West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Electronics & Instrumentation Engineering [EIE]

Part-III (5th Semester)

Revised 2022

Electronics & Instrumentation Engineering

Semester V									
Sl. No.	Category	Code No.	Course Title	Hours Per week			Total Contact hrs/week	Credits	Marks
				L	T	P			
1	Program Core Course	EIEPC301	Process Instrumentation -II	2	1		3	3	100
2	Program Core Course	EIEPC303	Microprocessor	2	1		3	3	100
3	Program Core Course	EIEPC305	Process Control -II	2	1		3	3	100
4	Program Core Course	EIEPC307	Analytical Instrumentation	2			2	2	100
5	Program Core Course	EIEPC309	Process Instrumentation -II Lab			2	2	1	100
6	Program Core Course	EIEPC311	Microprocessor Lab			2	2	1	100
7	Program Core Course	EIEPC313	Process Control Lab			2	2	1	100
8	Program Elective Course	EIEPE301	Biomedical Instrumentation Or Application of Robotics and CNC	2			2	2	100
9	Program Elective Course	EIEPE303	Electronic Communication Principle Or Control Theory	2			2	2	100
10	Internship-II (after Semester IV)	SI301						1	100
11	Minor Project	PR301				4	4	2	100
	TOTAL						25	**21**	**1100**

Semester	:	**V**
Course Code	:	**EIEPC301**
Course Title	:	**Process Instrumentation -II**
Number of Credits	:	**3 (L:2, T:1, P:0)**
Prerequisite	:	Basic idea of Physics, electronics, Instrumentation
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- ❖ To provide sound knowledge about various techniques used for the measurement of industrial parameters and processes.
- ❖ To have adequate knowledge of construction and working of various measuring instruments used for industrial purposes.
- ❖ To have sound knowledge about the calibration of various industrial instruments
- ❖ To get exposure on Humidity and Moisture measurement
- ❖ To provide sound knowledge on Hazardous and industrial safety
- ❖ To introduce HART and Field Bus

Course Content			**Hrs/Unit**
Module 1	**Unit 1**	**Temperature Measurement**	9
		1.1 Temperature scale - ITS 90, Different types of Thermometers- liquid in glass, liquid in metal, bimetallic thermometer 1.2 Thermocouple: construction, Output equation, thermocouple materials, cold junction compensation, range and types of different thermocouples, thermowell 1.3 RTD: construction & composition of RTD, output equation, Pt100, Two wire three wire & four wire RTD, Self-heating error. 1.4 Thermistor: construction & composition of thermistor, types of thermistors, Output equation. 1.5 Non-contact type temperature measurement: Radiation & Optical Pyrometer 1.6 Semiconductor type temperature sensor	
	Unit II	**Flow Measurement**	9
		2.1 Bernoulli's theorem, turbulent & laminar flow, Reynolds number 2.2 Head type: Orifice, Venturi 2.3 Area type: Rotameter 2.4 Electrical type: Electromagnetic, Turbine, Ultrasonic & Vortex Flow Meter 2.5 Mass Flowmeter: Coriolis, Thermal 2.6 Positive displacement flow meter	

		2.7 Solid flow measurement 2.8 Flow switch 2.9 Zero span calibration	
Module 2	**Unit III**	**Level Measurement**	7
		3.1 Gauge glass, float & displacer type 3.2 Differential Pressure type 3.3 Capacitive & Conductivity type 3.4 Radar, ultrasonic & nuclear type 3.5 Level switch 3.6 Zero span calibration	
	Unit IV	**Measurement of Humidity and Moisture**	6
		4.1 Definition: Moisture, Absolute Humidity, Relative Humidity, Due point temperature 4.2 Basic principles of hygrometers, psychrometers, humidity charts, 4.3 Measurement systems for humidity, 4.4 Infrared moisture measuring systems, radioactive moisture measuring systems	
Module 3	**Unit V**	**Instrumentation in Hazardous Location**	7
		5.1 Definition of Hazardous area & Safe area, Area classification, Material classification 5.2 Explosion proof enclosure, Pressurization, Intrinsic safety 5.3 IP type, safety triangle, PPE.	
	Unit VI	**HART and Field Bus**	7
		6.1 4-20 mA current transmission, live and dead zero 6.2 Introduction to smart sensor 6.3 HART communication protocol, HART networks, HART commands, HART applications 6.4 Fieldbus: General Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability, Interchangeability.	

Suggested Learning resources

Title	**Author**	**Publisher**
Principles of Industrial Instrumentation	D. Patranabis	TMH
Measurement System Application & Design	E.O. Doeblin	Mc Graw Hill
Introduction to Measurement & Instrumentation	Ghosh	PHI
Instrument Transducer	H K P Neubert	Oxford University Press

Industrial Instrumentation & Control	S K Singh	TMH
Instrument Engineers' Handbook, Vol I: Process Measurement & Analysis	Bela G. Liptak	CRC Press, Taylor &Francis
Sensors & Transducers	D. V. S. Murty	PHI
A Course in Electrical & Electronics Measurement & Instrumentation	J.B. Gupta	S. K. Kataria Pub. Co
The Essence of Measurement	Allan Morris	PHI
Mechanical Measurements	Beckwith, Buck & Marangoni	Narosa Pub. House
Electrical and Electronic Measurements and Instrumentation	A. K. Sawhney	Dhanpat Rai & Co.
Instrumentation & Control	Reddy, P S R Krishnudu	Scitech
Handbook of Modern Sensors	Fraden, Jacob	Springer

Course Outcome

At the end of the course student will be able to:	1. Acquire the knowledge of purpose and scope of instrumentation in Industrial processes 2. Be competent to handle different types of temperature measuring instruments and their application in various Industrial processes 3. Be conversant in construction and working of various flow, level, moisture, and Humidity measurement devices used for industrial purposes 4. Understand the calibration of various industrial instrument 5. Identify specific instrument can be used in Hazardous location 6. Use HART and Field bus technology in industries.

Semester	:	**V**
Course Code	:	**EIEPC303**
Course Title	:	**Microprocessor**
Number of Credits	:	**3 (L:2, T:1, P:0)**
Prerequisite	:	Idea on Digital Electronics
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

	❖ To understand the general architecture of a microcomputer system ❖ To comprehend the architecture and organization of 8085 and 8086 microprocessor ❖ To learn the Interfacing of 8-bit microprocessor with memory and peripheral chips involving system design ❖ To interpret and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming

Course Content			Hrs/Unit
Module 1	**Unit 1**	**Introduction to Microprocessor**	4
		1.1 Von Neumann & Harvard architecture 1.2 Microprocessor definition 1.3 Block diagram of Microprocessor based system 1.4 Machine Language, Assembly language, High level Language, Assembler,Compiler	
	Unit II	**Microprocessor Architecture & memory Interfacing**	8
		2.1 8085 architecture and its functional block 2.2 Pin details of Intel 8085 chip 2.3 De-multiplexing address and data bus, generation of control signals 2.4 Machine Cycle, Instruction Cycle, Timing Diagram 2.5 Hardware Interfacing or Types of I/O addressing-Interfacing Memory and Peripheral (I/o Mapped I/O and memory mapped I/O)	
Module 2	**Unit III**	**Programming of 8085 Microprocessor**	10
		3.1 Instruction set of 8085 3.2 Addressing modes 3.3 Writing assembly language program- looping, counting, indexing, BCD arithmetic, stack and subroutine, Delay, conditional call & return instruction 3.4 Stack and subroutine	
	Unit IV	**Peripheral Interface**	8
		4.1 8255: Block diagram, Interfacing of 8255 with 8085 microprocessor and programming. 4.2 ADC (0801/0808) and DAC (0808/0809) interfacing and programming 4.3 Interfacing with Stepper Motor	
Module 3	**Unit V**	**Interrupt of 8085**	8
		5.1 8085, RST instruction, vectored interrupts 5.2 8259 Programmable Interrupt Controller - Internal structure, pin diagram and modes of operation.	
	Unit VI	**Introduction to 8086 Microprocessor**	7
		6.1 Features of 8086 (16-bit Microprocessor), 6.2 Architecture of 8086, 6.3 Concept of parallel processing in 8086.	
Suggested Learning resources			

Title	Author	Publisher
Microprocessor Architecture, programming & applications	R. S. Gaonkar	Wiley
Microprocessor & Microcontroller	N Senthil	Oxford University press
Microprocessor and Microcontroller	Kumar, Saravanan, Jeevananthan	Oxford University Press
Introduction to Microprocessor	A.P. Mathur	TMH
Digital Circuits & Microprocessors	Herbert taub	TMH Pub.
Microprocessor Interfacing & Microcontroller	Azeez, Shemeena	Scitech
Computer system Architecture	Morris Mano	PHI India
Computer organization & Design	P. Pal Choudhuri	PHI
The 8085 Microprocessor: Architecture, Programming & Interfacing	Udaykumar	Pearson
The 8085 Basic, Programming & Interfacing	Kulkarni, Sontakke	SadhuSudha Prakasan
Microprocessor and Interfacing	D. Hall	TMH
Microprocessor & Peripherals	Chowdhury et al	Scitech

Course Outcome	
At the end of the course student will be able to:	1. Describe the general architecture of a microcomputer system 2. Understand the architecture and organization of 8085 and 8086 microprocessor 3. Construct the Interfacing of 8-bit microprocessor with memory and peripheral chips involving system design 4. Interpret and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming 5. Understand the architecture and operation of Programmable Interface Devices and realize the programming & interfacing of it with 8085 microprocessors

Semester	:	**V**
Course Code	:	**EIEPC305**
Course Title	:	**Process Control - II**
Number of Credits	:	**3 (L:2, T:1, P:0)**
Prerequisite	:	Basics on Process measurement
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- To realize the need and importance of automation in process industries
- To draw P&I diagram of different process and realization of control scheme.
- To provide knowledge on different advanced control techniques like Ratio, Feed forward, Cascade
- To understand Programmable Logic Controllers (PLCs) and learn their programming
- To understand the significance and application of DDC, DAS, DCS, SCADA, Drive in process automation industry

Course Content			**Hrs/ Unit**
Module 1	**Unit 1**	**Process Drawing**	9
		1.1 Concept and definition of P&I diagram. 1.2 ISA symbols: Line types, Instrument bubbles, Process valves, Actuators. 1.3 Instrument identification tag 1.4 P&I Diagrams of different control scheme 1.5 Loop diagram concept	
	Unit II	**Advanced Control Techniques**	4
		2.1 Ratio control. 2.2 Cascade control. 2.3 Feed forward control.	
Module 2	**Unit III**	**DDC and DAS**	4
		3.1 DDC: Concept, block diagram, operation, advantages and disadvantages. 3.2 DAS: Concept of Data Acquisition System, Block Diagram explanation of multichannel DAS.	
	Unit IV	**PLC and Drive**	10
		4.1 Introduction to PLC: What is PLC, Block diagram explanation of PLC, limitations of relay logic, Advantages of PLCs over electromagnetic relays. 4.2 Different programming languages used in PLC 4.3 Modules in PLC. 4.4 Source - sink concept of PLC	

		4.5 Ladder Diagram Programming: Programming based on basic instructions, timer, counter, and comparison instructions using ladder program 4.6 V.F.D. (Variable Frequency Drive): Operating principle and application	
Module 3	**Unit V**	**DCS and SCADA**	10
		5.1 DCS: Concept of centralized and distributed control systems, PLC vs DCS, DCS architecture, brief view on operator station, engineering station, field control station, communication techniques between different modules, concept of different standard panels like over view, graphic, tuning, control, alarm etc., and applications. 5.2 SCADA: Architecture, SCADA hardware and software, modems use in SCADA, communication techniques, RTU structure, SCADA application in industry	
	Unit VI	**Miscellaneous Process Plant Control Scheme**	8
		6.1 Boiler drum level control in thermal power plant – single element, two elements and three elements. 6.2 Combustion control of thermal power plant. 6.3 Control scheme of distillation column – overhead and bottom product. 6.4 Temperature control in soaking pit in steel plant.	

Suggested Learning resources

Title	**Author**	**Publisher**
Process Control Principle & Application	S Bhanot	Oxford University Press
Process Control: Concept Dynamics & Application	S. K. Singh	PHI
Principles of Process Control	D. Patranabis	Mc Graw Hill
Instrument Engineers' Handbook: Process Control and Optimization, Vol – II	Bela G Liptak	CRC Press, Taylor & Francis Group
Chemical Process Control: An Introduction to Theory & Practice	Stephanopoulos	Pearson
Instrumentation Fundamentals for Process Control	D. O. J. Desa	Taylor & Francis
Modern Control Engineering	K Ogata	PHI
Principles of Industrial Process Control	D. P. Eckman	J. Wiley & Sons
Automatic Process Control	D. P. Eckman	J. Wiley & Sons
Nice's Control System Engineering	Gupta	Wiley India
Process Control Instrumentation Technology	Curtis Johnson	PHI
Automatic Control System	Kuo	Wiley India
Instrument Engineers Handbook, vol. I to III,	Liptak, B. G.	Chilton Book Co.
PC interface for Data Acquiring & Process Control	S. Gupta, J P Gupta	Instrument Society of America.

Distributed Computer control & Industrial Automation	Bhatkar, Marshal	Dekker Publication.
Programmable Logic Controllers	John W. Web, Ronald A. Reis	PHI
Programmable Controllers: An Engineers' Guide	Parr A	Newnes, Butterworth-Heinneman Ltd
Programmable controllers: Principle and Applications	Webb J. W	PHI New Delhi
Programmable Logic Controller	Job Dan Otter	P.H. International
Introduction to PLCs	Gary Dunning	McGraw Hill
Module on PLCs and their Applications	Rajesh Kumar	NITTTR Chandigarh
Basic Instrumentation & PLC	U Rathore	S K Khataria
Programmable Logic Controllers	Frank D. Petruzella	McGraw Hill

Course Outcome

At the end of the course student will be able to:	1. Draw P&I diagram of different process and realization of control system in it. 2. Define, identify and implement different advanced control strategies in process automation 3. Understand the need for automation in process industries and learn integration of PLC, DCS, SCADA in process industries 4. Program PLC and solve critical control logics to control and run the process 5. Explain about DCS, SCADA and their usage in process automation and associated communication networks. 6. Demonstrate and explain different control schemes for different specific plant operations.

Semester	:	**V**
Course Code	:	**EIEPC307**
Course Title	:	**Analytical Instrumentation**
Number of Credits	:	**2 (L:2, T:0, P:0)**
Prerequisite	:	Basic knowledge on Physics and Chemistry
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- To provide various techniques and methods of analysis which occur in the various regions of the spectrum. These are the powerful tools used in clinical and research laboratories.
- To give unique methods of separation of closely similar materials, the most powerful being gas chromatography.
- To study important methods of analysis of industrial gases. Awareness and control of pollution in the environment is of vital importance.
- To provide knowledge on NMR techniques in structure determination.

Course Content			**Hrs/Unit**
Module 1	**Unit 1**	**Spectrophotometry**	6
		1.1 Spectral methods of analysis – Beer-Lambert law 1.2 UV-Visible spectroscopy. 1.3 IR Spectrophotometry: FTIR, FTNIR 1.4 Atomic absorption spectrophotometry - Flame emission and atomic emission photometry (Construction, working principle, sources detectors and applications).	
	Unit II	**Water Quality Analysis**	5
		2.1 pH: definition, scale, Nernst equation, pH sensitive electrodes, Principle of operation of pH meter. 2.2 Dissolved oxygen analyser, Sodium analyser, Silicon analyser, Phosphate analyser, Chlorine analyser - function. 2.3 Conductivity analysis	
Module 2	**Unit III**	**Industrial Gas Analysers**	5
		3.1 Paramagnetic, Magnetic wind type, Zirconia O2 analysers 3.2 IR/NDIR (for CO, CO2, O_3, NO_2, SO_2, H_2S, NH_3 etc.)	
	Unit IV	**Nuclear Magnetic Resonance and Mass Spectrometry**	5
		4.1 NMR: Feature, Basic principles, Instrumentation. Fourier Transform NMR spectroscopy 4.2 Mass Spectrometry: Feature, Mass spectrum, Basic principle, Instrumentation, working principle.	

Module 3	**Unit V**	**Chromatograph**	5
		5.1 GC: Function, Basic parts of GC, Instrumentation, function of different parts of GC, detectors used in GC. 5.2 HPLC: Use, Instrumentation, description of components, Operation, Detectors.	
	Unit VI	**Miscellaneous Analytical Process**	4
		6.1 Pollution monitoring control and stack analysers 6.2 Waste water treatment plant 6.3 ETP (Effluent Treatment Plant) 6.4 SWAS- power plant (Steam Water Analysis System) 6.5 Blast furnace 6.6 NCU (Naptha Cracker Unit) 6.7 Industrial Air separation (Student should get idea on Process and name of different analysers used there)	

Suggested Learning resources

Title	**Author**	**Publisher**
Handbook of Analytical Instruments	R S Khandpur	TMH
Instrumental Methods of Analysis	Willard, Merrit, Dean & Settle	CBS Pub.Co.
Analysis Instrumentation	R.P.Khare	CBS
Analytical Instrumentation	Skoog & Larry	Saunders Pub. Co.
Instrumentation Handbook	B. Liptak	Butterworth-Heinmann .
Principle of Industrial Instrumentation	D Patranabis	TMH
Quantitative analysis	R.A.Day & A.L.Underwood	Prentice-Hall of India Pvt. Ltd.
Instrumental Methods of chemical Analysis	Ewing	McGraw-Hill Inc
Instrumental Methodology of Analysis	Chatwal, Anand	Himalaya publishing house
Instrumental Method of Analysis	D Muralidhara Rao	CBS Publishers & Distributor

Course Outcome

At the end of the course student will be able to:	1. Choose the relevant analytical instruments for various applications. 2. Maintain the instruments based on absorption spectroscopy and separation technique. 3. Select and use relevant analytical instrument for specified industrial gases. 4. Maintain analytical instruments to monitor water quality and environment pollutants. 5. Select and specify specific analyser for process specific operation.

Semester	:	**V**
Course Code	:	**EIEPC309**
Course Title	:	**Process Instrumentation -II Lab**
Number of Credits	:	**1 (L:0, T:0, P:2)**
Prerequisite	:	Basics on process parameter measurement
Course Category	:	**PC**
Course Objective		
Following are the objectives of this course		
1		➢ To provide knowledge on temperature, flow and level measurement. ➢ To educate with different parts of control valve.
List of Practical work/experiments to be performed to achieve following aims.		
Sl. No.		**Aims:**
1		Temperature measurement using the following instruments (at least three types): a. RTD b. Thermocouple c. Thermistor d. AD590 e. Pyrometer (Student must know the basic operating principle of sensor, change the temperature and take readings, if and where possible calculate the error, if any)
2		Flow measurement using the following instruments (at least three types): a. Orifice b. Venturi c. Rotameter d. Magnetic flow meter e. D/P transmitter (Student should know the operating principle of sensor/ instrument. Use water as a fluid flow, take the reading of water flow. Where possible collect the total water for certain time duration and tally with the reading from flowmeter)
3		Level measurement using the following instruments (at least three type): 1. Conductivity gage 2. Capacitive gage 3. Gauge glass 4. Float type 5. Displacer type (Student should know the operating principle of sensor/ instrument. Take reading from instrument. Where possible take physical level reading and tally with the instrument reading. If any difference, calculate the error.
4		Study the different parts of Control Valve.
5		Stroke checking of control valve.

Course Outcome	
At the end of the course student will be able to:	1. Build temperature measuring system with RTD, Thermocouple, Thermistor, AD590, Pyrometer and measure temperature 2. Construct flow measuring system with Orifice, Venturi, Flow nozzle, Rotameter, D/P Transmitter and measure flow. 3. Develop level measuring system with Conductivity gauge, Capacitive gauge, Gauge glass, Float type, Displacer type and measure level. 4. Demonstrate different parts of control valve and explain valve stroke checking procedure.

Semester	:	**V**
Course Code	:	**EIEPC311**
Course Title	:	**Microprocessor Lab**
Number of Credits	:	**1 (L:0, T:0, P:2)**
Prerequisite	:	Idea on digital electronics
Course Category	:	**PC**
Course Objective		
Following are the objectives of this course		
		❖ Develop assembly language programs using instruction set of 8085 ❖ Design and develop microprocessor interfacing with different peripheral devices.
List of Practical work/experiments to be performed to achieve following aims.		
Sl. No.		**Aims:**
1		Introduction to Microprocessor Trainer Kit and identify the different peripheral devices, bus architecture on it.
2		To write program using data transfer instructions.
3		To write program using arithmetic instructions
4		To write program using Logical instructions
5		To write program using branching instructions
6		To write program and demonstrate delays & subroutines.
7		To study the Binary to BCD conversion
8		To demonstrate the programming & interfacing of 8255 Programmable Peripheral Interface.
9		To write program for interfacing ADC and DAC
		(Student should write the programming in assembly language, run the program in Microprocessor training kit and / or simulation software.)

Course Outcome	
At the end of the course student will be able to:	1. Write assembly programs to run on 8085 microprocessor and systems based on it 2. Understand and develop techniques for faster execution of arithmetic and logical operations 3. Understand and realize the Interfacing of memory & various I/O devices with 8085 Microprocessor 4. Design applications based on microprocessor 8085 using memory chips and peripheral ICs 5. Undergo minor projects based on 8085 assembly language programming

Semester	:	**V**
Course Code	:	**EIEPC313**
Course Title	:	**Process Control Lab**
Number of Credits	:	**1 (L:0, T:0, P:2)**
Prerequisite	:	Basic idea on process and measuring instruments
Course Category	:	**PC**

Course Objective	
Following are the objectives of this course	
	❖ To provide idea about temperature, flow and level control. ❖ To draw P&I diagram of different systems. ❖ To write Ladder programming for PLC.

List of Practical work/experiments to be performed to achieve following aims.	
Sl. No.	**Aims:**
1	Temperature control using ON OFF controller and temperature sensor.
2	Level control using D/P transmitter, single loop controller & control valve.
3	Level control using level switch and controller.
4	Flow control using orifice, D/P transmitter, single loop controller and control valve.
5	Flow control using mass flow meter, single loop controller and control valve.
6	Draw P&I diagram of a specific control loop using ISA symbols.
7	PLC programming with Ladder diagram. (Concern teacher should assign at least 10 problems, as per his/her choice, for programming. Few sample examples given here) • To start and stop a motor using START STOP switch. • Design all fundamental logic gates • Design for latching operation • Design various arithmetic operations • Design various logical operations

	• Design program for blinking LEDs • Design for implementing a digital timer • Design for implementing a digital counter • Design for a temperature control system • Design for a flow control system • Control the level of overhead tank. The control is performed when reservoir is having at least certain level of water.
Course Outcome	
At the end of the course student will be able to:	1. Build Control strategy using ON OFF controller and temperature sensors to control temperature. 2. Construct level control strategy using D/P transmitter & control valve and level switch and controller 3. Develop flow Control strategy using D/P transmitter & control valve and mass flow meter and control valve 4. Draw P&I diagram of any control loop using ISA symbols 5. Design PLC Ladder programming to solve different process logics

Semester	:	**V**
Course Code	:	**EIEPE301/1**
Course Title	:	**Biomedical Instrumentation**
Number of Credits	:	**2 (L:2, T:0, P:0)**
Prerequisite	:	Idea about human biology, basic sensors and transduces.
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- To identify and describe various biomedical signals.
- To describe the origin of biopotentials and explain the role of biopotential electrodes
- To understand the synchronization between physiological systems of the body.
- To understand the basic measurement principles behind biomedical instrumentation.
- To realize the working principle of numerous biomedical imaging techniques.
- To analyse the applications of biosensing in different domains of healthcare.

Course Content			**Hrs/ Unit**
Module 1	**Unit 1**	**Biopotential, Bioamplifiers, Bioelectrode**	4
		1.1 Introduction to bio-electric potential, bioamplifier 1.2 Transducers to measure various physiological events 1.3 Types of bio-potential electrodes (Body surface electrodes, Internal electrodes, Micro electrodes) 1.4 Properties of electrodes	

	Unit II	**Cardiac Vascular System & Measurements**	5
		2.1 ECG: origin, Instrumentation, bipolar lead system (I, II, III), Einthoven's triangle, Augmented lead system, unipolar chest lead system, types of display. 2.2 Blood pressure measurements: direct, indirect. 2.3 Defibrillators: AC, DC- circuit 2.4 Pacemaker: Internal, External 2.5 Oximeters	
Module 2	**Unit III**	**Respiratory Measurement Systems:**	5
		3.1 Types of volume, types of measurements, Instrumentation of respiratory system, pneumograph, Capnograph Spirometer, pneumotachometers, nitrogen wash out technique.	
	Unit IV	**Nervous system**	5
		4.1 Action potential of brain, brain wave, 4.2 Instrumentation of Electroencephalography (EEG), electrodes used for recording EEG analysis.	
Module 3	**Unit V**	**Medical Imaging Technique**	6
		5.1 Ultrasonography (Basic concept and basic block diagram) 5.2 Thermal imaging system, working, IR detectors, applications. 5.3 Radiography: conventional X-ray, properties, generation of X-ray, Fluoroscopy 5.4 Fundamental concepts of an image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology.	
	Unit VI	**Miscellaneous Medical Equipment**	5
		6.1 Audiometry equipment's and hearing aids 6.2 Foetal and neonatal monitoring systems. 6.3 Important of anaesthesia machine 6.4 Idea on Surgical equipment 6.5 Idea on instruments used in ICU/ICCU 6.6 Heart lung machine and its application (Brief idea and application only)	

Suggested Learning resources

Title	**Author**	**Publisher**
Handbook of Bio-Medical Instrumentation	R. S. Khandpur	Tata McGraw-Hill
Biomedical Instrumentation & Measurement	Cromwell, Weibell& Pfeiffer	Prentice Hall, India

Biomedical Engineering and Instrumentation	Joseph Bronzino	PWS Engg ,Boston
Bioinstrumentation	J.Webster	Wiley &Sons
The Biomedical Engineering handbook	Joseph D.Bronzino	CRC Press
Introduction to Biomedical Equipment Technology	Carr J. J, Brown J. M.	Pearson Education Inc
Principles of Biomedical Instrumentation & Measurement	Richard Aston	Merrill Publishing Company
Introduction to Biomedical Instrumentation	Mandeep Singh	PHI learning private limited
Software/ Learning Websites:		

Course Outcome	
At the end of the course, student will be able to:	1. Analyse the origin of various bioelectric signals (ECG, EEG) and the method of recording using different types of electrodes. 2. Develop the basic knowledge about Cardiovascular, respiratory and nervous system. 3. Develop an understanding of the measurement principles of medical instrumentation including measurement of respiratory function, cardiac variables, blood pressure as well as medical devices 4. Compare the working of various medical imaging techniques including X-ray, and ultrasonography 5. Design various biomedical instruments with the help of respective transducers

Semester	:	**V**
Course Code	:	**EIEPE301/2**
Course Title	:	**Application of Robotics and CNC**
Number of Credits	:	**2 (L:2, T:0, P:0)**
Prerequisite	:	Basic engineering
Course Category	:	**PC**

Course Objective	
Following are the objectives of this course	
	❖ To provide fundamental concept of robotic mechanism and operation ❖ To get familiar about the fundamentals of CNC application

Course Content			Hrs/Unit
Module 1	**Unit 1**	**Fundamentals of Robot**	6
		1.1 Definition 1.2 Functional components of Robot connected as a system. 1.3 Basic motion or degrees of Freedom (DOFs) 1.4 Mechanical configuration: Cartesian coordinate, Cylindrical, spherical, Jointed-arm configuration. 1.5 Different types of robot joints/pairs use in robots. 1.6 Industrial robot and its application 1.7 Work envelop/ Workspaces with Rectangular, Cylindrical and spherical kinematic configuration	
	Unit II	**Robotic End Effector**	5
		2.1 Definition 2.2 Types of end effector 2.3 Classification of end effector 2.4 Commonly used gripper mechanism 2.5 Various Design of gripper finger 2.6 Drive methods used for robot gripper system	
Module 2	**Unit III**	**Robotic Sensors**	5
		3.1 Classification of robotic sensor 3.2 Tactile sensor, Position and Displacement sensor 3.3 Force and torque sensor 3.4 Proximity sensor 3.5 Range sensor 3.6 Architecture of a computer based intelligent robotic manipulator 3.7 Scheme of robot sensors	
	Unit IV	**Robotic Vision**	4
		4.1 Definition 4.2 Robotic vision system 4.3 Components of vision system. 4.4 Advantage of machine vision	
Module 3	**Unit V**	**CNC Introduction**	5
		5.1 Introduction to NC / CNC 5.2 Advantages and disadvantages of NC/CNC over conventional machine tool. 5.3 Block Diagram of a CNC system, Physical components of CNC (MCU, Monitor, Machine TOOL) 5.4 CNC tools: End mills, Face mill, Corner radius tool, Slot Mill / Slotting Saw, Hole-making tools. 5.5 3D cartesian coordinate system	

	Unit VI	**CNC Programming Language**	5
		6.1 Define CNC program 6.2 Sequence of Operations in a typical CNC program 6.3 Commonly used G-code, their meaning and syntax 6.4 Commonly used M-codes, their meaning and syntax 6.5 Commonly used special characters in CNC programming	

Suggested Learning resources

Title	**Author**	**Publisher**
Robotics and Industrial Automation	R. K. Rajput	S. Chand
Robotics Engineering	Klafter, Chmielewski, Negin	PHI
Industrial Robotics	Groover, Wises, Nagel, Odrey	Mcgraw Hill
Industrial Robotics	B. Hodges	JAYCO
Robotics: Introduction, Programming and Projects	Maxwell	Macmilla
Robot Dynamics & Control	Spong, Vidyasagar	Wiley
CNC fundamentals and programming	Agrawal, Patel	Charotar
Fundamentals of CNC Machining	Desk Copy	Autodesk
Getting started with CNC	Edward Ford	
Computer Numerical Control Machine	P Radhakrisnan	New Central Book Agenc
Computer Numerical Control	Stenerson & Curren	PHI
CNC Programming Made Easy	B K Jha	Vikas

Course Outcome

At the end of the course student will be able to:	➢ Identify hardware of robot. ➢ Coordinate grippers and sensors ➢ Identify CNC machine components ➢ List the most commonly used CNC tools ➢ List the sequence of operations in a typical CNC program. ➢ List the most commonly used G-codes, M-codes their meaning, and syntax.

Semester	:	**V**
Course Code	:	**EIEPE303/1**
Course Title	:	**Electronic Communication Principle**
Number of Credits	:	**2 (L:2, T:0, P:0)**
Prerequisite	:	Basic Electronics
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- Understand basic elements of a communication system.
- Analyse baseband signals in time and frequency domain.
- Understand various analog and digital modulation/demodulation techniques along with their performances in various transmission environments

Course Content			**Hrs/ Unit**
Module 1	**Unit 1**	**Basics of Electronic Communication**	4
		1.1 Elements of basic electronic communication system 1.2 Information source, Transmission medium, Noise, Receiver, Destination 1.3 Necessity for modulation,	
	Unit II	**Analog Modulation Techniques**	5
		2.1 Amplitude modulation (AM): Definition, Mathematical representation of AM wave, Modulation Index, percentage of modulation, Bandwidth and side bands, Representation of AM wave in time domain and frequency domain. 2.2 Frequency modulation (FM) – Mathematical representation of FM wave, Frequency deviation, Modulation Index, Representation of FM wave in time domain and frequency domain, Bandwidth requirement	
Module 2	**Unit III**	**Digital communication**	5
		3.1 Sampling theorem 3.2 PAM (Pulse Amplitude Modulation), PWM (Pulse Width Modulation) and PPM (Pulse Position Modulation), Time Division Multiplexing (TDM), Generation and detection of PAM, PWM, PPM 3.3 Pulse Code Modulation (PCM)	
	Unit IV	**Wave Propagation**	5
		4.1 Concept of Electromagnetic Wave and it's properties 4.2 Ground wave propagation – VLF propagation 4.3 Sky wave propagation – critical frequency, Skip distance 4.4 Space wave propagation - multipath space wave propagation, Radio horizon	

Module 3	**Unit V**	**Radio Transmitters and Receivers**	6
		5.1 AM transmitters-High level and low-level transmitters - SSB transmitters - FM transmitters - Block diagram explanation. 5.2 AM receivers-operation - performance parameters - Communication Transceivers - Block diagram - SSB receiver - FM receivers - Block diagram explanation.	
	Unit VI	**Antenna**	5
		6.1 Antenna fundamentals: Resonant antenna and non-resonant antennas 6.2 Antenna parameters: Radiation pattern, polarization, bandwidth, beamwidth, antenna resistance, directivity and power gain, antenna gain 6.3 Dipole Antenna, loop antenna	

Suggested Learning resources

Title	**Author**	**Publisher**
Analog and Digital communication	Sanjay Sharma	S. K. Kataria
Analog and Digital communication	B. P. Lathi	OXFORD
Communication System	Simon Heykin	Wiley
Electronic Communication Systems	Kennedy G, Davis B, Prasanna SRM	Mc-Graw Hill
Electronic Communication System	Kennedy Tata	Tata MCGraw - Hill
Principle of Electronic Communication System	Frenzel Louis E.	Mc-Graw Hill
Electronic Communication System: Fundamentals Through Advanced	Tomasi W.	Pearson Education India
Antenna Theory: Analysis and Design	Constantine A. Balanis	Wiley-Student Edition India

Software/ Learning Websites

https://www.st-andrews.ac.uk/~www_pa/Scots_Guide/iandm/part3/page1.html
https://www.antenna-theory.com/basics/main.php
https://www.explainthatstuff.com/antennas.html
http://www.circuitdiagram.org/am-radio-receiver-with-mk484.html
http://www.circuitstoday.com/single-chip-fm-radio-circuit

Course Outcome

At the end of the course student will be able to:	1. Discuss in detail about the various components of communication system like transmitter, modulator, channel and receiver 2. Design different modulation and demodulation techniques used in analog communication. 3. Identify and solve basic communication problems. 4. Analyse transmitter and receiver circuits. 5. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems 6. Describe wave propagation and use of antenna

Semester	:	**V**
Course Code	:	**EIEPE303/2**
Course Title	:	**Control Theory**
Number of Credits	:	**2(L:2, T:0, P:0)**
Prerequisite	:	Basic idea on close loop system
Course Category	:	**PC**

Course Objective

Following are the objectives of this course

- To deduce transfer function of a system using block diagram reduction method and signal flow graph technique.
- To draw frequency response curve of a system using Bode plot.
- To assess relative stability of a system using Nyquist criterion.
- To evaluate different frequency response specifications of different systems.
- To get idea of state variable model of different system.
- To get idea of non-linear behaviour of different systems.

Course Content			**Hrs/Unit**
Module 1	**Unit 1**	**Mathematical Models of Physical Systems**	6
		1.1 Concept of Transfer function. 1.2 Block diagram representation of armature control and field control dc servomotor. 1.3 Derive transfer function using Block diagram reduction techniques. 1.4 Concept of signal flow graph, Mason's gain formula. 1.5 Derive transfer function using signal flow graph technique.	
	Unit II	**Time Domain Analysis**	4
		2.1 Time response of under-damped second order system using unit step input. 2.2 Time response specifications of second order systems: Rise time, Delay time, Peak time, Peak overshoot, Settling time, Steady state error	
Module 2	**Unit III**	**Concept of Stability**	6
		3.1 Asymptotic stability and conditional stability, 3.2 Routh – Hurwitz criterion, 3.3 Root Locus plots and their applications.	
	Unit IV	**Frequency Domain Analysis**	7
		4.1 Meaning of frequency response. 4.2 Bode plots (logarithmic plot) for representation of frequency response. 4.3 Assessment of relative stability using Nyquist Plot and criterion.	

		4.4 Gain margin, Phase margin, gain cross over frequency and Phase cross over frequency.	
Module 3	**Unit V**	**State Variable Analysis**	4
		5.1 Concept of State, State variable and State Model. 5.2 State models for linear continuous-time systems.	
	Unit VI	**Nonlinear Systems**	3
		6.1 Behaviour of nonlinear systems. 6.2 Common physical nonlinearities.	

Suggested Learning resources

Title	Author	Publisher
Process Control Principle & Application	S Bhanot	Oxford University Press
Process Control; Concept Dynamics & Application	S. K. Singh	PHI
Principles of Process Control	D.Patranabis	Mc Graw Hill
Instrument Engineers' Handbook: Process Control & Optimization, Vol-II	Bela G Liptak	CRC Press, Taylor & Fraancis Group
Chemical Process Control: An Introduction to Theory & Practice	Stephanopoulos	Pearson
Instrumentation Fundamental for Process Control	D.O.J.Desa	Taylor & Francis
Modern Control Engineering	K.Ogata	PHI
Principles of Industrial Process Control	D.P.Eckman	J. Wiley & Sons
Automatic Process Control	D.P.Eckman	J. Wiley & Sons
Process Control Instrumentation Technology	Curtis Johnson	PHI
Automatic Control System	Kuo	Wiley India
Process System Analysis & Control	Coughanowr	Mc Graw Hill International

Course Outcome

At the end of the course student will be able to:	1. Interpret and apply block diagram representations of control systems and design controllers based on empirical tuning rules 2. Solve the steady state and transient analysis of a system for standard inputs 3. Compute stability of linear systems using the Routh array test and use this to generate control design constraints 4. Use root locus techniques in control design for real world systems 5. Compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability

Semester	:	**V**
Course Code	:	**SI301**
Course Title	:	**Internship II**
Number of Credits	:	**1 (L:0, T:0, P:0)**
Prerequisite	:	
Course Category	:	**Internship**

Course Objective

Following are the objectives of this course

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Learn to apply the technical knowledge in real industrial situations.
- Gain experience in writing technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Promote academic, professional and/or personal development.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving

Few points

Area of internship	After 4th semester, for Internship II, students are required to be involved in Inter / Intra Institutional activities viz Training and/or simulation programme with different Institutes like workshop of ITI / Other Polytechnics / other technical Institutes; Soft skill training / industrial training / online training organized by Training and Placement Cell of the institutions / any other organization / Industry; contribution at incubation / innovation / entrepreneurship cell of the institute; participation in workshops / competitions etc; Learning at Departmental lab/ Institutional workshops; undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry.
Activity(s) may include -	✓ Training / Skill Development from any institute / organization [private/govt/govt aided] or from any individual expert on topics related to Instrumentation / Electronics engineering field. ✓ Soft skill training organized by Training and Placement Cell of the respective institutions or any other private / govt organization.

	✓ Working for consultancy job / project work within the institutes or outside the institute. ✓ Visit any industry. ✓ Activities may be arranged by the West Bengal State Council of Technical and Vocational Education & Skill Development. ✓ Board of Practical Studies, MSME or Department of Small-Scale Industries or other engineering department of State Government may be involved. ✓ Initiative from the Department of Technical Education, Training and Skill Development is highly solicited. ✓ Activities centering Private organization in the arena of Instrumentation engineering / Electronics engineering / Electrical engineering etc. may also be considered. ✓ It may be arranged in-campus or off-campus; online or offline mode or blended mode. ✓ Activities may be conducted continuously for stipulated period of time or may be arranged in a staggered fashion – in the latter case Saturday and Sunday may be utilized for the Internship Program and accordingly class schedule will have to be arranged. ✓ Training on Electrical auto CAD / PLC / Drive / SCADA in Inter/ Intra Institution may be organized.
Note	After completion of Internship, the student should prepare a comprehensive report to indicate what he / she has observed and learnt in training / course period. The student may contact Industrial Supervisor / Faculty Mentor to prepare the final report on the assigned topics. The training report should be signed by the Industrial Superviso r/ Internship Faculty Mentor, and / or HOD. The Internship Report will be evaluated on the basis of following criteria (as applicable). ✓ Originality ✓ Adequacy and purposeful writeup ✓ Organization, format, drawing, sketches, language ✓ Practical applications and relationship with basic theory ✓ Concepts taught in the course outcomes ✓ Attendance record, daily diary, quality of the internship report
Evaluation of Internship Report	Seminars must be arranged for the students based on his / her training report, before an internal committee constituted by the concerned department of the institute. The evaluation will be based on the following criteria: ✓ Awareness about the significance of training ✓ Observations and recording data ✓ Concept learned in training

	✓ Quality of content presented ✓ Proper planning for presentation ✓ Depth of knowledge and skills ✓ Submission of report in time ✓ Attendance record, daily diary, quality of internship report.
Assessment	Evaluation may be done purely by the Internal committee constituted by the concerned department of the institute and / or through external expert.
Course Outcome	
At the end of the course student will be able to:	1. Develop new skills and supplement knowledge. 2. Improve communication and teamwork skills. 3. Learn strategies like time management, multi-tasking etc. in an industrial setup. 4. Handle different Industrial / Institutional equipment / machineries 5. Meet new people and learn networking skill

Semester	:	**V**
Course Code	:	**PR301**
Course Title	:	**Minor Project**
Number of Credits	:	**2 (L:0, T:0, P:4)**
Prerequisite	:	Basic on Electronics & Instrumentation
Course Category	:	**PC**
Course Objective		
Following are the objectives of this course		
		➢ To understand the problem and solution of real-life problem ➢ To achieve the potentiality of doing team work ➢ To fill up the gap between academic knowledge and actual real-life problem-solving knowledge. ➢ To prepare the project repot in a skill full way. ➢ To develop technical skill, presentation skill and enhance creative thinking. ➢ To work in Groups, Plan the work and coordinate the work. ➢ To develop leadership qualities and Innovative ideas.

Project group	The project shall be undertaken by a group of students as per convenience. Individual student can also perform separate project.
Few suggestive project domain	
	Simple electrical and electronic project Project for process automation (level, Flow, temperature, pressure control) Microcontroller based project Arduino based project Raspberry Pi based project IoT project DTMF cell phone-based project RF and RFID based project Android application-based project Matlab based project LabView based project PC based project Robotic project Fuzzy logic based project Sensor based project Wireless sensor based project Bluetooth and Zigbee based Projects GSM based project GPS based project Solar system project Project on Irrigation system Robotic project TV remote-control based project PLC based Project Fingerprint based project Traffic density control project Voice control-based project Project on solar system Object detection project Vehicle detection project Obstacle detection project Human health monitoring project Vehicle speed control project Project with night vision camera Project work on women safety Agricultural robotic project Project based on Wireless surveillance Project for Blind hospitality
Note	➢ Project topic may be selected having consultation with project guide. ➢ Every student will have to maintain record of individual contribution on project work.

	➢ After completion of the project, each student should prepare project report. ➢ The project report should be signed by the guide and / or HOD. ➢ The student will have to submit reports on their assigned projects to the project guide in time. ➢ Student will have to perform a seminar presentation on their assigned project work in front of a Board of Internal Examiners of concern department at the time of end semester internal assessment. ➢ Seminar evaluation should be done on the basis of following points ✓ Quality of content presented ✓ Proper Planning for presentation ✓ Clarity of presentation ✓ Depth of knowledge and skills ✓ Questionnaire
Format of Project Report	1. Title page 2. Acknowledgement 3. Certificate from guide 4. Abstract 5. Objective 6. Literature review/ background survey/history 7. Present work 8. Methodology 9. Observation 10. Conclusion 11. References
Evaluation of Project Report	The project Report will be evaluated on the basis of following criteria ➢ Originality ➢ Awareness about the significance of project topic ➢ Setting and operation of experimental set up ➢ Observations and recording data ➢ Interpretation of result and conclusion ➢ Organizations, format, drawing, sketches, style, language ➢ Submission of report in time ➢ Answer to sample questions
Assessment	**Internal Assessment: Total marks: 60** ➢ Continuous assessment of performance, contribution and in time submission of reports on projects: 30 Marks ➢ Seminar Presentation and Viva Voce at end of semester: 20 Marks ➢ Class Attendance:10 Marks **External Assessment: Total marks: 40** (End Semester Examination) ➢ Performance on exhibition of project work: 20 marks ➢ Evaluation on Project Reports: 10 marks

	➢ Viva voce on project work: 10 marks
Course Outcome	
At the end of the course student will be able to:	1. Identify and analyse the problem statement. 2. Develop and design alternative solutions for the identified problem. 3. Adopt new skills and supplement knowledge 4. Build communication and teamwork skills. 5. Improve time management, multi-tasking, real time technical knowledge etc. 6. Apply their knowledge for doing some application-oriented work.

Overall Examination Scheme:

(1) Theory courses:

(a) Internal Assessment: **40** marks

- ❖ Class test: 20
- ❖ Quizzes / Assignment / Student activity: 10
- ❖ Class Attendance: 10

(b) End semester Examination: **60** marks

(2) Sessional / Practical courses:

(a) Internal Assessment: Continuous Internal Assessment throughout the Semester: **60** marks

- ✓ Continuous evaluation: 50 Marks;
- ✓ Class Attendance: 10 Marks

(b) External Assessment (end Semester examination): **40** marks

- ✓ Assignment on the day of exam + practical report copy submission: 20
- ✓ Viva-voce: 20

Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.