# 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**

| | Course Code | Name of Course | Theory/ Practical | Credits | Contact Hrs/week | Exam duration in hrs | Component of Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Internal | External | Total |
| **Core Courses** | US05CINS21 | 8085 Microprocessor Architecture and Programming - 1 | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US05CINS22 | Process Measurement Technique - I | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US05CINS23 | Introduction to Control Systems | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US05CINS24 | Programmable Logic Controller – 1 | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US05CINS25 | Instrumentation Practicals | PRACTICALS | 6 | 12 | 6 | 45 | 105 | 150 |
| **Discipline Specific Elective Course** | US05DINS26 | Industrial Electronics | Theory | 2 | 2 | 2 | ---- | 50 | 50 |
| | | | | Total 24 Credits | Total 30 hours | | | | |

# 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**

| | Course Code | Name of Course | Theory/ Practical | Credits | Contact Hrs/week | Exam duration in hrs | Component of Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Internal | External | Total |
| **Core Courses** | US06CINS21 | 8085 Microprocessor Architecture and Programming - 2 | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US06CINS22 | Process Measurement Technique – 2 | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US06CINS23 | Advanced Control Systems | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US06CINS24 | Programmable Logic Controller – 2 | Theory | 4 | 4 | 3 | 30 | 70 | 100 |
| | US06CINS25 | Instrumentation Practicals | PRACTICALS | 6 | 12 | 6 | 45 | 105 | 150 |
| **Discipline Specific Elective Course** | US06DINS26 | Analytical Instrumentation | Theory | 2 | 2 | 2 | ---- | 50 | 50 |
| | | | | **Total 24 Credits** | **Total 30 hours** | | | | |

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 5**
**INSTRUMENTATION COURSE CODE : US05CINS21 (4 Credit Course)**
**COURSE TITLE : 8085 Microprocessor Architecture and Programming - 1**
**(Effective from June 2020)**

**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 thermo meter, 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 guage, Pirani guage, 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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 5**
**INSTRUMENTATION COURSE CODE : US05CINS23 (4 Credit Course)**
**COURSE TITLE : Introduction to Control Systems**
**(Effective from June 2020)**

**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
4. Process Control (Concepts, Dynamics and Applications) By S. K. Singh
5. Control System By Nagrath and Gopal

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 5**
**INSTRUMENTATION COURSE CODE : US05CINS24 (4 Credit Course)**
**COURSE TITLE : Programmable Logic Controller – 1**
**(Effective from June 2020)**

**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**

Fundamentals of Ladder Diagrams: Basic Diagram Framework, Wiring, Reference Designators, Boolean Logic and Relay Logic, AND, OR, AND OR and OR AND, Ground Test, The Latch, Two - Handed Anti - Tie Down, Anti Repeat, Single Cycle, Combined Circuit, Master Control Relays and Control Zones; Machine Control Terminology

**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 □P 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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 5**
**INSTRUMENTATION COURSE CODE : US05DINS26 (2 Credit Course)**
**COURSE TITLE : Industrial Electronics**
**(Effective from June 2020)**

**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, generagor 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 :**


1. A text book of Electrical Technology by B.L. Theraja & A. K. Theraja S. Chand & Company Ltd., New Delhi
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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 6**
**INSTRUMENTATION COURSE CODE : US06CINS22 (4 Credit Course)**
**COURSE TITLE : Process Measurement Technique – 2**
**(Effective from June 2020)**

**Unit-1: Flow Measurement: I**

Flow of fluid in pipes & Bernoulli's equation, nature of flow, Head flow meters: Orifice plate, Venturimeter, Venturi nozzle, Pitot tube, Multiplying pitot tube, Variable Head flow meter: Rotameter. Quantity meters: Piston type, Nutating disk meter, Rotary vane type.

**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 anomometer, Ultrasonic method, Mass Flow measurement.

**Unit-3: Force and Torque Measurement:**

Force: Hydraulic force meter, Pneumatic force meter, Proving ring, Strain gauge load cell, Pressductors load cell. Torque: Inline rotating torque meter, inline stationary torque meter, Proximity sensors.

**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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 6**
**INSTRUMENTATION COURSE CODE : US06CINS24 (4 Credit Course)**
**COURSE TITLE : Programmable Logic Controller – 2**
**(Effective from June 2020)**

**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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 6**
**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

**SARDAR PATEL UNIVERSITY**
**SYLLABUS FOR INSTRUMENTATION**
**B. Sc. SEMESTER – 6**
**INSTRUMENTATION COURSE CODE : US06DINS26 (2 Credit Course)**
**COURSE TITLE : Analytical Instrumentation**
**(Effective from June 2020)**

**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:**

Gas analyzers: O2: Magnetic wind type, Dumbbell type, CO2, CO: IR type, gas chromatography type H2: thermal conductivity type. Conductivity: Introduction, measurement of conductance: null method, direct reading method, conductivity cells, Temperature compensation in conductivity measurements, Conductivity measurements using high frequency methods,

**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