# N. V. Patel College of Pure & Applied Sciences

## Course Structure for T. Y. B.Sc. Instrumentation Semester - 5

*(Effective from June 2020)*

Sardar Patel University  
Vallabh Vidyanagar  
Third Year B. Sc. [Instrumentation] Course Structure for Semester 5 (CBCS) System

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of Course</th>
<th>Theory/Practical</th>
<th>Credits</th>
<th>Contact Hrs/week</th>
<th>Exam duration in hrs</th>
<th>Component of Marks</th>
<th>Total</th>
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<td>Internal</td>
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<td><strong>Core Courses</strong></td>
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<tr>
<td>US05CINS21</td>
<td>8085 Microprocessor Architecture and Programming - 1</td>
<td>Theory</td>
<td>4</td>
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<td>US05CINS22</td>
<td>Process Measurement Technique - I</td>
<td>Theory</td>
<td>4</td>
<td>4</td>
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<td>30</td>
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<tr>
<td>US05CINS23</td>
<td>Introduction to Control Systems</td>
<td>Theory</td>
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<tr>
<td>US05CINS24</td>
<td>Programmable Logic Controller – 1</td>
<td>Theory</td>
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<td>US05CINS25</td>
<td>Instrumentation Practicals</td>
<td>PRACTICALS</td>
<td>6</td>
<td>12</td>
<td>6</td>
<td>45</td>
<td>105</td>
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<td><strong>Discipline Specific Elective Course</strong></td>
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<tr>
<td>US05DINS26</td>
<td>Industrial Electronics</td>
<td>Theory</td>
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<td><strong>24</strong></td>
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<td><strong>Total 30 hours</strong></td>
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# N. V. Patel College of Pure & Applied Sciences
## Course Structure for T. Y. B.Sc. Instrumentation Semester - 6
**Effective from June 2020**

Sardar Patel University  
Vallabh Vidyanagar  
Third Year B. Sc. [Instrumentation] Course Structure for Semester 6 (CBCS) System

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of Course</th>
<th>Theory/Practical</th>
<th>Credits</th>
<th>Contact Hrs/week</th>
<th>Exam duration in hrs</th>
<th>Component of Marks</th>
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<tr>
<td>US06CINS21</td>
<td>8085 Microprocessor Architecture and Programming - 2</td>
<td>Theory</td>
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<td>US06CINS22</td>
<td>Process Measurement Technique – 2</td>
<td>Theory</td>
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<td>US06CINS23</td>
<td>Advanced Control Systems</td>
<td>Theory</td>
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<td>US06CINS24</td>
<td>Programmable Logic Controller – 2</td>
<td>Theory</td>
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<td>US06CINS25</td>
<td>Instrumentation Practicals</td>
<td>PRACTICALS</td>
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<td>US06DINS26</td>
<td>Analytical Instrumentation</td>
<td>Theory</td>
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<tr>
<td>US06CINS21</td>
<td>8085 Microprocessor Architecture and Programming - 2</td>
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<tr>
<td>US06CINS22</td>
<td>Process Measurement Technique – 2</td>
<td>Theory</td>
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<tr>
<td>US06CINS23</td>
<td>Advanced Control Systems</td>
<td>Theory</td>
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<tr>
<td>US06CINS24</td>
<td>Programmable Logic Controller – 2</td>
<td>Theory</td>
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<td>US06CINS25</td>
<td>Instrumentation Practicals</td>
<td>PRACTICALS</td>
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<tr>
<td>US06DINS26</td>
<td>Analytical Instrumentation</td>
<td>Theory</td>
<td>2</td>
<td>2</td>
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**Total Credits**: 24
**Total 30 hours**
UNIT 1:
Microprocessors (μP): Microprocessor as a Programmable Device; Machine Language, 8085 Assembly Language, High - Level Languages, 8085 Programming Model: 8085 Hardware Model, 8085 Programming Model; Instruction Classification, Instruction, Data Format, and Storage: Instruction Word Size, Related examples/programs

UNIT 2:
Microprocessor Architecture and its operations: μP - Initiated Operations and 8085 Bus Organization; Memory: Latch as a Storage Element, Memory Map and Addresses; Input and Output (I/O) Devices: Peripheral - Mapped I/Os, Memory – Mapped I/Os; Logic Devices for Interfacing: Tri - State Devices, Buffer, Decoder, Encoder, Related examples/programs

UNIT 3:
The 8085 MPU: The 8085 μP, μP Communication and Bus Timings, Demultiplexing the Bus AD7 - AD0, Generating Control Signals, A detailed look at the 8085 MPU and its Architecture, Related examples/programs

Unit 4:
Data Transfer Operations, Arithmetic Operations, Logic Operations, Branch Operations, Related examples/programs

Text Books:
1. Microprocessor Architecture, Programming, and Application by Ramesh. S. Gaonkar
2. Understanding 8085/8086 Microprocessor and Peripheral ICs Through Questions and Answers By S. K. Sen
3. Microprocessor (8085) by B. Ram
SARDAR PATEL UNIVERSITY
SYLLABUS FOR INSTRUMENTATION
B. Sc. SEMESTER – 5
INSTRUMENTATION COURSE CODE : US05CINS22 (4 Credit Course)
COURSE TITLE : Process Measurement Technique - I
(Effective from June 2020)

Unit-1: Temperature Measurement:
Definition & Scales, Liquid in glass thermometer, Bimetallic thermometer, Filled System thermometer, Liquid filled, gas filled, Vapour Pressure thermometer, Thermocouple Laws and material types

Unit-2: Pressure Measurement:-I
Terminology: Absolute pressure, Atmospheric pressure, Gauge pressure, Static pressure, Vacuum, Total pressure and their units, Manometers: U-tube, Inclined manometer, Ring balance manometer

Unit-3: Pressure Measurement:-II
Mechanical Gauges: Bourdon Tube, Diaphragm, Bellows, Low pressure gauges: Mcleod gauge, Pirani gauge, ionization gauge, Dead weight Tester.

Unit-4: Level & Density Measurement:
Direct methods: Sight glass, Float & Tape, Float & Shaft, Float & Spring: Electrical methods: Capacitance level indicator, Ultrasonic method, Radioactive method; Air and liquid purge method of level measurement.

Text Books:
1. Process instrumentation by D.P. Eckman
2. Mechanical measurement and control by D.S. Kumar
3. Principles of industrial instruments by Patranabis
4. Instrumentation measurement and analysis by Nakara and Chaudhary
5. Principles of measurement and instrumentation by A.S. Morris
Unit – 1 : Controller Principles - 1
Introduction, Process Characteristics: Process Equation, Process Load, Transient, Process Lag, Self Regulation; Control System Parameters: Error, Variable Range, Control Parameter Range, control Lag, Dead Time, Cycling, Controller Modes; Discontinuous Controller Modes (with Electronic Design): Two - Position Mode, Multiposition Mode, Floating - Control Mode

Unit – 2 : Controller Principles - 2
Continuous Controller Modes (with Electronic Design): Propotional (P) Control Mode, Integral (I) Control Mode, Derivative (D) Control Mode; Composite Control Modes (with Electronic Design): PI, PD, PID

Unit – 3 : Instrument Air System (IAS)
Introduction, Characteristics of Air, Various Factors for Designing IAS: Sizing Criteria, Pressure Level, Air Supply Source (Small Scale Requirement, Typical IAS); Compressor System: Positive Displacement Type, Dynamic; Compressor Cooling, Compressor Control, Oil Removal, Dryer (Desiccant Type, Refrigeration Type), Necessity for Dryers, Distribution System

Unit – 4 : Control Valves
Introduction, Valve Terminology, Valve Capacity, Valve Rangeability, Body Design: Globe Bodies; Angle, Needle, Ball, Butterfly, Diaphragm, Pinch, Drag, Flow Characteristics, Trim Design: Materials, Plugs, Seats, Guides, Cage; Bonnet Assembly, Actuators: Pneumatic Type, Electric Type, Electrohydraulic type; Positioners: Pneumatic, Electropneumatic

Text Books:
1. Process Control Instrumentation Technology By Curtis Johnson
2. Handbook of Instrumentation By W. G. Andrew
3. Computer - Based Industrial Control By Krishna Kant
5. Control System By Nagrath and Gopal
Unit – 1: Ladder Diagram Fundamentals - 1
Introduction, Basic Components and Their Symbols: Control Transformers, Fuses, Switches, Indicator Lamps, Relays, Time Delay Relays

Unit – 2: Ladder Diagram Fundamentals - 2

Unit – 3: The Programmable Logic Controller (PLC)
Introduction, A Brief History, PLC Configurations, System Block Diagram, Update - Solve the Ladder - Update, Update, Solve the Ladder

Unit – 4: Fundamental PLC Programming
Introduction, Physical Components Vs Program Components, Example Problem - Lighting Control, Internal Relays, Disagreement Circuit, Majority Circuit, Oscillator, Holding Contacts, Always - ON and Always - OFF Contacts, Ladder Diagram Having More Than One Rung

Text Books:
1. Programmable Logic Controllers (Programming Methods and Applications) By John R. Hackworth & Frederick D. Hackworth, Jr.
2. Automatic manufacturing system using PLCs By Jack Hugh
3. Programmable Logic Controller By Petruzella
4. Introduction to programmable logic controller By Thomas Hughes
SARDAR PATEL UNIVERSITY
SYLLABUS FOR INSTRUMENTATION
B. Sc. SEMESTER – 5
INSTRUMENTATION COURSE CODE : US05CINS25 (6 Credits, 12 hours per week)
COURSE TITLE : Instrumentation Practicals
(Effective from June 2020)

01. Introduction to 8085 µP kit
02. Data transfer operations
03. Arithmetic operations - I
04. Logic operations
05. Bit Manipulation Operations
06. Branch Operations
07. Time Delay programming
08. Analog to Digital conversion
09. Other µP experiments based on theory
10. Study of LVDT characteristics
11. Study of RTD characteristics
12. Study of Strain gauge characteristics
13. Proportional controller study
14. Frequency modulation and demodulation
15. TRIAC for phase control
16. SCR for half and full wave phase control
17. Study of Thermocouple characteristics
18. Study of Dead Weight Tester
19. Characteristics of FET
Unit – 1: Transformers
Working principle, construction, core type transformer, shell type transformer, theory of ideal transformer, EMF equation of transformer, voltage transformation ratio, transformer with losses but no magnetic leakage: Transformer on No-load, transformer on load, transformer with winding resistance but no magnetic leakage, equivalent resistance, magnetic leakage, transformer with resistance and leakage reactance, equivalent circuit

Unit – 2: DC Generators and Motors
DC Generator, generator Principle, simple loop generator: construction, working, total losses in D.C. Generator. D.C. Motors: principles, comparison of Generator and Motor action, significance of back emf, voltage equation of a motor, condition for maximum power, torque, armature torque of a motor, shaft torque, Speed of a dc motor: for series and shunt motors, speed regulation, torque and speed of a motor

Unit – 3: Induction and Synchronous Motors
Classification of A.C. motors, general principle, construction, production of revolving magnetic field (two and three phase), why does the rotor rotate? Slip. Synchronous motor, introduction, principle of operation, method of starting, motor on load with constant excitation, power flow within synchronous motor, synchronous motor applications

Unit – 4: Special Machines
Stepper motor: step angle, applications, Types of stepper motors, variable reluctance stepper motor, multi-stack VR stepper motor, permanent magnet stepping motor, hybrid stepper motors

Text Book:
2. Electrical Engineering Fundamentals by Vincent Del Toro, PHI Pvt. Ltd., New Delhi
SARDAR PATEL UNIVERSITY
SYLLABUS FOR INSTRUMENTATION
B. Sc. SEMESTER – 6
INSTRUMENTATION COURSE CODE : US06CINS21 (4 Credit Course)
COURSE TITLE : 8085 Microprocessor Architecture and Programming - 2
(Effective from June 2020)

Unit – 1
Example of an 8085 - Based Microcomputer: The 8085 Machine Cycles and Bus Timings, Opcode Fetch Machine Cycle, Memory Read Machine Cycle, Basic Interfacing Concepts: Peripheral I/O Instructions, I/O Execution, Absolute Vs Partial Decoding

Unit – 2
Programming Techniques: Looping, Counting, and Indexing; Additional Data Transfer and 16 - bit Arithmetic Instructions, Arithmetic Operations Related to Memory

Unit – 3
Logic Operations: Rotate; Logic Operations: Compare, Counters and Time Delays, Hexadecimal Counter, Modulo Ten Counter, Generating Pulse Waveforms

Unit – 4
Stack, Subroutine, Restart, Conditional Call, and Return Instructions, BCD to Binary Conversion, Binary to BCD Conversion, BCD to Seven - Segment LED Code Conversion, Binary to ASCII and ASCII to Binary Conversion

Text book:
1. Microprocessor Architecture, Programming, and Application by Ramesh. S. Gaonkar
2. Understanding 8085/8086 Microprocessor and Peripheral ICs Through Questions and Answers By S. K. Sen
3. Microprocessor (8085) by B. Ram
Unit-1: Flow Measurement: I

Unit-2: Flow Measurement: II
Open Channel meters: Rectangular weir, V-notch weir, Trapezoidal weir, Electrical type flow meters: Turbine type, Electromagnetic flow meter, Hot wire anemometer, Ultrasonic method, Mass Flow measurement.

Unit-3: Force and Torque Measurement:

Unit-4: Speed Measurement:
Speed: Revolution Counter, Tacho-scope, Slipping clutch tachometer, Centrifugal force techometer, Drag cup, Contact less electrical tachometers, Tacho-generators.

Text Books:
1. Process instrumentation by D.P. Eckman
2. Mechanical measurement and control by D.S. Kumar
3. Principles of industrial instruments by Patranabis
4. Instrumentation measurement and analysis by Nakara and Chaudhary
5. Principles of measurement and instrumentation by A.S. Morris
SARDAR PATEL UNIVERSITY
SYLLABUS FOR INSTRUMENTATION
B. Sc. SEMESTER – 6
INSTRUMENTATION COURSE CODE : US06CINS23 (4 Credit Course)
COURSE TITLE : Advanced Control Systems
(Effective from June 2020)

Unit – 1 : Advanced Process Control Strategies
Introduction, Cascade Control, Feedforward Control, Predictive control Systems: Model Based Control; Multivariable Control System, Adaptive Control

Unit – 2 : Supervisory Control And Data Acquisition Systems (SCADA)
Channel Scanning, Conversion to Engineering Units, Data Processing, Distributed SCADA System; Remote Terminal Unit: Input/Output Modules, Communication Modules, Special Software Facilities

Unit – 3 : Distributed Digital Control (DDC)
Distributed Vs Centralised, Advantages of Distributed Control Systems; Functional Requirements of (Distributed) Process Control System: Plant Operator’s Requirements, Maintenance Engineer’s Requirements, Design Engineer’s Requirements, Manager’s Requirements, Distributed Control Systems Evolution, System Architecture, Distributed Control Systems

Unit – 4 : Modeling and Simulation for Plant Automation
Introduction, Definition of Terms, Why do we need the system Modeling?, Uses of Systems Simulation, How to Build the Mathematical Model of a Plant?, Model Evaluation and Improvement, Modern Tools for Modeling and Simulation of Systems, Application Examples, Future Perspectives

Text Books:
1. Computer - Based Industrial Control By Krishna Kant
2. Process Control (Concepts, Dynamics and Applications) By S. K. Singh
3. Process Control Instrumentation Technology By Curtis Johnson
4. Handbook of Instrumentation By W. G. Andrew
Unit – 1 : Advanced Programming Techniques
Introduction, Ladder Program Execution Sequence, Flip Flops, R - S Flip Flop, One Shot, D Flip Flop, T Flip Flop, J - K Flip Flop, Counters, Sequencers, Timers, Flashers, Timed One Shot, Timed Sequencer, Master Control Relays and Control Zones

Unit – 2 : Mnemonic Programming Code
Introduction, AND Ladder Rung, Entering Normally Closed Contacts, OR Ladder Rung, Simple Branches, Complex Branches

Unit – 3 : Wiring Techniques
Introduction, PLC Power Connection, Input Wiring, Inputs Having a Single Common, Isolated Inputs, Output Wiring, Relay Outputs, Solid State Outputs,

Unit – 4 : Analog I/O
Introduction, Analog (A/D) Input, Analog (D/A) Output, Analog Data Handling, Analog Input Potential Problems

Text Book:
1. Programmable Logic Controllers (Programming Methods and Applications) By John R. Hackworth & Frederick D. Hackworth, Jr.
2. Automatic manufacturing system using PLCs By Jack Hugh
3. Programmable Logic Controller By Petruzella
4. Introduction to programmable logic controller By Thomas Hughes
INSTRUMENTATION COURSE CODE : US06CINS25 (6 Credits, 12 hours per week)
COURSE TITLE : Instrumentation Practicals
(Effective from June 2020)

1. Arithmetic operations - II
2. Counter programming
3. Programming using Stack & Subroutine
4. Code conversion programming
5. BCD Arithmetic
6. 16 - Bit Data Operations
7. Digital to Analog conversion
8. And other experiments based on theory
9. Study of Hall effect
10. Eg measurement using four probe method
11. Voltage to frequency converter
12. PID Controller Study
13. Pulse modulation and demodulation
14. Study of UJT Characteristics
15. RC phase shift oscillator
16. Impedance by Voltage drop
17. Multivibrator using IC555
Unit-1 pH measurement
Introduction, principle of pH measurement, pH electrodes: hydrogen, glass, calomel, combined, The asymmetry potential, Buffer solutions, pH meters: null detector, direct reading, chopper amplifier type, Vibrating condenser amplifier type, zero corrected DC amplifier type.

Unit-2 GAS chromatography:
Introduction, basic parts of chromatograph, carrier gas supply, sample injection system and the size of the sample, chromatographic column, thermal compartment, Detection system: Thermal Conductivity Detector, Flame Ionization Detector (FID), Electron Capture Detector (ECD), Argon ionization Detectors, Cross-sectional area Ionization Detectors.

Unit-3 Gas analyzers and Conductivity:

Unit-4 Liquid Chromatography:
Introduction, Type of liquid Chromatography, the liquid chromatograph, high pressure pump system, gradient elution, sample injection system, The column, Detection system: UV-Visible- Spectrophotometric absorption, fluorescence detector, Refractive Index detectors, adsorption detectors, electrical conductivity detectors, Thermal detectors.

Text Books:
1. Handbook of analytical instrumentation by R.S. Khandpur
2. Bio-medical instrumentation and measurement by Cromwell, Weibell and Pfeiffer