GUJARAT TECHNOLOGICAL UNIVERSITY
DIPLOMA IN INSTRUMENTATION & CONTROL ENGINERING

TEACHING SCHEME (w. e. f. 10th Jan,' 11)

SEMESTER- VI

SR. NO	SUB.CODE	SUBJECT	TEACHING SCHEME (HOURS)			CREDITS
			THEORY	TUTORIAL	PRACTICAL	
1	361701	Applied Instrumentation	3	0	4	7
2	361702	Industrial Electronics and Control	3	0	2	5
3	361703	Biomedical Instrumentation	3	0	4	7
4	361704	Micro Controllers	4	0	2	6
5	361705	Advance Process Control	3	0	2	5
		TOTAL	**16**	**0**	**14**	**30**

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SEMESTER- VI

Subject Code :   361701

Subject Name**:   APPLIED INSTRUMENTATION**

Sr. No.	Subject Content	Hrs.	Pract. Hrs.

1	**1.0 WATER TREATMENT PLANT**
	  1.1 Overall view , diagram of a water treatment plant and short descriptionof processes involved.
	  1.2 Demineralizing water treatment system and its logic control concept.
	  1.3 Effluent water treatment system.
	  1.4 Control system in water treatment plant ie. PH, Vacuum
	    Filtration sludge dewatering, multiple hearth incinerator for sludge disposal.
		7	8

2	**2.0 SELECTION OF INSTRUMENTS** 2.1 Factors affecting selection of pressure instruments, temp. instruments, flow instruments, level instruments.	5	6

3	**3.0 INSTRUMENTS AIR SUPPLY SYSTEM**
	  3.1 Designing Factors – Sizing criteria, Pressure level, Source criteria ,Typical system schematic diagram for large intermediate or small instrument air requirements,
	    Reciprocating two stage air compressors, Desiccant and heated dryers, Distribution System for instrument air at user plant, Typical schematic diagram with two filters / regulators in parallel and common air header with multiple branching for instruments of control room
		7	6

4	**4.0 PLANT INTERLOCKS AND SPECIAL CONTROL SCHEMES.**
	4.1 Need for plant interlocks, simple interlock circuit for any one process.
	4.2 Schematic diagram, working and one application for the Following control Schemes :
	  a. Cascade control
	  b. Ratio control
	  c. Feed forward control and
	  d. Split range control.
		5	12

5	**5.0 INSTALLATION AND COMMISSIONING OF INSTRUMENTS.**
	  5.1 Instrumentation and general requirement, Engineering Drawings for mechanical flow sheets, Panel drawings, Instrument location plans and electrical wiring details, requirements for instrument piping and tubing – impulse
	  line, requirement for cabling and earthing , pre-installation testing,
	  5.2 Calibration of instruments, piping , pneumatic lines, impulse lines and cables
	  5.3 Check points for good installation practices, loop checking, typical Checkout procedure for Flow & Temp.
	  Transmitter, Control valve.
	  5.4 Plant startup procedures and tuning of controllers.
		9	12

6	**6.0 MAINTENANCE OF INSTRUMENTS.**
	  6.1 Need for maintenance, breakdown, preventive and predictive maintenance records, history card system etc., maintenance / calibration tools and instruments listing pneumatic calibrator, electronic calibrator, dead weight tester for pressure instruments, constant temp. bath and oven etc.
	  6.2 Maintenance requirements for :
	  Pressure gauges and Pressure Transmitters / DP transmitters.
	  Temperature gauges, Temp. Transmitter, Rotameter, Control valve,
	  Sight glasses, P0ressure-temp- flow level switches, recorders and indicators, I to P converter,
	  P to I converter.
		9	12

	Total	42	56

Note :- Above are the minimum experiences required, but the college can do more experiences if possible.

Reference Books:

1. Applied process control instrumentation   John Potwin.
2. Applied Instrumentation in the Process   WG Andrew.
   Industries vol,II
3. Hand book of maintenance engineering.   H. P. Gerg.

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Subject Code :   361702

Subject Name: **INDUSTRIAL ELECTRONICS AND CONTROL**

Sr. No.	Subject Content	Hrs.	Pract. Hrs.

1	**1.0 THYRISTOR :**
	    1.1 SCR, DIAC, TRIAC, UJT constructions, operations and characteristics.
	    1.2 Two transistor analogy of SCR.
	    1.3 Overview of following properties of SCR
	        1.3.1 Voltage and current rating of SCR.
	        1.3.2 Latching and holding current of SCR.
	        1.3.3 Turn on time, turn off time, dv/dt, di/dt.
	        1.3.4 Forced and natural commutation.
	    1.4 Turn on methods.
	    1.5 Firing of SCR using UJT.
	    1.6 Series and parallel operation of SCR.
	    1.7 Importance of Snubber circuit
		9	6

2	**2.0 MODERN POWER CONTROL DEVICES:**
	    2.1 Power BJT, MOSFET & IGBT operations & characteristics
	    2.2 Merits & demerits of above power devices.
	    2.3 Simple driver circuit of MOSFET and IGBT
		5	4

3	**3.0 CONVERTERS :**
	    3.1 Operation of half controlled and fully controlled bridge converters.
	    3.2 Microprocessor based firing circuit of converters using SCR
	    3.3 Effect of inductance on free wheeling diodes.
	    3.4 Principle of operation of Dual converter.
	    3.5 Protective circuits for over current and over voltage.
		7	2

4	**4.0 CYCLO-CONVERTERS** :
	    4.1 Principle of operation of single phase Cyclo-converter Circuits.
	    4.2 Merits and demerits of Cyclo-converters.
		5	4

5	**5.0 CHOPPERS & INVERTERS** : 5.1 Operational principle of chopper. 5.2 Principle and operation of Line commutated and forced commutated inverters. 5.3 Principle and operation of Series and Parallel inverter	5	4
6	**6.0 CONTROL OF D.C. MOTOR** : 6.1 Speed control using current and speed feedback. 6.2 Field current control. 6.3 Circulating current method.	4	4
7	**7.0 CONTROL OF A.C. MOTOR** : 7.1 Speed and torque control of a.c. Motors. 7.2 Static methods of control.	2	2
8	**8.0 Resistance Welding Control:** 8.1 Duty cycle of welding process. 8.2 SCR as electronic contactor in welding 8.3 Energy storage welding 8.4 Sequence timer using IC	5	2
	Total	42	28

Note :- Above are the minimum experiences required, but the college can do more experiences if possible.

Reference Books:

1. Industrial electronics and control - S K Bhattacharya & S. Chatterjee (TMH Publication)
2. Power electronics (TMH Publication) - M D Singh
3. Modern power electronic (TMH Publication)- Ned mohan.
4. Thyristor and their application -M Ramamorthy
5. Power Electronics (Khanna Publication) -P S Bimmhra

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Subject Code :   361703

Subject Name: **BIOMEDICAL INSTRUMENTATION**

Sr. No.	Subject Content	Hrs.	Pract. Hrs.

1	**1.0 Bio-electric Amplifiers:**
	  1.1 Bioelectricity.
	  1.2 Bioelectric amplifiers and their properties.
		2	4

2	**2.0 Medical Electrodes and transducers:**
	  2.1 ECG, EEG, EMG medical electrodes.
	  2.2 Working Principle of following Biomedical
	      Transducers:
	    2.2.1 Body Temperature transducers.
	    2.2.2 Blood Pressure Transducer
	    2.2.3 Blood Flow Transducer
	    2.2.4 Pulse Transducers
	    2.2.5 Respiration Transducer
		5	6

3	**3.0 Electrocardiograph:**
	  3.1 The ECG waveform.
	  3.2 The standard lead system.
	  3.3 Block Diagram and working principle of ECG
	      machine.
	  3.4 ECG preamplifiers
	  3.5 ECG machine faults and troubleshooting.
	  3.6 Cardiac stimulation and life support equipment-
	      Defibrillators, Defibrillator circuits, Cardio-version
	      Pacemaker, pacemaker classification
		5	6

4	**4.0 Electroencephalograph:** 4.1 Electro-encephalography. 4.2 EEG electrodes and the10-20 electrode placement system 4.3 EEG amplitude and frequency bands. 4.4 Block Diagram and working principle of EEG Machine.	5	6
5	**5.0 Medical Ultrasonic equipments:** 5.1 Physics of Ultrasound 5.2 Ultrasonic foetal monitors, 5.3 Echoencephalography. 5.4 Echocardiography. 5.5. Working Principle and Diagram of color Doppler ultrasound machine	5	6
6	**6.0 Therapeutic instruments:** 6.1 Working Principle & Block Diagram of electro-surgery machine 6.2 Working Principle & Block Diagram of Hemo-dialysis machine. 6.3 Principle of Electromyography, Muscle Stimulators.	5	8
7	**7.0 Medical Laboratory Instrumentation and Monitoring Instruments :** 7.1 Working Principle , Block Diagram and Applications of Blood Cell Counter, Blood pH Analyzer and Autoanalyser. 7.2 Monitoring instruments - Alarms, Respiration rate monitor, Heart beat monitor, Temperature monitor.	6	8

8	**8.0 Radiological Equipments.** 8.1 Block diagram and operation of an X-Ray machine. 8.2 Types and uses of X-Ray machines. 8.3 Introduction to Tomography and Computerised Axial Tomography (CAT) technique.	5	8
9	**9.0 Miscellaneous:** 9.1 Theory of Macroshock and Microshock, Physiological effects of Electricity on the human body. 9.2 Line Isolation Systems.	4	4
	Total	42	56

NOTE:
   1. At least two visits of different hospitals is recommended as a part of Syllabus.
   2. **Above are the minimum experiences required, but the college can do more experiences if possible.**

Reference Books:

1. Hand Book Of Bio-Medical Instrumentation   -   Khandpur, TMH
2. Bio Medical Instrumentation & Measurement   -   Leslie Cromwell, FJ
                                                     Weibell, EA Pfeiffer PHI
3. Principle of applied Bio- Medical Instrumentation -   LA Geddes & LE Baker
                                                     Willey, Network

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Subject Code :   361704

Subject Name: **MICROCONTROLLERS**

Sr. No.	Subject Content	Hrs.	Pract. Hrs.
1	**1.0 MICROPROCESSORS AND MICRO CONTROLLERS** 1.1 Introduction to Microcontroller 1.2 Block diagram of a Microcontroller 1.3 Comparison between Microprocessors and Microcontrollers 1.4 Microcontroller Families	4	--
2	**2.0 THE 8051 MICROCONTROLLER ARCHITECTURE** 2.1 Introduction 2.2 8051 microcontroller hardware – block diagram and function of each block 2.3 8051 Programming model 2.4 8051 DIP Pin assignment 2.5 8051 oscillator and clock 2.6 Program counter and data pointer 2.7 A and B CPU registers 2.8 Flags and PSW (Program Status Word) Register 2.9 Internal memory and Internal RAM organization 2.10 Stack and stack pointer 2.11 Special function registers 2.12 Internal ROM 2.13 Input /Output Pins, Ports and Circuits 2.14 External Memory Interfacing 2.15 Counters and Timers 2.16 Serial Data input / output 2.17 Interrupts Handling	17	6
3	**3.0 MOVING DATA** 3.1 Introduction 3.2 Addressing Modes 3.3 External Data Moves 3.4 Code memory Read-only Data Moves 3.5 Push and Pop opcodes 3.6 Data exchanges 3.7 Example programs	8	6

4	**4.0 LOGICAL, ARITHMETIC OPERATIONS , JUMP AND CALL INSTRUCTIONS** 4.1 Introduction 4.2 Byte level logical operation 4.3 Bit level logical operation 4.4 Rotate and swap operation 4.5 Flags 4.6 Incrementing and decrementing 4.7 Additions 4.8 Subtraction 4.9 Multiplications and division 4.10 Decimal arithmetic 4.11 Jump and call program range, Jumps 4.12 Calls and subroutines 4.13 Interrupts and returns 4.14 Example programs	11	10
5	**5.0 8051 MICRO CONTROLLER DESIGN** 5.1 Introduction 5.2 Microcontroller specifications 5.3 A Microcontroller design 5.4 Testing the Design 5.5 Timing Subroutines 5.6 Lookup table for 8051 5.7 Serial data transmission	8	2
6	**6.0 APPLICATIONS** 6.1 Interface Keyboard with 8051 based microcontroller 6.2 Interface LED & LCD display with 8051 based microcontroller 6.3 Interface Analog to Digital converters with 8051 based microcontroller 6.4 Interface Digital to Analog converters with 8051 based microcontroller	8	4
	Total	56	28

Note :- Above are the minimum experiences required, but the college can do more experiences if possible.

Reference Books:

1. The 8051 Microcontroller Architecture, Programming and Applications –
                        Kenneth J. Ayala (Penram International Publishing)
2. 8051 Microcontrollers MCS 51 Family And Its Variants –
                        Satish Shah (Oxford University Press)
3. The 8051 Microcontroller and Embedded Systems Using Assembly and C –
                        Mazidi, Mazidi and McKinlay (Pearson)

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Subject Code :   361705

Subject Name: **ADVANCE PROCESS CONTROL**

Sr. No.	Subject Content	Hrs.	Pract. Hrs.

1	**1.0 PROCESS CONTROL & AUTOMATION**
	  1.1 Introduction.
	  1.2 Continuous Process Control.
	  1.3 Discrete-state Process Control.
	  1.4 Composite Process Control.
	  1.5 Examples of Discrete-State Process Control
		4	2

2	**2.0 PLC ARCHITECTURE:**
	  2.1 Introduction to PLC
	  2.2 Advantages of PLC over other conventional automation
	        system
	  2.3 Types of PLCs
	  2.4 Principle of Operation
	  2.5 Architecture of PLC
	      2.5.1 Input Modules
	      2.5.2 Output Modules
	      2.5.3 Processor
	      2.5.4 Memory Unit
	      2.5.5 Programmer Unit
	      2.5.6 Power Supply Unit
	  2.6 Listing of PLC Peripherals and block diagram and brief description
	        Of each blocks.
		10	4

3	**3.0 PROGRAMMING THE PLC:**
	  3.1 Different types of Programming Languages like STL, CSF,
	        Ladder.
	  3.2 Ladder Diagram
	  3.2.1 Ladder Diagram Elements
	  3.2.2 Symbols of Relays, Motors, Solenoids, Lights, Limit
	            witches, Timer, Counter etc.
	  3.2.3 Development of Ladder Diagram for different Processes.
	
	  3.2.4 Programming of Industrial Controls using Timers &
	        Counters Flag Programming , Logic gates etc.
		10	10

	3.3 PC-based Programmable Logic Controller.
	  3.3.1 Introduction
	  3.3.2 Block diagram
	  3.3.3 Brief description of each block		

4	**4.0 DISTRIBUTED CONTROL SYSTEM:**
	  4.1 Introduction.
	  4.2 Evolution of DCS.
	  4.3 Block diagram and brief description of following systems :
	    4.3.1 Data Logger.
	    4.3.2 Supervisory Control & Data Acquisition System
	      (SCADA)
	    4.3.3 Direct Digital Control.
	  4.4 Advantages of DCS in operation and safety.
	  4.5 Functional Requirements of DCS.
	  4.6 System Architecture of DCS.
	    4.6.1 DCS I/O Hardware: Analog Input Module, Analog
	      Output
	       Module, Digital Input Module, Digital Output Module,
	       CPU Module.
	    4.6.2 Field Control Station
	    4.6.3 Central Computer Station
	  4.7 DCS – Network Topology
	  4.8 DCS – CRT Display : Describe the salient features of the
	    following
	    4.8.1 Group / Overview Display
	    4.8.2 Trend Display
	    4.8.3 Mimic Display
	    4.8.4 Report Generating Display
	    4.8.5 History Display
	    4.8.6 Alarm / Event Display
	  4.9 An Industrial Control Application of DCS in cement plant.
		14	12

5	**5.0 INTRODUCTION TO INTELLIGENT CONTROL AND ARTIFICIAL INTELLIGENCE** 5.1 Features of Intelligent Control 5.2 Definition of Artificial Intelligence 5.3 Achievements and Future of Artificial Intelligence	4	--
	Total	42	28

Note :-
1. **Two Industrial visits are recommended as a part of the syllabus**
2. **Above are the minimum experiences required, but the college can do more experiences if possible.**

Reference Books:

1. Process Control Instrumentation Technology - C. D. Johnson, PHI
2. Computer-Based Industrial Control - Krishna Kant, PHI
3. Process Control Principles And Applications – Surekha Bhanot (Oxford University Press)
4. Mechanical and Industrial Measurements - R. K. Jain, Khanna Publishers
5. Programmable Logic Controllers - W. G. Ottah