEASURING INSTRUMENTS

- Galvanometers, volt meter, ammeter connections. use of shunts
- Absolute and secondary instruments
- Recording, indicating, integrating instruments
- Characteristics of the measuring instruments.
- Deflecting Torque, Damping torque etc..
- Moving iron attraction and repulsion type , moving coil instruments.
- Induction type instruments, Thermo couple instruments
- Wheatstone Bridge, Wattmeter, Megger

CHAPTER 6:-TRANSFORMERS

- Working principle of transformers
- Mutual Induction and Self induction
- Transformer theory
- Different Types of Transformers, Transformer losses
- Transformer efficiency
- Auto transformer, RF transformers, Instruments transformers

SUBJECT TITLE : ELECTRONICS & COMPUTER SCIENCE

SUBJECT CODE : PDCI T004

CONTENT DETAILS

MARKS: 100 + Internal 25

ELECTRONICS (SECTION)

CHAPTER 1:-FUNDAMENTALS

- Atomic structure
- Valance electronics
- Energy of electron
- Conductor, Semi conductor and Insulating materials
- Passive and active components in electronic circuits
- P- type and N – type Materials doping principles
- P-N diode principles and operation
- HW and Bridge rectifiers

CHAPTER 2:- INTRODUCTION TO TRANSISTORS.

- Basic principles of PNP and NPN Transistors
- Symbols , Biasing rules
- CB, CE, CC mode collections
- I C, Different types and it's uses

CHAPTER 3:- DIGITAL ELECTRONICS

- Binary number system
- Boolean algebra
- Logic gates, symbols, truth tables for
- AND gate, OR , NOT , NOR , NAND, EX- OR gates
- Simple problems, Logic family classification

CHAPTER 4:-OPERATIONAL AMPLIFIERS

- Inverting and non inverting OP amps.
- Different types and it's applications
- Adder , Integrating, Differentiating OP Amp.
- Simple OP amp. Circuits

COMPUTER SCIENCE (SECTION)

CHAPTER 1:- INTRODUCTION

- Computer generations 1,2,3,4 and 5.
- Basic structure input, output, CPU
- Analog, Digital and hybrid computers
- Desktop computer, Note book computer, Mini computer, main frame , Super computer
- Parts of computer systems
- Hardware, Software, data, users
- Information's, Processing cycle, Output storage devices
- Processing devices, memory devices, input and output devices

CHAPTER 2 :-INPUT AND OUTPUT DEVICES

- Key board, mouse, light pen, touch screen, barcode readers, image scanner. OCR, OMR, MICR, micro phones, Digital Camera.
- Monitors- Monochrome, gray scale, color , CRT monitor, Flat panel or LCD monitors, Plasma panel Display .
- VGA, SVGA, SGA
- Data projectors, sound systems, card , head phone, headset
- Printers. Working , it's characteristic, speed, quality, memory
- Serial type and Parallel printers, Dot matrix printer, Line printer, Ink jet printer, laser printers, plotters

CHAPTER 3:-DATA STORAGE

- Types of data storage
- Magnetic storage devices
- Optical storage device
- Solid state storage device
- Boot sector, FAT, Root folders, Data Area, Floppy disk, hard disk, CD – ROM, DVD – ROM, CD- R, CD-RW, DVD- R, DVD-RAM.
- Solid state storing devices
 - Flash memory, smart cards.
- Optimizing disk performance
 - Cleaning unwanted files
 - Scanning a disk for errors
 - Defragmentation a disk
 - File compression
- Drive interface standers
 - IDE, EIDE, SCSI, USB and FIREWALL

CHAPTER 5:-OPERATING SYSTEMS

- Principle of OS
- Memory management, processor, device, file managements
- Types of OS
 - Single user, single tasking Os, multitasking OS, multi user
 - Multi-tasking, Real-time OS
- Providing a user interface
 - Graphical use interface
 - Command line interface
- Basic components of GUI
 - Pointer, icons, shortcuts, desk top, windows, menus, dialog boxes
 - Menu bars, title bars, scroll, tool bars
- Command line interface OS
 - DOS
 - Internal and external commands
 - DIR commands
- WINDOWS
 - Different WINDOWS Operating Systems

CHAPTER 6:-ALGORITHM AND FLOW CHARTS

- Steps involved in problem solving
- Algorithms
- Characteristic of an algorithm
- Algorithmic notations
- Problems, flow chart, programme flow chart

CHAPTER 7:-NETWORK BASICS

- Uses of network
- Common types of networks
- Network topology and protocols
- Internet and major services
- Under standing WWW
- E- mail
- Common terms in network systems
- Bus topology, star, ring, mesh, tree
- Network transmission media , Twister pair cable
- Coaxial cable, fiber optic cable, Wireless transmission
- Network hardware's
- NIC card, HUB, Bridge, router, switch

SUBJECT TITLE : ENGINEERING DRAWING
SUBJECT CODE : PDCI T005

CONTENT DETAILS

MARKS: 100 + Internal 25

CHAPTER 1:-INTRODUCTION

- Engineering graphics
- BIS, plain geometry, solid geometry
- Drawing instruments
 - Drawing boards
 - T- squire or mini drafter
 - Set squares
 - Protector
 - Engineers scale set
 - Instrument box etc...
- Drawing board size's
- Drawing sheet size. A0,A1,A2,A3,A4
- Margins, boarder lines, Borders and frame
- Title block
- Drawing the lines with 30 degree, 60, 90, 45 degree
- Drawing parallel lines with set square
- Drawing pencils and numerals
 - HB - pencil for sketching
 - H – out lines, visible lines, dimension lines, letters, arrows etc...
 - 2 H – construction lines, dimensional lines, centre lines etc...

**CHAPTER 2:-LINES, LETTERING, FREE HAND SCATCHS AND
DIMENSION**

- Types of lines and their applications
 - Type A, B, C, D, E, F, G, H, J and K lines
- Conventional representation of materials
 - Metals, glass, packing and insulating materials, liquids, wood, concrete
- Lettering
 - Vertical and inclined
 - Height, space, thickness of lower case and capital letters
- Dimensioning and dimension problems
 - Classification. Elements of dimension. Projection line. Dimensional lines, ladder line, termination , origin indication and dimensions, chain dimension, parallel dimensions. Etc....

CHAPTER 3: PIPING & INSTRUMENTATION DIAGRAM (P & ID)

- Graphics symbols in electrical Engg.
 - Electronic Engg
 - Instrumental Engg
- Instrument Symbol Representation
 - Valves
 - Transmitters
 - Controllers
 - Motor
 - Pump
 - Switches
 - Relays etc..

- Flow-sheet Symbols
 - Electrical lines
 - Pneumatic lines
 - Supply lines
- Flow-Sheet Codes and Line Symbols
 - Instrument Air
 - Fuel Gas
 - Steam
 - Plant Air etc..

- Factory Symbols and lines
 - Boiler
 - Chemical Reactors
 - Condensers
 - Separators
 - Agitators
 - Pre-heater etc..

SUBJECT TITLE : INSTRUMENTATION PRACTICAL
SUBJECT CODE : PDCI T006

CONTENT DETAILS

MARKS: 200 + Internal 75

INSTRUMENTATION

1. Dismantling and Assembling Air regulator
2. Familiarization of Diaphragm pressure Gauge
3. Calibration of Helical Type pressure Gauge
4. Familiarization of sealed diaphragm pressure gauge
5. Familiarization & Calibration of pressure switch
6. Dismantling and assembling of Bourdon tube pressure Gauge
7. Calibration of Pressure Gauge
8. Familiarization of Dead Weight Tester
9. RTD sensitivity
10. Familiarization of Thermowell
11. Bi-metallic Thermometer reading compared with RTD
12. Calibration of Bimetallic Thermometer
13. Calibration of mercury in steel thermometer
14. Thermo couple sensitivity
15. Calibration of Temperature switch
16. Familiarization of Rotameter
17. Familiarization Operation of Druck calibrators
18. Electronic timer settings
19. Familiarization Circuit breakers
20. pH measurement with the help of pH meter
21. Screw gauge
22. Vernier Caliper
23. Megger and it's testing
24. Testing of proximity switch
25. Vibration probe
26. Tube bending practice
27. Tube cutting practice
28. Familiarization of Tube fittings
29. cable glanding
30. Cable termination
31. Wire stripping and crimping practice
32. Familiarization with control valve
33. Familiarization of different types of control valves
34. Overhauling of control valve
35. Operation of safety valve
36. calibration of safety valve
37. Limit switch setting
38. Familiarization manifold valve
39. Familiarization Solenoid valve
40. Familiarization of Pneumatic transmitters

41. Calibration of Pneumatic transmitters
42. Familiarization of Electronic transmitters(Non SMART)
43. Familiarization of SMART Transmitters
44. Calibration of Electronic Transmitters
45. Control valve stroke checking
46. Familiarization of I/P converter
47. Familiarization of valve Positioner

ELECTRICAL AND ELECTRONIC PRACTICALS

48. Multi meter
49. Electronic components identification
50. Colors coding of resistance
51. Ohms law verifications
52. Resistance in series
53. Resistance in parallel
54. Rectification Circuits
55. OR Gate
56. NOR Gate
57. AND Gate
58. NAND Gate
59. NOT gate
60. Calibration of Voltmeter
61. Calibration of Ammeter