GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151708
Semester – V
Subject Name: MEASUREMENT IN INDUSTRY

Type of course: Professional Core Engineering Course

Prerequisite: concepts of physical measurements, basics of sensors and measuring instruments

Rationale: Industrial Measurement instruments are used in different setups and applications: For example in industrial process control where the quality of specific production and joining processes is checked. Certain applications of measuring instruments may be characterized as having essentially a monitoring function, e.g., strain measurement, displacement measurement, analytical parameter humidity, temperature measurement, automotive speedometer and fuel gage. These are the one of the most important classes of measurement application

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Displacement Measurement** Pneumatic Transducers, electrical Transducers, Optical Transducers, Ultrasonic Transducers, Magnetostrictive Transducers, Digital Displacement Transducers, proximity Sensors	6
2.	**Strain Measurement** Stress-strain relations, Resistance strain gauges, Fiber-optic strain gauges	4
3	**Acceleration, Force and Torque Measurement** Acceleration measurement, Force measurement, Industrial weighing system, Torque measurement, Tachometers	8
4	**Miscellaneous Measurements** Humidity and Moisture measurement, Density measurement, Conductivity measurement, Oxidation-Reduction Potential, pH measurement, polarography, Viscosity measurement, Consistency measurement, Turbidity measurement, Opacity measurement	8
5	**Analytical Instrumentation** Industrial gas analysis, Chromatography, Mass spectrometer, Infrared analyser, UV-visible absorption spectrophotometer, X-ray methods, Radiation detectors, Sample handling systems	8

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151708

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
21	**21**	**14**	**7**	**7**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Instrument Engineers' Handbook: Process Measurement and Analysis by B. G. Liptak.
2. Handbook of Applied Instrumentation by D. M. Considine and Sidney David Ross, McGraw – Hill
3. publication.
4. Encyclopedia of Instrumentation and Control by D. M. Considine, Krieger publication Co.
5. Instrumentation Reference Book by Walt Boyes, Butterworth – Heinemann publisher.
6. Introduction to Instrumentation and Control by A. K. Ghosh, 4th edition, PHI publications
7. Industrial Instrumentation by K. Krishnaswamy and S. Vijayachitra, New Age International Publication.
8. Measurement Systems: Application and Design by E. D. Doeblin, McGraw – Hill Publication.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the basic measurement principles of displacement, strain, acceleration, force, torque and other analytical parameters.	30
CO-2	Identify the type of sensor and their relevant specification .etc which can be used in a particular process parameter measurement selection.	20
CO-3	Understand the concepts of various analytical methods used for instrumental techniques used for physical, chemical, quantitative and qualitative analysis	20
CO-4	Design and conduct experiments for measurement, characterization and able to analyze and interpret data.	15
CO-5	Understand and identify various instruments for environmental health	15

	monitoring and quality control applications.	

List of Experiments:

1. Characterization and calibration of potentiometer based displacement sensor
2. Characterization and calibration of LVDT as displacement sensor
3. Measurement of strain on a beam using strain gauge.
4. Determine the effect of temperature and electromagnetic interference on Strain Gauge and LVDT respectively.
5. Characterization and calibration of speed measurement system. (Tachometer, Photoelectric and magnetic Pick-up).
6. Characterization and calibration of vibration measurement system. (Piezo-resistive vibration pick-up)
7. Characterize the Proximity sensors (inductive) and study its behavior under environment under study.
8. Identify the absolute position of the shaft using encoders.
9. Study of the detectors (leak detectors, flame detectors, smoke detectors)
10. Case study based on applications of sensors used in auto industry
11. Case study based on applications of sensors used in process industry.
12. To find out transmittance and absorbance of a given sample using colorimeter.
13. To calibrate pH measurement system and to measure pH of given sample.
14. Qualitative and quantitative analysis using UV-Visible spectrophotometer.
15. Study of spectrophotometers.
16. To analyze a given water sample using turbidity meter, DO meter, hygrometer, etc.

Students should be taken for at least one industrial visit of medium scale/ large scale industry to give them exposure towards the topics discussed in the subject.

Design based Problems (DP)/Open Ended Problem: **Nil**

Major Equipment:

Universal calibrator, Temperature bath, Voltage/ current Simulator, Measurement set up for different parameters.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151709
Semester – V
Subject Name: PROCESS INSTRUMENTATION

Type of course: Professional Elective

Prerequisite: Control System Components, Measurement

Rationale: Process instrumentation is about the measurement of process parameters and its control. Instrumentation is a collective term for measuring instruments that are used for indicating, measuring and recording physical quantities. Instrumentation system includes control panel, valves, signal conditioners and transmitters.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**BASICS OF INSTRUMENTATION :** -Introduction -Instrument symbols & Tag numbering system -Organization of instrumentation dept.	**04**
2	**CONTROL CENTERS & PANELS** - Electric Power Systems, Instrument Power Requirements, Instrument Power Distribution, Control Room Lighting, Communication Systems, Electrical Classifications, - Control Panel Types, Flat face Panels, Breakfront Panels, Consoles, Comparison Of Panel Types, Panel Layout, Face Layout, Rear Layout, Auxiliary Racks & Cabinets, Panel Piping & Tubing, - Air Headers, Tubing Runs, Panel Wiring, Nameplates & Tags, Painting, Graphic Displays - Control Room Layout Panel, Human engineering, Panel enclosure standard - Bid Specifications, Panel Inspections, Control center inspection	**06**
3	**INSTRUMENT AIR SYSTEM** - Sizing criteria, pressure level, air supply source, - Compressor systems, positive displacement compressors, dynamic compressors, non lubricated compressor, compressor cooling, compressor Control Oil removal, general considerations, refrigeration type, necessity for dryers, desiccant type,Design guideline criteria, distribution systems, general layout, Header & branch sizing, materials, take off & valving, control room air supply, case purging for electrical area classification	**06**

4	**CONTROL VALVES** - Valve Terminology, Valve Capacity, Valve rangeability, - Valve type based on body Design: Globe Bodies, Angle, Needle, Ball, Eccentric Rotating, Plug, Butterfly, Diaphragm, Pinch, Drag - Flow Characteristic, Trim Design, Mechanical Feature - Actuator, Pneumatic Types, Electric Types, Electro Hydraulic Types - Positioner- Pneumatic, Electro Pneumatic, Positioner Features & accessories, - Control Valve Accessories. - Testing procedure of control valve CV and Rangeability (Valve sizing- initial level) **PRESSURE RELEIVING DEVICES** - Relief valve, Safety valves and Rupture discs	**06**
5	**SIGNAL CONVERTING ELEMENTS :** - Pneumatic to electrical convertors, Electric to Pneumatic convertors, Voltage to Current convertor, Current to Voltage convertor, Frequency to voltage & Voltage to Frequency convertor	**04**
6	**INDICATOR RECORDERS AND ANNUNCIATORS :** -Indicators :Types of Indicators for various applications -Recorders : Types of recorders and It's merits and demerits, -Annunciators: Function ,sequences displays , types, - Microprocessor for recording, announcing and indicating purpose.	**04**
7	**TRANSMITTER:** -Pneumatic Transmitter- Force balance & Motion Balance -Electronic Transmitter- 2- wire & 4-wire system - Smart Transmitter	**04**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
21	**21**	**21**	**7**	**-**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

(1) William andrews: Applied Instrumentation in Process Industry Vol. I &II, Gulf Book Co.P. (1994).
(2) B. G. Liptak: Process Control, Instrumentation Engineering hand book , Chilton Book Company, 3rd edition,
(3) Curtis Johnson, "Process Control and Instrumentation Technology, Prentice-Hall of India Fourth ed., 1997
(4) E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain basic fundamentals of instrumentation and Control room design	20
CO-2	Select and employ control system components like transmitters, converters, safety valves for process loop setup	30
CO-3	Perform maintenance & calibration of final control elements and telemetry systems	15
CO-4	Identify the Plant hazards, select safety devices and apply protection methods for risk management	15
CO-5	Apply relevant concept to design and analyse the process and instrumentation diagram (P&ID) for project engineering of process plants	20

List of Experiments and Design based Problems (DP)/Open Ended Problem:

1. Study of Basic instrumentation symbols.
2. Study of Tag numbering system.
3. Study of various control panel type with their front and rear layouts.
4. Study of instrument air system.
5. Study of various enclosure types (NEMA standards) used for instrument system.
6. Understanding of hazardous area classification and required protection method by specifying a sample product (Chemical/Petrochemical/Paper/Pulp/Sugar/Agro/Steel/Power, etc.)
7. Study of Control valve characteristics and calculating Cv for linear, quick opening and equal percentage control valve.
8. Study of various part of control valves including actuators and other accessories like positioner, hand wheel etc.
9. Study of flapper-nozzle system used in pneumatic transmitter/ controllers/ indicators.
10. Study of working and testing of indicators and recorders used to monitor various parameters.
11. Study of alarm annunciator and its various sequences
12. Study of working and calibration of transmitters using standard calibrating device
13. Study of working principle and calibration of current to pneumatic converter
14. Study of P/I, I/V, V/I, F/V and V/F converters

Students should be taken for at least one industrial visit of medium scale/ large scale industry to give them exposure towards the topics discussed in the subject.

Major Equipment:

Charts for tag numbering system and standard symbols, Relevant ISA standards, Field instruments like transmitters, Control valve trainer, Control valve with positioned and other accessories, I/P converters, Customized control panel, etc. along with standard test and calibrating devices.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151710
Semester – V
Subject Name: Biomedical Instrumentation

Type of course: Open Elective

Prerequisite: Knowledge of sensor/ transducers, op-amp based circuit, simulation know- how on MatLAB or other software

Rationale: The biomedical parameters like ECG, EEG, EMG, etc. are vital signs considered for preliminary diagnostic tools for patient health condition. This course describes the principles, applications, and design process of the medical instruments used for such measurement. The course covers the topic from the origin of bio-potential, through electrodes, to the special amplifier design requirement and electric safety in hospitals.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**The Human Body: An Overview** Cell structure, Body fluids, Major systems of the body	2
2	**Basic concepts of Medical Instrumentation** Generalized medical instrumentation system, operational modes, medical measurement constraints, classification of biomedical instruments.	2
3	**The Origin of Bio-potential** Electrical activity of excitable cells- Resting states, Nernst equation, G-H-K equation, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential Volume conductor fields	4
4	**Bio-potential Electrodes** The electrode-electrolyte interface, Polarization, Polarizable and nonpolarizable electrodes, Electrode behaviour and circuit models, The electrode skin interface and Motion artifact, Body-surface recording electrodes, Internal electrodes, Electrode arrays, Microelectrodes, Electrodes for electric stimulation of tissue	4

5	**Electrocardiography** Electro-conduction system of the heart, The ECG waveform &Wigger's diagram, Heart problems The standard lead system, other ECG signals, ECG Noises, ECG amplification and signal conditioning circuits, ECG readout devices	**4**
6	**The Human nervous system & Brain function measurement** Anatomy & physiology of nervous system **Instrumentation for brain function measurement** Cerebral angiography, cranial x-rays, brain scans, ultrasonic equipment **Electroencephalography:** Neuron membrane potentials, EEG electrodes and the 1-20 system, EEG amplitude and frequency bands, EEG diagnostic uses and sleep patterns, EEG system block diagram, Preamplifiers and EEG system specifications, Visual and auditory evoked potential recordings, EEG telemetry	**4**
7	**Electrical Safety** Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macroshock hazards, Microshock hazards, Electrical- Safety codes and standards	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**21**	**14**	**14**	**14**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Introduction to Biomedical Equipment Technology by Josheph J. Carr and John M. Brown, Pearson Education
2. Medical Instrumentation- Application and Design by John. G. Webster, John Wiley & Sons,
3. Biomedical Digital Signal Processing by Willis J. Tompkins, Prentice-Hall of India
4. Biomedical Signal analysis- A Case Study Approach by Rangraj M. Rangayyan, Wiley India,
5. Signals and Systems in Biomedical Engineering by Suresh R. Devashahayan, Kluwer academics/ Plenum publication

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151710

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Characterize anatomy and physiology of important physiological system of human body.	15
CO-2	Analyze and design of medical instruments by evaluating medical parameter measurement constraint.	25
CO-3	Analyze various types of bio-potential electrodes, machines and its application	20
CO-4	Analyze important vital sign parameters to evaluate certain disease conditions.	25
CO-5	Develop habit of following electrical safety rules and regulations while using Biomedical Instruments	15

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151711
Semester – V
Subject Name: BULDING AUTOMATION

Type of course: Open Elective

Prerequisite: Fundamental of sensors, Control, Fire and Safety

Rationale: The Building Automation System (BAS) core functionality is to keep building climate within a specified range, light rooms based on an occupancy schedule, monitor performance and device failures in all systems and provide malfunction alarms. Automation systems reduce building energy and maintenance costs compared to a non-controlled building.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

S. N.	Content	Total Hrs
1	**Introduction** Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.	02
2	**Fire Alarm System** Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation. FAS Components: Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples. FAS loops: Classification of loops, Examples. Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, IS Concept of IP enabled fire & alarm system, design aspects and components of PA system.	04

3	**Access Control System:** Access Components, Access control system Design. **CCTV:** Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. **CCTV Applications:** CCTV Applications.	04
4	**Security Systems** **Fundamentals:** Introduction to Security Systems, Concepts. **Perimeter Intrusion:** Concept, Components, Technology, Advanced Applications. Security Design: Security system design for verticals. Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.	04
5	**HVAC system** **Fundamentals:** Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating ,Cooling etc) **Human Comfort:** Human comfort zones, Effect of Heat, Humidity, Heat loss. **Processes:** Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, and Exhaust Fans), Unitary Systems (VAV, FCU etc).	04
6	**Energy Management System:** **ASHRAE** Symbols **Energy Management:** Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.	04
7	**Building Management System:** IBMS (HVAC, Fire & Security) project cycle, Project steps BMS. Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS	02

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**14**	**14**	**14**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Introduction to Biomedical Equipment Technology by Josheph J. Carr and John M. Brown, Pearson Education.
2. Medical Instrumentation- Application and Design by John. G. Webster, John Wiley & Sons.
3. Biomedical Digital Signal Processing by Willis J. Tompkins, Prentice-Hall of India.
4. Biomedical Signal analysis- A Case Study Approach by Rangraj M. Rangayyan, Wiley India.
5. Signals and Systems in Biomedical Engineering by Suresh R. Devashahayan, Kluwer academics/ Plenum publication.
6. Introduction to Biomedical Equipment Technology by Josheph J. Carr and John M. Brown, Pearson Education.
7. Medical Instrumentation- Application and Design by John. G. Webster, John Wiley & Sons.
8. Biomedical Instrumentation and Measurements by Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer, Prentice-Hall of India.

Course Outcome:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand and analyze current philosophy, technology, terminology, and practices used in building automation	30
CO-2	Interpret different safety and security standards for building management system	20
CO-3	Investigate various hardware and software requirement for given HVAC system	15
CO-4	Evaluate energy management and communication for efficient Building Management System	15
CO-5	Identify various tools and techniques in BMS for Design of Secure, Safe and Green building	20

List of Experiments:

1. Study of typical medical and physiological parameters along with their measurement range, frequency and standard sensor or method.
2. Study of Physiological system of human body.

3. Implementation of various Bio-electric amplifiers.
4. Implementation of Filter for noise removal in medical parameter measurements using software or hardware.
5. Implementation of Multiplexer, ADC & DAC.
6. Implementation of semiconductor based sensor ICs.

   a. Temperature sensor IC- TMP 102, LM 35
   b. Pressure Sensor IC- Smartec SPD015G
   c. Light sensor OPT 101

7. Study of ECG measurement system : - (i) study of electrodes, patient cable and monitors (ii) Study of ECG simulation software (iii) demonstration of wireless ECG system (lead-I measurement only).

8. Measurement of Blood pressure using i).sphygmomanometer ii) Pressure gauge

9. Visit report of I.C.U of hospital / micro biology laboratories

10. Course Project - A product report of any bio-medical instrument/ device/ system.

Design based Problems (DP)/Open Ended Problem:

1. Design ECG front end (monitoring grade only) using instrumentation amplifier/ operational amplifiers.
2. Propose a remote patient monitoring system.
3. Simulate generation of action potential phenomena using MatLab or Scilab.
4. Simulate various filters/ algorithm to remove noise from ECG/EEG, etc using MaLAB, LabVIEW or SciLab.

Major Equipment:

Computers, simulation software, ECG measurement system, Blood pressure measurement system, etc.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151712
Semester – V
Subject Name: Environment Instrumentation

Type of course: Open Elective

Prerequisite: Fundamental knowledge of sensors & transducers

Rationale: Climate change is a big issue in today's scenario. Change in climate affecting not only the farmers but also affecting the living species on the earth. This subject will help to know the threats to environment, measurement of the parameters affecting the environment and control techniques by which such parameters are maintained at specified limit.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1.	**Introduction:** Necessity of Instrumentation & Control for environment, sensor requirement for environment.	4
2.	**Quality of water:** Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters. Water treatment: Requirement of water treatment facilities, process design. **Waste water monitoring:** Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants.	8
3.	**Sedimentation & flotation:** General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin , reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation.	4
4.	**Air pollution:** definitions, energy environment relationship, importance of air pollution, air pollution from thermal power plant, their characteristics & control. Air sampling methods & equipments, analytical methods for air pollution studies. Control of air pollution. Flue gas analysis for pollution control – Measurement of CO, carbon di-oxide, NOX and SOX, dust and smoke measurement.	4
5.	**Air monitoring:** measurement of ambient air quality. Flow monitoring: Air flow	4

	measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water.	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**14**	**21**	**21**	**7**	

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Environmental Instrumentation & Analysis Handbook by Randy D. Down and Jay H. Lehr, John-Wiley & Sons, ISBN 0-471-46354-X
2. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.
3. Introduction to Instrumental Analysis by Braun, Robert D., Pharma Book Syndicate, Hyderabad. 2006
4. Analytical Instrumentation by Sherman, R.E. and Rhodes L.J., ISA Press, New York, 1996.
5. Process Measurement and Analysis by Liptak B.G, 3rd Edition, Chilton Book Company, Pennsylvania, 1995.
6. Process / Industrial Instruments and Controls Handbook by Considine D.M, 4th Edition, McGraw Hill, Singapore, 1993.
7. Air pollution engineering – M. N. Rao & H. V. N. Rao
8. Air pollution control technology – Wark & Warner

Text Book:

1. Instrumental Methods of Analysis by Willard, Merritt, Dean and Settle, 7th Edition, CBS Publishers and Distributors, India,1988.
2. Instrumental Methods of Analysis by Ewing G.W, 5th Edition, McGraw Hill, Singapore, 1992.
3. Mechanical and Industrial Measurements by Jain R. K, Khanna Publishers, Nai Sarak, Delhi, 1985.

Course Outcome: After learning the course the students will be able to

Sr. No.	CO statement	Marks % weightage

CO-1	able to understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of sensors and transducers used for environment monitoring	20
CO-2	able to justify the use of an analytical instrument in monitoring and maintaining the quality of water and air for solving real world environmental problem.	20
CO-3	able to summarize and classify capabilities and limitations of analytical instruments	20
CO-4	able to prepare a report on various cases of environmental parameters monitoring and control	20
CO-5	able to work as an individual and as a team-member to design and implement analytical instrument using embedded systems.	20

List of Experiments:
1. To find out transmittance and absorbance of a given sample using colorimeter
2. Qualitative and quantitative analysis using UV-Visible spectrophotometer
3. To analyze a given water sample using turbidity meter
4. To detect hydrocarbon contents from a gas sample
5. Test and calibrate the pH electrode and pH meter.
6. To calibrate the conductivity meter and measure the conductivity of given sample.
7. Study of Gas Chromatograph
8. Study of HPLC system
9. Study of measurement for air polluting parameters like SO_2, NO_x, etc.
10. Prepare a report on weather stations
11. Prepare a visit report on water/waste water/ effluent treatment plant.
12. To design low cost analytical instrument.

At least one industrial visit is preferable to any water/ waste water/ effluent treatment plant.

Design based Problems (DP)/Open Ended Problem: **Nil**

Major Equipment:

Analytical instruments, Ambient condition monitoring system, etc.

List of Open Source Software/learning website:
http://www.nptel.ac.in/courses/105102089/9
http://nptel.ac.in/video.php

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3150004
Subject Name: Contributor Personality Development Program
Semester V

Type of course: Work-Personality Development

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them to recognize how they, as technical professionals, can participate and make a positive contribution to their communities and to their state.

Towards this goal, the Contributor Program has been designed to awaken and strengthen students from within, in terms of building positive self-esteem, increasing their confidence level and I-can attitude, improving their aspirations, giving them new methods of thinking, building their cognitive capacities, exposing them to the skills and practices associated with being contributors in the workplace (not mere employees).

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Gujarat.

The Contributor Program syllabus has been evolved and fine-tuned over several years, (a) to address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire and (b) by working extensively with universities and students building an appreciation of their challenges and concerns. At the core, the program is guided by the higher ideas and principles of practical Vedanta in work.

Teaching and Examination Scheme per semester:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	30	20	150

Note:

- Weekly 2 hours of Classroom facilitated sessions are planned which include Solutioning and Self-discovery sessions.

- In addition, there will be individual/ team projects as part of Practicals. Students can do this on their own, with faculty as guide.

Note:
It is the responsibility of the institute heads that marks for PA of theory & ESE and PA of practical for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

Content:

Sr. No.	Content	Total Hrs
1	**The Contributor Work Ideal** *In this topic, students explore what is their "ideal" of work - is the ideal to be a "worker" or to be a "contributor"? For example, an employee who has the ideal of a "worker" goes to work to pass time, earn a living, get benefits; in contrast to an employee with the ideal of a "contributor" who wants to make a difference, get things done well, create value for the company. This enables students to transform their expectation of themselves in work*	1.5 hrs Classroom engagement *(including self-discovery/ solutioning sessions)*
2	**Identity & Self-esteem** *In this topic, students engage with the question "who am I?" or on what basis do they define themselves. Is their identity defined by what others think of them (extrinsic self-esteem) or by what they think of themselves (intrinsic self-esteem)? Further, they discover positive identities that lead to intrinsic self-esteem, such as an I-can identity based on one's capacity and inner strength. This enables them to build confidence and self-esteem.*	Same as above
3	**Become a Creator of one's destiny** *In a "victim stance", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator of destiny stance" to challenges and situations. This stance frees them to try out new things, open up new possibilities, take on responsibility, see the opportunity hidden in their environment.*	Same as above
4	**Achieving Sustainable Success** *In this topic, students discover how to achieve sustainable or lasting success, by building one's "engine of success", making them success-worthy. Where their focus shifts to building one's "engine of success" rather than being on chasing the "fruits of success". This is important,*	Same as above

	because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. And with a strong engine of success, fruits come to them in time.	
5	**Career Development Models** *In this topic, students explore a range of diverse "career development models" and the possibilities for contribution each opens up to them (e.g. start-up career model, change-maker career model, etc.). This opens their mind to different and even unconventional career models possible, beyond the usual (such as "stable large company career model" where one gets an engineering degree, then MBA, then get a job in a large company). This frees them from a herd mentality when making career choices.*	Same as above
6	**Expanding contribution in every role** *In this topic, students explore the many roles they can play in their life & discover the power they have to expand the contribution possible in any role. (E.g. role of student, role of manager, role of a project site engineer). So, the potential of a role is in the individual's hands. This opens their mind to an alternative way of career growth.*	Same as above

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (for B.Pharma)					
R Level	U Level	A Level	N Level	E Level	C Level
-	**15**	**20**	**-**	**25**	**20**

Distribution of Theory Marks (for B.E., Diploma, MCA)					
R Level	U Level	A Level	N Level	E Level	C Level
-	**15**	**15**	**-**	**20**	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference resources:

A. Basic reference for both students and teachers

1. Contributor Personality Program textbook cum workbook developed by Illumine

2. Web-based ActivGuide™ for self-exploration of rich media resources to vividly understand many of the ideas, watch role models, learn from industry people, get reference readings – that help them enrich the understanding they gained in the class published by Illumine Foundation

B. Advanced reference for teachers

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
3. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan
4. Karma Yoga, Swami Vivekananda; Advaita Ashrama
5. Vivekananda: His Call to the Nation, Swami Vivekananda; Advaita Ashrama
6. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
7. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
8. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007
9. Why not?: how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
10. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
11. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
12. Creating Shared Value, Michael E. Porter and Mark R. Kramer; Harvard Business Review; Jan/Feb2011, Vol. 89 Issue 1/2
13. The Speed of Trust: The One Thing That Changes Everything, Stephen M. R. Covey, Rebecca R. Merrill, Stephen R. Covey; Free Press, 2008
14. The Courage to Meet the Demands of Reality, Henry Cloud; HarperCollins, 2009
15. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 2007

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
Outcome of theory sessions		
CO-1	Students will be able to recognize & appreciate two alternative ideals of work – ideal of a "worker" and ideal of a "contributor". And why organizations of today expect people they employ to be contributors and not just workers.	10-12%
CO-2	Students will be able to recognize & appreciate alternative ways in which they could define themselves or "who am I" (their identity) – and which are positive identities that will lead to building intrinsic self-esteem and confidence in oneself; in contrast to identities that will lead to extrinsic self-esteem that makes them	10-12%

	more dependent on their environment.	
CO-3	Students will be able to recognize & appreciate a "victim" stance as distinct from a "creator of destiny" stance in the way people approach challenges and situations; and how the latter frees individuals to take on challenges and open up opportunities.	10-12%
CO-4	Students will be able to differentiate between two alternative approaches to success - 'building one's engine of success' and 'chasing the fruits of success'; they also appreciate the payoffs/ consequences of both and which is more likely to lead to sustainable or lasting success in the long run.	10-12%
CO-5	Students will be able to recognize & appreciate different career models and their value; to help them make more informed career-related choices.	10-12%
CO-6	Students will be able to recognize & appreciate how one can expand the contribution possible in any role, thereby opening up an alternative way of career growth to them.	10-12%
Outcome of practical sessions		
CO-7	Students learn to re-interpret their life and college experiences to showcase their contribution affinities which are relevant for employers.	15%
CO-8	Students learn to apply contributor thinking to real-world or career relevant challenges.	15%

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150005
Semester – V
Subject Name: INTEGRATED PERSONALITY DEVELOPMENT COURSE

Type of Course –
Value-based holistic personality development course for university students.

Rationale -
This course aims to help a person understand and know his / her purpose in life, get a positive thought pattern, gain confidence, improve behaviour, learn better communication and develop a healthy physique with morality and ethics in its core.

Today youth lack the guidance to face insecurity about their health and career, premature relationships and family breakdown, addictions and substance abuse, negative impact of internet and social media etc. This course includes such topics that will cover all aspects and provide solution to the current challenges through creative and interactive activities.
This course will allow students to enjoy, understand and practice invaluable lessons preparing them for a successful future.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	30	20	150

Content:

Lecture No.	Content	Hours
	IPDC-1 (Semester-1)	
1	**Remaking Yourself** - Restructuring Yourself	2
2	**Remaking Yourself** - Power of Habit	2
3	**Learning from Legends** - Tendulkar & Tata	2
4	**Mass Management** - Project Management	2
5	**From House to Home** - Affectionate Relationships	2
6	**Facing Failures** - Factors Affecting Failures	2
7	**Facing Failures** - Failures are not Always Bad	2

8	**Remaking Yourself** - Being Addiction-Free	2
9	**Soft Skills** - Teamwork & Harmony	2
10	**Remaking Yourself** - Handling the Devil - Social Media	2
11	**From House to Home** - Forgive & Forget	2
12	**From House to Home** - Listening & Understanding	2
13	**Financial Wisdom** - Basics of Financial Planning	2
14	**Soft Skills** - Networking - Decision Making - Leadership	2
15	**Review Lecture** - Student Voice-1	2

BASIC STUDY MATERIAL / MAIN COURSE WORK-BOOK -

1. IPDC Workbook-I
2. IPDC Workbook-II

IPDC REFERENCES –

- *These are the reference material for each lectures of IPDC.*

Module No.	Module/ Course Topics	Lectures	References

1	Facing Failures	Factors Affecting Failures Failures are not Always Bad Insignificance of Failures Power of Faith Practicing Faith	1. Thomas Edison's factory burns down, New York Times Archives, Page 1, 10/12/1914 2. Lincoln Financial Foundation, Abraham Lincoln's "Failures": Critiques, Forgotten Books, 2017 3. J.K. Rowling Harvard Commencement Speech | Harvard University Commencement, 2008 4. Born Again on the Mountain: A Story of Losing Everything and Finding It Back, Arunima Sinha, Penguin, 2014 5. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell, Thomas Nelson, 2007 6. Steve Jobs: The Exclusive Biography Paperback, Walter Isaacson, Abacus, 2015
2	Learning from Legends	Tendulkar & Tata Leading Without Leading	1. Chase Your Dreams: My Autobiography, Sachin Tendulkar, Hachette India, 2017 2. Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 2014 3. The Wit and Wisdom of Ratan Tata, Ratan Tata, Hay House, 2018 4. The Tata Group: From Torchbearers to Trailblazers, Shashank Shah, Penguin Portfolio, 2018 5. The Leader Who Had No Title, Robin Sharma, Jaico Publishing House, 2010 6. In the Joy of Others: A Life Sketch of Pramukh Swami Maharaj, Mohanlal Patel and BAPS Sadhus, Swaminarayan Aksharpith, 2013
3	Mass Management	Project Management	1. Project Management Absolute Beginner's Guide, Gregory Horine, Que Publishing, 2017 2. The Fast Forward MBA in Project Management, Eric Verzuh, Wiley, 2011 3. Guide to Project Management: Getting it right and achieving lasting benefit, Paul Roberts, Wiley, 2013

4	My India My Pride	Glorious Past - Part 1 Glorious Past - Part 2 Present Scenario An Ideal Citizen - 1 An Ideal Citizen - 2 An Ideal Citizen - 3	1. Hidden Horizons, Dr. David Frawley and Dr. Navaratna S. Rajaram, 2006 2. Rishis, Mystics and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpith, 2011 3. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 2016 4. The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 1982 5. The Āryabhaṭīya of Āryabhaṭa: An Ancient Indian Work on Mathematics and Astronomy (1930), Walter Eugene Clark, University of Chicago Press, reprint, Kessinger Publishing, 2006
5	Remaking Yourself	Restructuring Yourself Power of Habit Being Addiction-Free Begin with the End in Mind Handling the Devil – Social Media	1. Power of Habit, Charles Duhigg, Random House Trade Paperbacks, 2014 2. Change Your Habit, Change Your Life, Tom Corley, North Loop Books, 2016 3. The Seven Habits of Highly Effective People, Stephen Covey, Simon & Schuster, 2013 4. Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 2012 5. Atomic Habits, James Clear, Random House, 2018 6. How a handful of tech companies control billions of minds every day, Tristan Harris, TED Talk, 2017
6	Financial Wisdom	Basics of Financial Planning Financial Planning Process	1. Rich Dad Poor Dad, Robert Kiyosaki, Plata Publishing, 2017 2. The Warren Buffett Way, Robert Hagstrom, Wiley, 2013 3. The Intelligent Investor, Benjamin Graham, Harper Business, 2006 4. Yogic Wealth: The Wealth That Gives Bliss, Gaurav Mashruwala, TV18 Broadcast Ltd, 2016
7	From House to Home	Affectionate Relationships Forgive & Forget Listening & Understanding Bonding the Family	1. "What Makes a Good Life? Lessons from the Longest Study on Happiness", R. Waldinger, Ted Talks, 2015 2. Long Walk To Freedom, Nelson Mandela, Back Bay Books, 1995 3. Outliers, Malcolm Gladwell, Back Bay Books, 2011

8	Soft Skills	Teamwork & Harmony Networking - Decision Making - Leadership	1. The 17 Indisputable Laws of Teamwork, John Maxwell, HarperCollins, 2013 2. Team of Teams: New Rules of Engagement for a Complex World, Stanley McChrystal, Portfolio, 2015 3. Predictably Irrational, Revised and Expanded Edition: The Hidden Forces That Shape Our Decisions, Harper Perennial, Dan Ariely, 2010
9	Review	Student Voice – 1 Student Voice – 2 Words of Wim	

Course Outcomes:

- To provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient.
- To provide students with hard and soft skills, making them more marketable when entering the workforce.
- To educate students on their social responsibilities as citizens of India and have a greater sense of social responsibility.
- To provide students with a value-based education which will enable them to be successful in their family, professional, and social relationships by improving their moral and ethical values.
- To teach self-analysis and self-improvement exercises to enhance the potential of the participants.
- To have a broader sense of self-confidence and a defined identity.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151705
Semester – V
Subject Name: PROCESS CONTROL

Type of course: Professional Core

Prerequisite: Process Instrumentation, Control Theory, Mathematical Modeling,

Rationale: Process control deals with the science of maintaining the output of a specific process within a desired range. Process control is commonly used for mass production. Due to its precise nature, it enables the automation of industrial processes

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

SR NO.	TOPIC	HRS
1.	**INTRODUCTION** Introduction to Process Control. Control objectives, servo regulatory control, and classification of process variables.	**2**
2.	**MODELING OF SOME CHEMICAL PROCESS SYSTEMS** Modeling basics, Degree Of Freedom, Mass Balance, Energy Balance equations, linearization of nonlinear systems, Modeling of Level Tank System, Continuous Stirred Tank Heater, Continuous Stirred Tank Reactor, Transfer function.	**6**
3.	**ELEMENTS OF PROCESS CONTROL** Dead time, Interacting and non-interacting systems, self-regulation, inverse response, capacity of process, integrating systems, multi-capacity process.	**4**
4.	**PROCESS IDENTIFICATION** Dynamic behavior of first and second order processes, Obtaining First Order Plus Time Delay (FOPTD) model with Process Reaction curve. Obtaining second order model of processes.	**4**
5.	**COMMON CONTROLLER MODES** Controller Modes, ON OFF, Multi position, time proportional controller, Theory Proportional, Integral and Derivative modes, PI, PD, PID Controller, Electronics Controller implementation,	**8**

	Dynamic Behavior of closed loop systems with P, I, D , PI , PID modes.	
6.	**DISCRETISATION AND IPLEMENTATION ISSUES** Discrete time control mode realization. Velocity and Position algorithm of PID control. Integral windup, anti-windup systems, controller bias, bumps less transfer.	**4**
7.	**TUNING OF CONTROLLERS** Application and tuning, ZN Tuning (Open loop and Closed loop), Performance criteria, Integral criteria,	**4**
8.	**SOME ADVANCE CONTROL TECHNIQUES** Cascade Control, Feed forward Control, ratio Control, Air Fuel Ratio Control for Drum Boilers. Level Control in Drum Boiler, Shrinking and Swelling, Inverse response of Drum Boiler.	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
21	**14**	**14**	**14**	**7**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the need of process control, basic principles of various manufacturing processes and apply engineering knowledge to do problem analysis in process control.	30
CO-2	Define common dynamics of processes found in many industries and model them mathematically.	15
CO-3	Select the proper controller and apply the tuning rules to achieve optimum performance	15
CO-4	Understand , interpret and implement tuning of the controllers using various methods and study about digital controllers	25
CO-5	Select advanced control strategy to enhance the performance	15

Reference Books:

Text Books:

1. G. Stephanopolous, "Chemical Process Control An Introduction to Theory and Practice", Prentice Hall India, August 2000.
2. Surekha Bhanot, "Process Control Principles and Applications", Oxford, 2008 3. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall India.
4. Thomas Marlin, "Process Control Designing Processes and Control for Dynamic Performance", Tata MC Graw Hill, 2012.
5. F.G. Shinskey, "Process Control Systems Application Design and Adjustment" 3rd editionn, McGraw Hill International,
6. D. E. Seborg, T.F. Edgar, D. A. Mellichamp, "Process Dynamics and Control", Wiley, 2004

List of Experiments: (Outlines)

1. Introduction to Matlab/Scilab
2. To find Unit step, ramp, impulse response of first and second order system using MATLAB/Scilab.
3. To implement the ON OFF control with op-amp or other equivalent circuits.
4. Software implementation of On OFF controller using 8051 or equivalent.
5. Understanding FOPTD and SOPTD modeling of systems with MATLAB or SCILAB.
6. Implementation of PI controller with op-amp or other equivalent circuit.
7. Implementation of PID controller with op-amp or other equivalent circuit.
8. To study ZN tuning for a given plant/system with MATLAB or SCILAB.
9. Hardware implementation of closed loop systems with any control system trainer.
10. Implementation of P, PI, PID algorithm with microcontrollers like 8051.
11. Implementation of Cascade Control System.
12. Implementation of feed forward control
13. Implementation of Ratio control
14. Study of industrial grade single loop controller (specifications, configuration, testing, calibration)

Design based Problems (DP)/ Open Ended Problem:

To develop a simple control loop for a system using microcontroller or hardware circuit e.g. on off control of heaters/temperature control systems, displaying of the variables on computer screens or LCD screens etc.

Major Equipment:

MATLAB/SCILAB software/control loop trainer, PROTEUS, KEIL or equivalent.