THIRD SEMESTER (INSTRUMENTATION AND CONTROL)

Sr. No	Subject	STUDY SCHEME Hrs/week L	T	P	EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
3.1	Basics of Control Systems	4	-	3	25	25	100	3	50	3	**200**
3.2	Transducers and Signal Conditioning	3	-	2	25	25	100	3	50	-	**200**
3.3	Test and Measuring Instruments	3	-	2	25	25	100	3	50	3	**200**
3.4	Basics of Instrumentation	3	-	2	25	25	100	3	50	3	**200**
3.5**	Electrical Machines	3	-	2	25	25	100	3	50	3	**200**
3.6*	Digital Electronics	3	-	3	25	25	100	3	50	3	**200**
Soft Skills-I*		-	-	2	-	25	-	-	-	-	**25**
Total		**19**	**-**	**16**	**150**	**175**	**600**	**-**	**300**	**-**	**1225**

* Common with diploma programmes (latest scheme) in Electronics & Communication Engg. and Computer Engg.

** Common with diploma programmes (latest scheme) in Electronics & Communication Engg.

FOURTH SEMESTER (INSTRUMENTATION AND CONTROL)

Sr. No	Subject	STUDY SCHEME Hrs/week L	T	P	EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
4.1	Microcontroller and Embedded systems	4	-	3	25	25	100	3	50	3	**200**
4.2	Advanced Control System	3	-	3	25	25	100	3	50	3	**200**
4.3	Industrial Communication	3	-	3	25	25	100	3	50	3	**200**
4.4	Instrumentation Drawing	-	-	4	-	50	-	-	50	3	**100**
4.5	Principles of Energy Management	4	-	3	25	25	100	3	50	3	**200**
4.6	Installation and Maintenance of Industrial Equipments	-	-	3	-	100	-	-	100	3	**200**
Soft Skills-II*		-	-	2	-	25	-	-	-	-	**25**
Total		**14**	**-**	**21**	**100**	**275**	**400**	**-**	**350**	**-**	**1125**

Industrial Training - After examination of 4th Semester, the students shall go for training in a relevant industry/field organization for a minimum period of 6 weeks and shall prepare a diary. It shall be evaluated during 5th semester by his/her teacher for 50 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 50 marks. This evaluation will be done by HOD and lecturer In-charge – training in the presence of one representative from training organization.

* Common with diploma programmes (latest scheme) in Electrical Engg. and Others.

FIFTH SEMESTER (INSTRUMENTATION AND CONTROL)

Sr. No.	Subject	Study Scheme			Evaluation Scheme						Total Marks
					Internal Assessment		External Assessment (Examination)				
		Hrs/Week			Theory	Practical	Written Paper		Practical		
		L	T	P	Max. Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
Industrial Training		-	-	-	-	100	-	-	100	3	200
5.1	Power Electronics	3	-	3	25	25	100	3	50	3	200
5.2	Analytical and Environmental Instruments	4	-	3	25	25	100	3	50	3	200
5.3	Process Instrumentation	4	-	3	25	25	100	3	50	3	200
5.4	Process Control	4	-	3	25	25	100	3	50	3	200
5.5	Minor Project Work	-	-	6	-	100	-	-	100	3	200
Soft Skill-III*		-	-	2	-	25	-	-	-	-	25
Total		**15**		**20**	**100**	**325**	**400**		**400**		**1225**

* Common with diploma programmes (latest scheme) in Electrical Engg. and Others.

SIXTH SEMESTER (INSTRUMENTATION AND CONTROL)

Sr. No.	Subject	Study Scheme			Evaluation Scheme						Total Marks
					Internal Assessment		External Assessment (Examination)				
		Hrs/Week			Theory	Practical	Written Paper		Practical		
		L	T	P	Max. Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
6.1	PLC, DCS and SCADA	4	-	3	25	25	100	3	50	3	200
6.2	Biomedical Instrumentation	4	-	3	25	25	100	3	50	3	200
6.3	Elective	4	-	3	25	25	100	3	50	3	200
6.4*	Entrepreneurship Development and Management	3	-	-	25	-	100	3	-	-	125
6.5	Major Project Work	-	-	9	-	100	-	-	100	3	200
Soft Skill-IV *		-	-	2	-	25	-	-	-	-	25
Total		**15**		**20**	**100**	**200**	**400**		**250**		**950**

* Common with diploma programmes (latest scheme) in Electrical Engg. and others.

Electives: To choose any one from the following:

6.3 (a) Opto electronic devices and their applications
6.3 (b) Advance measurement Techniques
6.3 (c) Virtual Instrumentation
6.3 (d) Auto Electrical******

** Common with Electrical Engg. 5th Semester Elective

THIRD SEMESTER

BASICS OF CONTROL SYSTEM

L	T	P
4	-	3

RATIONALE

It is pre-requisite for the students to know the various total plant controls in the process industry. An automatic control system saves manpower, reduces cost of production, increases the accuracy of the finished product and helps in mass production. The knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation.

LEARING OUTCOMES

After undergoing the subject, student will be able to:

- Understand fundamentals of control system.
- Understand the different type of control system and to analyze feedback characteristics of linear control system to reduce the disturbance.
- Acquire knowledge about working of different control components
- Analyze the response of first order system w.r.t different I/P signals
- Analyze the stability/behavior of closed loop systems using various tools routh array, root locus and bode plot.
- Learn about the transfer function and analyze different methods to find the transfer function.

DETAILED CONTENTS

1. Introduction (16 hrs)

Basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, basic elements of a servo mechanism, Examples of automatic control systems, linear systems, non-linear systems, control system examples from chemical systems, mechanical systems, electrical systems, introduction to laplace transform.

2. Control Components (12 hrs)

Working principle and application of following components

AC and DC servomotors

- Torque Speed characteristic

Synchros

- Synchro-pair error detector

Stepper motor

- Variable-Reluctance type
- Permanent-magnet motor type

Potentiometer

- Characteristics of Potentiometer

Tachometer

- A.C. and D.C. Tachometer

3. Control system representation (12 hrs)

Transfer function, block diagram, reduction of block diagram, problems on block diagram, Mason's formula signal flow graph

4. Time Response Analysis (12 hrs)

Standard test signals, time response of first order system subjected to step and impulse input. Introduction to second order system (over damped, critically damped and under damped systems). Time domain specifications (Delay time, rise time, peak time, peak overshoot, settling time, steady state error).

5. Stability (12 hrs)

Routh Array Criterion, Root Locus, Bode Plotting using semi log graph paper

LIST OF PRACTICALS

1 Study of characteristic of servomotor

2 Characteristics and speed control of a stepper motor

3 To demonstrate the synchro characteristic and use a synchro pair as error detector

4 To study of characteristics of potentiometer

5 Measurement of speed control of motor with tachometric feedback.

6 Study of a DC speed control system

7 Simulation of a position control system

8 Study of temperature ON-OFF controller

INSRUCTIONAL STRATEGY

Since the knowledge of this subject is required to have deeper grasp of the control environment/techniques as need to be studied in the forthcoming subjects e.g. process control, process instrumentation, the subject teacher is required to make the subject interesting and

provide information about practical applications. The students may be given exposure in process industry and shown various controls.

RECOMMENDED BOOKS

1 Control Systems by Nagrath and Gopal

2 Linear Control Systems by B. S. Manke, Khanna Publication

3 Control Systems: Theory and Applications by Ghosh, Pearson Education, Sector 62, Noida

4 Control Systems by R. C. Sukla, Dhanpat Rai and Sons.

5 Control Systems by Ogata

6 E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in
https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr No	Topic	Time Allotted (Hours)	Marks Allotted (%)
1.	Introduction	16	25
2.	Transfer function	12	15
3.	Control System Representation	12	20
4.	Time Response Analysis	12	20
5.	Stability	12	20
Total		**64**	**100**

TRANSDUCERS AND SIGNAL CONDITIONING

L T P
3 - 2

RATIONALE

Signal conditioning is an integral part of any instrumentation system. This subject gives an introduction to various methods of processing a signal available from a transducer to make it worth displaying or computer compatible. Telemetry is an advanced application of communication for instrumentation which lays the foundation for modern means of information transmission and reception like digital data, satellite based communication.

After studying the course the students will be able to identify different types of sensors and transducers and their applications in the field of instrumentation and control. The students will be able to select appropriate transducers relating to a process and will also get the relevant technical know how about the conditioning of a signal from a transducer for the purpose of control. Subject teachers are advised to show the students different types of sensors and transducers while teaching the various topics of this course. Further, teachers may give some assignment problems related to industrial signal processing and applications which calls for use of specific transducer and signal conditioning equipment in specifications.

LEARING OUTCOMES

After undergoing the subject, student will be able to:

- Identify different types of sensors and transducers and their applications in the field of Instrumentation and Control.
- Select appropriate transducers relating to a process.
- Aquire technical know how about the conditioning of a signal from a transducer for the purpose of control.
- Aquire and convert a signal available from a transducer to make it worth displaying or computer compatible.
- Understand working principle and pros & cons of different transducers.

DETAILED CONTENTS

1. Introduction to Transducer (08 hrs)

Defination of Transducer
Classification of Transducer
Selection Criteria of Transducer
Characteristics of Transducer

2. Resistive Transducer (10 hrs)

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer
Potentiometer
Strain Gauage
Hot Wire anemometer
Resistive Temperature Transducer (RTD, Thermistor)
Pick-up

3. Inductive Transducer (07 hrs)

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer
LVDT
RVDT
Electromagnetic Pick-up
Inductive Microphone

4. Capacitive Transducer (07 hrs)

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer
Capacitive Pick –Up
Condenser/Capacitor microphone
Differntional Capacitor Pick-up

5. Other Types of Transducers (10 hrs)

Construction, working Principle, Advantage and Disadvantage, Application of following Transducer
Piezoelectric Transducer
Seismic Pick-up
Accelerometer
Digital Transducer –Shaft Encoders
Carbon / Resistive Microphone

6. Principle of Analog Signal Conditioning (06 hrs)

Linearization
Conversion
Voltage to Frequency
Frequency to Voltage
Voltage to Current
Current to Voltage
Filtering and Impedance Matching

Note: Visits may be arranged to concerned industries

LIST OF PRACTICALS

1. Study of strain gauge and measurement of strain for a given sample
2. Study of piezoelectric pressure transducer
3. Study of RTD (Resistance Temperature detector)
4. Study of thermistor and Measurement of temperature
5. Study of calibration of LVDT
6. Study of capacitive transducer and measurement of angular displacement
7. Study of magnetic pick up
8. Study and draw the characteristics of a capacitance transducer
9. Study of thermocouple
10. To study and draw the characteristics of following
    - LDR
    - Photo diode
    - Photo transistor
    - Capacitance transducers

RECOMMENDED BOOKS

a) Mechanical and industrial measurements by RK Jain, Khanna Publishers, New Delhi
b) Modern Control Engineering by OGATA
c) Fundamentals of Instrumentation by AE Fribance
d) Transducers by Peter Norton
e) Mechatronics by Bolton, Prentice Hall of India, New Delhi
f) Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co, New Delhi
g) E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in
https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (Hours)	Marks Allocation (%)
1.	Introduction to Transducer	08	14
2.	Resistive Transducers	10	22
3.	Inductive Transducer	07	16
4.	Capacitive Transducers	07	16
5.	Other Type of Transducers	10	22
6.	Principle of Analog Signal Conditioning	06	10
	Total	**48**	**100**

3.3 TEST AND MEASURING INSTRUMENTS

L T P
3 - 2

RATIONALE

Instrumentation and control engineering diploma holders are normally placed in process and manufacturing industries and service sector. They are required to operate and maintain various electrical and electronic systems. This course provides a starting background to the students of diploma programme in Instrumentation and Control acquainting him/her with various electrical and electronic instruments for their principle, operation, testing, calibration and applications. The detailed content of this course has been tailored as per industrial needs. Proper understanding of the measuring techniques, construction and working principles of various instruments will help the students in proper handling, operation and maintenance of industrial plants, control circuits and panels etc. This course will help the diploma students to pursue higher studies as well.

LEARING OUTCOMES

After undergoing the subject, student will be able to:

- Describe various Electrical and Electronic Instruments.
- Understand proper handling, operation and maintenance of instruments used in industries.
- Describe Indicating, Recording and Integrating Instruments.
- Measure Resistance, Capacitance and Inductance with the help of different instruments.
- Operate Ammeter, Voltmeter and Multimeter.
- Describe Power, Energy and Frequency measurement.
- Demonstrate C.R.O. and D.S.O.

DETAILED CONTENTS

1. Introduction to Measurements and Instrumentation (4 hrs)

Need & importance of measurement
Typical application of instrumentation system
Classification of instruments
Review of units, dimensions and standards

2. Measurement of Resistance, Inductance and Capacitance (10 hrs)

Measurement of resistance:

- Ohmmeters
- Meggers
- Wheatstone Bridge
- Potentiometer method

Measurement of inductance and capacitance by

- Hay's bridge
- Maxwell Bridge

Wagner earth devices

3. Ammeter, Voltmeter and Multimeter (8 hrs)

Construction and working principle, applications of Ammeter and voltmeter

- Moving Iron
- Permanent Magnet Moving Coil Meters
- Thermocouple type
- Electrostatic type
- Rectifier type

Multimeter: Principle of multimeter, Measurement of d.c. voltage and a.c. voltage

4. Power and Energy Measurements (4 hrs)

Working principle, construction and applications of dynamometer type watt meter

Power measurement methods 2 watt meter or 3 watt meter

Working principle, construction and applications of energy meter

5. Frequency Measurement (8 hrs)

Working principle, construction and applications of

Stroboscopes

Digital frequency meters

Phase sequence indicators

6. Construction, working principle and application of the following instruments (8 hrs)

Q-meter

transistor tester

LCR Bridge

Function generator

7. Cathode Ray Oscilloscope (6 hrs)

Construction and working of Cathode Ray Tube (CRT)

Block diagram, description of a basic CRO and triggered sweep oscilloscope,front panel controls.

Specifications of CRO and their explanation.

Measurement of voltage, current, frequency, time period and phase using CRO.

Digital storage oscilloscope (DSO): block diagram and working principle.

LIST OF PRACTICALS

1 To identify and study of indicating, integrating and recording instruments.

2 Extension of range of a given voltmeter and an ammeter.

3 Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
4 Study the constructional details, working and calibration of an ammeter (moving
5 coil and moving iron type)
6 To measure power, power factor in a 1-phase circuit, using wattmeter and power
7 factor meter and verify results with calculations.
8 Study the constructional details, working of a meggar and measurement of insulation resistance of a given motor.
9 To measure the value of earth resistance using earth tester.
10 To measure unknown resistance with wheat-stone bridge.
11 To measure frequency, power, power factor in a single-phase circuit, using digital frequency meter, wattmeter and power factor meter and to verify results with calculations.
12 Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
13 Use of LCR meter for measuring inductance, capacitance, Q-factor and resistance.
14 Measurement of voltage, frequency, time period, phase using CRO
15 Measurement of voltage, frequency, time period, phase using digital CRO

INSTRUCTIONAL STRATEGIES

While teaching this course the teacher should give demonstration in working and calibration of the instruments pertaining to relevant topics in the class. A visit to power plant or industry can also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals

RECOMMENDED BOOKS

1. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney; Dhanpat Rai and Sons, New Delhi
2. Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International Publications, Jalandhar
3. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
4. Electronic, Instrumentation Fundamentals by Malvino
5. Electrical Measurement by DR Nagpal
6. Electric Instruments by D. Cooper, Prentice Hall of India, New Delhi
7. Electronics Instrumentation by JB Gupta, Satya Prakashan, New Delhi
8. Modern Electronic Instrumentation and Measurement Techniques by Cooper,
9. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in
https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (Hours)	Marks Allocation (%)
1.	Introduction to Measurements and Instrumentation	4	08
2.	Measurement of Resistance, Inductance and Capacitance	10	20
3.	Ammeter, Voltmeter and Multimeter	08	18
4.	Power and Energy Measurements	04	08
5.	Frequency Measurement	08	18
6.	Construction, working principle and application of the following instrument	08	18
7	Cathode Ray Oscilloscope	06	10
Total		**48**	**100**

3.4 BASICS OF INSTRUMENTATION

L	T	P
3	-	2

RATIONALE

This syllabus has been designed to impart the knowledge of basic principles involved in instrumentation systems. The student will learn the various characteristics of instruments, means of transduction and displaying variables besides instrument selection criteria. The concepts will help the students in forming a solid foundation for higher learning.

LEARING OUTCOMES

After undergoing the subject, student will be able to:

- Explain basic principles involved in instrumentation systems and significance of measurement.
- Describe the characteristics of instruments like Static and Dynamic characteristics.
- Understand various display devices and instrument selection criteria.
- Calibrate various instruments.
- Detect and remove different errors in Instrumentation systems.
- Design Op-amp circuits like Adder, Subtractor, Integrator and Differentiator.

DETAILED CONTENTS

1. Basics of Instrumentation Systems (08 hrs)

1.1 Scope and necessity of instruments
1.2 Measurement, its significance and types
1.3 Building blocks of instrumentation systems
1.4 Various testing signals
1.5 Important process variables and their units

2. Performance Characteristics and selection criteria of Instruments (12 hrs)

Performance characteristics: -

Static characteristics of instruments-accuracy, precision, linearity,resolution, sensitivity, hysteresis, drift, dead time, loading effects.

Dynamic characteristics-time constant, response time, natural frequency,damping coefficient.

Selection criteria of instruments

Calibration

Definition and importance of calibration
Process of calibration

3. Display and recording devices (14 hrs)

2.1 Working principle construction of strip chart and X-Y recorders
2.2 Merits and demerits of circular chart and strip chart recorder
2.3 Basics of printing devices
2.4 Scanning, data logging and field buses (GPIB, RS-232C)
2.5 LED, Seven segment display, LCD

4. Errors (04 hrs)

4.1 Sources of errors
4.2 Classification of errors
4.3 Grounding/ Earthing
4.4 Precautions

5. Operational Amplifier (10 hrs)

Characteristics of an ideal operational amplifier and its block diagram
IC -741 and its pin configuration
Definition of differential voltage gain, CMRR, PSRR, slew rate and inputOffset current
Operational amplifier as an inverting mode & non inverting mode, Adder, Subtractor, Differentiator and Integrator
OP- Amp. As Instrumentation amplifier

LIST OF PRACTICALS

1. To assemble seven segment display using LEDs
2. To make fourteen segments display using LED/LCD and verify it
3. Make any word using LCD and LED
4. To study circular and strip chart recorder
5. To use IC 741 (op-amplifier) as adder and subtractor
6. To use IC 741 (op-amplifier) as inverter and non inverter
7. To use IC 741 (op-amplifier) as integrator and differentiator

INSTRUCTIONAL STRATEGY

This being a first branch specific subject, the teacher should lay emphasis on giving an overview of the field of instrumentation and control. In addition, for exposure the students should be taken to various process industries or where control system and electronic instrumentation is being used. The teacher shall demonstrate the instruments and their functioning.

LIST OF RECOMMENDED BOOKS

1. Mechanical and Industrial Measurement by RK Jain, Khanna Publishers, New Delhi
2. Electrical and Electronic Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co., New Delhi

3. Elements of Electronic Instrumentation and measurement by Carr, Pearson Education, Sector 62, Noida
4. Electronic Instrumentation and measurement by Kishore, Pearson Education , Sector 62, Noida
5. Electrical and Electronic Measurement and Instrumentation by JB Gupta; S.K Kataria and Sons Publishers, New Delhi
6. OP-AMP and liner integrated circuits by Ramakant A. Gayakwad, Pearson Publication.
7. Measurement Systems by Doeblin.
8. Industrial Instrumentation by Donald P Eickrman
9. Advanced Instrumentation and Control by MF Kureshi
10. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Basics of Instrumentation Systems	8	10
2	Performance Characteristics of Instruments	12	25
3	Display and Recording Devices	14	30
4	Errors	4	10
5	Operational Amplifier	10	25
Total		**48**	**100**

ELECTRICAL MACHINES

L	T	P
3	-	2

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Describe star delta 3-phase connections
- Explain phase, line voltages and current relationships in 3-phase power supply.
- Demonstrate the concept of single phase transformers
- Measure the power and power factor in 3 phase load
- Determine the efficiency of a single phase transformer
- Apply the working principle of rotating electrical machines.
- Demonstrate the working of DC, AC and single phase fractional kilowatt motors.
- Connect and run a DC shunt motor with supply through a 3 point starter

DETAILED CONTENTS

1. Three Phase Supply (04 hrs)

- Advantage of three-phase system over single-phase system.
- Star Delta connections
- Relation between phase and line voltage and current in a three phase system
- Power and power factor in three-phase system and their measurement by one, two and three water meter methods.

2. Transformers (06 hrs)

Principle of operation and constructional details of single phase transformer

- Voltage Regulation of a transformer (No Derivation)
- Losses in a transformer
- Efficiency, condition for maximum efficiency and all day efficiency
- CTs and PTs (Current transformer and potential transformer)
- CVT (Constant Voltage Transformer)

3. Introduction to Rotating Electrical Machines (06 hrs)

- E.M.F induced in a coil rotating in a magnetic field.

- Definition of motor and generator
- Basic principle of a generator and a motor
- Torque due to alignment of two magnetic fields and the concept of Torque angle
- Basic Electromagnetic laws (Faraday's laws of Electromagnetic Induction)

4. DC Machines (12 hrs)

- Principle of working of d.c motors and d.c generator, their constructional details
- Function of the commutator for motoring and generating action
- Factors determining the speed of a DC motor
- Different types of excitation
- Characteristics of different types of DC machines
- Starting of DC motors and starters
- Application of DC machines

5. AC Motors (10 hrs)

- Revolving magnetic field produced by poly phase supply
- Brief introduction about three phase induction motors, its principle of operation
- Principle and working of Synchronous Machines
- Application of Synchronous Machines

6. Single Phase Fractional Kilowatt Motors (10 hrs)

- Introduction
- Principle of operation of single phase motors
- Types of single phase induction motors and their constructional details
- Single phase synchronous motors – reluctance motor (hysteresis motor)
- Introduction to Commutator type single-phase motors
- Introduction to servo- motors and stepper motors
- Concept of micro-motors.

LIST OF PRACTICALS

Demonstrate various instruments use viz Ammeter, Voltmeter, Wattmeter, p.f meter etc for their identification and and connecting procedure in a circuit.

1. To measure power and power factors in 3 Phase load by two wattmeter method
2. To determine the efficiency of a single phase transformer from the data obtained through open circuit and short circuit test
3. To measure power and power factor of a single phase induction motor.
4. To run a synchronous motor with a.c supply and to measure speed to verify the relation N=12O f/ P
5. To make connections of starting and running winding of a single phase capacitor motor and to run it with the help a DOL starter and to measure its speed
6. Study construction of a stepper and servomotor and to write their complete specifications.

Class Project: Fabricate a transformer using simple iron core and two copper coils and read the output voltage.

INSTRUCTIONAL STRATEGY

A visit to a small factory (Preferably Transformer Factory) must be organised to give live exposure to students. For this the teacher should visit first to understand the assembly line-up which could be followed by a visit of the students in groups of 10-20 (depending upon the size of the factory), where the instructor can give an idea of the working of the factory without much seeking assistance of the factory staff.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1) Electrical Machine by SK Bhattacharya, Tata McGraw Hill Education Pvt Ltd, New Delhi
2) Electrical Machines by Nagrath and Kothari, Tata McGraw Hill Education Pvt Ltd, New Delhi
3) Experiments in Basic Electrical Engineering: by S.K. Bhattacharya, KM Rastogi: New Age International (P) Ltd. Publishers, New Delhi
4) Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
5) Electrical Engineering by JB Gupta, SK Kataria & Sons, New Delhi
6) Electrical Machines by DR Arora, Ishan Publications, Ambala city
7) Electrical Technology Vol. - I and II B.L. Thareja, S Chand and Co. New Delhi
8) E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR

Websites for Reference:

http://swayam.gov.in

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SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic Names	Time Allotted (Hours)	Marks Allocation (%)
1.	Three Phase Supply	04	10
2.	Transformers	06	15
3.	Introduction to Rotating Electrical Machines	06	15
4.	DC Machines	12	20
5.	A.C. Motors	10	20
6.	Single Phase Fractional Kilowatt Motors	10	20
Total		**48**	**100**

DIGITAL ELECTRONICS

L	T	P
3	-	3

RATIONALE

This course has been designed to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips. This subject aims to give a background in the broad field of digital systems design and microprocessors.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Explain the importance of digitization.
- Verify and interpret truth tables for all logic gates.
- Realize all logic functions with NAND and NOR gates
- Design half adder and full adder circuit
- Demonstrate and design 4-bit adder, 2's complement subtractor
- Verify and interpret truth tables for all flip flops.
- Verify and interpret truth tables of multiplexer, demultiplexer, encoder and decoder ICs
- Design and realize different asynchronous and synchronous counters
- Design 4-bit SISO, PISO, SIPO, PIPO shift registers
- Explain the features and applications of different memories.
- Verify performance of different A/D and D/A converters.

DETAILED CONTENTS

1. Introduction (02 hrs)

a) Distinction between analog and digital signal.
b) Applications and advantages of digital signals.

2. Number System (03 hrs)

a) Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa.
b) Binary addition and subtraction including binary points. 1’s and 2’s complement method of addition/subtraction.

3. Codes and Parity (03 hrs)

a) Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code.
b) Concept of parity, single and double parity and error detection

4. Logic Gates and Families (05 hrs)

a) Concept of negative and positive logic

b) Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates.

(a) Introduction to TTL and CMOS logic families.

5. Logic Simplification (04 hrs)

a) Postulates of Boolean algebra, De Morgan's Theorems. Implementation of Boolean (logic) equation with gates

b) Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits

6. Arithmetic circuits (02 hrs)

a) Half adder and Full adder circuit, design and implementation.

b) 4 bit adder circuit

7. Decoders, Multiplexeres, Multiplexeres and Encoder (04 hrs)

a) Four bit decoder circuits for 7 segment display and decoder/driver ICs.

b) Basic functions and block diagram of MUX and DEMUX with different ICs

c) Basic functions and block diagram of Encoder

8. Latches and flip flops (04 hrs)

a) Concept and types of latch with their working and applications

b) Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops.

c) Difference between a latch and a flip flop

9. Counters (06 hrs)

a) Introduction to Asynchronous and Synchronous counters

b) Binary counters

c) Divide by N ripple counters, Decade counter, Ring counter

10. Shift Register (06 hrs)

Introduction and basic concepts including shift left and shift right.

a) Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

b) Universal shift register

11. A/D and D/A Converters (06 hrs)

a) Working principle of A/D and D/A converters

b) Brief idea about different techniques of A/D conversion and study of :

- Stair step Ramp A/D converter

- Dual Slope A/D converter
- Successive Approximation A/D Converter

c) Detail study of :
- Binary Weighted D/A converter
- R/2R ladder D/A converter

d) Applications of A/D and D/A converter.

12. Semiconductor Memories (03 hrs)

Memory organization, classification of semiconductor memories (RAM, ROM, PROM, EPROM, EEPROM), static and dynamic RAM, introduction to 74181 ALU IC

LIST OF PRACTICALS

1. Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR (EXNOR) gates
2. Realization of logic functions with the help of NAND or NOR gates.
3. To design a half adder using XOR and NAND gates and verification of its operation
   Construction of a full adder circuit using XOR and NAND gates and verify its operation
4. Verification of truth table for positive edge triggered, negative edge triggered, level triggered IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops).
5 Verification of truth table for encoder and decoder ICs, Mux and DeMux
6. To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation.
7. To design a 4 bit ring counter and verify its operation.
8. Use of Asynchronous Counter ICs (7490 or 7493)

Note: Above experiments may preferably be done on Bread Boards.

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce.

RECOMMENDED BOOKS

1. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi.Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi
2. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd.
3. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar.
4. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd.
5. Digital Fundamentals by Thomas Floyds, Universal Book Stall.
6. Digital Electronics by RP Jain, Tata McGraw Hill Education Pvt Ltd, New Delhi.
7. Digital Electronics by KS Jamwal, Dhanpat Rai and Co., New Delhi.
8. Digital Electronics by Yashpal and Sanjeev Kumar; North Publication, Ambala City.
9. Digital Electronics by BR Gupta, Dhanpat Rai & Co., New Delhi.
10. Digital Systems: Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi.
11. Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi.
12. Fundamentals of Digital Electronics by Naresh Gupta, Jain Brothers, New Delhi.
13. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html.

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic Name	Time Allotted (Hours)	Marks Allocation (%)
1.	Introduction	02	04
2.	Number System	03	05
3.	Codes and Parity	03	05
4.	Logic Gates and Families	05	10
5.	Logic Simplification	04	10
6.	Arithmetic circuits	02	05
7.	Decoders, Multiplexeres, Multiplexeres and Encoder	04	10
8.	Latches and flip flops	04	10
9	Counters	06	12
10.	Shift Register	06	12
11.	A/D and D/A Converters	06	12
12	Semiconductor Memories	03	05
Total		**48**	**100**

SOFT SKILLS – I

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Identify components of effective verbal communication
- Prepare a report
- Learn the techniques of enhancing memory
- Set goals for overall personality development
- Understand the concept of quality and its implementation in an organization.

DETAILED CONTENTS

- Soft Skills - Concept and Importance
- Communication Skills- Improving verbal communication
- Report Writing
- Method to enhance memory and concentration
- Component of overall personality- Dressing sense/etiquettes/body language etc.

In addition, the students must participate in the following activities to be organized in the institute.

- Sports
- NCC/NSS
- Camp – Blood donation
- Cultural Event

Note: Extension Lectures by experts may be organized. There will be no examination for this subject.

FOURTH SEMESTER

MICROCONTROLLER BASED EMBEDDED SYSTEMS

L T P
4 - 3

RATIONALE

The study of microcontrollers in terms of architecture, software and interfacing techniques leads to the understanding of working of microcontrollers and applications of microcontroller in Instrumentation Industries. The microcontroller is an area of specialization & microcontroller is the heart of the programmable devices. Students of Instrumentation and related engineering branches often use microcontroller to introduce programmable control in their projects, automation and fault finding in industry.

LEARNING OUTCOMES

After completion of the subject, the learner should be able to:

- Understand the application of microcontrollers in industries.
- Understand the working of microcontrollers.
- Familiar with the instruction set and addressing modes of microcontroller
- Understand basic knowledge of embedded systems.
- Explain the architecture of advanced microcontrollers.

DETAILED CONTENTS

1. Introduction: **(08 Hours)**

Difference between microprocessor and microcontroller.
Microcontroller and their applications.
Microcontroller for embedded system.
Overview of the 8051 family.

2. 8051 Architecture: **(20 Hours)**

Block Diagram and Pin Diagram of 8051 microcontroller.
The 8051 Oscillator & clock.
Program Counter and Data Pointer.
A & B CPU registers.
Flag and the program status word (PSW).
Internal Memory.
The stack and stack pointer.
Input/output ports.
Counters and timers.
Serial Data input/output.
Interrupts.

3. Addressing Modes & Instructions: (12 Hours)

Instructions set of 8051.
Arithmetic instructions.
Loops and jump instructions.
Call instructions.
Push and Pop Instructions.
Addressing modes of 8051.

4. Introduction to Embedded System (12 Hours)

Definition of embedded system.
Processor embedded into a system.
RTOS.
Embedded operating system.
Embedded hardware units and devices in a system.
Examples of embedded system.
Present trends in embedded system.
Design parameters of an embedded system and its importance.
Applications of embedded system.

5. Advanced Microcontroller: (12 Hours)

Only brief general architecture of AVR, PIC and ARM microcontroller
Applications of advanced microcontroller in the Instrumentation and Controlfield.

LIST OF PRACTICALS

1. Familiarization with Micro-controller Kit and its different sections.
2. Familiarization with Assembly Language Programming (PC Based).
3. Familiarization with C Language Programming (PC Based).
4. Program to add two hexadecimal numbers using C Language Programming.
5. Program to add two decimal numbers using C Language Programming.
6. Program to check whether number is odd or even using C Language Programming.
7. Programming to interface switches and LEDs.
8. Programming and interface of Seven Segment and LCD.
9. Programming and interfacing of Graphical LCD.
10. Programming to interface Keypad.
11. Programming for A/D converter, result on LCD.
12. Programming for D/A converter, result on LCD.
13. Programming for serial data transmission from PC to Kit or vice versa.
14. Programming and interfacing of RELAY and Buzzer.
15. Programming and interfacing of Stepper Motor.

INSTRUCTIONAL STRATEGY

Instruction should be given to students to get familiar with the microcontrollers in the class room so that they can develop the concept of controllers. Programming should be done by taking simple examples like interfacing of switch, LCD and relay, keypad etc.

RECOMMENDED BOOKS:-

1. Fundamentals of Microprocessor and Microcontroller by B. Ram, Dhanpat Rai Publications.
2. Microcontroller: Architecture, Programming & Applications by Ayala, Kenneth J., Penram
3. Microcontroller and Embedded Systems using Assembly And C by Muhammad Ali Mazidi, Rolin Mckinlay, Janice Gillespie Mazidi: Pearson
4. PIC Microcontroller and Embedded Systems : Using assembly and C by Muhammad Ali Mazidi, Rolin Mckinlay, Danny Causey; Pearson
5. The 8051 microcontroller by K.J. Ayala, Penram International.
6. J B Peatman, Design with PIC Microcontrollers, Prentice Hall.
7. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in.
https://nptel.ac.in/course.html.

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Periods)	Marks Allotted (%age)
1	Introduction	08	14
2	8051 Architecture	20	30
3	Addressing Modes & Instruction	12	20
4	Introduction to Embedded System	12	16
5	Advanced Microcontroller	12	20
Total		**64**	**100**

ADVANCED CONTROL SYSTEM

L T P
3 - 3

RATIONALE

This course will enable students to study in detail the different types of advanced control systems used in instrumentation and will provide understanding of basic control characteristics of various controllers. The students will appreciate the importance and limitations of process control and actual controlling aspects. Hence this subject increases the knowledge of advance control strategies used in industry.

LEARNING OUTCOMES

After undergoing this course, the student will be able to:

- Classify and analyze various advance control systems.
- Explain non-linear control system.
- Introduce artificial intelligence, robotics & Fuzzy Logic.
- Understand Robotic arm configuration.
- Get familiar with the computational softwares.

DETAILED CONTENTS

1. Single and Multi loop Control System (16 Hours)

Introduction to single and multi loop control system and its types like feedback, feed-forward, cascade, ratio, split range control system their advantages and disadvantages. Difference between feedback and feed forward control system. Study of atleast one application for all above control systems with suitable diagrams.

2. Non-Linear Control System (12 Hours)

Introduction to behavior of non-linear control system. Principle of superposition and homogeneity. Classification of non-linearities- Inherent and Intentional. Different types of non-linearities-saturation, backlash, hysteresis, dead zone, relay, friction, limit cycles, jump resonance, jump phenomenon. Difference between linear and non-linear control system.

3. Advance Control Techniques (14 Hours)

Introduction to Artificial Intelligence, Fuzzy Logic & Neuro fuzzy logic in control system and their applications. Artificial Neural Networks, Introduction to Robotics: degree of freedom, the robot arm configuration and its applications.

4. Computer Applications in Control System (06 Hours)

Introduction of various latest computational softwares related to Instrumentation & Control engineering such as LabVIEW, PLC Software, SCADA Software, MATLAB etc.

Note: Visit to industries such as Cement Plant, Thermal Plant and Pharmaceutical Plant, Steel Plant etc.

LIST OF PRACTICALS

1. To perform non-Linearity in relay.
2. To perform cascade control system.
3. To perform ratio control system.
4. To perform feed forward control system.
5. To perform split-range control system.
6. To perform at least two applications using LABVIEW.
7. To get familiar with PLC Software.
8. To get familiar with SCADA Software.
9. To study an application of Artificial Neural Network/Robotics.
10. To study an application of Artificial Intelligence/ Fuzzy Logic.

INSRUCTIONAL STRATEGY

Since the knowledge of this subject is required to have good grasp of the control techniques. The subject teacher is required to lay more emphasis on providing information about practical applications. The students may be given exposure to laboratory exercises and process industry and show various controls and latest software used in the field of Instrumentation and Control Engineering.

RECOMMENDED BOOKS

1. Control System Engineering by Bhattacharya, Pearson Education, Sector 62, Noida.
2. Chemical Process Control by George Stephanopoulos: EEE edition, PHI Publishers, New Delhi.
3. Process Control by Peter Harrot, Tata Mc Graw Hill Publishing Co. New Delhi.
4. Control System by Nagrath Gopal.
5. Control System: Theory and Practice by Ghosh, Pearson Education, Sector 62, Noida.
6. Control Engineering by Ganesh Rao, Pearson Education, Sector 62, Noida.
7. Control System by R C Shukla.
8. Introduction to Fuzzi Logic by Bo-Yuan.
9. Neural Networks, Fuzzy Logic And Genetic Algorithms by S. Rajasekaran, G.A. Vijayalakshmi Pai, PHI Learning Private Limited.

10. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Single and Multi loop Control System	16	32
2	Non-linear Control System	12	26
3	Advance Control Techniques	14	30
4	Computer Applications in Control System	06	12
Total		**48**	**100**

INDUSTRIAL COMMUNICATION

L	T	P
3	-	3

RATIONALE

This subject gives introduction to the basic communication techniques which forms a foundation for understanding practical methods used in industries. Study of Digital Data communication is essential for modern means of information transmission and reception like fax, mobile, Ethernet and other satellite based communication. Communication transducer measurements may also be implemented using the same principle which is the main objective of instrumentation engineer.

LEARNING OUTCOMES

After undergoing this course, the student will be able to:

- Explain basics of telemetry with its block diagram.
- Classify different Telemetry system.
- Explain overview of different transmitters.
- Understand data communication for modern means of transmission & reception.
- Understand instrumentation buses and fiber optic communication.

DETAILED CONTENTS

1. TELEMETRY (06 Hours)

Introduction and applications of telemetry.
Methods of data transmission.
Block Diagram of general Telemetry system.

2. CLASSIFICATION OF TELEMETRY SYSTEM (10 Hours)

Land Line Telemetry

Voltage telemetry.
Current Telemetry.
Position Telemetry.
Ratio Telemetry.
R.F. Telemetry

2.2.1 A.M., F.M.
Block diagram of P.A.M.
Block diagram of P.C.M.

3. TRANSMITTER (10 Hours)

Pneumatic Transmitter

PDPT bellow type.
PDPT diaphragm type.
Force balance type.
Hydraulic Transmitter
Bellow type.
Electric Transmitter
Resistive Transmitter.
Inductive Transmitter.

4. TRANSMISSION CHANNELS (08 Hours)

Wire line channels.
Radio Channels.
Multiplexing channels
Time division multiplexing.
Frequency division multiplexing.

5. DATA COMMUNICATION (08 Hours)

Introduction and block diagram of data communication.
Modulation & demodulation of signals using.
Amplitude shift keying.
Frequency shift keying.
Phase shift keying.

6. INSTRUMENTATION BUSES (06 Hours)

General view of instrumentation buses.
GPIB.
Interbus and Profibus/Profinet.
Ethernet/LAN.
HART Communication Protocol.
Fibre Optic Communication.

LIST OF PRACTICALS

1. Measurement of pressure using pneumatic transmitter.
2. Measurement of differential pressure using PDPT.
3. Realization of electric transmitter.
4. Study of hydraulic transmitter.
5. To observe AM & FM waves on CRO.
6. To calculate modulation index m for AM & FM.

7. Familiarization with Ethernet and LAN.
8. Install and configure a network interface card in a workstation.
9. Identify the IP address of a workstation and the class of the address and configure the IP Address on a workstation.
10. Visit to nearby industry for latest networking techniques.
11. Create a network of at least 6 computers.

INSTRUCTIONAL STRATEGY

The Teacher should explain the background and importance of the subject. Lay emphasis on the meaning of various terms, working of telemetry and communication and their applications may be explained to students. Reinforce theory with practical.

RECOMMENDED BOOKS

1. Mechanical and industrial measurements by R.K. Jain.
2. Modern Control Engineering by Ogata.
3. Fundamentals of Instrumentation by A.E. Fribance.
4. Electrical and Electronic measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai Pulications.
5. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in
https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	Telemetry	06	12
2	Classification of telemetry system	10	20
3	Transmitter	10	20
4	Transmission channels	08	16
5	Data communication	08	16
6	Instrumentation buses	06	16
Total		**48**	**100**

4.4 INSTRUMENTATION DRAWING

L	T	P
-	-	4

RATIONALE

Since drawing is the language of engineers through which they can express technical ideas in this subject, students will be able to draw component layouts and interpret the actual drawings used in the field of Instrumentation. Also student will be able to study various graphical symbols as per ANSI standards

LEARNING OUTCOMES

After undergoing this course, the student will be able to:

- Identify the different types of symbols as per ANSI standards.
- Read different types of instrument diagrams.
- Identify instruments and go through installation procedure.
- Understand the drawing of power plant, steel plant & cement plant.

DETAILED CONTENTS

1. STUDY OF SYMBOLS

Electronic symbols.
Process instrumentation symbols.
Graphical symbols for pipe fittings (Valves and Piping), Graphical symbols and codes for pressure, temperature, flow, level measuring instruments as per ANSI standards.
Color coding of lines (Electric lines and fluid lines).

2. INSTRUMENT DIAGRAMS

Study of block diagram.
Study of schematic diagram.
Study of wiring diagram.
Study of graphical panel diagram.
Study of P& I diagram.

3. INSTRUMENT INSTALLATION SYSTEM

Instrument Identification.
Study of instrument installation procedure.
Check list of good installation system.

4. PLANT INSTRUMENTATION (POWER AND REFINERY PLANT)

Instrumentation drawing of power and refinery plant.
Block diagram of power and refinery plant.
Flow diagram of power and refinery plant.

5. PLANT INSTRUMENTATION (STEEL AND CEMENT PLANT)

Instrumentation drawing of steel and cement plant.
Block diagram of steel and cement plant.
Flow diagram of steel and cement plant.

6. SCHEMATIC DIAGRAMS

Schematic diagram of single acting cylinder.
Schematic diagram of double acting cylinder.
Schematic diagram of spring return cylinder.
Schematic diagram of tandem valve and shuttle valve.
Schematic diagram of SOL-Valve.

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on identification of symbols, draw sketches, wiring diagrams. Demonstrate different views, working drawings for interpretation. Make students aware of handbooks, data books and manuals for reference.

RECOMMENDED BOOKS

1. Applied Instrumentation by WG Andrews.
2. Instrumentation Engineers Hand Book by BG Liptic Vol.2.
3. Handbook of Applied Instrumentation by DM Considine.
4. Mechanical and Industrial Measurements by RK Jain, Khanna Publishers, New Delhi.
5. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

4.5 PRINCIPLES OF ENERGY MANAGEMENT

L T P
4 - 3

RATIONALE

This course will enable the students to discuss and apply the concept, principle of various energy storage methods and also examine, apply, analyze different energy efficient technologies, various methods of energy conservation and energy audit. The Instrumentation & Control diploma holder must be made aware about latest energy efficient technologies and tackle the problems of environmental pollution as they will have to face this challenge in future life.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Explain the importance of non-conventional energy sources for the present energy scenario.
- Understand various renewable sources of energy.
- Understand working principle of solar cell.
- Different energy efficient technology and various methods of energy conservation.
- Explain principle of various energy storage methods.
- Do the energy audit using different energy audit instruments.

DETAILED CONTENTS

1. Introduction (08 Hours)

Energy and its sources.
Types of Energy Sources and their advantages and disadvantages.
Difference between renewable and non renewable energy sources.
Present energy scenario in India, Sector wise consumption i.e. Domestic,Industrial and Agriculture.

2. Renewable Energy (18 Hours)

Type of renewable energies.
Methods of obtaining energy (Thermal and electricity) from solar.
Concept of MPPT.
Methods for obtaining energy from bio mass.
Principle of wind energy conversion.
Other Non-Conventional Energy Sources –
Magneto Hydro Dynamic Convertor (MHD).
Tidal.

Geo-Thermal.
Ocean etc.

3. Energy Conservation (16 Hours)

Definition.
Need and importance of energy conservation.
Use of Energy efficient technology in Domestic and Industrial Sector.
Energy Conservation by Improving Load Factor and Power Factor.
Type of tariff structure for electricity.
Use of Instrumentation & Control for energy conservation.

4. Energy Storage (10 Hours)

Need of energy storage.
Energy storage methods and their advantages and disadvantages.
Working Principle and applications of
Secondary batteries.
Fuel cells.
Hydrogen energy system.

5. Energy Audit (12Hours)

Definition.
Need for Energy Audit.
Methodology for preliminary and detailed energy audit.
Energy audit instruments.

LIST OF PRACTICALS

1. Realization of energy conservation by improving power factor.
2. Case study on energy audit (college/hostel building etc.).
3. To demonstrate the I-V characteristics using PV module with varying radiation and temperature level.
4. To demonstrate the P-V characteristics using PV module with varying radiation and temperature level.
5. To study the effect of variation in tilt angle on PV module.
6. To study the effect of shading on module output power.
7. To perform cost benefit analysis for installing solar photovoltaic roof top system.
8. To study the effect of shading on PV module output power.
9. Prepare a model of renewable and non- renewable sources of energy.
10. Prepare project on application of solar energy like solar water heaters, solar

furnaces, solar cookers, solar lighting and solar pumping.

11. Visit to solar power plants for understanding.
    a. Fixed tilt and seasonal tilt arrangement.
    b. Tracking System.
    c. Weather monitoring system.

INSTRUCTIONAL STRATEGY

The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. While explaining the need and energy management, the teacher should give students home assignments bases on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Teacher must give practical application of these energy sources in nearby surrounding areas.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making.
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce.

RECOMMENDED BOOKS:

1. Solar Energy – Principles of thermal collection and Storage SP Sukhatme, Tata McGraw Hill Publication, New Delhi.
2. Non-Conventional Energy Resources by RK Singal, SK Kataria and Sons, New Delhi.
3. Solar Energy Utilization; GD Rai ; Khanna Publishers, New Delhi.
4. Renewable Energy Sources and Conversion Technology by NK Bansal, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.
5. Guidebook on Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency, Government of India.
6. Guidebook on Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, Government of India.
7. Guidebook on General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, Government of India.
8. Energy Management, Dr. Sanjeev Singh, Umesh Rathore, S.K.Kataria & Sons, 2014.
9. Manual on Energy Efficiency at Design Stage, CII Energy Management Cell.
10. Non – conventional Energy Sources by G. D. Rai, Khanna Publications.
11. E-books / e-tools / relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Hours)	Marks Allocation (%)
1.	Introduction	08	14
2.	Renewable Energy	18	30
3.	EnergyConservation	16	22
4.	Energy Storage	10	16
5.	Energy Audit	12	18
	Total	**64**	**100**

INSTALLATION AND MAINTENANCE OFINDUSTRIAL EQUIPMENTS

L	T	P
-	-	3

RATIONALE

When the students reach the industries, they will be able to install various instruments, identify the various instrumentation devices, measure the current, voltage and power, solder and desolder the components, identify and remedy the electrical faults, test and wire the instrumentation loop and recognize the use of instrumentation tools. They will also be able to select right instruments and tools for the right work.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Understand vernier calipers and micrometer.
- Identify various electronics components and understand techniques of soldering and desoldering on PCB.
- Troubleshoot instrumentation panel wiring.
- Differentiate between open circuit and short circuit fault.
- Install any instrument using screw and hange type instruments.
- Select right tools for right work.
- Develop technical knowledge for different instruments.

SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS

The exercises/practical/experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency. Following is the list for guidance for exercises/practical/experiments

S. No.	Exercises/Practical
1	Measure inner & outer diameter using vernier calipers & compare it with standards.
2	Measure thickness of the metallic sheet with micrometer & compare it with standards.
3	Identify different electronic components viz. Resistor, Capacitor, Inductor, transformer, fuse, diode and transistor.
4	Identify various capacitors viz paper, silvered paper, mica, silvered mica, ceramic plastic foil, Electrolytic.
5	Identify various inductors viz fixed and variable inductors.
6	Identify Piezo electric crystal & study it’s application
7	Measure voltage, current & power using suitable instrument.

8	Connect 3 phase power supply (star , delta) to suitable load.
9	Identify terminals of diodes and transistors
10	Identify & Test fuses & transformers
11	Solder and de-solder electronic components on PCB as well solder earth connection.
12	Wire instrumentation signals, low/ high power supply and connect appropriate earth to it.
13	Wire instrument panel with various accessories as per instrument hook-up diagram.
14	Wire the MCB, ELCB to supply electrical power to instrument panel.
15	Prepare specifications for instrumentation tools, wires, cables, switches, electronic components for a given application.
16	Wire electrical circuit diagram using IEEE standard symbols for one instrument panel application.
17	Wire instrumentation loop as per given diagram using ISA standard symbols for one instrument panel application controlling single loop.
18	Identify open circuit, short circuit faults.
19	Test assembled instrument loop wiring for various parameters and faults.
20	Troubleshoot instrument panel wiring for various parameters and faults.
21	Identify tools, equipments & components required for installation of process control instruments.
22	Dismantle & assemble recorder to identify it's components.
23.	Install any one instrument using screw type instrument.
24.	Install any one instrument using hange type instrument.
25.	Install any one As per sketch with bill of materials (BOM)
26.	Test pressure/flow /level/temperature switch.

Note: At least 18 exercises/practical from the above should be performed.

INSTRUCTIONAL STRATEGY

Students are required to prepare and submit a laboratory report on instruction/demonstration given by teacher and workshop activities done by students as a part of team work.

RECOMMENDED BOOKS

1. Murthy, D. V. S. Transducers and Instrumentation PHI Learning 2011
2. Kalsi, H.S.Measurement Systems Mcgraw hill Publishers 2011
3. Bell, D.A.Electronic Instrumentation and Measurements PHI Learning 2010
4. Carr, Joseph J.Elements of Electronic Instrumentation and Measurements Pearson Education, 2010
5. E-books / e-tools / relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

LIST OF MAJOR EQUIPMENT/ INSTRUMENT:

Multimeter, Megger, Clamp-on meter, CRO, soldering iron, de-soldering pump, pliers, cutters, L-end key, spanner (ring/open /box/ adjustable), stripper, screw driver, pointer remover, tube bender, tube cutter, flaring tools etc.

List of Software/Learning Websites

http://www.instrumentationworld.com/instrumentation_tutoral.htmI

http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.html

SOFT SKILLS – II

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Develop Communication Skills.
- Work in a team.
- Learn to resolve conflict by appropriate method.
- Identify leadership traits and learn self motivation.
- Follow ethics.

DETAILED CONTENTS

- Concept of team building, behavior in a team.
- Developing Interpersonal Relations- empathy, sympathy.
- Communication skills-improving non-verbal communication.
- Conflict Management.
- Motivation.
- Leadership.
- Professional Ethics and Values.
- Health, Hygiene, Cleanliness and Safety.

In addition, the students must participate in the following activities to be organized in the institute.

- Sports.
- NCC/NSS.
- Camp – Environment awareness.
- Cultural Event.

Note: Extension Lectures by experts may be organized. There will be no examination for this subject.

INDUSTRIAL TRAINING OF STUDENTS
(After IV Semester examinations)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 6 weeks duration to be organized during the semester break starting after second year i.e. after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable the write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behavior, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

FIFTH SEMESTER

POWER ELECTRONICS

L T P
3 - 3

RATIONALE

Diploma holders play a vital role in the field of Instrumentation and Control especially in industry and research organizations are required to handle a wide variety of power electronic equipment used in process control and Automation Industry. This subject will provide the student basic understanding of the principles of their working. The practical training will further reinforce the knowledge and skill of the students.

LEARNING OUTCOMES

- Students will understand the basics of Power Electronics.
- Students will learn the details of power semiconductor switches (Construction, Characteristics and operation).
- Students will learn the designing of various application circuits using Thyristor.
- Students will learn how to design single phase Rectifier using SCR.
- Student will understand the basics of Choppers, Inverter, Cycloconverter, UPS, and SMPS etc.
- Student will understand various AC/DC drives using Thyristor.

DETAILED CONTENTS

1. Introduction to Thyristor and other Power Electronics Devices (12 hrs)

Construction, Working principle of SCR, two transistor analogy of SCR, V-I characteristics of SCR.
SCR specifications and ratings.
Different methods of SCR triggering.
Different commutation circuits for SCR.
Series and parallel operation of SCR.
Construction and working principle of DIAC, TRIAC and their V-I characteristics.
Construction, working principle of UJT, V-I characteristics of UJT. UJT as relaxation oscillator.
Brief introduction to Gate Turn off thyristor (GTO), Programmable Uni - junction Transistor (PUT), MOSFET.
Basic idea about the selection of Heat sink for Thyristor.

Applications such as

Light Intensity control
Speed control of universal motors
Fan regulator
Battery charger.

2. Controlled Rectifiers (08 hrs)

Single phase half wave controlled rectifier with load (R, R-L)
Single phase half controlled full wave rectifier with load (R, R-L)
Single phase fully controlled full wave bridge rectifier.
Single phase full wave centre tap rectifier.

3. Inverters, Choppers, Dual Converters & Cycloconverter. (12 hrs)

Principle of operation of basic inverter circuits
Series and Parallel Inverters
Square wave Inverters and Sine wave Inverters
Choppers
Introduction
Types of choppers (Class A, Class B, Class C, and Class D).
Step up choppers
Step down choppers
Dual Converters and Cycloconverter
Introduction
Working principle of dual converters
Cycloconverter applications.

4. Thyristorised Control of Electric drives (10 hrs)

DC drive control
Half wave drives.
Full wave drives
Chopper drives (Speed control of DC motor using choppers)
AC drive control
Phase control
Constant V/F operation
Cycloconverter / inverter drives
AC/DC drive control applications in Automobile

5. Power Electronics Applications (06 hrs)

5.1 UPS: on-line and off-line

5.2 Concept of high voltage DC transmission

5.3 Concept of SMPS

LIST OF PRACTICALS

1) To plot VI characteristic of an SCR.
2) To plot VI characteristics of TRIAC.
3) To plot VI characteristics of UJT.
4) To plot VI characteristics of DIAC.
5) Study of UJT relaxation oscillator. And observe I/P and O/P wave forms
6) Observation of wave shape of voltage at relevant point of single-phase half wave controlled rectifier and effect of change of firing angle.
7) Observation of wave shapes of voltage at relevant point of single phase full wave controlled rectifier and effect of change of firing angle.
8) Observation of wave shapes and measurement of voltage at relevant points in TRIAC based AC phase control circuit for varying lamp intensity and AC fan speed control.
9) Installation of UPS system and routine maintenance of batteries.
10) Speed control of motor using SCRs

INSTRUCTIONAL STRATEGY

Power Electronics being very important for industrial controls requires a thorough know how about industrial devices. Teacher should take to the class various SCRs and other semiconductor devices to demonstrate these to the students. The teacher may encourage students to perform practical simultaneously for better understanding of the subject and verification of theoretical concepts. So industrial visit in between the course is a must.

RECOMMENDED BOOKS

1) Power Electronics by P.S. Bhimbhra, Khanna Publishers, New Delhi
2) Power Electronics by P.C. Sen, Tata Mc Graw Hill Education Pvt Ltd. New Delhi
3) Power Electronics – Principles and Applications by Vithayathi, Tata McGraw Hill Education Pvt Ltd. New Delhi
4) Principles of Power Electronics by Kassakian, Pearson Education, Sector 62, Noida.
5) Power Electronics by M.S. Berde, Khanna Publishers, New Delhi.
6) Power Electronics by MH Rashid
7) Industrial Electronics and Control by SK Bhattacharya and S. Chatterji, New Age Publications. New Delhi
8) Power Electronics by S Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi
9) Power Electronics by Sugandhi and Sugandhi
10) Power Electronics – Principles and Applications by J Michael Jacob, Vikas Publishing House, New Delhi

11) E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (hrs)	Marks Allotted (%)
1	Introduction to Thyristor and other Power Electronics Devices	12	30
2	Controlled Rectifiers	08	15
3	Inverters, Choppers, Dual Converters & Cycloconverter.	12	25
4	Thyristorised Control of Electric drives	10	20
5	Power Electronics Applications	06	10
Total		**48**	**100**

5.2 ANALYTICAL AND ENVIORONMENTAL INSTRUMENTS

L T P
4 - 3

RATIONALE

Analytical and Environmental Instruments have an important role in the field of Pharmaceutical, food and medicine industry. This subject will provide the knowledge and skill to student of Instrumentation and control about machine and equipments, which are used to check various parameters in Agriculture, food, medicine, lab testing and environment. Diploma holder will also able to understand the various instruments which are used to measure and check the different harmful constituents in air and water pollution. These analytical and environmental Instruments are also used for new research possibilities for any vaccine and medicine.

LEARNING OUTCOMES:

After completion of the subject, the learner should be able to:

- To learn about gas chromatography.
- To learn proper handling of industrial panel. To learn about pollution monitoring instruments using new techniques like Arduino and IoT
- To learn about indicating instruments. To learn about concept of liquid analysis.
- To learn about recording instruments. To learn about mass spectroscopy.
- To know about paramagnetic oxygen analysis.

DETAILED CONTENTS

1. Introduction (06 hrs)

Fundamental blocks of analytical instruments(brief details)

2. Spectroscopic analysis (10 hrs)

Absorption spectroscopy
NMR spectroscopy
Mass spectroscopy
(Brief Concept of all these methods)

3. Gas analysis (08 hrs)

Infra-red gas analyzer
Paramagnetic oxygen analyzers
Thermal conductivity analysis
(Principles of working of these analyzers and block-diagram explanation)

4. Gas Chromatography (14 hrs)

Introduction
Instruments : injectors, oven, column and detectors

5. Liquid Analysis (08 hrs)

5.1 Principle of pH measurement
5.2 Electrodes used for pH measurement
5.3 Electro chemical analyzer

6. Environmental Pollution Monitoring Instruments (08 hrs)

IOT based air, water, gas and noise quality monitoring system

Arduino based air, water, gas and noise quality monitoring system

7. Electrochemical Instruments (06 hrs)

Electro chemical cell

Types of electrodes

Conductivity meters

8. Instrumentation used for water and noise pollution and their monitoring (04 hrs)

LIST OF PRACTICALS

1. To find conductivity of a given solution.
2. To measure total dissolved solutions in water.
3. To measure oxygen content dissolved in water
4. Demonstration of mass spectrometer
5. Demonstration of gas chromatograph
6. To measure noise level
7. To study spectrometer
8. To study thermal conductivity gas analyzer
9. Monitoring of air, water, gas and noise quality using Arduino.

INSTRUCTIONAL STRATEGY

Efforts should be made to keep relevant instruments in the laboratory. It will be beneficial for students to visit different laboratories setup in Food, Pharmaceutical industry, Agrifarm and Pollution control department etc. and show them equipments used in the relevant field.

RECOMMENDED BOOKS

1. Handbook of analytical instruments by R.S. Khandpur; Tata Mc Graw Hill Publishing Co. New Delhi.
2. Principles of Instrumental Analysis by Dr. DA Skoog.

3. Introduction to Instrumental Analysis by Chhatwal.
4. Hand book of Applied Instrumentation by DM Considine.
5. Mechanical and Industrial Measurements by RK Jain; Khanna Publisher, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1.	Introduction	6	8
2.	Spectroscopic analysis	10	16
3.	Gas analysis	8	14
4.	Gas Chromatography	14	20
5.	Liquid Analysis	8	12
6.	Environmental pollution monitoring instruments	8	14
7.	Electro chemical instruments	6	10
8.	Instrumentation used for water and noise pollution and their monitoring	4	6
Total		**64**	**100**

5.3 PROCESS INSTRUMENTATION

L T P

4 - 3

RATIONALE

This course will impart students about the importance of process variables and their measuring techniques in process industries, which includes different process measuring instruments and related transducers. Supervisor employed for maintenance of measuring instruments is required to diagnose faults, rectify them and test the total system for good performance. The diploma holders of Instrumentation and Control will appreciate the importance and limitations of different measuring techniques of process variable.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Explain importance of measurement
- Use various transducers
- Use various measuring devices.
- Use instrument for measurement of a temperature and pressure.
- Use instruments for measurement of a flow and level.
- Explain controlling system of a particular instrument.

DETAILED CONTENTS

1. Introduction (08 hrs)

Define following process variables along with their importance and measuring units.
Temperature
Pressure
Level
Flow

2. Temperature Measurements (10 hrs)

Construction, working principle, applications, advantages & disadvantages of the following.
Thermocouples
Thermistors
Radiation pyrometer
IR detectors
Fiber Optic Thermometer

3. Pressure Measurements (18 hrs)

Construction, working principle, applications, advantages & disadvantages of the following.
Pressure Measurements using Manometers (U, Well and Inclined)
Pressure Measurements using elastic elements (Bourdon, Bellow, Diaphragm)
Low Pressure Measurements using (Thermocouple, Pirani, Ionization, Mc Leod, Kundsen gauges)
High Pressure Measurements using Bridgman Gauge

4. Flow Measurements (16 hrs)

Construction, working principle, applications, advantages & disadvantages of the following.
Variable flow meter (Venturimeter and Orifice)
Rotameters
Electromagnetic flow meter
Hot Wire Anemometers
Turbine Flow Meters
Ultrasonic Flow Meters

5. Level Measurements (12 hrs)

Construction, working principle, applications, advantages & disadvantages of the following.
Level Measurements using Sight glass
Level Measurements using Pressure Transducers (Two Scheme only)
Level Measurements using Buoyancy Method (Two Scheme only)
Level Measurements using Electrical (Resistive, Inductive and Capacitive)Method
Level Measurements using Gamma Rays
Level Measurements using Ultrasonic Method

Note: Visit may be arranged in concerned industries.

LIST OF PRACTICALS

1. Measurements of flow using Rotameters
2. Measurement of flow using Venturi tube and U-tube manometer
3. Measurement of Level using capacitive method
4. Measurement of Level using resistive method

5. Measurement of Pressure using U-tube manometer
6. Measurement of Pressure using Bourdon tube
7. Measurement of Temperature using IR detector
8. Level Measurements using Ultrasonic Method

INSTRUCTIONAL STRAGEGY

Since the subject is of practical nature, it is suggested that teacher must take the students for visit of nearby process industry and show them different measurement devices. It is also recommended that various measurement devices may be brought in the lab for demonstration purpose. Student may be encouraged to explore the information on the Net.

RECOMMENDED BOOKS

1. Mechanical and Industrial Measurements by RK Jain, Khanna Publishers, New Delhi
2. Mechanical Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co, New Delhi
3. Electronic Instrumentation by H S Kalsi; Tata McGraw Hill.
4. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction	08	14
2	Temperature Measurements	10	16
3	Pressure Measurements	18	28
4	Flow Measurements	16	24
5	Level Measurements	12	18
Total		**64**	**100**

5.4 PROCESS CONTROL

L T P
4 - 3

RATIONALE

This course will enable the students to study in detail different types of control devices used in instrumentation and will provide understanding of basic control loops and characteristics of various controllers. The course also introduces various control mechanisms, modes and valves which are necessary to understand simple control systems in a process plant. The contents of the course have been selected and arranged so as to treat it in a logical manner, to understand the important laws of operation of industrial automatic control systems, to provide practical background of theory and to evaluate the effect of changes in process parameters on the control response.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Understand the evaluation criteria and selection techniques of controllers.
- Analyze the working of electrical, pneumatic and hydraulic control element
- Analyze the working of different valves so that well desired control is achieved
- Troubleshoot and identify various switches in the industry
- Understand basic principles and importance of process control in industry

DETAILED CONTENTS

1. Basic Control Loops and Characteristics (08 hrs)

Basics of process control
Different process variables
Single loop temperature control system
Single loop pressure control system
Flow loop Control system
Process lag, Measurement lag and Transmission lag

2. Basic Controller Modes and Characteristics (16 hrs)

Concept of on-off control, advantages and disadvantages.
Proportional, Integral, Derivative action and their combinations PI, PD and PID controls, their examples, merits and demerits.

3. Control Elements (20 hrs)

Construction, principle of operation and applications of
Electrical control elements: limit switches, auto transformer, magnetic amplifier
Electric Actuators
Pneumatic control elements: pneumatic pressure supply, pneumatic actuator,pneumatic relay, Flapper Nozzle system as control element.
Hydraulic control elements: hydraulic actuators, hydraulic valves
I/P Converter and P/I Converter
Comparison between Pneumatic and Hydraulic control systems

4. Control Valves (14 hrs)

Principle of operation, constructional details and applications of
Diaphragm operated valve
Globe valve
Ball valve
Butterfly valve
Solenoid Valve

5. Switches (06 hrs)

Temperature switches
Flow switches
Pressure switches
Interlocking and Sequencing Circuit

Field visits to any relevant process industries or laboratories like paper mills, sugar mill, thermal plant and power house etc. to show them control components physically. The teacher should also explain the salient features of control scheme used there.

LIST OF PRACTICALS

1. To demonstrate the working of any on-off control system
2. To rig up an electronic proportional controller and verify its working
3. To rig up an electronic proportional integral controller unit
4. To rig up an electronic proportional integrated derivative controller unit
5. To demonstrate the working of Auto transformer
6. To demonstrate the working of pneumatic pressure supply.
7. To demonstrate the working of Hydraulic valve.
8. To demonstrate the construction and working of any one control valve.

9. To study the construction and working of a pressure switch.
10. To study the construction and working of a temperature switch.
11. To study the construction and working of a float type of level switch.
12. Case study: Student may visit any one process plant along with teacher and write a report of 4-5 pages.

Note: Industrial Visit may be arranged in concerned industries.

INSTRUCTIONAL STRATEGY

Along with theoretical inputs, visits to process plants must be organized where the students will be exposed to various types of control actions. Small projects in the form of control loops may be identified and given to students as assignments or report writing.

RECOMMENDED BOOKS

1. Process Control by Peter Harrot, Tata McGraw Hill Publishers, New Delhi
2. Automatic process control by Eckman DP; John Wiley and Sons, New Delhi
3. Instrument Engineers Handbook by Liptak BG
4. Process Control Instrumentation Technology by Johnson Curtis D; John Wiley and Sons, New Delhi.
5. Process Measurement and Analysis by Liptak BG
6. Handbook of Applied Instrumentation by DM Considine
7. Mechanical and Industrial Measurements by RK Jain; Khanna Publishers, New Delhi
8. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Basic Control Loops and Characteristics	08	16
2	Basic Controller Modes and Characteristics	16	20
3	Control Elements	20	30
4	Control Valves	14	20
5	Switches	06	14
Total		**64**	**100**

MINOR PROJECT WORK

(Preferably Industry Oriented)

L	T	P
-	-	6

Note: The project may be identified at the end of 4th semester

Realizing the great importance of students' exposure to world of work for his professional growth, two spells of industry oriented projects-minor and major have been included in the curriculum. It is necessary that teachers to play a pro -active role in planning and guidance of individual students for optimizing the benefits of the activity in stipulated time.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Apply concepts, principles and practices taught in the classroom in solving field / industrial problems.

GENERAL GUIDELINES

Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries. Also the students will be able to correlate concepts, principles and practices taught in the classroom with their application in solving field/industrial problems. The work done in minor project work will also prepare them in taking up problem solving at latter stage under major project work.

Depending upon the interests of the students and location of the organization the student may be asked to visit:

1. Process industries like Petrochemical Units/Fertilizers /Paper etc.
2. Various instrumentation industries.
3. Thermal power stations.
4. Electronics and Microprocessor based control system industries.
5. Medical electronics industries.
6. Repair and maintenance workshops.
7. Pressure measuring systems.
8. Digital display systems.
9. Calibration of different types of indicating instruments, measurement of process variables in industry.
10. Repair of different instruments being used in various laboratories.
11. Case study of process industries using PLC or DCS.

LIST OF MINOR PROJECTS

1. LPG leakage detector
2. Smoke detector
3. Mobile detector
4. Street light control
5. Power supply design
6. Clamp switch
7. Fire alarm
5. Metal detector
6. Rain Alarm
7. Fastest finger first
8. A Timer
9. Filters
10. Running Light Control
11. Message Display
12. Digital Alarm Clock
13. PCB Design
14. Temperature Controller
15. Power Supply for Mobile
16. Multiple O/P Power Supply
17. Lab Experimental Trainer Board
18. On-Off Control
19. Use of for controlling speed of motors.

(This list is only suggestive, however other problems may also be identified depending on local industries)

For effective planning and implementation of the above, it is suggested that polytechnics / institutes should:

a) Identify adequate number of industrial/field organizations and seek their approval for deputing students for exposure/visits.

b) Prepare a workbook (which can be used by students) for guiding students to perform definite task during the above mentioned exposure.

c) Identify teachers who would supervise the students activities and provide guidance on continuous basis during the above project work

The components of evaluation will include the following:

Sr. No.	Component	Weightage
a)	Punctuality and regularity	10%
b)	Initiative in learning new things	10%
c)	Relationship with others/workers	10%
d)	Project Report/ Technical report	50%
e)	Seminar based on Project	20%

SOFT SKILLS – III

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Develop communication skills.
- Learn how to speak without fear and get rid of hesitation
- Use effective presentation techniques
- Understand entrepreneurial traits
- Exhibit attitudinal changes

DETAILED CONTENTS

- Communication Skills - Handling fear and phobia
- Resume Writing
- Applying for job through email/job portal
- Interview preparation : Mock Interview, Group Discussions and Extempore
- Presentation Techniques
- Developing attitude towards safety. Disaster management.

In addition, the students must participate in the following activities to be organized in the institute

- Sports NCC/NSS
- NCC/NSS
- Camp Entrepreneurial awareness
- Cultural Event

Note: Extension Lectures by experts may be organized. There will be no examination for this subject

SIXTH SEMESTER

6.1 PLC, DCS and SCADA

L	T	P
4	-	3

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design, modify and troubleshoot such control circuits. Looking at the industrial applications of PLC, DCS and SCADA in the modern industry, this subject finds its usefulness in the present era.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Understand the basic concept and functions of PLC and different programming languages.
- Understand operation and principles of PLC and Selection the PLC
- Have hands on experience with the programming techniques of PLC, design PLC based application
- Understand of the concept of DCS, and its applications
- Implement features of SCADA and its importance in Automation

DETAILED CONTENTS

1. Introduction to PLC (12 hrs)

What is PLC, Concept of PLC
Building blocks of PLC, Functions of various blocks
Limitations of relays, Advantages of PLCs over electromagnetic relays.
Different programming languages
PLC specifications and manufacturers

2. Working of PLC (16 hrs)

Basic operation and principles of PLC
Scan Cycle
Memory structures, I/O structure
Programming terminal, power supply
Comparisons and selection of PLC as per industrial demands

3. Instruction Set (20 hrs)

Basic instructions like latch, master control self-holding relays (MCR).
Timer instructions like ON, OFF and Retentive timers, resetting of timers.
Counter instructions like UP counter, DOWN counter, resetting of counters.
Arithmetic Instructions (ADD, SUB, DIV, MUL etc.)
MOV instruction
RTC(Real Time Clock Function)
Watch Dog Timer
Comparison instructions like equal, not equal, greater, greater than equal, lessthan, less than equal.
Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

4. DCS Concepts (08 hrs)

Concept of DDC
Introduction to DCS
Block Diagram of DCS
I/O Hardware
Advantages of DCS in operation and safety.

5. SCADA Concepts (08 hrs)

Block Diagram and Concept of SCADA
Applications of SCADA in the field of Instrumentation and Control
Introduction to RTU
Introduction to HMI and its advantages.
Difference between DCS and SCADA

LIST OF PRACTICALS

1. Components/sub-components of a PLC, Learning functions of different modules of a PLC system
2. Installation of PLC software and Interfacing of PLC with PC.
3. Practical steps in programming a PLC (a) using a hand held programmer (b) using computer interface.
4. Introduction to ladder diagram symbols, instruction list syntax.
5. Basic logic operations, AND, OR, NOT functions.
6. Logic control systems with time response as applied to Traffic light control.
7. Sequence control system e.g. in lifting a device for packaging and Counting.
8. Ladder diagram for Motor Speed Control
9. Demonstration of Conveyor Belt System.
10. Ladder diagram for Water level Control or Reaction Vessel.

11. Ladder diagram for Star delta starter interface.
12. Practical steps for automatic bottle filling, capping and labeling process.
13. Practical steps for working of lift control through PLC.
14. Make a practical animation for Elevator using SCADA Software.
15. Make a practical process animation for Water treatment using SCADA Software.
16. Use SCADA Software for an application (teacher may decide any two).
17. Use of PLC for an application (teacher may decide any two).

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLC, DCS and SCADA. The inputs shall start with theoretical inputs to architecture, instruction set, ladder logic language programming, Small projects may be identified, be designed and implemented. Concept of DCS, SCADA should be supplemented with visits to relevant industry. More emphasis may be given to practical work.

RECOMMENDED BOOKS

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
4. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
5. Module on "Allen Bradlag PLC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
7. Instrument engineers Handbook - Process Control, Modern Control Techniques for Process Industries by G Liptak
8. Computer based Industrial Control - Krishan Kant, PHI
9. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction to PLC	12	20
2	Working of PLC	16	30
3	Instruction Set	20	30
4	DCS Concepts	08	10
5	SCADA	08	10
Total		**64**	**100**

6.2 BIO-MEDICAL INSTRUMENTATION

L	T	P
4	-	3

RATIONALE

Recent advances in medical field have been fuelled by the instruments developed by the Electronics and Instrumentation Engineers. Pacemakers, ultrasound machine, medical diagnostic systems are few names, which have been contributed by engineers. Now health care industry uses many instruments, which are to be looked after by instrumentation engineers. This subject will enable the students to learn the basic principles of different instruments/equipment used in health care industry. The practical work done in this area will impart skill in the use, servicing and maintenance of these instruments/equipment. Proficiency in this area will widen the knowledge and skill of diploma holders in the field of biomedical instrumentation.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Understand measurement of principles of sensors found in health technologies.
- Familiar with different medical instruments used in Hospitals.
- Familiar with the concept of theoretical and practical preparation enabling students to maintain medical instrumentation.
- Understand about basic medical terms and physical Values that can be handled by medical Instrumentation Engineer.
- Understand methods and implementation of electrical and non electrical medical parameters diagnostics.
- Measure B.P. by analog and Digital instruments.
- Measure blood glucose of a blood sample.

DETAILED CONTENTS

1. Introduction to Biomedical Instrumentation (06 hrs)

Introduction
Development of biomedical instrumentation
Man-instrumentation system and its components
Research and clinical instrumentation
In-vivo and in-vitro measurements
Specifications of medical instrumentation system.

2. Physiology (12hrs)

Introduction
Physiological systems of the body

Cardiovascular system
Respiratory system
Nervous system
Bio-chemical system

3. Biomedical Signals and Electrodes (10hrs)

Study of bio-electric potentials
Resting and action potentials
Bio-electrodes
Electrode- tissue interface
Contact impedance
Types of electrodes

4. Diagnostic Instruments (16hrs)

Brief study of the following
Electro cardiograph(ECG)
Electro encephalograph (EEG)
Electro myograph (EMG)
Pacemakers
Defibrillators
Spirometer
Pulse oxymeter SPO2
NIBP (non invasive blood pressure)
Glucometer
Speech audiometer

5. Bio-telemetry (03 hrs)

Introduction
Block Diagram of Bio-Telemetry Systems
Telemedicine

6. Intensive Care Unit (05 hrs)

Introduction
Elements of Intensive Care Unit (ICU)
Introduction of Ventilators

7. Computer applications (12 hrs)

Computer applications in biomedical devices
Computerized Axial Tomography(CAT) scanners
Applications of Embedded system in Bio-medical instrumentation

Note: Field visit be arranged for students during the semester for exposure and better understanding of the subject.

LIST OF PRACTICALS

1. To measure blood pressure of a person using analog and digital B.P. gauge.
2. To study the various physiological systems of the body.
3. To study the electrode-tissue interface and contact impedance.
4. To study the concept of EEG.
5. To study the concept of EMG.
6. Visit of Intensive Care Units (ICUs), for practical number 4 and 5 of a hospital and to prepare a report.
7. Measurement of blood sugar of a patient using glucometer.
8. Measurement of heart beat with ECG machine using cardio-scope / ECG machine.

INSTRUCTIONAL STRATEGY

In addition to classroom teaching, maximum stress may be given on practical exposure in nearby hospitals, clinics, biomedical laboratories etc. Expert lectures may be arranged from field/organization related to biomedical instruments.

RECOMMENDED BOOKS

1) Biomedical Instrumentation and Measurements by Cromwell; Prentice Hall of India, New Delhi.
2) Hand book of Medical Instruments by RS Khandpur.
3) Medical Electronics and Instrumentation by Sanjay Guha-University Publication.
4) Bio-Medical Instruments by KR Nahar
5) Introduction to Biomedical Equipment Technology by Carr, Pearson Education, Sector-62, Noida.
6) Servicing Medical and Bio-electronic Equipment by Carl JJ.
7) Electronics for Medical Personnel by Buckstein
8) E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1	Introduction to Biomedical Instrumentation	6	05
2	Physiology	12	25
3	Bioelectric Signals and Electrodes	10	15
4	Diagnostic Instruments	16	25
5	Bio-telemetry – Introduction	03	05
6	Intensive Care Unit	05	10
7	Computer applications	12	15
Total		**64**	**100**

ELECTIVE

(a) OPTO ELECTRONIC DEVICES AND THEIR APPLICATIONS

L	T	P
4	-	3

RATIONALE

To impart latest developments in the opto electronic devices and fiber optics in the field of measurement and instrumentation technology, this subject is included in the syllabus.

LEARNING OUTCOMES

After undergoing the subject, students will be able to understand:

- Optical Sources like LED, Laser diode etc.
- Different types of photodetectors.
- Concept of laser.
- Different type of optical instrumentation
- Fundamental of optics.

DETAILED CONTENTS

1. Fundamentals of optics (10 hrs)

Reflection, refraction, diffraction interference, polarization, photo-electric field, dispersion

2) Optical sources (08 hrs)

Light emitting diodes (LEDs), their structure, materials characteristics, efficiency, laser diodes, infrared and ultra-violet sources, power LEDs.

3) Photo-detectors (08 hrs)

Photo-diodes, Avalanche photo-diodes, PIN diodes, LDRs and photo-conductive devices, phototransistors, opto-isolators.

4) Optical fibers and their applications (16 hrs)

Principle of transmission through fiber, construction, classification and material consideration of optical fiber, mode of communication, characteristics of fibers, optical transmitters and detectors used in optical fibers, coupling, splices and connectors.

5) Lasers (10 hrs)

Fundamentals of laser emission, types of Lasers. Use of Lasers in measurement of dimensions, distance, velocity, acceleration, Industrial applications of Lasers

6) Optical instruments (12 hrs)

Light intensity meter, optical pyrometer, polari-meter, infra-red thermometer, spectro-photo meter, optical filters, beam splitters.

LIST OF PRACTICALS

1. Verification of laws of reflection in curved mirrors.
2. Measurement of refractive index and critical angle.
3. Measurement of light intensity/optical power of 1. A bulb, 2. LED, 3. Laser diode and its variation with distance.
4. Study characteristics of photo-diode detector and one of its applications (say light intensity measurement).
5. Use of photo-resistor (LDR) for controlling light sensitive switch.
6. Study and use of opto – isolation, triggering an SCR/Triac.
7. Study and use of optical pyrometer for temperature measurement.
8. Measurement of distance using laser based trans-receiver.
9. Study and use of optical fiber based trans-receiver.
10. Detection of laser beam using Photodiode.

RECOMMENDED BOOKS

1. Optical Fiber Communication by M Senior; Prentice Hall of India, New Delhi
2. Fiber Optics: Theory and Practices by W.B. Allan, Plenum Press, London
3. Optical Electronics by A K Ghatak and K Thyagrajan, Cambridge Press
4. Optical Electronics by Amnon Yarib; CBS College Publishing.
5. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic Name	Time Allotted (hrs)	Marks Allocation (%)
1	Fundamentals of optics	10	10
2	Optical sources	08	15
3	Photo-detectors	08	10
4	Optical fibers and their applications	16	25
5	Lasers	10	15
6	Optical instruments	12	25
Total		**64**	**100**

6.3(b) ADVANCED MEASUREMENT TECHNIQUES

L	T	P
4	-	3

RATIONALE

The syllabus has been designed to impart knowledge about various measurement techniques to the students. These concepts will help the students in learning advanced measurement techniques comprising optical, vibration, ultrasonic etc.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Explain importance of measurement
- How to deal with input output configuration.
- Use various measuring devices.
- Use instrument for measurement of Velocity & Vibration.
- Use instruments for measurement of a density, Ph & Viscosity
- Explain controlling system of a particular instrument.

DETAILED CONTENTS

1. Review of Measurement System (08 hrs)

Functional elements of a measuring system
Input – output configuration of instrumentation system

2. Measurement of (Length, Angle & Area) (14 hrs)

Length Measuring Standard Instruments (Meter Rods, Scale, Tapes, Micrometer,Vernier Calliper)
Angle Measuring Standard Instruments (Protector, Clinometers and Dial Bevel Protractor)
Area Measuring Standard Instruments (Graphical Method and Numerical Method)

3. Measurement of Vibration (Velocity & Vibration) (16 hrs)

Linear Velocity Measurement by using (Electro Magnetic, Seismic, Doppler,Digital Transducer)
Angular Velocity Measurement by using
Tachogenerator (Photo Electric, Tooth Rotor Variable Reluctance)
Stroboscope Methods
Vibration Measurement by using Seismic Transducer (Potentiometric, LVDT,Strain Gauge Accelerometers)

4. Opto Electronic Measurement (10 hrs)

Photo sensitive devices – light emitting diodes, LDR, photo conductors
Photo voltaic cell, photo Thyristor, photo transistors, opto-isolator
Light modulating techniques – light suppression, light attenuation, photo-metricand radiometric fittings

5. Miscellaneous Measurements (16 hrs)

Measurement of density and specific gravity (by using Hydrometer, LVDT, Gamma Rays, Force Balance Methods).
Measurement of Ph.
Measurement of Viscosity by using falling sphere, falling piston and rotating cylinder viscometer.
Measurement of Thickness by using Resistive, Capacitive, Inductive, Nuclear and Ultrasonic methods.

LIST OF PRACTICALS

1. Measure thickness of plate using micrometer
2. Measure inner and outer Diameter of pipe using Vernier Calliper
3. Measure angle of a given sample using Dial Bevel Protractor
4. Measure thickness of plate using any thickness measuring scheme
5. Measure angular speed using Stroboscope
6. Measure Angular Velocity using Electro Magnetic Method
7. Measurement of Ph of a given solution
8. Use of LDR for controlling light sensitive switch.
9. Study and use of opto – isolation, triggering an SCR/Triac.

INSTRUCTIONAL STRAGEGY

Since the subject is of practical nature, it is suggested that teacher must take the students for visit of nearby process industry and show them different measurement devices. It is also recommended that various measurement devices may be brought in the lab for demonstration purpose. Student may be encouraged to explore the information on the Net.

RECOMMENDED BOOKS

1. Measurement systems, Application and Design – E.O Doeblin, McGraw Hill International Editions
2. A Course in Electrical and electronics Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co Pvt. Ltd., New Delhi
3. Mechanical and Industrial Measurement by R K Jain, Khanna Publishers, New Delhi.
4. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE /

NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation
1	Review of Measurement System	8	12
2	Measurement of (Length, Angle & Area)	14	24
3	Measurement of Vibration (Velocity & Vibration)	16	26
4	Opto Electronic Measurement	10	12
5	Miscellaneous Measurements	16	26
	Total	**64**	**100**

6.3(c) VIRTUAL INSTRUMENTATION

L	T	P
4	-	3

RATIONALE

Virtual instrumentation is one of the latest emerging techniques in the field of instrumentation. Because of its numerous advantages over traditional instruments, VI is being used in almost every field. Knowledge of this subject will enable diploma students to make them aware of hardware, software and interfacing devices and its importance in the field of instrumentation.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Understand the Lab VIEW and its functions.
- Learn about Data Acquisition system in Lab VIEW.
- Understand about instrumentation buses.
- Learn various application of VI in process industry.

DETAILED CONTENTS

1. Introduction to Virtual Instrumentation (08 hrs)

Historical perspective, advantages of virtual instruments over conventional / traditional instruments block diagram and architecture of virtual instruments.

2. Learning Lab view (22 hrs)

Introduction, Front panel, Block diagram, Menus, Palettes, VI &Sub VI, Editing and Debugging VI, Structures, Arrays, clusters, charts & Graphs, Data acquisition, Instrument control, signal processing examples.

3. Data Acquisition Basics (20 hrs)

ADC, DAC, DIO, connectors and timers, PC hardware structure, Introduction to various Data Acquisition Cards

4. Common Instrumentation Interfaces (08 hrs)

Introduction to RS232 / RS485, GPIB, USB, instrumentation buses (introduction such as inter bus).

5. Applications of VI in process control like pressure, temperature control etc. (06 hrs)

LIST OF PRACTICALS

1. G-programming using LAB view/flex pro.
2. Create a simple VI consisting of a dial and a thermometer.
3. Developing VI for converting temperature in degree Centigrade to degree Fahrenheit
4. Creation of sub-VI using above VI as sub VI to convert the temperature in degree Kelvin.
5. Application of LABVIEW / Flex Pro.
6. Simulation of Process control system using computer simulation.
7. Acquisition of signals from transducers such as temperature, acceleration or function generator using USB interface and transfer the same to PC.

RECOMMENDED BOOKS

1. LABVIEW Graphical Programming by Gary Johnson; Tata McGraw Hill Publishing Co. New Delhi.
2. Basic Concepts of LABVIEW 4 by SOKO loft; PHI
3. PC Interfacing for data acquisition and Process Control by S Gupta, JP Gupta; Instrument Society of America.
4. Learning with Lab View 7 by Robert H. Bishop, Pearson Education.
5. Lab view for Every One by Jeffrey Tran's, Pearson Education.
6. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Introduction to Virtual Instrumentation	8	15
2	Learning Lab view	22	30
3	Data Acquisition Basics	20	30
4	Common Instrumentation Interfaces	8	15
5	Applications of VI in process control like pressure, temperature control etc.	6	10
Total		**64**	**100**

6.3 (d) AUTO ELECTRICAL

L	T	P
4	-	3

RATIONALE

Diploma holders of engineering background have to deal with different types of batteries, their charging and testing, regulators, lighting system and various other electrical accessories used in automobiles. Hence the subject of automotive electric equipment is very essential for diploma holders.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- Identify various auto-electrical faults/troubles and their causes.
- Analyze and rectify various auto-electrical troubles with the help of troubleshooting charts.
- Use suitable instruments and tools for diagnosis and testing of automotive electrical system.
- Describe different type of accessories used in automobiles.
- Explain charging and starting system.

DETAILED CONTENTS

1. Introduction (04 Periods)

Various Electrical and Electronics equipment components/systems in Automobile. Their functions and demands, earth return system, types of earthing, 6V, 12V system.

2. Batteries (12 Periods)

Lead Acid Batteries: Construction, working, elements, types, materials used, electrolyte and its strength, effect of added plate area and temperature, rating, capacity, efficiency, temperature characteristics, terminal voltages, charging and discharging.

Battery Testing: Electrolyte testing by hydrometer, voltage test, high discharge and cadmium test. (Voltage)

Battery Charging: Constant potential and constant current, initial charging, normal charging, trickle charging, intermittent charging, boost charging.

Battery Defects: Stipulation, plates decay, working, erosion, cracking, sedimentation, separator defects, short circuits, overcharging

Basic description of Alkaline Batteries:

2.6 Lithium ion battery: Construction and working

3. Charging System (10 Periods)

Circuits, function and various components, dynamo and alternator, types, construction, working, advantages and disadvantages of dynamo and alternators, drives, cut out relay.
Regulation: Functions of various components of two unit, three unit and heavy duty Regulators, Regulators for alternators.

4. Starting System (10 Periods)

Function of various components, torque terms, principle and constructional details of starter motor, switches, types, starter to engine drive and their types, integrated started motor.

5. Lighting System (08 Periods)

Various lighting circuits, head lamp, type and constructional details, sealed beam, double filaments, asymmetric and dual units, vertical and side control of lamps, fog light, side light, brake light, instrument light, indicator lights, reversing light, lamp mounting.
Wiring: HT and LT, their specifications, cable colour codes, wiring Harness, Cable connections, Wiring diagrams of cars and two wheeler, Fuses, faults and rectification.

6. Electrical Accessories (08 Periods)

Fuel gauges - bimetallic and balancing coil type, Air Pressure gauges, temperature gauges, Ammeter, warning light, speedometer, wind screen wipers, horns, horn relay, electric fuel pump, Faults and rectification.

7. Control Area Network (07 periods)

Block diagram
Control of different sub systems in modern automobiles using micro controller.

8. Miscellaneous Electrical Equipments (05 Periods)

Impulse Speedometer, tachometer, heater, defroster, Air conditioner, and Electric door locks, window actuation, Seat adjusters.

LIST OF PRACTICALS

1. Testing of battery - specific gravity test using hydrometer, voltage test, high rate discharge test; Charging of battery using battery charger.
2. Testing of field winding of alternator and armature of starter motor for open circuit, short circuit and Earthing.
3. Study and sketching of various lighting circuits on a working model circuit board.

4. Basic electrical checks: - Battery connections, electrical bulbs and units, circuit protection devices, wiring harness connections, colour coding.
5. Replacement of head lamps, tail lamps, indicator lamps, fog lamps and lamp holders.
6. Head light beam alignment and setting
7. Testing and setting of horn and relay.
8. Servicing of windscreen wiping system; replacement of wiper blade assembly.

INSTRUCTIONAL STATREGY

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Automobile Engineering by Dr. Kirpal Singh, Standard Publishers, Delhi
2. Automotive Electrical Equipment by P.L. Kohli, Tata McGraw Hill, Delhi
3. Automotive Electrical Equipment by William H. Crouse, Tata McGraw Hill, Delhi
4. Automobile Engineering by Dr. R.B. Gupta, Satya Prakashan, New Delhi
5 E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/ NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	Introduction	04	06
2	Batteries	12	20
3	Charging System	10	16
4	Starting System	10	16
5	Lighting System	08	12
6	Electrical Accessories	08	12
7	Control Area Network	07	10
8	Miscellaneous Electrical Equipment	05	08
Total		**64**	**100**

ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	T	P
3	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mindset with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of the organization.
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, JIT and CRM.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (10 Periods)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms and other forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State,

District –level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation (08 Periods)

- Scanning of the business environment
- Salient features of National and Haryana State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection
- Converting an idea into a business opportunity

3. Project report Preparation (06 Periods)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report
- Sample project report

SECTION –B MANAGEMENT

4. Introduction to Management (04 Periods)

- Definitions and importance of management
- Functions of management: Importance and process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations and their advantages
- Line organisation, staff organisation
- Line and staff organisation
- Functional Organisation

5. Leadership and Motivation (03 Periods)

a) Leadership
   - Definition and Need
   - Qualities and functions of a leader

- Manager Vs leader
- Types of leadership
- Case studies of great leaders

b) Motivation
- Definition and characteristics
- Importance of self motivation
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (06 Periods)

a) Human Resource Management
- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management
- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales
- Introduction, importance, and its functions
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management
- Introductions, importance and its functions
- knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (04 Periods)

Introduction and importance of Healthy Work Culture in organization
Components of Culture
Importance of attitude, values and behavior
Behavioral Science – Individual and group behavior.
Professional ethics – Concept and need of Professional Ethics and human values.

8. Basic of Accounting and Finance (04 Periods)

a) Basic of Accounting:
- Meaning and definition of accounting
- Double entry system of book keeping
- Trading account, PLA account and balance sheet of a company

b) Objectives of Financial Management

- Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (03 Periods)

a) Total Quality Management (TQM)
- Statistical process control
- Total employees Involvement
- Just in time (JIT)

b) Intellectual Property Right (IPR)
- Introduction, definition and its importance
- Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. E-books/e-tools/relevant software to be used as recommended by AICTE / HSBTE / NITTTR.

Websites for Reference:

http://swayam.gov.in

https://nptel.ac.in/course.html

SUGGESTED DISTRIBUTION OF MARKS

Sr. No.	Topic	Time Allotted (Periods)	Marks Allotted (%)
1	Introduction	10	20
2	Market Survey and Opportunity Identification /Ideation	08	16
3	Project report Preparation	06	14
4	Introduction to Management	04	10
5	Leadership and Motivation	03	06
6	Management Scope in Different Areas	06	14
7	Work Culture	04	08
8	Basic of Accounting and Finance	04	08
9	Miscellaneous Topics	03	06
Total		**48**	**100**

MAJOR PROJECT WORK

L	T	P
-	-	9

RATIONALE

Project plays an important role in the final stage of learning for assimilation of all what has been learnt till now. It also gives an opportunity to the students to show their innovation capabilities. In addition, it gives a confidence in handling different technical situations faced in the world of work. In this syllabus, topics of projects have been listed. The faculty is advised to encourage new projects to be cultivated by the students themselves.

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

- Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project.

In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines:

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify the project or give project assignment at give least two to three months in advance. The project work identified in collaboration with industry should be preferred.

The students may be given major project assignment for a period of 8 weeks at a stretch during the final semester. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. During this project period, concerned teacher will monitor the progress of students on regular basis. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

The students will submit a comprehensive project report (in a presentable manner, preferably typed and bound) for evaluation by the teacher/guide, an expert from industry and an external examiner.

SUGGESTED LIST OF PROJECTS

Some of the project activities are given below:

1. Controls of Thermal Power station and Cement Plant. Prepare process flow and piping and instrumentation diagram of a section. Identify their various instruments, systems and control parameters, ranges, specifications and making of each item.
2. Design and rigging up of a simple control loop for example temperature control in an oven, maintaining constant temperature in hot water tank, level control in a water tank, flow control in a pipe line, control of pressure in a pressurized vessel by injection (acid or alkali).
3. Design and making a simple on/off controller for temperature using ICs, capacitors, resistors on a printed circuit board.
4. Design an alarm annunciation scheme for motor control (trip, supply, failure, overheating) and realizing the same in a control panel using lamps.
5. Design and making a DC regulated power supply.
6. Design and fabricate a digital combination lock
7. Design and fabricate a digital frequency counter.
8. Design and fabricate a digital stop watch.
9. Design and fabricate a digital timer.
10. To dismantle and lap a control valve. Assemble and test it hydraulically.
11. Design and fabricate a simple measuring instruments for temperature, pressure, flow or level
12. Design and fabricate a signal converter.
13. Design and fabricate a signal transmitter.
14. Use of PLC for DAS controls.
15. Design, construction and implementation of load cell in a given problem
16. Design and construction of pressure transducers for industrial implementation
17. ECG analyzer while taking a case
18. Spiro data analysis for a given case

19. PLCs based design and implementation for industrial control system
20. Study and analysis of a plant Digital Distribution Control (DDC)
21. Study and analysis of a plant SCADA
22. Study and analysis of automation of a cement plant, sugar plant and Regional Research Laboratory.
23. Study and analyze automation of textile/refinery
24. Study and analyze distributed control system (DCS)
25. Data acquisition and handling for industrial problems
26. Waveform Generation using 8085
27. Measurement of Certain parameters in CNC Lathe/ Milling Controller
28. Trouble shooting of industrial plant operations
29. Estimation and costing of control system design in an industrial plant
30. Production scheduling and control technology in an industrial plant instrumentation
31. Stepper motor control using 8-bit micro-controller/ microprocessor
32. 2 x 16 alphanumeric LCD interface using 8-bit micro-controller/microprocessor
33. EPROM programmer using 8051 series micro-controller/microprocessor
34. Real time clock using 8-bit micro-controller/microprocessor
35. Temperature control using 8-bit micro-controller/microprocessor
36. Draw specifications, diagrams of various equipment systems and accessories used in a process control system. Prepare cost and time estimates
37. Draw specifications, diagrams of various equipment system and accessories used in process control in the
    a) Heat exchanger
    b) Evaporator
    c) Crystalizer
    d) Ratio control
    e) Cascade control
    f) Feed forward control
    g) Distillation column
38. Simulate control operations of
    i) pressure control and compressor
    ii) Simulate control operations of temperature control
    iii) Simulate control operations of ratio control
    iv) Simulate control operations of cascade control
    v) Simulate control operations of feed forward control

39 a) To operate and control the temperature by PLC
   b) To operate and control the flow by PLC
   c) To operate and control the pressure by PLC
   d) To operate the cascade control using PLC
   e) To operate the ratio control by PLC

f) Simple control of pick-and-place robot using PC/PLC
g) Alphanumeric display system using LEDs
h) Digital Pulse rate meter using photo sensor
i) Design and fabrication of a panel for control of temperature and Pressure in a boiler
j) Study of various control elements in furnace instrumentation.

Additional List

1. Automatic Data level controller using Microcontroller
2. On-Off Temperature controller/Display using Microcontroller
3. Seven segment display using Micro-controller
4. Design of real time-clock using micro-controller
5. Automatic land Rover using Micro-controller
6. Automatic land Rover Control using Mobile phone.
7. Water level control using Micro-controller
8. Water level control using Mobile phone
9. Home Lighting control system using mobile phone
10. Control of conveyor belt using PLC
11. Water level control using PLC
12. Temperature control using PLC/MC
13. Traffic light control using PLC/MC
14. Secure Door opening control MC
15. Home security system using Mobile phone/MC
16. To control flow of liquid using PLC
17. To design a display system using Micro-controller
18. To design a object counter using PLC and MC
19. Speed checker for highways
20. Line followed Robot based on MC.
21. Speed control of motor using M.C
22. Control of Railway crossing using M.C.
23. Buzzer Control using M.C.
24. Steeper motor control using MC.
25. To control a Robotic arm using MC.
26. Water purifier system
27. Inverter
28. UPS
29. Solar energy based project
30. Wind energy based project
31. Sequence control using PLC.

Note:

1. **The list is only the guideline for selecting a project, however a student is at liberty to select any other related project of his choice independently under guidance of his teacher**
2. **The quality of end-product and process adopted by the students in its execution should be taken into consideration along with other parameters while evaluating the students**
3. **The project should be preferably undertaken by a group of students depending upon cost and time involved.**

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max. Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1	Selection of project assignment	10	10	8	6	4	2
2	Planning and execution of considerations	10	10	8	6	4	2
3	Quality of performance	20	20	16	12	8	4
4	Providing solution of the problems or production of final product	20	20	16	12	8	4
5	Sense of responsibility	10	10	8	6	4	2
6	Self-expression/communication Skills	5	5	4	3	2	1
7	Interpersonal skills/human relations	5	5	4	3	2	1
8	Report writing skills	10	10	8	6	4	2
9	Viva voce	10	10	8	6	4	2
TOTAL MARKS		**100**	**100**	**80**	**60**	**40**	**20**

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students' performance as per the above criteria.
4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work.

SOFT SKILL - IV

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Communicate effectively
- Apply techniques of effective time management
- Develop habits to overcome stress
- Face problems with confidence
- Exhibit attributes required to appear for an interview
- Learn about current and future career opportunities
- Exhibit entrepreneurial skills
- Use QC/QT tools

DETAILED CONTENTS

- Communication Skills – Presentation
- Time management
- Stress Management
- Problem solving
- Career opportunities-Current and future
- Entrepreneurial Skills
- Quality and Quality tools used in industry

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Cultural Event

Note: Extension Lectures by experts may be organized. There will be no examination for this subject.