CURRICULUM

for

DIPLOMA PROGRAMME

in

INSTRUMENTATION ENGINEERING

3rd Year (5rd & 6th Semester)

FOR THE STATE OF HIMACHAL PRADESH

June, 2019

Study & Evaluation Scheme

5th SEMESTER (Instrumentation Engineering)

Sr. No.	SUBJECTS	STUDY SCHEME Hrs/Week		EVALUATION SCHEME								Total Marks of Int. &Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
5.1	Industrial Instrumentation**	5	2	30	20	50	100	3	50	3	150	200
5.2	Analytical and Biomedical Instrumentation	5	2	30	20	50	100	3	50	3	150	200
5.3	Process Control	5	2	30	20	50	100	3	50	3	150	200
5.4	Control System-II	5	2	30	20	50	100	3	50	3	150	200
5.5	Elective-I 5.5.1 Data Acquisition & Networks 5.5.2 Introduction to Machine Learning 5.5.3 Internet of Things	4	2	30	20	50	100	3	50	3	150	200
5.6	Practices in Communication Skills*	0	2	-	50	50	-	-	50	3	50	100
Industrial Training		-	-	-	50	50	-	-	50	3	50	100
Student Centered Activities		-	4	-	25	25	-	-	-	-	-	25
Total		**24**	**16**	**150**	**225**	**375**	**500**	**-**	**350**	**-**	**850**	**1225**

*Common with other diploma programmes

**Common with diploma in Electrical and Electronics Engineering

Note: *Apart from the above mentioned number of hours for each subject (Theory & Practical), at least **TWO** hours/week for each class should be allocated for Library to motivate the students to attend library compulsory. The attendance of library period should be added in master attendance.*

Study & Evaluation Scheme

6th SEMESTER (Instrumentation Engineering)

Sr. No.	SUBJECTS	STUDY SCHEME Hrs/Week		EVALUATION SCHEME								Total Marks of Int. &Ext.
				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr	Th	Pr	Total	Th	Hrs	Pr	Hrs	Total	
6.1	Digital Signal Processing	4	2	50	-	50	100	3	-	-	100	150
6.2	Maintenance and Trouble Shooting	4	2	30	20	50	100	3	50	3	150	200
6.3	Programmable Logic Controllers and SCADA*	4	2	30	20	50	100	3	50	3	150	200
6.4	Virtual Instrumentation	4	2	30	20	50	100	3	50	3	150	200
6.5	Elective-II 6.5.1 Industrial Electronics 6.5.2 Industrial Automation & Robotics	4	2	30	20	50	100	3	50	3	150	200
6.6	Major Project	-	8	-	100	100	-	-	100	3	100	200
	Student Centered Activities	-	2	-	25	25	-	-	-	-	-	25
	Total	**20**	**20**	**170**	**205**	**375**	**500**	**-**	**300**	**-**	**800**	**1175**

* Common with diploma in Electronics and Communications Engineering

Note: *Apart from the above mentioned number of hours for each subject (Theory & Practical), at least **TWO** hours/week for each class should be allocated for Library to motivate the students to attend library compulsory. The attendance of library period should be added in master attendance.*

5.1 INDUSTRIAL INSTRUMENTATION

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RATIONALE

Measurement of different parameters in the field of Instrument Engineering is very important, hence the syllabus has been designed in two parts to give through in sight in the measurements of parameters. Different methods of measurement and their appropriate selection with limitation have also been considered to bring the students to a level where they will be able to solve practical problems faced in the field.

DETAILED CONTENTS

1. **Temperature Measurement** **(20 hrs)**

- 1.1 Introduction to Temperature, Temperature scales and Conversions.
- 1.2 Methods of Temperature Measurements
  - 1.2.1 Expansion Type: Bi-Metallic Thermometer, Liquid in Glass and Metal Thermometer.
  - 1.2.2 Electrical Type
    - 1.2.2.1 RTD: Principle, Working, Construction and Types with Ranges, Different Configurations of RTD: Two Wire, Three Wire and Four Wire, Lead Wire Compensation in RTD, Applications.
    - 1.2.2.2 Thermistor: Principle, Working, Construction, Types, Applications.
    - 1.2.2.3 Thermocouple: Different Thermal Effects (Seebeck, Peltier and Thomson), Working Principle (Seebeck Effect), Thermocouple Construction, Types of Thermocouple (only Material of Constructions and their Ranges): J, K, T, E, N, S, R and B Type, Cold Junction Compensation of Thermocouples.
    - 1.2.2.4 Pyrometers: Radiation Pyrometers and Optical pyrometer.

2. **Level Measurement** **(15 hrs)**

- 2.1 Introduction to Level Measurement.
- 2.2 Methods of Level Measurement: Direct Methods and Indirect Methods.
- 2.3 Direct Methods: Visual level indicator, Hook Type Level Indicators, Float Type Level Indicators.
- 2.4 Indirect Methods (Hydrostatic Pressure Type): Pressure Gauge Methods, Air Bellows and Air Purge System.
- 2.5 Indirect Methods (Electrical Type): Resistance Type, Capacitance Type, Gamma ray Type (Radiation Type) and Ultrasonic Type.

3. **Flow Measurement** **(25 hrs)**

- 3.1 Introduction to Flow Measurement, Concept of Volumetric and Mass Flow Rate.
- 3.2 Concept of Reynolds Number in Flow Measurement, Different Types of Flow: Laminar and Turbulent, Bernoulli Equation.
- 3.3 Methods of Flow Measurement:

3.3.1 Variable Head/Differential Pressure/Obstruction Type Flow Meters:
3.3.1.1 Basic Operating Principle, Concept of Pressure Head.
3.3.1.2 Primary Elements of Differential Flow Meters: Orifice Plate, Venturi Tube, Flow Nozzle and Pitot Tube.
3.3.2 Variable Area Flow Meter: Rotameter.
3.3.3 Electromagnetic Flow Meter.
3.3.4 Ultrasonic Flow Meter.
3.3.5 Turbine Flow Meter.
3.3.6 Mass Flow Meter.

4. **Pressure Measurement** **(20 hrs)**

4.1 Introduction to Pressure and different types of Pressure.
4.2 Methods of Pressure Measurement:
4.2.1 Manometer: U Tube Manometer, Barometer, Inclined Manometer and Well Type Manometer.
4.2.2 Elastic Pressure Transducers: Bourdon Tube, Diaphragm and Bellow Type.
4.2.3 Force Balance Type: Dead Weight Tester.
4.2.4 Electrical Type: Strain Gauge Pressure Transducer, Potentiometric Pressure Transducer, Capacitive Pressure Transducer and LVDT Type Pressure Transducer.
4.3 Measurement of Vacuum: Pirani Gauge, Capsule Gauge, Mcleod Gauge, Thermal Conductivity Gauge.

LIST OF PRACTICALS

1. To Study a Resistance Thermometer.
2. To Study Variable Area Flow Meter.
3. To Observe Flow Rate using a Turbine Type Flow Meter.
4. To Dismantle and Assemble a Bourdon's Pressure Gauge and identify its parts.
5. To Observe Pressure using Pressure Gauge of a Pressure Tank.
6. To Calibrate a Pressure Gauge using a Dead Weight Tester.

RECOMMENDED BOOKS

1. Industrial Instrumentation and Control, by S. K. Singh, TMH.
2. Introduction to Instrumentation and Measurement, by A. K. Ghosh, PHI.
3. Instrumentation Measurement and Analysis, by B. C. Nakra and K. K. Chaudhary, TMH.
4. Industrial Instrumentation, by Umesh Rathore, S. K. Kataria.
5. Industrial Instrumentation, by K. Krishnaswamy, New Age Publication.
6. Measurement, Instrumentation & Sensors, by John G. Webster, Springer.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs)	Marks Allotted (%)
1	20	25
2	15	20
3	25	30
4	20	25
Total	**80**	**100**

5.2 ANALYTICAL AND BIOMEDICAL INSTRUMENTS

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RATIONALE

Analytical and Biomedical Instruments branch is used in the industries for checking and testing incoming or final product for quality and required specifications. The latest techniques such as laser, radioactive isotopes etc. have been included. Bio Medical Instruments are very important for the human treatment as they help to find the actual diseases in the human body. After careful inspection and real results doctors are able to treat the patient rightly. Bio-medical instrumentation industry is developing day by day, swell as these instruments are being installed in number of Public/Private medical centers. The instrumentation technician is the person who is to work with Bio-medical instruments and has to repair and maintain them in the medical centers. The knowledge gained in this subject will help the students to work in this field.

DETAILED CONTENTS

1. Introduction (10 hrs)

1.1 Elements of an Analytical Instrument
1.2 Properties of Analytes & Techniques used in Analytical Instruments, Types of Analytical Methods
1.3 Electromagnetic Radiation & Optical Spectrum (UV, Visible & IR)
1.4 Radiometry & Photometry- Definition
1.5 Concept of Interaction of Radiation with Matter
1.6 Laws related to Absorption of Radiation: Lambert's Law, Beer's Law & Beer-Lambert law

2. Spectroscopy (22 hrs)

2.1 Absorption Instruments & its Various Components: Block Diagram having Sources of Radiation, Optical Components & Detecting System
2.2 UV-Vis Absorption Spectroscopy
2.3 Filter Photometers: Single Beam Filter Photometer & Double Beam Filter Photometer
2.4 UV Spectrophotometers: Single Beam Spectrophotometer & Double Beam Spectrophotometers
2.5 IR Spectrophotometer: Introduction to Infrared Spectroscopy, Basic Components of IR Spectrophotometers: Radiation Sources, Mono-chromators, Slits, Mirrors & Detectors. Double Beam IR Spectrophotometer

3. Flame Emission And Atomic Absorption Spectroscopy (10 hrs)

3.1 Flame Photometers: Principle of Flame Photometry, Constructional details of Flame Photometers: Emission System, Selection System & Recording Systems
3.2 Atomic Absorption Spectrophotometer: Atomic Absorption Spectroscopy, Atomic Absorption Spectrophotometer

4. Nuclear magnetic resonance spectroscopy (08 hrs)

4.1 Introduction to NMR Spectroscopy
4.2 Principles of NMR: Nuclear Spin, Nuclear Energy Levels, Resonance Conditions, NMR Absorption Spectra, Chemical Shift
4.3 Nuclear Magnetic Resonance Spectrometer: Block Diagram, Construction & Working

5. Introduction To Biomedical Instrumentation (12 hrs)

5.1 Sources/Origin of Bio-Medical/Bio-Electric Signals
5.2 Generalized Block Diagram of Biomedical Instrumentation System
5.3 Various Types of Bio-Medical Electrodes
5.4 Basics of Pulse Rate Measurement
5.5 Blood Pressure Measurement using Sphygmomanometer & Stethoscope
5.6 Basic Concept of Telemedicine Technology & its Applications

6. Biomedical Recorders & Equipments (18 hrs)

6.1 ECG: ECG Signal, ECG Machine Block Diagram, ECG Recording Analysis & Applications
6.2 EMG: EMG Signal, EMG Signal, EMG System Block Diagram & Applications
6.3 EEG: EEG Signals, EEG Mchine Block Diagram & Applications
6.4 CT Scan: CT Scanner Principle, Block Diagram, Working & Applications
6.5 Pacemakers: Principle of Operation & Need of Pacemakers & Different Types of Pacemakers
6.6 Defibrilators: Principle of Operation & Need of Defibrilators & Different Types of Defibrilators

LIST OF PRACTICALS

1. Study of Filter Photometer.
2. Study of Flame Photometer.
3. Study of Spectrophotometer.
4. Study of Heart Rate Monitor.
5. Study of ECG Machine.
6. Study of EMG Trainer.
7. Study of EEG Trainer.

RECOMMENDED BOOKS

1. Handbook of Analytical Instruments,by R.S. Khandpur, TMH
2. Handbook of Biomedical Instrumentation,by R.S. Khandpur, TMH
3. Handbook of Analytical Instrumentation,by Bela G. Liptak
4. Biomedical Instrumentation & Measurements, by Leslie Cromwell, PHI
5. Introduction to Biomedical Instrumentation, by Mandeep Singh, PHI.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	10
2	22	30
3	10	10
4	08	10
5	12	15
6	18	25
Total	**80**	**100**

5.3 PROCESS CONTROL

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RATIONALE

The subject enables the students to study in detail different types of control systems used in instrumentation. The contents of the syllabus lead the students to appreciate the importance and limitation of different types of process controls. Knowledge of tuning of a process control loop is covered in depth. It deals with operation and characteristics of various controllers and with actual controlling aspect involved in process control loops.

DETAILED CONTENTS

1. **Introduction to Process Control** **(18 hrs)**
   - 1.1 Introduction to Process Control
   - 1.2 The Feedback Principle
   - 1.3 Block Diagram Representation of Process Control System
   - 1.4 Various Components/Elements & Terms of Process Control System: Sensor/Transducer, Controller, Final Control Element, Error Detector, Controlled Variable, Process Variable, Set Point, Manipulated Variable, Disturbances
   - 1.5 Process Characteristics: Process Equation, Process Load, Process Lag, Self-Regulation
   - 1.6 Control System Parameters: Error, Control Lag, Dead Time, Cycling, Reverse-Direct Action

2. **Theory of Controllers** **(25 hrs)**
   - 2.1 Introduction & Classification of Controllers
   - 2.2 Discontinuous Controllers: On-Off Controller Mode, Multi-position Controller Mode, Floating Control Mode
   - 2.3 Continuous Controllers: Proportional (P) Controller, Integral (I) Controller, Derivative (D) Controller, Proportional- Integral (PI) Controller, Proportional- Derivative (PD) Controller, Proportional- Integral-Derivative (PID) Controller
   - 2.4 Comparison of P, PI, PD & PID Controller Modes
   - 2.5 Response of P, PI, PD & PID Controller for Step, Pulse, Ramp & Sinusoidal Test Inputs
   - 2.6 Important Terminology and Issues related to PID:
     - 2.6.1 Proportional Band, Neutral Zone, Gain, Reset Time, Derivative Time, Parallel PID, Series PID and Real PID

3. **Advanced Control Strategies** **(09 hrs)**
   - 3.1 Feed Forward Control
   - 3.2 Cascade Control
   - 3.3 Ratio Control

4. **Controller Tuning** **(10 hrs)**
   - 4.1 Selection of Control Mode
   - 4.2 Criteria for Good Control: ISE, IAE and ITAE
   - 4.3 Process Reaction Curve
   - 4.4 Ziegler-Nichols Method

5. **Control Valves** **(18 hrs)**

5.1 Introduction to Control Valves

5.2 Control Valve Construction

5.3 Valve Sizing

5.4 Valve Characteristics: Effective Valve Characteristics, Equal Percentage Valve, Quick Opening Valve and Linear Valve, Benefits of Equal Percentage Valve

5.5 Valve Positioner

LIST OF PRACTICALS

1. To study & observe important components of process control system like Sensors, I/P Converter, Control Valve.
2. To observe the flow control loop using PID.
3. To observe the pressure control loop using PID.
4. To observe the temperature control loop using PID.
5. To study the ratio control.
6. To study the cascade control.

RECOMMENDED BOOKS

1. Process Control Instrumentation Technology, by Curtis D. Johnson, Pearson Education
2. Process Control Principles and Applications, by Surekha Bhanot, Oxford
3. Process System Analysis and Control, by Donald R. Coughanowr, McGraw-Hill
4. PID Controllers: Theory, Design and Tuning, by Karl J. Aström and Tore Hägglund, Instrument Society of America
5. Chemical Process Control, by George Stephanopoulos, PHI
6. Industrial Instrumentation & Control, by S.K. Singh, TMH
7. Industrial Instrumentation, by Dr. Umesh Rathore, SK Kataria

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	18	25
2	25	35
3	09	10
4	10	10
5	18	20
Total	**80**	**100**

5.4 CONTROL SYSTEM-II

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RATIONALE

The Subject enables the students to have a wide exposure of the fundamental concepts of Control systems and mathematical modeling of the system by Studying root locus, Bode plot using software. Students learn the design of passive as well as active filter for particular application, different types of filters are elaborated for better understanding of subject.

DETAILED CONTENTS

1. **Stability** **(20 hrs)**
   Concept of Stability in *s* domain, Classification of Stability (BIBO stability and asymptotic stability), pole- zero plots in *s* domain, response term contributed by different types of poles, stability analysis by Hurwitz criterion and Routh array, determination of marginal gain and oscillation frequency using Routh array, concept of relative stability and its analysis using Routh array.

2. **Root locus** **(20 hrs)**
   Definition, magnitude and angle conditions, construction rules, determination of system gain at any point on root locus (from magnitude condition and by graphical method), root locus of systems with dead time: Concept, approximation of dead time and construction rules.

3. **Frequency domain analysis of control systems** **(20 hrs)**
   Response of control systems to sinusoidal inputs, frequency domain specifications of a second order system (resonant frequency, resonant peak), correlation between time domain and frequency domain specifications.

4. **Stability analysis in frequency domain using Bode plot** **(20 hrs)**
   Concept of gain margin, phase margin and bandwidth, stability analysis, dead time, gain and phase cross-over frequency, Determination of transfer function from asymptotic Bode plot.

LIST OF PRACTICALS

1. Study of Routh-Hurwitz using a Computer based Software Tool.
2. Plot root locus of a Transfer Function using a Computer based Software Tool.
3. Plot root locus of a Transfer Function with Dead Time using a Computer based Software Tool.
4. To Study Frequency Domain Specifications using a Computer based Software Tool
5. To determine phase margin and gain margin in Bode Plot using a Computer based Software Tool.

RECOMMENDED BOOKS

1. Control systems Engineering by Nagrath and Gopal; 6th edition; New Age International Publications
2. Feedback Control Systems: Schaum's Outline Series; 2nd edition; McGraw Hill Education
3. Solutions to Control System Problems by A K Jairath; 5th edition; CBS publications
4. Control Systems Engineering by SK Bhattacharya, 2nd edition; Pearson Education
5. Modern Control Engineering by Katsuhiko Ogata, 5th edition; PHI publications
6. Feedback Control systems by R.A.Barapte, Techmax Publication, 2008
7. Process Control Instrumentation by CD Johnson; 8th edition; Prentice Hall India publications

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Alloted (Hrs)	Marks Allotted (%)
1	20	25
2	20	25
3	20	25
4	20	25
Total	**80**	**100**

5.5.1 DATA ACQUISITION AND NETWORK

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RATIONALE

In the modern plants total data regarding temperature, pressure, voltage, current etc. from the different selections is centrally recorded and controlled for recording and transmitting the data from different sections, knowledge of data transmission, and data acquisition by an technician is essentially required. The knowledge of this subject will help him in transferring the data and its acquisition in sophisticated plants.

DETAILED CONTENTS

1. Computer Network model (12 hrs)

1.1 Definition of Protocol

1.2 The Network Core– Packet Switching, Circuit Switching; Delay, Loss, and Throughput in Packet- Switched Networks

1.3 OSI Model and TCP/IP Model: Architecture, Description/function of Layers

2. Industrial Communication and Networking (16 hrs)

2.1 Types of communication interface

2.2 Parallel communication interface: IEEE-488 Bus and Handshaking Process

2.3 Serial communication interface: Balanced and Unbalanced systems

2.4 Communication mode: Simplex, Half Duplex and Full Duplex

2.5 Serial Interface RS 232C

2.6 HART Communication: HART Network Connection; HART Communication Modes and HART Protocol Layers

2.7 Fieldbuses: MODBUS, PROFIBUS, Device Net and Control Net

3. Data Transmission (16 hrs)

3.1 Introduction to data transmission

3.2 Digital Transmission: Line coding, Digital rate v/s Signal rate, Bandwidth, Baseline wandering, D.C components, Self-synchronization; Block coding; Digitization using PCM.

3.3 Aspects of digital to analog conversion; Data element v/s Signal element, Data rate v/s Signal rate (Baud rate); Frequency Shift Keying; Phase Shift Keying

3.4 Analog Transmission: Aspects of analog to analog conversion; Amplitude Modulation (AM); Frequency Modulation (FM); Phase Modulation (PM). PAM, PWM & PPM

3.5 Case Study: Data Transmission using telephone and networks

4. Transmission Media (12 hrs)

4.1 Guided Media: Twisted-Pair Cable, Unshielded v/s Shielded Twisted-Pair Cable, EIA category, Connectors; Coaxial Cable**,** Coaxial Cable Standards, Coaxial Cable Connectors, Fiber-Optic Cable

4.2 Unguided Media (Wireless): Propagation methods, Radio Waves, Omni-directional Antenna and applications, Microwaves, Unidirectional Antenna and applications, Infrared and applications

5. Data Acquisition **(08 hrs)**

5.1 Introduction
5.2 Typical Data Acquisition System
5.3 Multiplexer and Sample Hold circuits
5.4 Components of Digital and Analog Data Acquisition System

LIST OF PRACTICALS

1. To conserve an AM wave on CRO/DSO & Measurement of modulation index.
2. To observe time division multiplex the two given signals on CRO/DSO.
3. To observe the modulated signals using PAM and compare them with the corresponding analog input signal on CRO/DSO.
4. To observe the modulated signals using PWM and compare them with the corresponding analog input signal on CRO/DSO.
5. To perform the Data Acquisition operation.
6. To study communication between two devices.

RECOMMENDED BOOKS

1. Data Communications and Networking by Behrouz A. Forouzan; TMH
2. Telemetry Principles by D. Patranabis, TMH
3. PC-Based Instrumentation: Concepts and Practice by N. Mathivanan, PHI
4. A course in Elec. & Electronic Meas. & Instrumentation by A.K. Sahwney, Dhanpat Rai Pub.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	16	25
3	16	25
4	12	10
5	8	10
Total	**64**	**100**

5.5.2 INTRODUCTION TO MACHINE LEARNING

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RATIONALE

The purpose of this course is to impart knowledge on Internet of Things (IoT), which relates to study of sensors, actuator and controllers among other things, IoT applications and examples overview (building automation, transportation, healthcare, industry etc.)

DETAILED CONTENTS

1. Introduction **(09 hrs)**

1.1 What is Machine Learning

1.2 Examples of machine learning applications

a) Unsupervised Learning

b) Supervised Learning

c) Reinforcement Learning

1.3 Issues in Machine Learning

1.4 Perspectives of Machine Learning

2. Concept Learning **(12 hrs)**

2.1 Introduction

2.2 Concept Learning Task

2.3 Concept Learning as search

2.4 Inductive bias

a) A biased hypothesis space

b) An unbiased learner

2.5 The LIST- Then eliminate algorithm

2.6 CANDIADATE- ELIMAINATAION learning algorithm

3. Decision tree **(12 hrs)**

3.1 Introduction

3.2 Decision Tree representation

3.3 Appropriate problems for decision Tree Learning

3.4 The basic Decision Tree Learning algorithm

3.5 Issues in Decision Tree Learning

4. Bayesian and Instance based Learning **(12 hrs)**

4.1 Bayesian Learning

4.1.1 Introduction

4.1.2 Bayes Theorem

4.1.3 Bayes Theorem and Concept Learning

4.1.4 Bayesian Belief Networks

4.2 Instance- Based Learning

4.2.1 Introduction

4.2.2 k-NEAREST NEIGHBOR LEARNING

4.2.3 Locally Weighted Regression

4.2.4 Case- Based Reasoning

5. Genetic Algorithm (10 hrs)

5.1 Introduction
5.2 Genetic Algorithms
5.3 Genetic Programming
5.4 Models of Evolution and Learning

6. Artificial Neural Networks (09 hrs)

6.1 Introduction
6.2 Neural Network Representation
6.3 Perceptrons
6.4 BACKPROPAGATION Algorithm

LIST OF PRACTICALS

1. To demonstrate supervised learning using a computer based tool.
2. To demonstrate unsupervised learning using a computer based tool.
3. To demonstrate LIST Then elimination algorithm/ or candidate elimination algorithm using a computer based tool.
4. To study decision tree learning algorithm.
5. To demonstrate Genetic algorithm using a computer based tool.
6. To demonstrate Artificial Neural Network using a computer based tool.
7. To demonstrate Deep Learning using a computer based tool.

RECOMMENDED BOOKS

1. Machine Learning by Tom M. Mitchell
2. Introduction to Machine Learning by Ethem Alpaydin

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	9	15
2	12	17
3	12	18
4	12	20
5	10	15
6	9	15
Total	**64**	**100**

5.5.3 INTERNET OF THINGS

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RATIONALE

Internet of Things (IoT) is all about connecting physical objects to the Internet to enable same level of interaction with rest of the world as any other computing device. Applications of IoT include homes, buildings, environment, transport, education, logistics, security and many more. Raspberry Pi is a single-board computers made by the Raspberry Pi Foundation that aims to educate people in computing. People use Raspberry Pi to learn programming skills, build hardware projects, do home automation, and even use them in industrial applications. This practical-only course is designed to promote creativity and innovation in the students by designing and implementing IoT based projects. The students may choose either a Raspberry Pi or Arduino board to implement small projects.

DETAILED CONTENTS

1. **Introduction to Internet of Things** **(10 hrs)**
   Internet of Things (IoT), Characteristics of IoT, Key features of IOT, Advantages and Disadvantages of IOT, IoT Applications, Physical Design of IoT, logical design of IoT, Generic block diagram of an IoT Device.

2. **IoT Architecture** **(14 hrs)**
   Architecture of IoA, SOA based Architecture, API-Oriented Architetecture, Resource management-resource partioning, computation offloading, communication model, IoT levels and deployment templates.

3. **Communication Technologies** **(12 hrs)**
   Protocol standardization for IoT – ZigBee architecture, BLE protocol , Wifi, LTE, IEEE 802.11, 802.15.4 – LR-WPAN, RFID protocols, NFC

4. **IoT Physical Devices and End points** **(12 hrs)**
   Introduction to embedded electronics, introduction to Arduino, Arduino UNO, fundamentals of Arduino programming, introduction to Raspberry Pi. Building IoT with any platform.

5. **IoT Security** **(8 hrs)**
   IoT security issues, IoT security threats, security requirements – IP protocol based IoT, hetrogenous IoT, light weight security.

(i) LIST OF PRACTICALS

1. To setup development environment for Raspberry Pi or Arduino
2. To understand the logical board layout of Raspberry Pi or Arduino
3. To interface basic sensors and actuators with development board
4. To interface various communication modules (Bluetooth, WiFi) with development board
5. To design a project using sensors, actuators, communication modules (at least one each), draw the circuit diagram and prepare the list of required parts
6. To develop, test and implement the designed project

(ii) LIST OF PARTS

1.	Development Board : Raspberry Pi or Arduino with Power Supply and Case	12.	PIR Motion Sensor
2.	Bluetooth module: HC05	13.	Ultrasonic Sensor : HC-SR04
3.	MicroSD Card	14.	Infrared distance meter : GP2Y0A02YK
4.	HDMI – HDMI cable	15.	Inductive RFID card reader : RFID-RC522
5.	Jumper Wires : M-M, M-F, F-F	16.	Gyroscope : MPU-6050
6.	Red, Green, Blue, White LEDs	17.	Realtime clock : DS1307 RTC
7.	Bread Boards	18.	Servo Motor
8.	LCD Module	19.	Stepper Motor
9.	Push Buttons	20.	Servo Board : PCA9685
10.	Humidity / Temperature Sensor : DHT11, DHT22, DS18B20 and DS18S20	21.	Relays
11.	Gas Sensor : MQ-2	22.	Photoresistors

RECOMMENDED BOOKS

1. Internet of Things with Raspberry Pi 3 By Maneesh Rao, Packt Publication
2. Raspberry Pi IoT Projects By John C. Shovic, Apress Publication
3. Programming Arduino : Getting Started with Sketches By Simon Monk, McGraw Hill

REFERENCE DIGITAL RESOURCES

1. https://www.electronicsforu.com
2. https://projects.raspberrypi.org
3. https://create.arduino.cc

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Marks Allotted (%)
1	10	20
2	14	25
3	12	25
4	12	20
5	08	10
Total	**56**	**100**

5.6 PRACTICES IN COMMUNICATION SKILLS

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RATIONALE

For successful completion of diploma programme, the students should possess adequate command on language and communication skills so that they are able to express themselves with ease and felicity. The language used by the students should be appropriate to objectives and occasion. The contents of this subject shall provide them practical training through language laboratory.

LIST OF PRACTICALS

1. **Exercises on phonetics** **(8 hrs)**
   - 1.1 Identifications of English phonemes
   - 1.2 Stress and Intonation
   - 1.3 Speaking exercises with emphasis on voice modulation (reading and extempore)

2. **Group Discussion** **(4 hrs)**

3. **Exercises on** **(4 hrs)**
   - Self-assessment using tools like SWOT analysis
   - Listening skills

4. **Internet communication and Correspondence** **(4 hrs)**
   - 4.1 Resume writing
   - 4.2 Covering letter
   - 4.3 Agenda and Minutes of meeting
   - 4.4 Business Correspondence

5. **Exercises on** **(4 hrs)**
   - 5.1 Body language and Dress sense
   - 5.2 Etiquettes and mannerism in difficult situations like business meetings, table manners, Telephone etiquette
   - 5.3 Manners related to opposite gender
   - 5.4 Cross-cultural Communication

6. **Mock interviews** (telephonic/personal) **(4 hrs)**

7. **Role plays for effective Communication** **(4 hrs)**

6.1 DIGITAL SIGNAL PROCESSING

L T P
4 - 2

RATIONALE

Digital Signal Processing has many applications in the field of Instrumentation Engineering such as MEMS sensor, Data Acquisition (DAQ), virtual instrument etc. This course will give students an understanding of the analysis of discrete signals and systems, and their application in the design of filters and signal processors used in control and instrumentation.

DETAILED CONTENTS

1. Introduction (14 hrs)

1.1 What is DSP?
1.2 Basic Elements of DSP and its requirements
1.3 Advantages of Digital over Analog Signal Processing and limitations of Digital Signal Processing
1.4 Application of Digital Signal Processing
1.5 Classification of Discrete Time Signals
1.6 Basics of Standard Test Signals
1.7 Sequence Operation of Discrete Time Signals: Time Shifting, Time Scaling and Amplitude Scaling and Folding
1.8 Properties and Classification of Discrete Time System
1.9 LTI System, Impulse Response

2. Z Transform (10 hrs)

2.1 Introduction to Z Transform
2.2 Z Transform of various Standard Signals and their Region of Convergence
2.3 Properties of Z Transform
2.4 Inverse Z Transform
2.5 LTI System Analysis: Pole Zero Plot; System Transfer Function; Causality and Stability; Difference Equation
2.6 Analog Filter Design

3. Discrete Fourier Transform (12 hrs)

3.1 DTFT: Introduction and its properties
3.2 Relationship of DTFT and DFT
3.3 DFT of Standard Signals
3.4 Cyclic Property of Twiddle factor
3.5 Properties of DFT
3.6 Relationship between DFT and Z Transform

4. Fast Fourier Transform (14 hrs)

4.1 Introduction
4.2 Radix-2 FFT Algorithm
4.3 Radix-2 Decimation in Time Algorithm (DIT FFT)
4.4 Radix-2 Decimation in Frequency (DIF) FFT Algorithms
4.5 Computation of Inverse DFT (IDFT) using FFT Algorithms

5. Filter Designing (14 hrs)

5.1 Introduction
5.2 Transfer Function of FIR Filter
5.3 FIR Filter Structure: Direct Form; Cascade Form; Structure of Linear phase FIR Filters
5.4 IIR Filter Structure: Direct Form; Cascade Form; Parallel form
5.5 FIR Filter Design: Properties of commonly used Windows; Gibb's Phenomenon; Filter Design using any one Window Method
5.6 IIR Filter Design: Impulse Invariance Method; Bilinear Transformation Method

LIST OF PRACTICAL

1. Representation of Sine and Cosine wave Signal using a Computer based Software Tool.
2. Representation of Impulse, Step, Ramp and Parabolic Signal using a Computer based Software Tool.
3. To Design a Low Pass Filter.
4. To Design a High Pass Filter.
5. To Design FIR Filter for any system.
6. To Design IIR Filter for any system.
7. To Implement FFT algorithm for any system.

RECOMMENDED BOOKS

1. Introduction to Digital Signal Processing by Johhny R. Johnson; Englewood Cliffs, NJ : Prentice Hall, c1989
2. Digital Signal Processing: Principles, Algorithms, and Applications by John G. Proakis and Dimitris G. Manolakis, Pearson Education
3. Signals and Systems by H. P. Hsu, Shaum's Outline, TMH
4. Signals and Systems by Alan V. Oppenheim and Alan S. Willsky, PHI
5. Digital Signal Processing by R. A. Barapate and J. S. Katre, Tech-Max Publication
6. Digital Signal Processing by Sanjay Sharma, S. K. Kataria Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	10	15
3	12	20
4	14	20
5	14	25
Total	**64**	**100**

6.2 MAINTENANCE AND TROUBLESHOOTING

L T P
4 - 2

RATIONALE

The Subject enables the Students to have a wide exposure on Various Maintenance Procedures and developing troubleshooting skills .The Methods adopted for regular and Systematic Inspection, replacement of Worn parts, materials and systems ensures good working order and high efficient output of the system. Troubleshooting helps in minimize Failure, saving time and money of organization also it is a learned skill based on Knowledge and personal experience.

DETAILED CONTENTS

1. Introduction (20 hrs)

1.1 Importance/ Scope of maintenance
1.2 Objective of plant maintenance
1.3 Functions of plan maintenance department
1.4 Safety at workplace
1.5 Computerized maintenance management information system (CMMIS/CMMS)
1.6 Types of maintenance: Planned and Unplanned Maintenance
- 1.6.1 Breakdown Maintenance
- 1.6.2 Preventive maintenance - Periodic Maintenance (Time based maintenance) & Predictive maintenance (Condition based maintenance)
- 1.6.3 Comparison between preventive and breakdown maintenance; planned and unplanned maintenance

2. Maintenance Plans (10 hrs)

Tools and spares required, listing, procurement and storage, Maintenance plans, checklists, machine schedules and maintenance manuals, history- sheet, equipment log-book, breakdown intimation slip, job order, work order.

3. Maintenance Records (10 hrs)

Need for maintaining records, responsibility of preparing and storing records, time-frames for maintaining records, Importance in keeping the plant running, Effective maintenance and cost savings, Motivation factors in timely maintenance.

4. Component Testing (15 hrs)

Component Symbols and Line Diagrams (Electrical, Electronics, Mechanical), Location of faults, checking, Replacement of different fuses, lamps and lamps holders, switches, cables, cable connectors, relays, Identification and testing of variable components, diodes, Transistors (Active/Passive Components).

5. Energy And Environment Management (09 hrs)

5.1 Concept of energy conservation, neat and clean environment

5.2 Energy saving Measures and Devices
5.3 Air, Water, Noise Pollution
5.4 Laws and Acts for Environment
5.5 Fire and Prevention (Classification, Types of fire and fire extinguishers)

LIST OF PRACTICALS

1. Preparation of Maintenance schedule of various shops of Institutional Workshop.
2. Maintenance & up keep of Laboratory inventory.
3. Maintenance & repair of various lab equipments.
4. Test and troubleshoot various Active/Passive Components in a circuit.
5. Handling of different types of fire extinguishers for different kind of fires.

RECOMMENDED BOOKS

1. Industrial Machinery Repair: Best Maintenance Practices Pocket Guide by Ricky Smith, R. Keith Mobley; Butterworth-Heinemann Publications, 2003
2. Troubleshooting: A Technician's Guide, 2nd Edition (ISA Technician Series) by William L. Mostia; ISA Technician series
3. TROUBLESHOOTING ELECTRONIC EQUIPMENT: Includes Repair and Maintenance by Dr R.S. Khandpur; 2nd edition; McGraw Hill Publications
4. Electrical Equipment Handbook: Troubleshooting and Maintenance by Philip Kiameh; McGraw-Hill Professional publications, 2003
5. Electric Motor Maintenance and Troubleshooting by Augie Hand; 2nd edition, 2011; McGraw-Hill Education publications

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	20	30
2	10	15
3	10	15
4	15	25
5	09	15
Total	**64**	**100**

6.3 PROGRAMMABLE LOGIC CONTROLLERS AND SCADA

L T P
4 – 2

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of latest controlling techniques like DCS,SCADA and 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), SCADA etc. A diploma holder in industry is called upon to design, modify and troubleshoot such control circuits. Looking at the industrial applications of these techniques in the modern industry, this subject finds its usefulness in the present curriculum.

DETAILED CONTENTS

1. Introduction to PLC (10Hrs)

Relays based logic circuits, limitations of relays based logic circuit, Concept of PLC, Advantages of PLCs over electromagnetic relays based logic circuits, Different programming languages used in PLC, PLC specifications.

2. Architectural Detail and Working of PLC (10Hrs)

2.1 Basic operation and principle of working of PLC
2.2 Architectural details of PLC
2.3 Input & Output Modules in PLC
2.4 Opto-isolation Circuit in PLC and its need
2.5 Memory structures in PLC,
2.6 HMI (Human Machine Interface) used in PLC system
2.7 Power supply requirements in PLC

3. Instructions Set (16Hrs)

3.1 Addressing in PLC: I/O Address
3.2 Basic instructions: Examine ON, Examine OFF, Latch/Unlatch, Output Energize, Hold ON.
3.3 Timer instructions: On delay timer, Off delay timer, retentive/non-retentive timers, resetting of timers.
3.4 Counter instructions: Up Counter, Down Counter, resetting of counters.
3.5 Sequencers.
3.6 Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal.

4. Ladder Logic Programming (16Hrs)

Introduction to Ladder Logic programming, Ladder logic programming examples based on basic instructions, timer and counter instructions. Simple Applications of PLCs:

4.1 Bottle filling Process
4.2 Traffic Light Control
4.3 Material handling

4.4 Elevator
4.5 Oven Control
4.6 Stirred tank reactor (Process Control)
4.7 Forward/reverse control of motor using PLC

5. DCS & SCADA (12Hrs)

5.1 Introduction & History of DCS
5.2 Hierarchical Architecture of DCS
5.3 System Elements of DCS(Field Station, Intermediate Station and Central Computer Station)
5.4 Advantages and Disadvantages of DCS
5.5 Definition of SCADA
5.6 Major elements of SCADA
5.7 Advantages and Disadvantages of SCADA
5.8 Application areas of SCADA
5.9 Comparison of PLC, SCADA and DCS

LIST OF PRACTICALS

1. Develop a ladder logic Program for Elevator.
2. Develop a ladder logic Program for Oven Control.
3. Develop a ladder logic Program for Bottle Filling.
4. Develop a ladder logic Program for Stirrer Tank Control.
5. Develop a ladder logic Program for Switching of Lights.
6. Study of basic SCADA system.
7. Study of basic DCS system.

RECOMMENDED BOOKS

1. Process Control Instrumentation Technology, Curtis D. Johnson, Pearson
2. Programmable Logic Controllers and Industrial Automation, Madhuchhanda Mitra, PHI
3. Basic Instrumentation System & Programmable Logic Controller, Dr. Umesh Rathore, S.K. Kataria Publication
4. Process Control –Principles & Applications, Surekha Bhanot, Oxford University Press
5. Instrument Engineer's Handbook: Bela G. Liptak

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	10	15
2.	10	15
3.	16	25
4.	16	25
5.	12	20
Total	**64**	**100**

6.4 VIRTUAL INSTRUMENTATION

L T P
4 – 2

RATIONALE

The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

DETAILED CONTENTS

1. Introduction to Virtual Instrumentation System (15 Hrs)

1.1 Instrumentation System
   a) Traditional Instrumentation
   b) Virtual Instrumentation
   c) Comparison between Traditional and Virtual Instrumentation System

1.2 Software based Instrumentation System

1.3 Programming
   a) Graphical Programming
   b) Structured Programming

1.4 Software Based Instrumentation

1.5 Various application of virtual Instrumentation in different domains

1.6 Introduction to Intelligent Instrumentation

2. Introduction to LabVIEW (08 Hrs)

2.1 Introduction to LabVIEW

2.2 Component of LabVIEW

2.3 Role of Hardware in virtual Instrumentation system

2.4 Role of Software in virtual Instrumentation system

2.5 Introduction to data flow programming

3. LabVIEW Environment (18 Hrs)

3.1 Introduction
   a) VI
   b) SubVI

3.2 Local Variable and Global variable

3.3 Repetition/Loop
   a) For loop
   b) While loop

3.4 Array
   a) 1-dimensional
   b) 2-dimensional

3.5 Charts and graphs

3.6 Structure
   a) Case Structure
   b) Sequence structure
3.7 Introduction to Formula Node
3.8 String
   a) Creating string control and indicator
   b) String function
   c) Editing, formatting and parsing string
3.9 Introduction to File input/output

4. Data Acquisition Methods (12 Hrs)

4.1 Introduction to analog input/output (AIO)
4.2 Introduction to digital input/output (DIO)
4.3 Introduction to counter
4.4 Introduction to timer
4.5 Basic of analog to digital designs
4.6 Interfacing methods of Data Acquisition (i.e. DAQ) Hardware
4.7 Introduction to software structure to interface DAQ hardware to LabVIEW
4.8 Use of Data Sockets for networked communication and controls

5. Communication between PC and DAQ hardware (12 Hrs)

5.1 Introduction to PC buses : ISA, EISA, VME, PCI, IEEE488 & USB
5.2 PC interface: Expansion bus, RS232 & RS485

LIST OF PRACTICALS

1. Familiarization with LabVIEW working environment (i.e its Front Panel, Block Panel, and functions)
2. Design a VI to perform basic mathematical function on two numbers (i.e. addition, subtraction, multiplication, division).
3. Design a VI to demonstrate Loop operation using for loop/while loop.
4. Design a VI to demonstrate array operation using one/two dimensional array
5. Design a VI to demonstrate case structure operation.
6. To study the different types of graphs available in the LabVIEW environment
7. Design a VI to draw sinusoidal function.

RECOMMENDED BOOKS

1. "Virtual Instrumentation Using Labview" by Jerome J; PHI Publications; 2010
2. "Virtual Instrumentation using Labview" by Sanjay Gupta; 2nd Edition 2017; McGraw Hill Education Publications
3. LabVIEW Graphical Programming, G. Johnson; McGraw-Hill
4. LabView for Everyone by Lisa, K. Well & Jeffery Travis; Prentice Hall Inc.

5. PC Interfacing for data acquisition and process control by S. Gupta, Publication Instrumentation Society of America

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	15	25
2.	08	10
3.	18	30
4.	12	20
5.	12	15
Total	**64**	**100**

6.5.1 INDUSTRIAL ELECTRONICS

L T P
4 - 2

RATIONALE

Electronics adapted to industrial plant, in terms of timings action switching and action or parameter control, is called. Industrial Electronics. Other common areas of application where electronics is increasing its interface with other branches of engineering include temperature control, welding control, speed regulation of motor and soldering. The student should study this subject with a view to understand the use of electronics to bring about faster and more accurate responses in industrial plants.

DETAILED CONTENTS

1. Thyristors: working principle-V-I characteristics and ratings, turn on methods, Natural and forced turn off methods, MOSFET and IGBT. **(7 Hrs)**

2. Heat Dissipation in thyristors **(10 Hrs)**

2.1 Internal power dissipation and need for heat sinks in thyristors.

2.2 Definition of following terms and their relationship with the power dissipation of the device (no derivation).

a) Heat sink efficiency
b) Heat sink transfer co-efficient
c) Heat dissipating area of a heat sink.

2.3 Concept of thermal resistance of heat sinks.

2.4 Various types of heat sinks and techniques of mounting device on heat sinks.

3. Principle of operation and working of the following switching circuits, using SCRs and Triacs

3.1 Automatic Battery charger

3.2 Voltage regulator

a) Uncontrolled voltage regulator
b) Controlled voltage regulator

3.3 Emergency light

3.4 Alarm circuit

3.5 Time delay relay circuit

3.6 Circuits for over voltage and over current **(12 Hrs)**

4. Controlled rectifiers **(10 Hrs)**

Explanation of controlled single and three phase halfwave and fullwave bridge rectifier for the resistive and inductive load.

5. Application of phase controlled rectifications and AC phase control circuits in: **(8 Hrs)**

5.1 Illumination Control using TRIAC

5.2 Fan speed control using SCR

5.3 Temperature Control

5.4 Speed control of dc and small ac motors

6. Principles of operation of Basic inverter circuits. Basic series and parallel commutated inverters.
(10 Hrs)

7. Principle of working dc Chopper & ac Cyclo convertor circuit using SCR and its applications.
(7 Hrs)

LIST OF PRACTICALS

1. V-I characteristics of SCR.
2. Observation of wave shape and measurement of voltage relevant points of an SCR based single phase halfwave controlled rectifier circuit using resistive Load.
3. Observation of wave shapes and measurement of voltages at relevant points of an SCR based single phase full wave controlled rectifier circuit RC Load.
4. Observation of wave shapes and measurement of voltage at relevant points of an SCR based single phase controlled bridge rectifier circuit.
5. Observation of wave shapes and measurement of voltage at relevant point in a triac based AC phase control circuit used for lamp intensity/motor control.
6. Study of inverter.

RECOMMENDED BOOKS

1. Industrial Electronics and Control by Biswanath Paul; 3rd edition; PHI publications
2. J.M.D. Murphy, F.G. Turnbull, Power Electronic Control of ac Motors, Pergamon (1990).
3. Thyristor DC Drives, P.C. Sen; John Wiley and Sons (1981)

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	07	10
2	10	15
3	12	18
4	10	15
5	08	12
6	10	15
7	07	15
Total	**64**	**100**

6.5.2 INDUSTRIAL AUTOMATION & ROBOTICS

LT P
4 - 2

RATIONALE

The subject prepares students for design, interface, installation and troubleshooting of industrial automation systems. Emphasis is on electronics, electrical controls, motors, programmable logic controllers, servo systems, robotics, hydraulic and pneumatics. Students will integrate electronics and electrical controls with mechanical systems and programmable controllers and explore alternative trade-offs in the process of problem solving and troubleshooting.

DETAILED CONTENTS

1. **Introduction** **(8 Hrs)**

   Robotics and automation, Robot anatomy, Classification of robots, Specification of robots: DOF, Joints and axes, Load carrying capacity, resolution, accuracy, repeatability, precision etc.

2. **Kinematics** **(14 Hrs)**

   Introduction, The direct Kinematics and Inverse kinematic for three and four degrees of freedom Robot arms. Kinematic equation using homogeneous Transformations.

3. **Driver, Actuator and Control** **(18 Hrs)**

   3.1 Introduction to driver and actuator system
   3.2 Different types of driver and actuator system
   a) Hydraulic driver and actuator system
   b) Pneumatic driver and actuator system
   c) Electrical driver and actuator system

4. **Robot End effectors/Grippers** **(10 Hrs)**

   Introduction, Classification of end effectors, Drive system for Grippers, Mechanical, Magnetic, Vacuum, Adhesive Grippers, Gripper force analysis and gripper design (Basic elementary level). Active and Passive grippers

5. **Robot Sensors** **(6 Hrs)**

   5.1 Introduction to Analog Sensors
   5.2 Different types of analog sensors
   5.3 Introduction to Digital Sensors
   5.4 Different types of Digital sensors
   5.5 Selection of sensors for specific application
   5.6 Sensor signal conditioning

6. **Robotic Applications** **(8 Hrs)**

   6.1 International scenario for implementing robots in commercial sectors
   6.2 International scenario for implementing robots in industrial sectors

6.3 Applications of robots in different industrial processes like welding, painting, furnaces, pick and place, hazards and safety aspects.

LIST OF PRACTICALS

1. Demonstration of use of hydraulic system based actuator and final control element available in your lab.
2. Study based on direct kinematics.
3. Study based on inverse kinematics.
4. Demonstration of use of pneumatic system based actuator and final control element available in your lab.
5. Demonstration of use of electrical system based actuator and final control element available in your lab.
6. Observe the variation in a process which utilizes Proportional, Proportional- Integral and Proportional-Integral-Derivative controller and analyse results of above mentioned different controllers.
7. To study the gripper/ end effecter kinematics of robotic hand.

RECOMMENDED BOOKS

1. Robotics and automation handbook by Thomas R. Kurfess, Publication CRC Press
2. Modern Control Engineering by Katsuhiko ogata, Publication Pearson
3. Hydraulics and Pneumatics: A Technician's and Engineer's Guid, by E. A. Parr, Publication Butterworth-Heinemann

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	15
2	14	20
3	18	25
4	10	20
5	6	10
6	8	10
Total	64	100

6.6 MAJOR PROJECT

LTP

- - 8

Major Project Work aims at developing innovative skills in the students whereby they 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 students for project oriented practical training in actual work situation for the stipulated period with a view to:

i. 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.
ii. Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
iii. Develop first-hand 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.
iv. Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

The individual students have different 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.

The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. 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 project work identified in collaboration with industry should be preferred.

This practical training cum project work should **not be considered** as merely conventional industrial training in which students are sent at workplaces with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. 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. Some of the project activities are given below:

1. - Study of a large size plant (Power Station, Cement etc.) and its controls.

- Prepare process flow and piping and instrumentation diagram of a section. Identify their various instruments, systems and control parameters, ranges, specification and makes of each item.

2. Design and rigging up of a simple control loop e.g.
   - Temperature control in oven.
   - Maintaining constant temperature in hot water tank.
   - Level control in a water tank.
   - Flow control in a pipeline.
   - Control of pressure in a pressurized vessel.
   - Maintaining a constant Ph of a solution by injection (acid or alkali).
3. - Design and making a simple on/off controller for temperature using ICs, capacitors, resistors on a printed circuits board
   - Design making simple automatic controller (Electronic/Pneumatic).
4. Design and alarm annunciation scheme for motor control (trip, supply, failure, overheating) and relishing the same in a control panel using relays, push button and lamps.
5. Design and fabricate a signal transmitter.
6. Design and fabricate a signal convertor.
7. Speed control of motor using feedback controller.
8. Automatic PCB drilling machine.
9. To interface the different types of controller/transmitter with computers.
10. Develop the software to operate given controller for different application.

NOTE:

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.