M. Sc. Electronics and Instrumentation

Syllabus

UNIVERSITY DEPARTMENT

Program Code: ELIA

2021 – 2022 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **M. Sc. Electronics and Instrumentation** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	To provide the necessary foundation and advanced techniques on computational and software platforms related to the field of Electronics and Instrumentation
PEO2	To be successful in their respective professional careers in the field of Electronics & Instrumentation
PEO3	To engross in life long process of learning that keep themselves abreast of new developments in the field of Electronics & Instrumentation

Program Specific Outcomes (PSOs)	
After the successful completion of M. Sc. Electronics and Instrumentation program, the students are expected to	
PSO1	Be able to Select, install, calibrate and maintain instruments used formeasurement and analysis and interpret the data obtained to arrive at a significant conclusion.
PSO2	Be able to analyze, design and develop signal conditioning circuits for sensors, actuators and select a suitable Embedded System for realizing various control schemes and smart instruments.
PSO3	Be able to design, develop and implement control schemes for various industrial processes and gain hands on experience in configuring Industrial Automation System such as PLC and LabVIEW.

Program Outcomes (POs)	
On successful completion of the M. Sc. Electronics and Instrumentation program	
PO1	Understand and apply the Mathematical knowledge of Signals and systems, Electro Magnetic theory, Control Theory, VLSI Design, Medical Electronics and Signal Processing concepts to solve the problems pertaining in the field of Electronics and Instrumentation.
PO2	Identify, analyze and solve the Electronics and Instrumentation problems from literatures using the imported concepts.
PO3	Understand, analyze and apply Embedded Systems, LabVIEW, PLC VLSI Design, Medical Electronics and Robotics Automation concepts in various industrial applications.
PO4	Demonstrate the knowledge and understanding of Electronics and Instrumentation principles and to apply these to one's own work as a member / leader in a team to manage Electronics / Instrumentation / Control and Robotics Automation projects.
PO5	Self and life-long learning, keeping pace with advanced technological challenges in the broadest sense.
PO6	Ability to analyze complex problems in Instrumentation domain and recommend right solutions with acquired mastery technical knowledge in Electronics and Instrumentation.
PO7	Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
PO8	An ability to independently carry out research and developmental work and arrive at well-founded solutions for complex Electronics and Instrumentation problems
PO9	Select and apply relevant techniques, Engineering and IT tools for Engineering activities like modelling and control of systems/processes and also being conscious of the limitations.
PO10	Comprehend professional and ethical responsibility in the field of Electronics and Instrumentation

BHARATHIAR UNIVERSITY : : COIMBATORE 641 046

M. Sc. Electronics and Instrumentation Curriculum(UniversityDepartment)

(For the students admitted during the academic year 2021– 22 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	Sensors and Transducers	4	4	-	50	50	100
13B	Signals and systems	4	4	-	50	50	100
13C	Embedded Systems	4	4	-	50	50	100
13D	Electro Magnetic Theory	4	4	-	50	50	100
13P	PIC Micro Controller Laboratory	3	-	3	30	45	75
13Q	Instrumentation Laboratory	3	-	3	30	45	75
1EA	Elective	4	4	-	50	50	100
Supportive	Offered by other Departments	2	2	-	25	25	50
	Total	**28**	**22**	**06**	**335**	**365**	**700**
SECOND SEMESTER							
23A	Control Systems	4	4	-	50	50	100
23B	ARM Processor	4	4	-	50	50	100
23C	Intelligent Instrumentation	4	4	-	50	50	100
23D	Introduction to Industry 4.0	4	4	-	50	50	100
23P	ARM Processor Laboratory	3	-	3	30	45	75
23Q	Intelligent Instrumentation & Medical Electronics Laboratory	3	-	3	30	45	75
2EB	Elective	4	4	-	50	50	100
Supportive	Offered by other Departments	2	2	-	25	25	50
	Total	**28**	**22**	**06**	**335**	**365**	**700**
THIRD SEMESTER							
33A	Process Control	4	4	-	50	50	100
33B	Digital Signal Processing	4	4	-	50	50	100
33C	VLSI Design	4	4	-	50	50	100
33P	Digital Signal Processing Laboratory	3	-	3	30	45	75
33Q	VLSI Laboratory	3	-	3	30	45	75
3EC	Elective	4	4	-	50	50	100
Supportive	Offered by other Departments	2	2	-	25	25	50
	Total	**24**	**18**	**06**	**285**	**315**	**600**
FOURTH SEMESTER							
43A	PLC and Its Applications	4	4	-	50	50	100
43P	PLC, SCADA Laboratory	3	-	3	30	45	75
47V	Project, Viva-Voce and Industrial Visit	3	-	3	30	45	75
	Total	**10**	**04**	**06**	**110**	**140**	**250**
	Grand Total	**90**	**66**	**24**	**1065**	**1185**	**2250**
ONLINE COURSES							
	SWAYAM – MOOC – Online Course*	2	--	--	--	--	--
		Non-scholastic with Credits					
VALUE ADDED COURSES							

	Digital Tools (Lab Integrated Theory)	2	15	15	25	25	50
	NLP and NLP (Theory)	2	30	--	50	-	50
JOB ORIENTED COURSES							
	DSP Using MATLAB	2	40	40	50	50	100
	Embedded System Design Using ARM/Cortex Mi**croco**ntroller	2	40	40	50	50	100

*SWAYAM – MOOC – online course shall be of duration at least 4 weeks with at least 2 credits. The course shall be mandatory and shall be completed within third semester (i.e., before the beginning of fourth semester).

First Semester

Course Code	13A	SENSORS AND TRANSDUCERS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Student should have the good knowledge on Basic of Sensors andTransducer	Syllabus Version		2021 -22	

Course Objectives:

The main objectives of this course are to:

1. Provide an adequate knowledge in resistance, inductance and capacitance transducers.
2. Study the characteristics of Transducers, sensors and MEMS
3. To explore on various types of transducers, sensors.
4. Understanding the Fabrication of the sensors

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Familiarize with the fundamentals and standards of sensors and transducers	K1
2	The Application and functioning of latest sensor can be understood	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Sensors and Transducers**	**12 hours**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

Unit:2	**Transducers and its types**	**12 hours**

Principle of operation, construction details, Characteristics and application of resistance potentiometer, Strain Gauge, Resistance Thermometer, Thermistor, Hotwire Anemometer, Piezeoresistive Sensor and Humidity Sensor. Induction potentiometer-Variable Inductance Transducers-EI picks up LVDT-Capacitive transducer and types-Capacitor Microphone Frequency response. Piezoelectric transducer, Magnetostrictive - IC Sensor-Digital Transducers-Smart sensor, Fibre optic sensors, SQUID sensors, Film sensors. Ultrasonic sensors – IR sensors

Unit:3	**Signal Conditioning and DAQ Systems**	**10 hours**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Unit:4	**MEMS**	**12 hours**

MEMS Overview of MEMS and Microsystems-Working principles of Microsystems: Micro sensors-Microactutation-MEMS with Microactuators- Micro accelerometers

Unit:5	**MICROSYSTEMS FABRICATION PROCESSES**	**12 hours**

Introduction- Photolithography-Ion Implementation-Diffusion-Oxidation-Chemical vapor deposition- Physical vapor deposition- Deposition by Epitaxy-Etching. Overview of Micro Manufacturing: Bulk Micro Manufacturing-Surface Micromachining-The LIGA Process.

Unit:6	**Contemporary Issues**	**2 hours**

Biosensor, Nano electronics

	Total Lecture hours	**60 hours**

Text Book(s)

1	A.K.Sawhney, "A course in Electrical & Electronic Measurement and Instrumentation" Dhanpat Raj and Co (P) Ltd.2015.

2.	E.O.Doebelin, "Measurement Systems-Applications and Design", Tata McGraw Hill, New Work, 1990
3.	D.V.S Murthy, "Transducer and Instrumentation", Prentice Hall of India, 1995.
4.	Tai-Ran Hsu "MEMS and microsystems: design and manufacture "McGraw-Hill, 2002.
Reference Books	
1.	John P.Bentley, "Principles of Measurement Systems", III Edition, Pearson Education, 2000.
2.	Hermann K.P.Neubert, "Instrument Transducers", Oxford University Press, 2000.
3.	D.V.S.Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2001.
4.	D.Patranabis, "Sensors and Transducers", Prentice Hall of India, 1999
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1.	https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
2.	https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty?reading
3.	https://nptel.ac.in/content/storage2/courses/108105063/pdf
Course Designed By: Dr.K.G.Padmasine	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	L	M	M	S	S	S
CO2	S	S	M	L	L	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	**13B**	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		**Basic mathematics knowledge is Essential**	**Syllabus Version**		**2021- 22**	

Course Objectives:

The main objectives of this course are to:

1. Understand the basic properties of signal & systems
2. Know the methods of characterization of LTI systems in time domain
3. Analyze continuous time signals and system in the Fourier and Laplace domain
4. Analyze discrete time signals and system in the Fourier and Z transform domain

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Determine if a given system is linear/causal/stable	K2
2	Capable of determining the frequency components present in a deterministic signal	K4
3	Capable of characterizing LTI systems in the time domain and frequency domain	K4
4	Compute the output of an LTI system in the time and frequency domains	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit:1	**Classification of Signals and Systems**	**12 hours**

Standard signals - Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

Unit:2	**Analysis of Continuous Time Signals**	**12 hours**

Fourier series for periodic signals - Fourier Transform – properties- Laplace transforms and properties

Unit:3	**Linear Time Invariant Continuous Time Systems**	**12 hours**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

Unit:4	**Analysis of Discrete Time Signals**	**10 hours**

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties

Unit:5	**Linear Time Invariant-Discrete Time Systems**	**12 hours**

Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel

Unit:6	**Contemporary Issues**	**2 hours**

Fast Fourier Transform, Inverse Fast Fourier Transform

	Total Lecture hours	**60 hours**

Text Book(s)	
1	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems‖, Pearson, 2015
2	John Alan Stuller, An Introduction to Signals and Systems‖, Thomson, 2007.
Reference Books	
1	B. P. Lathi, Principles of Linear Systems and Signals‖, Second Edition, Oxford, 2009.
2	R.E.Zeimer, W.H.Tranter and R.D.Fannin, Signals & Systems - Continuous and Discrete‖, Pearson, 2014.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/101/117101055/
2	https://nptel.ac.in/courses/108/104/108104100/
3	https://nptel.ac.in/courses/117/104/117104074/
Course Designed By: Dr.J.Vijayakumar	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	L	M	M	S	S	S
CO2	S	S	L	L	M	S	M	M	S	S
CO3	S	S	L	M	L	M	S	M	S	S
CO4	S	S	M	L	L	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13C	EMBEDDED SYSTEM DESIGN	L	T	P	C
Core/Elective/ Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge about Digital Electronics	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Study the basics of embedded system design.
2. Understand the architecture of PIC microcontroller.
3. Familiarize in PIC programming.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Depth knowledge in PIC Microcontroller in application perspective.	K4
2	Design capability of PIC Microcontroller based embedded for industrial application	K5&K6
3	Competence technical knowledge, Skill and also to identify, comprehend and solve problems in industry, research and academics related to power, information and electronics hardware.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to Embedded Systems	12 hours

Embedded systems-processor embedded into a system-Components of Embedded System- Forecasting the scope and development of the embedded system- Selection of Microcontroller- Tuning of embedded system for variant similar application -Design process in embedded system- formalization of system design-design process and design examples- classification of embedded systems- skills required for an embedded system designer- Battery Management-Embedded High-Performance Computing (eHPC).

Unit:2	Introduction to PIC Microcontroller	12 hours

PIC 16F877 – Features – Device overview and Architecture – WREG register – Memory Organization-File Registers – access bank – Status Register – Data types and directives – I/O Ports-Resets- Sleep mode..

Unit:3	PIC Programming	12 hours

Introduction to PIC assembly programming – Assembling and linking – Program counter and program ROM space – RISC architecture –Instruction set .

Unit:4	PIC Peripherals	11 hours

Timers – Capture/ Compare/PWM Module - MSSP: SPI – I^2C – USART - Analog to Digital Converter Module – CPU Special features – Interrupts – WDT– ADC, DAC

Unit:5	PIC Application	11 hours

7 Segment display interfacing - Stepper motor- Ultrasonic interfacing- Temperature control- DC Motor Speed Control- LCD interface - Keyboard interface-memory interface.

Unit:6	Contemporary Issues	2 hours

Servomotor control in robots- IoT devices- case study accelerometer interfacing.

	Total Lecture hours	60 hours

Text Book(s)	
1	Raj Kamal "Embedded Systems Design", TMH. 3 rd Edition 2009
2	Muhammed Ali Mazidi, "PIC microcontroller and Embedded Systems Using assembly and C for PIC 18", Pearson Education .2008
Reference Books	
1	John B Peatman, "Design with PIC microcontrollers", Pearson Education 2010
2	Vahid ,"Embedded System Design: A Unified Hardware / Software Introduction",Wiley, 2014.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/108/102/108102045/
2	https://nptel.ac.in/courses/117/104/117104072/
3	http://nptel.unipune.ac.in/LocalG/listLectures.php?cid=1d964ef8dd297d44&bid=c6c45d988f670c72
Course Designed By: Dr.S.Rathinavel	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13D	ELECTRO MAGNETIC THEORY	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic mathematics	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Understand the basic mathematical operators required for electromagnetic problem solving.
2. Understanding the concept of static and dynamic charges.
3. Acquiring knowledge on the concept of wave equation and radiation phenomenon.
4. Know the state of the art measurement equipment's and facilities used for antenna research.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understanding the basic mathematics applicable to electromagnetic theory	K2
2	Apply the knowledge gained in analyzing advanced electromagnetic problems	K5
3	Understanding the behavior of charges in presence and absence of the electric and magnetic fields	K2
4	Create scientific enthusiasm by knowing the state of the art instruments and facilities used for antenna fabrication and measurements.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Fundamental Mathematics**	**10 hours**

Fundamental vector operations, Coordinate systems and transformation, Integrals of vector functions, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stokes's theorem, Physical Interpretation of Gradient, divergent and curl.

Unit:2	**Electrostatics**	**12 hours**

Electric charge and fields, Postulates of electrostatics, Conductor, Insulator, Triboelectricity, Electric potential, Electric flux, Electrostatic induction, dielectrics, Electric dipole moment, Polarization density, Coulomb's law, Gauss's law and applications, Electrostatic energy and forces, Poisson's and Laplace's equations, Uniqueness theorem, Electrostatic Boundary value problems.

Unit:3	**Magnetostatics**	**12 hours**

Electric Currents, current density and ohms law, Electromotive force and Kirchoffs voltage law, Equation of continuity and Kirchhoff's current law, Biot-Savart Law, Gauss and Ampere's Law, Magnetic dipole, Boundary conditions for magnetostatic fields, Magnetic energy, Energy stored in magnetic field.

Unit:4	**Electromagnetic Fields And Waves**	**12 hours**

Faraday's law of electromagnetic induction, Inconsistency of Amperes law, Maxwell's equations , Integral and differential forms, conduction current and displacement current, Boundary conditions for Electromagnetic fields, Helmholtz wave equation, Wave polarisation, Poynting vector and powerflow in EM field.

Unit:5	**Antennas & Radiating Systems**	**12 hours**

Radiation fundamentals, Antenna parameters, Hertz dipole, Wire antennas, Loop antennas, Introduction of Antenna arrays. Printed microstrip antennas: Basic characteristics, Introduction to Photolithography, Introduction to EMI and EMC, Anechoic chamber and RF Network Analyzer.

Unit:6	Contemporary Issues	2 hours
Horn Antennas, Specific Absorption rate		
	Total Lecture hours	60 hours

Text Book(s)	
1	Principles of Electromagnetics, M.N.O.Sadiku & SV Kulkarni,Oxford University Press, 2015.
2	Electromagnetic Field Theory and Transmission Lines, G. S. N. Raju,Pearson Education,2006
3	Electromagnetic Waves, R. K. Shevgaonkar, McGraw Hill, 2017.
4	Electromagnetic Field Theory, U A. Bakshi & A V Bakshi, Technical publication, 2009.
Reference Books	
1	Engineering Electromagnetics, Haytt, McGraw-Hill Education,2001
2	Field and Wave Electromagnetics, D. K. Cheng, Pearson, 2001.
3	Engineering Electromagnetics, N. Ida, Springer, 2000.
4	Introduction to Electrodynamics, J. Griffiths, PHI, 1999.
5	Antenna Theory: Analysis and Design, C. A. Balanis, John Wiley, 2005
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.fcc.gov/consumers/guides/specific-absorption-rate-sar-cell-phones-what-it-means-you
2	https://nptel.ac.in/courses/108/101/108101092/
3	https://nptel.ac.in/courses/108/105/108105114/
Course Designed By: Dr.Sujith Raman	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	L	L	L	L	L	L
CO2	S	S	L	M	L	L	L	L	L	L
CO3	S	S	L	M	L	L	L	M	M	L
CO4	S	S	L	S	M	L	L	S	S	L

*S-Strong; M-Medium; L-Low

Course code	13P	PIC MICROCONTROLLER LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		Basic C Language	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Write programs in PIC microcontroller
2. Understand the functions of peripherals in PIC microcontroller
3. Solve the real world problems through embedded System.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Embedded programming knowledge	K3
2	Highly debugging capability of embedded programming	K5
3	Design embedded system to meet out industry needs.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

List OF Experiments (Any 12 experiments)

1. LCD interface for an application
2. Ultrasonic interface for an application.
3. DAC interface for an application
4. ADC interface for an application.
5. Servomotor interfacing for an application
6. Stepper motor control for an application
7. Speed control of DC motor using PWM
8. 4X4 matrix Keypad interfacing
9. 5 channel blue tooth system for controlling device
10. SPI communication
11. UART communication
12. I2C Communication
13. CCP module for generating delay
14. Timer1 module for generating delay
15. Multiplexed seven segment display
16. Zero crossing detector and control a SCR firing angle for controlling of AC load.

	Total Lecture hours	45 hours

Course Designed By: Dr.S.Rathinavel

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	S	S	S	S	M	S
CO2	S	S	S	M	S	S	M	S	S	S
CO3	S	S	S	M	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13Q	INSTRUMENTATION LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		Knowledge gaining and analysing the sensors and transducers using laboratory equipments	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To make the students aware of basic concepts of measurement and operation of different types of transducers.
2. To make the students conscious about static and dynamic characteristics of different types of transducers.
3. To make the students to calibrate the electrical instruments.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of measurement, error and uncertainty.	K2
2	Understand the static and dynamic characteristics of measuring instruments.	K2
3	Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.	K3
4	Acquire knowledge of analyzing different stages of signal conditioning units	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (any 12 experiments)

1. Displacement measurement using LVDT.
2. Characteristics of Strain gauges.
3. Study of Thermocouple Compensation.
4. Study of Thermistor Linearization transmitter design.
5. Pressure Calibration
6. Study and control of flow process using Compact Flow Control Unit
7. Design and implementation of Inverting and Non – inverting Op-amp configuration.
8. Design and implementation of Summing and Difference amplifier using Op-Amp.
9. Design and implementation of Instrumentation amplifier.
10. Design of V-F converter.
11. Design of F-V converter.
12. Characteristics of differential pressure transmitter with zero elevation and zero suppression.
13. Signal conditioning circuit for any resistive pressure, transducer.
14. Signal conditioning circuit for optical encoder.
15. Tuning of PID Controller for mathematically described processes.
16. Design and implementation of ON/OFF Controller for the Temperature Process.

	Total Practical hours	**45 hours**

Course Designed By: Dr. Azha. Periasamy

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	L	S	S	S	S	S	S	S
CO2	L	S	L	S	S	S	S	S	S	S
CO3	L	S	L	S	S	S	S	S	S	S
CO4	L	S	L	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code	23A	CONTROL SYSTEMS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Mathematics knowledge is Essential	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Introduce the elements of control system and their modelling using various Techniques.
2. Introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. Introduce the state variable analysis method.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Perform time domain and frequency domain analysis of control systems required for stability analysis	K4
2	Design the compensation technique that can be used to stabilize control systems	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Systems and Their Representation	12 hours

Basic elements in control systems – Open and closed loop systems – Mathematical modelling of Physical parameters-Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

Unit:2	Analyze of Time Response	12 hours

Time response – Time domain specifications – Types of test input – I and II order System response –Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

Unit:3	Analyze of Frequency Response	12 hours

Frequency response – Bode plot – Polar plot – Constant M an N circles – Nichols chart – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications

Unit:4	Stability of Control System	12 hours

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

Unit:5	Compensator Design	10 hours

Performance criteria- Frequency response- Lag Compensator- lead Compensator- lag-lead Compensator– Compensator design using bode plots.

Unit:6	Contemporary Issues	2 hours

Control systems for industrial process applications(any two applications)

	Total Lecture hours	60 hours

Text Book(s)	
1	Nagrath, I.J., and Gopal, M., "Control systems Engineering", Wiley Eastern Ltd., 2012.
2	Katsuhiko Ogata, "Modern control Engineering", Fourth Edition, Pearson Education, First Indian Reprint 2015.
Reference Books	
1	A. Nagoor Kani, "Control Systems", Second Edition, RBA Publications 2014.
2	Richard C.Dorf and Robert H.Bishop, "Modern control systems", Addison - Wesley, Eight Edition 2016.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/107/106/107106081/
2	https://nptel.ac.in/courses/108/106/108106098/
3	https://nptel.ac.in/courses/108/101/108101037/
Course Designed By: Dr.J.Vijayakumar	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	S	S	L	M	S	M	S	S
CO2	S	L	M	S	L	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Coursecode	23B	ARM PROCESSOR	L	T	P	C
Core/Elective/Supportive	Core		4	0	0	4
Pre-requisite	Basic 8 bit processor knowledge		Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Understand the architecture and overview of ARM7 Processor.
2. Facilitate to write programs in ARM7 processor
3. Design embedded system with the usage of peripherals in ARM processor

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Depth knowledge in ARM processor in application perspective.	K5
2	Design ARM based embedded for industrial application	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to ARM	12 hours

Introduction to ARM7TDMI Core – Pin Diagram - Architecture – Instruction Pipeline- Memory Access and Interface - Registers – ARM State and Thumb State Register Set - Program Status Registers, Safety and code encryption-Power dissipation.

Unit:2	Data Types and Signals	12 hours

Program"s Model – Memory Formats – Data Types — Exceptions – Interrupt Latencies – Reset – Memory Interface – Bus Cycle – Addressing Signals – Address Timing – Data Timed Signals - Power-up Mode.

Unit:3	Coprocessor and Debugging Techniques	12 hours

Introduction – Coprocessor Interface Signals – Pipeline Signals – Interface Handshaking – Connecting Coprocessor – Undefined Instructions – Privileged Instructions - Debug Systems – Debug Interface Signals – Enabling and Disabling Embedded ICE – Communication Channels.

Unit:4	Introduction to LPC 2378	11 hours

Introduction – Features of LPC 2378 – Block Diagram – Pin Description – Functional Description: On-chip Flash Program Memory – On-chip SRAM – Memory Map – Interrupt Controller – External Memory Controller – General Purpose DMA Controller – Fast General Purpose Parallel I/O.

Unit:5	ARM Peripherals	11 hours

Ethernet – USB Interface – CAN Controller – ADC – DAC – UART – SPI Serial I/O Controller – SSP – I2C Bus Serial I/O Controllers – I2S Bus Serial I/O Controllers General Purpose 32-bit Timers/Counters – PWM – Watchdog Timer – R Ethernet – USB Interface – CAN Controller – ADC – DAC – UART – SPI Serial I/O Controller – SSP – I2C Bus Serial I/O Controllers – I2S Bus Serial I/O Controllers General Purpose 32-bit Timers/Counters – PWM – Watchdog Timer – RTC .

Unit:6	Contemporary Issues	2 hours

Blue tooth based controlling devices - ZigBee based monitoring devices-wireless nodes with ARM processor

	Total Lecture hours	60 hours

Text Book(s)	
1	David Seal, "ARM Architecture Reference Manual", Addison Wesley, 2nd Edition, 2000.
2	Steve Furber, "ARM System On-Chip Architecture", Addison Wesley, 2nd Edition, 2000.
3	Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2011
4	David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2010
Reference Books	
1	ARM7TDMI-S Technical Reference Manual, 1999.
2	Larry D. Pyeatt , "Modern Assembly Language Programming with the ARM Processor", Newnes,2016.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/106/117106111/
2	https://nptel.ac.in/courses/106/105/106105193/
Course Designed By: Dr. S. Rathinavel	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course Code	23C	INTELLIGENT INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Student with adequate knowledge on Basic Computer Systems	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Provide knowledge about data acquisition and control an external measuring device by interfacing to a computer.
2. Familiarize in signal conditioning and various processing tools.
3. Become competent in designing virtual instruments for various industrial measurements and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Design interfacing circuits to acquire real time data and process it using software	K6
2	Design interfacing circuits to acquire real time data and process it using software	K4
3	The students will be outfitted with hands-on knowledge in LabVIEW	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Introduction**	**12 hours**

Introduction to Virtual Instrumentation – Hardware and Software – Virtual Instrumentation for Test, Control & Design – Graphical System Design using LabVIEW - comparison with conventional programming. Introduction to LabVIEW Software Environment – Front Panel: Control & Indicators – Block diagram: Data types and Data Flow programming.

Unit:2	**Graphical Programming and LabVIEW**	**12 hours**

Concept of VIs and sub VI – Case Structures - Loops: For Loop – While Loop – Structure Tunnels – Shift Registers – Feedback Nodes – Communication between parallel loops - Chart and Graphs – Arrays and Clusters

Unit:3	**Managing Files & Design Patterns**	**12 hours**

Implementing file I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – Stata machine programming – Understanding and avoiding race conditions – Notifiers & Queues – Producer Consumer design patterns

Unit:4	**PC Based Data Acquisition**	**12 hours**

Introduction to signal conditioning – Sampling fundamentals, ADCs, DACs, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

Unit:5	**Analysis Tools in Virtual Instrumentation**	**10 hours**

Channel wire communication – Control design and simulation toolkit – Data Communication – Image Acquisition and processing using Vision Assistant Module – Introduction to LabVIEW NXG.

Unit:6	Contemporary Issues	2 hours
Tank level control using LabVIEW, Implementation of Mathematical equations in LabVIEW		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", Eastern Economy Edition, PHI Learning private ltd, 2010.
Reference Books	
1.	Lisa, K.Wells & Jeffery Travis," Lab VIEW For everyone", Prentice Hall, Publication, 2000
2.	S.Gupta and J.P.Gupta, "PC Interfacing for Data Acquisition and Process Control" Instrument society of America, 1994.
3.	Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2011.
4.	Robert H.Bishop, "Learning with LabVIEW" Prentice Hall, 2013.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.ni.com/pdf/manuals/373427j.pdf
2	www.Itrpub.com
3	http://ece-research.unm.edu/jimp/415/labview/LV_Intro_Six_Hours.pdf
Course Designed By: Dr.K.G.Padmasine	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	L	L	M	M	S	S	S
CO2	M	S	M	L	L	S	M	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23D	INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic mathematics and programming automation knowledge is Essential	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To know the automated learning techniques.
2. To study the techniques of knowledge representation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the representation of knowledge	K2
2	Understand machine learning, AI and RPA techniques in developing real world applications.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit	Title	Hours
Unit:1	**Industry 4.0**	**12 hours**

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

Unit	Title	Hours
Unit:2	**Machine Learning**	**12 hours**

Machine Learning - Introduction – Definition – Types of Machine Learning –Supervised, Unsupervised, Reinforcement Learning – Algorithms for Machine Learning – Problems solved by Machine Learning - Tools for Machine Learning - Applications areas of Machine Learning.

Unit	Title	Hours
Unit:3	**Artificial Intelligence**	**12 hours**

Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI - environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI

Unit	Title	Hours
Unit:4	**Robotic Process Automation (RPA)**	**12 hours**

Robotic Process Automation (RPA): Introduction to RPA – Need for automation – Programming constructs in RPA – Robots and Softbots – RPA architecture and process methodologies - Industries best suited for RPA - Risks & Challenges with RPA.

Unit	Title	Hours
Unit:5	**Applications and Tools of Industry 4.0**	**10 hours**

Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.

Unit	Title	Hours
Unit:6	**Contemporary Issues**	**2 hours**

Applications of Industrial Automation Systems using Machine Learning & Artificial Intelligence

	Total Lecture hours	**60 hours**

Text Book(s)	
1	P. Kaliraj, T. Devi, Higher Education for Industry 4.0 and Transformation to Education 5.0, 2020
Reference Books	
1	Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015
2	S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India, 2007
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105195/
2	https://nptel.ac.in/courses/106/106/106106139/
3	https://nptel.ac.in/courses/106/105/106105077/
4	https://nptel.ac.in/courses/112/101/112101098/
Course Designed By: Dr.J.Vijayakumar	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	M	S	S	S
CO2	S	S	S	S	S	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	23P	ARM PROCESSOR LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		Basic C Language	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Write programs in ARM Processor.
2. Understand the functions of peripherals in ARM Processor.
3. Solve the real world problems through 32-bit processor.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Hands on experience on ARM Processor.	K4
2	Highly debugging capability in ARM Processor programming	K5
3	ARM Processor based embedded system design to meet out industry needs.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

List of Experiments (Any 12 experiments)

1. Temperature controller application.
2. External interrupt and interrupt latency
3. GLCD interface for an application
4. Ultrasonic interface for an application.
5. DAC interface for an application
6. Solenoid valve interface for an application.
7. Servomotor interfacing for an application
8. Stepper motor control for an application
9. Speed control of DC motor using PWM
10. 4X4 matrix Keypad interfacing
11. SPI communication
12. UART communication
13. Time delay utility
14. Rotary encoder interfacing
15. ZigBee based Wi-Fi node for monitoring devices

	Total Lecture hours	**45 hours**

Course Designed By: Dr.S.Rathinavel

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	M	S
CO2	S	S	M	M	S	M	M	S	S	S
CO3	S	S	M	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23Q	INTELLIGENT INSTRUMENTATION & MEDICAL ELECTRONICS LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		**Student should have the basic knowledge on circuit design**	**Syllabus Version**		**2021-22**	

Course Objectives:

The main objectives of this course are to:

1. Provide knowledge about data acquisition and control an external measuring device by interfacing to a computer.
2. Familiarize in signal conditioning and various processing tools.
3. Become competent in designing virtual instruments for various industrial measurements and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify salient traits of a virtual instrument and incorporate these traits in projects	K4
2	Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments. Course	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

INTELLIGENT INSTRUMENTATION LAB: (USING LabVIEW) (Any 6 Experiments)

1. Converting VI in to Sub VI
2. ADC using DAQ Interface
3. DAC using DAQ Interface
4. Temperature control using WSN
5. Implementation of Digital filters using LabVIEW DSP Module
6. ADC and LCD interface using LabVIEW ARM Module
7. Tank level monitoring system using DAQ Interface
8. Traffic light control using DAQ Interface

MEDICAL ELECTRONICS (Any 6 Experiments)

1. Hand Grip heart rate monitor.
2. Characteristics of O2 gas sensor.
3. Measuring blood pressure using Sphygmomanometer and give the tabular column for various stages.
4. Plethysmograph and to measure the heart rate.
5. Spiro meter used to perform an air flow and lung volume.
6. Hand Dynamometer.
7. pH meter
8. Observe the output wave form of heart rate monitoring using pulse oximeter in DSO

	Total Lecture hours	**45 hours**

Course Designed By: Dr.K.G.Padmasine

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	L	M	S	S	S	S
CO2	S	S	S	S	L	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code	33A	PROCESS CONTROL	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic understanding on Industrial Automations	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:
1. Introduce dynamics of various processes
2. Educate on the effect of various control actions
3. Impart knowledge on the final control elements
4. Introduce the evaluation criteria and tuning techniques of controllers
5. Introduce the concept of multi loop control techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Ability to understand the actuator and its applications	K2
2	Again knowledge on Industrial automation	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Final Control Elements**	**12 hours**

Final control operation: Signal conversion, actuators, control element- signal conversions: analog electrical signals, digital electrical signals, pneumatic signals- power electronics, switching devices, controlling devices – actuators: electrical actuators, pneumatic actuators – control elements: mechanical, electrical, fluid walls .

Unit:2	**Discrete State Process Control**	**12 hours**

Definition of Discrete state process control – characteristics of the system: Discrete state variables, process specification, event sequence description –Controller modes- Discontinuous Controller Modes: Two-position Mode, Multiposition Mode, Floating control Mode – Continuous control Modes: Proportional control Mode, Integral control Mode, Derivative – control Mode- Composite Control Mode: Proportional –Integral Control, Proportional – Derivative Control Mode, Three Mode controller (PID) .

Unit:3	**Analog and Logic Controllers**	**12 hours**

General features of analog controllers: Physical layout, front panel, side panel – Electronic controllers: Error detector, Single mode, composite controller mode – Pneumatic Controllers: General features, Mode Implementation – Relay controllers: Background, Ladder diagrams- Programme Logic Controllers: Relay sequences, Programmable Logic Controller Design, PLC operation, Programming, Functions of PLC software.

Unit:4	**Computer Based Control**	**12 hours**

Digital applications: Single and multivariable alarms, Two position control – Computer based controllers: Hardware configuration, Smart sensors, multiloop controllers- Software requirements- algorithms to implement the control equations: errors, proportional mode, integral mode, derivative mode, PID Control mode – Data Loggers – Supervisory control – Process control system networks, field bus operations, General characteristics of buses

Unit:5	**Control Loop Characteristics**	**10 hours**

Control System configurations: Single variable, Cascade Control – Multivariable control system: analog control, supervisory and direct digital control – Control system quality: definition of quality, measure of quality – Stability: Transfer function frequency dependence,

stability criteria- Process Loop Tuning: Open Loop Transient Response Method, Ziegler-Nichols Method, Frequency Response Method .		
Unit:6	**Contemporary Issues**	**2 hours**
Mixing, Drying Process in industry		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Curtis D. Johnson, "Process control instrumentation Technology", Eight editions, PrenticeHall of India, 2006.

Reference Books

1	Stephanopoulos G, "Chemical Process Control", Prentice Hall of India, New Delhi, 2008.
2	Donald R Coughanowr, "Process Systems Analysis and Control", Tata McGraw Hill Inc., 2006.
3	Wayne Bequette B. "Process Dynamics Modeling, Analysis and Simulation", Prentice Hall, 2003.
4	Liptak B G, "Process Control", Chilton Book Company, 2005.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	www.nptel.in
2	http://www.pc-education.mcmaster.ca/Lecture_Slides/Chap_01_Marlin_2002.pdf
3	www.lecturenotes.com
4	https://sites.google.com/a/nirmauni.ac.in/process-instrumentation-and-control--- 1ecd03/course-contents/lecture-notes

Course Designed By: Dr.K.G.Padmasine

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	L	L	M	M	S	S	S
CO2	S	S	M	L	L	S	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	33B	DIGITAL SIGNAL PROCESSING	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		The mathematics, signals & systems knowledge is most Important	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Make the students to design Digital Filters, based on the Filter specifications.
2. Provide the exposure to different applications of digital signal processing and the architectures of DSP processors.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze & understand the Filter specifications and digital Filters	K4
2	Understand the different applications of digital signal processing and the architectures of DSP processors	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**The Fast Fourier Transform**	**12 hours**
Introduction- Direct Evaluation of the DFT-The Fast Fourier Transform-Decimation-in-Time Algorithm-Decimation-in-Frequency Algorithm-IDFT using FFT Algorithm		
Unit:2	**Infinite Impulse Response Filters**	**12 hours**
Introduction - Analog Lowpass Filter Design - Steps to Design an Analog Butterworth Low pass Filter-Steps to Design an Analog Chebyshev Lowpass Filter- Comparison between Butterworth Filter and Chebyshev Filter-Frequency Transformation in Analog Domain -Design of Highpass, Bandpass and Bandstop Filters- Design of IIR Filters from Analog Filters-Frequency Transformation in Digital Domain -Realization of Digital Filters		
Unit:3	**Finite Impulse Response Filters**	**12 hours**
Introduction- Linear Phase FIR Filters-Frequency Response of Linear Phase FIR Filters-Location of the Zeros of Linear Phase FIR Filters-Design of FIR Filters using Windows-Digital Differentiator-Frequency Sampling Method of Designing FIR Filters-Realization of FIR Filters.		
Unit:4	**Applications of Digital Signal Processing**	**10 hours**
Introduction-Speech Processing - Speech Analysis-Speech Coding - Subband coding-Channel Vocoder - Homomorphic Vocoder - Digital Processing of Audio Signals.		
Unit:5	**Digital Signal Processors**	**12 hours**
Overview of Digital Signal Processors-Selecting Digital Signal Processors-Applications of DSPs-Architecture of TMS320C50-Addressing modes-Instruction Set-Simple Assembly Language Programs-Architecture of TMS320C54x-Accumulators.		
Unit:6	**Contemporary Issues**	**2 hours**
DSP Based Measurement System, Radar Signal Processing		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	John G. Proakis & Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2011.
2	Dr. P. Ramesh Babu, Digital Signal Processing, Seventh Edition SciTech publications (India) pvt. Ltd., 2017.
Reference Books	
1	Emmanuel C. Ifeachor & Barrie. W. Jervis, Digital Signal Processing‖, Second Edition, Pearson Education / Prentice Hall, 2002.
2	A. V. Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing‖, 8th Indian Reprint, Pearson, 2004.
3	Sanjit K. Mitra, Digital Signal Processing – A Computer Based Approach‖, Tata Mc Graw Hill, 2007.
4	Andreas Antoniou, Digital Signal Processing‖, Tata Mc Graw Hill, 2006.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/104/117104070/
2	https://nptel.ac.in/courses/117/102/117102060/
3	https://nptel.ac.in/courses/108/105/108105055/
Course Designed By: Dr.J.Vijayakumar	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	S	L	S	S	S
CO2	S	S	S	L	S	M	L	S	S	S

*S-Strong; M-Medium; L-Low

Course code	33C	VLSI DESIGN	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		An overall study of the fabrication of MOS transistor, design process VHDL, Verilog programming language and the basics of IoT	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To develop the basic idea about VLSI technology
2. To learn and attempt to execute the concepts of integrated circuit design and testing.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn the MOS processor technology	K1
2	Rightly apply the concepts in real time applications and to explain the recent developments in the present area	K3
3	Learn the concepts of modelling a digital system using Hardware Description language	K2
4	Give basic knowledge of ASIC internals	K2
5	Impart knowledge on ASIC types and tools used in the design	K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create

Unit:1	Introduction to MOS technology	12 hours

Basic MOS transistors: Symbols, Enhancement mode, Depletion mode transistor operation, Basic electrical properties of MOS and BICMOS circuits, An overview of silicon semiconductor technology: NMOS fabrication, CMOS fabrication: n-well, p-well, twin tub, interconnects, Bipolar transistors, Latch up and prevention.

Unit:2	MOS circuit design process	12 hours

CMOS inverter DC characteristics, Determination of pull up to pull down ratio, Transmission gate NMOS and CMOS inverter, Pass transistor, Design of logic gates and flip flops using CPTL, Switch logic networks, Stick diagrams for logic gates, Design rules and layout.

Unit:3	CMOS Subsystem Design	12 hours

Alternative Gate circuits, Design of different types of Adders, Manchester carry chain adder, Carry Look Ahead, Carry Select Adder, Carry skip adder, Design of different types of multipliers: Braun array, Baugh-woolly array, Wallace tree multiplier, systolic array multiplier, Latches and flip flops, Barrel shifter, Memory structures.

Unit:4	ASIC	10 hours

Introduction, Types of ASIC, Design flow of VLSI, Types of simulation, programmable ASIC, Floor planning, Placement Partitioning and routing.

Unit:5	VHDL and Verilog	12 hours

Program structure, types and constants, functions and procedures, Libraries and packages, structural design elements, Data flow design elements, behavioural design elements, Time dimensions and simulation, synthesis.

Unit:6	Contemporary Issues	2 hours
Application Specific Internet of Things: Application or field of use – sensor specific to the application		
	Total Lecture hours	60 hours

Text Book(s)

1	Douglas Pucknell, " Basic VLSI Design systems and circuits" Prentice Hall PTR, 2005
2	Michael John Sebastian Smith, " Application Specific Integrated Circuits" Addision Wesley, 1st edition, 1997

Reference Books

1	Michael P.Lukas, "Distributed Control Systems", Van Nostrand Reinfold Company,2000
2	Neil Weste & Kamarn Eshrangian, " Principles of CMOS VLSI design" Addision Wesley, 2nd Edition, 1998
3	Jacob Baker, Harry, David E.Boyce, " CMOS circuit design, layout and simulation" Prentice Hall India, 1998
4	Bhasker J. " A VHDL Primer" Pearson Eduction, 3rd Edition, 1999
5	John Wakerly, " Digital Design Priciples & Practices", 3rd Edition, Pearson Education, 2002

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/108/107/108107129/
2	https://nptel.ac.in/courses/117/101/117101105/
3	https://nptel.ac.in/courses/117/101/117101004/
4	https://nptel.ac.in/courses/117/108/117108040/
5	https://swayam.gov.in/nd1_noc20_ee05/preview

Course Designed By: Dr.Azha.Periasamy

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	33P	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		The mathematics, signals & systems and programming knowledge is most Important	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB.
2. To implement FIR and IIR filters in MATLAB and DSP Processor.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Carryout basic signal processing operations.	K2
2	Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.	K4
3	Design a DSP system for various applications of DSP.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

SIMULATION USING MATLAB (Any 6 Experiments)

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
7. Design of Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.

USING TMS320C5X/TMS320C54XX/TMS320C67XX (Any 6 Experiments)

1. Arithmetic operations.
2. Waveform generation of elementary Discrete-Time sequences
3. Study of Sampling and effect of under sampling
4. Frequency Analysis using DFT
5. Design of FFT Computations.
6. Linear and Circular convolutions of two discrete signals.
7. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
8. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering

	Total Lecture hours	45 hours

Course Designed By: Dr.J.Vijayakumar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	L	S	S	M	S
CO2	S	S	L	M	S	L	M	S	S	S
CO3	S	S	L	M	S	L	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	33Q	VLSI LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		**Making students to understand, execute his knowledge in the VLSI work bench, FPGA kit with cadence and xilinix software**	**Syllabus Version**		**2021-22**	

Course Objectives:

The main objectives of this course are to:

1. To prepare the students to be able to have a successful career in dynamic industry that is global, multi-disciplinary, and evolving
2. Develop their engineering skills in problem solving, design and innovation as they work individually and/or in multi-disciplinary teams with sense of professional ethics and social responsibility.
3. Communicate effectively and manage resources skillfully as members and leaders of the profession.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and develop the test bench code for combinational circuits and sequential circuits	K2
2	Simulate various combinational and sequential logic circuits and verify the simulation with truth table through EDA tools	K3
3	Document the experimental process and corresponding outcomes.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (any 12 experiments)

I. VLSI Design flow and the tools used in cadence

II. PART A: Digital Simulation

Procedure for creating digital simulation using Verilog and cadence digital tool

1. Inverter
2. Buffer
3. Transmission Gates(TG)
4. Logic Gates AND,OR,NAND,NOR,XOR,XNOR
5. Flip Flops JK,MS,SR,D,T
6. Synchronous Counter
7. Asynchronous Counter
8. Parallel Adder
9. Serial Adder

III. PART B: Analog Design

PART B[1] : Schematic Simulation:

Procedure for creating the schematic simulation

1. Inverter Schematic and test Cell View

2. Common Source Amplifier Schematic and test Cell View
3. Common Drain Amplifier Schematic and test Cell View
4. Differential Amplifier Schematic and test Cell View
5. Operational Amplifier Schematic and test Cell View
6. R-2R DAC Schematic and test Cell View

PART B[1] : Layout Simulation

Layout Design Rules

Procedure for creating the layout and simulating

1. Inverter Layout Design
2. Common Source Amplifier Layout Design
3. Common Drain Amplifier Layout Design
4. Differential Amplifier Layout Design
5. Operational Amplifier Layout Design

		Total Practical hours	**45 hours**
Course Designed By: Dr. Azha. Periasamy			

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code	43A	PLC AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic Electrical and Electronics equipment operation knowledge is Necessary	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Provide theoretical knowledge of PLC and SCADA
2. Create ladder diagrams from PLC, SCADA functions and Data Handling Functions.
3. Create PLC and SCADA systems in their applications to various industries.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and create ladder diagrams from PLC and SCADA functions.	K6
2	Understand, analyze and apply PLC and SCADA systems in their applications to various industries	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basic PLC Programming	12 hours

General PLC programming procedures - Programming on/off inputs and outputs: Relation of digital gate logic to contact/ coil logic - Creating ladder diagrams from process control descriptions - Logic gates. PLC Register Basics.

Unit:2	PLC Function and Intermediate Function	12 hours

Programming Timers - On Delay Timer Instruction - Off Delay Timer Instruction. Programming Counters - Up Counter - Down Counter. Math Instruction - Addition - Subtraction - Multiplication - Division. Number comparison functions - Numbering systems and PLC number conversion functions.

Unit:3	Data Handling Functions and PLC Functions Working With Bits	10 hours

The PLC SKIP and MASTER CONTROL RELAY functions - JUMP Functions - Data Move Systems - Other PLC Data Handling Functions - Digital Bit Functions and Applications - Sequencer functions - Controlling Robot with a PLC - Matrix functions.

Unit:4	PLC Installation Practices, Editing and Troubleshooting	12 hours

PLC Enclosures - Electrical Noise - Leaky Inputs and Outputs - Grounding - Voltage Variations and Surges - Program Editing - Programming and Monitoring - Preventive Maintenance - Troubleshooting - Connecting your Personal Computer and Your Programmable Logic Controller.

Unit:5	Introduction to SCADA	12 hours

SCADA definitions, SCADA Functional requirements and components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits. Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED). Introduction - Communication Network, SCADA Server, SCADA Control systems and Control panels. Introduction to DCS - Difference between DCS and SCADA.

Unit:6	**Contemporary Issues**	**2 hours**
Introduction to Industrial Automation, Architecture of Industrial Automation Systems		
	Total Lecture hours	**60 hours**

Text Book(s)

1	John W. Webb &Ronald A., Reis, "Programmable Logic Controllers Principles and Applications", Fifth Edition, Prentice Hall Publication, New Delhi, 2015.
2	Frank D. Petruzella, "Programmable Logic Controllers", Third Edition, Tata McGraw Hill Education Private Limited, 2010.
3	Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2011
4	David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2010

Reference Books

1	Michael P.Lukas, "Distributed Control Systems", Van Nostrand Reinfold Company,2000
2	Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/108/105/108105088/
2	https://nptel.ac.in/courses/108/105/108105063/
3	http://www.nptelvideos.in/2012/11/industrial-automation-and-control.html

Course Designed By: Dr. J. Vijayakumar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	43P	PLC, SCADA LABORATORY	L	T	P	C
			0	0	3	3
Pre-requisite		Basic Electrical and Electronics equipment operation knowledge is Necessary	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Provide practical knowledge of PLC and SCADA
2. Create ladder diagrams from PLC, SCADA functions and Data Handling Functions
3. Create PLC and SCADA systems in their applications to various industries.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and create ladder diagrams from PLC and SCADA functions.	K2
2	Understand, analyze and apply PLC and SCADA systems in their applications to various industries.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS(any 12 experiments)

1. Programming Logic Gates Function in PLC
2. Implementing Mathematical Operations in PLC
3. Programming Jump-to-subroutine & return operations in PLC
4. Develop and test the control circuit for dynamic braking of DC motor using ladder Programming (Timer and UP/Down Counter).
5. Develop and test the control circuit for Conveyor using ladder programming.
6. Develop the control circuit for automatic tank filling using ladder programming.
7. Develop the control circuit for automatic Traffic Light using ladder programming.
8. Develop the control circuit for automatic Bottle filling using ladder programming.
9. Develop the automatic Vehicle parking using ladder programming.
10. Develop and test the control circuit for Conveyor using SCADA system.
11. Develop the control circuit for automatic tank filling using SCADA system.
12. Develop the control circuit for automatic Traffic Light using SCADA system.
13. Develop the control circuit for automatic Bottle filling using SCADA system.
14. Develop the automatic Vehicle parking using SCADA system.
15. Interfacing of PLC with SCADA system.
16. Interfacing of PLC with SCADA system for motor control process.

	Total Lecture hours	**45 hours**

Course Designed By: Dr.J.Vijayakumar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code	1EA	ELECTRONIC TEST INSTRUMENTS	L	T	P	C
Core/Elective/Supportive		**Elective**	**4**	**0**	**0**	**4**
Pre-requisite		**In depth study about basic electronic devices, active and passive circuit devices, wave shaping instruments, test and measurements**	**Syllabus Version**		**2021-22**	

Course Objectives:

The main objectives of this course are to:

1. Develop skills to become professional technician with capability to measure electrical parameters using various instruments.
2. By learning this course students will able to know basics of various Instruments, transducers and working of electronic circuits used in electronic test and measuring instruments

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Measure various electrical parameters with accuracy, precision, resolution.	K3
2	Use AC and DC bridges for relevant parameter measurement.	K3, K4
3	Select appropriate passive or active transducers for measurement of physical phenomenon	K3
4	Use Signal Generator, frequency counter, CRO and digital IC tester for appropriate measurement.	K3,K4
5	Test and troubleshoot electronic circuits using various measuring instruments	K3,K4, K5
6	Maintain various types of test and measuring instruments.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Characteristics of measurements and bridges**	**12 hours**

Accuracy, precision, resolution, error and noise,Types of errors,Limiting of errors,Wheatstone bridge, Kelvin's double bridge,Maxwell's bridge, Hay bridge, Schering bridge.

Unit:2	**Basic parameter measurements**	**12 hours**

Moving coil and moving iron type instruments,DC and AC voltmeter,Electronic multimeter (DVM), Types-ramp type, integrating type and successive approximation type DVMs,Watt meter, Energy meter, clip-on meter,Hot wire instrument, LCR-Q meter : Basic circuit, applications,Series and parallel.

Unit:3	**Oscilloscopes**	**12 hours**

Connection of Capacitor and Inductor. Block diagram of CRO, Cathode ray tube: construction, operation, screens, graticules,Vertical deflection system, Horizontal deflection system, Delay line, Measurement of frequency, time delay, phase angle and modulation index(trapezoidal method, Oscilloscope probe: structure of 1:1 and 10:1 probes, multiple trace CRO, Digital storage oscilloscope and its features.

Unit:4	**Transducers**	**12 hours**

Classification of transducers,Unbounded strain gauge,Displacement transducers,LVDT,Capacitive

transducers,Inductive transducers,Resistive and capacitive touch screen transducer used in mobile,Resistive and capacitive touch screen transducer used in mobile,Velocity transducer,RPM measurement technique, Temperature measurement: Thermocouples: See beck, Peltier Effect, J,K,R,S,T Types, Thermistors,Resistance thermometer RTDs –PTC,PT-100 (2-3-4 Wire systems-only circuit).		
Unit:5	**Test and measuring instruments**	**12 hours**
Function generator,Audio frequency signal generation,Sweep frequency generatorr, Pulse and square wave generator, Simple frequency counter, Display counter, Cascading counters,Multiplexing of display in frequency counter,Digital IC tester, Logic analyzer, Spectrum analyzer, Harmonic distortion analyzer, Field strength meter (dB meter).		
Unit:6	**Contemporary Issues**	**2 hours**
Data acquisition systems for personal computer: Essential features of Data acquisition boards - The Dasylab Data acquisition and processing software .		
	Total Lecture hours	**62 hours**

Text Book(s)	
1	Electronic Instruments and Measurement Techniques,Cooper, W.D. Halfrick, A.B.PHI Learning, New Delhi, latest edition
2	Electrical and Electronic Measurements, Sahani, A.K.,Dhanpat Rai, New Delhi, latest edition
3	Elements of Electronic Instrumentation and Measurement,Joseph, J.Carr,Pearson,New Delhi, latest edition
4	Electronic Instrumentation and Measurements,David, Bell,PHINew Delhi, latest edition
5	Electronic Measurements and Instrumentation,Kishor, K Lal,Pearson, New Delhi, latest edition
Reference Books	
1	Michael P.Lukas, "Distributed Control Systems", Van Nostrand Reinfold Company,2000
2	Neil Weste & Kamarn Eshrangian, " Principles of CMOS VLSI design" Addison Wesley, 2nd Edition, 1998
3	Jacob Baker, Harry, David E.Boyce, " CMOS circuit design, layout and simulation" Prentice Hall India, 1998
4	Bhasker J. " A VHDL Primer" Pearson Eduction, 3rd Edition, 1999
5	John Wakerly, " Digital Design Priciples & Practices", 3rd Edition, Pearson Education, 2002
6	Ernest O Doebelin,Dhanesh N Manik, " Doebelin's Measurement Systems, 6th Edition,Tata Mc Graw Hill, India, 2011
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Electronic Workbench/MultiSIM/Circuit Maker
2	www.ocw.mit.edu
3	www.home.agilent.com
4	http://www.mhhe.com/doebelin/ms6e
Course Designed By: Dr.Azha.Periasamy	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	M	L	S	S	S	S	S	S	S
CO2	L	M	L	S	S	S	S	S	S	S
CO3	L	M	L	S	S	S	S	S	S	S
CO4	L	M	L	S	S	S	S	S	S	S
CO5	L	M	L	S	S	S	S	S	S	S
CO6	L	M	L	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	1EA	BIO MEDICAL INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Making knowledge about the physiology, study of medical equipments, knowing the patient and his safety measures.	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

17. To educate students on the various physiological systems of human body
18. Provide an exposure to the medical instruments
19. Making an awareness on the patient safety systems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the physical foundations of biological systems and the various electrodes used in the medical field	K2
2	Have a detailed understanding about the various electro physiological measurements in the human body	K2
3	Gain knowledge on the measurement of non-electrical parameter in the human body	K3
4	Understand the basic concepts of various medical imaging techniques and their applications	K2
5	Understand medical assisting and therapy equipment's	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Physiology and transducers	12 hours

Man instrument system, problems encountered in measuring a living system, transducers for biomedical applications, Cell and its structure, resting and action potential, propagation of action potentials, the heart and cardiovascular system, electrophysiology of cardiovascular system, physiology of the respiratory system, nervous system, Electrode theory, biopotential electrodes

Unit:2	Electrophysiological measurement	12 hours

Lead system, recording methods and typical waveforms of ECG, Vector cardiography, EEG Lead system, recording and methods and typical waveforms of EMG,ERG,EOG

Unit:3	Non electrical parameter measurements	12 hours

Measurement of blood pressure, blood flow and cardiac output, plethysmography Measurement of heart sounds, Gas Analyzers, Blood gas analyzers, Oximeters

Unit:4	Medical Imaging and Telemetry	10 hours

X-ray machine, Echocardiography, computer tomography, MRI, Diagnostic ultrasound, PET, SPECT, Electrical impedance tomography, thermography, biotelemetry

Unit:5	Assisting and therapeutic device	12 hours

Pacemakers, Defibrillators, Ventilator, Heart lung machine, Kidney machine, Diathermy endoscopes, Lasers in biomedicine, Discussion of research papers on the applications of biomedical instruments in various aspects.

Unit:6	Contemporary Issues		2 hours
Robotics in medical industry: Industrial and non-industrial robots, remote controlled robots, typical examples of automated industries.			
		Total Lecture hours	60 hours
Text Book(s)			
1	Leslie Cromwell, Fred, J.Weibell and Erich A. Pleiffer, " Biomedical Instrumentation and Measurements" 2nd Edition, Prentice Hall of India, 2014		
2	Kandpur, R.S. " Handbook of Biomedical Instrumentation" 2nd Edition, Tata Mc Graw Hill, 2011		
3	K.S.Fu,R.C. Gonazlez, CSG, Lee Robotics, Control sensing vision and intelligence, Tata Mc Graw Hill 2008		
4	M.Arumugam, " Biomedical Instrumentation" Anuradha Publications, 2015		
Reference Books			
1	John G.Webster, Editor, " Medical Instrumentation, Application and Design" John Wiley and Sons Inc. 2009		
2	Morelli S Salerno S , Ahmed H, Piscioneri A, DeBartolo L," Recent strategies combining biomaterials and Stem cells for bone, liver and skin Regenerations" Current stem cell Research & therapy, 2016		
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
1	https://nptel.ac.in/courses/127/106/127106134/		
2	https://nptel.ac.in/courses/108/105/108105101/		
3	https://swayam.gov.in/nd1_noc19_ge33/preview		
4	https://swayam.gov.in/nd1_noc19_bt28/preview		
Course Designed By: Dr.Azha.Periasasmy			

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	M	S	S	S	S
CO2	S	M	S	M	S	M	S	S	S	S
CO3	S	M	S	M	S	M	S	S	S	S
CO4	S	M	S	M	S	M	S	S	S	S
CO5	S	M	S	M	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	1EA	POWER PLANT INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Basic knowledge in instrumentation	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Study and learn the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants
2. Learn the practices followed in Thermal Power Plant and Nuclear Power Plants, to better environmental conditions and the safety measures
3. Gain the knowledge on steam power plants, steam generators and gas turbine power plants, their analyses on fuel and fluidized bed combustion, ash handling systems,
4. Gain the knowledge on Power Load calculation, distribution and optimum loading. etc.,

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyze the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants and identify the losses to get better efficiency.	K4
2	Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants, to improve the efficiency and reduce the thermal losses.	K3
3	Develop the methods for the Economies of Power Generation and Power plant instrumentation	K6
4	Apply the knowledge in calculating the Power Load Calculations and Distribution.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Fundamentals Of Power Plant	9 hours

Classification of Power Plant- Energy and Power- Power Distribution in India- Power generation- Power corporations- Classifications of Power Plant Cycle- Fuels and Combustion- Steam Generator- Steam Condenser- Turbines.

Unit:2	Steam Power Plant	11 hours

Essentials of Steam Power Plant Equipment- Coal handling- Fuel Burning Furnaces- Method of Fuel Firing- Automatic Boiler Control- Pulverized Coal- Water Walls- Ash Disposal- Smoke and Dust Removal- Dust Collectors.

Unit:3	Steam Generator	12 hours

Introduction- Types of Boilers- Cochran Boiler- Lancashire Boiler- Locomotive Boiler- Industrial Boiler- Requirement of Good Boiler- High Pressure Boiler.

Unit:4	Steam Turbine	12 hours

Introduction- Principal and operation of steam Turbine- Classification of Steam Turbine-Simple Impulse Turbine- Compound Impulse Turbine- Pressure Compound Impulse Turbine- Impulse Reaction Turbine- Steam Turbine Governing- Steam Turbine Testing- Choice of Steam Turbine- Steam Turbine Generators- Steam Turbine Specifications.

Unit:5	**Nuclear Power Plant And Pollution Control**	**14 hours**
Atomic Structure- Nuclear Energy Concepts and Terms- Nuclear Fusion and Fission- Nuclear Reactor- Comparison of Nuclear Power Plant and Steam Power Plant. Pollution Control: Environmental Pollution due to Energy use, Industrial Trail Emission and Road Transport Noise Pollution and Control- Pollution due to Combustion of fuel- Air Pollution and water pollution by thermal power plants- Radiations from Nuclear Power Plant Effluents.		
Unit:6	**Contemporary Issues**	**2 hours**
Hydroelectric power plants, Hydro turbines		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Power Plant Engineering, A.K. Raja, Amit Prakash Srivastava, Manish Dwivedi, 2008.
2	Power Plant Instrumentation, K. Krishnaswamy, M. Ponni Bala, Prentice hall India, 2011
3	Power Plant Instrumentation and Controls, Philip Kiameh, McGraw-Hill, 2014

Reference Books

1	Power Plant Performance, A.B.Gill, Elsevier India, New Delhi, 2003.
2	Standard Boiler Operations, S.M.Elonko and A.L.Kohal, McGraw Hill, New Delhi, 1994
3	The Control of Boiler, Sam G. Duke Low, ISA Press, 1991.
4	Mechanical and Industrial Measurements, R.K.Jain, Khanna Publishers, New Delhi, 1995

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/112/107/112107291/
2	https://www.energy.gov/eere/water/types-hydropower-plants
3	https://www.nationalgeographic.org/encyclopedia/hydroelectric-energy/

Course Designed By: Dr. Sujith Raman

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	L	S	L	L	L	S	S	S
CO2	L	S	L	M	L	L	L	S	S	S
CO3	L	S	L	M	S	S	L	S	S	S
CO4	L	S	L	M	S	M	L	S	S	S

*S-Strong; M-Medium; L-Low

Course code	2EB	COMMUNICATION SYSTEM AND FIBER OPTICS	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Basic knowledge in Communication	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Understand the fiber optic concepts and identify the elements of an optical fiber transmission link
2. Understand optical fiber structure, wave guiding and fabrication
3. Understand the various modes in slab waveguide, step index fiber and graded index fiber

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of different modes in step index fiber and graded index fiber.	K2
2	Analyze the principles of operation and properties of optoelectronic components, as well as the signal guiding characteristics of glass fibers.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Linear Modulation	9 hours

Basic Elements of Communication system – Need for Modulation – Linear and angle Modulation Techniques – AM – frequency spectrum – Representation of AM - Power relation – Generation of AM –DSB SC - SSB – Suppression of unwanted sideband – VSB.

Unit:2	Angle And Pulse Modulation	12 hours

FM – Frequency spectrum – Pre-emphasis and De-emphasis – FM Methods: Direct method, AFC & Indirect Method – Pulse Modulation: PAM, PWM, PPM, PCM.

Unit:3	Radio Receivers And Transmitters	11 hours

AM Transmitters – classification – low level and high level –FM transmitter – Radio Receiver – TRF receiver – super heterodyne receiver –AM Receiver – envelop detector– Automatic Gain control – FM receiver – FM demodulators.

Unit:4	Optical Fiber	14 hours

Structure of Fibres– Refractive index – Snell‟s Law – Total internal reflection – step Index fiber structure and types– Ray optics representation –Numerical Aperture – wave equation for step index fiber –graded index fiber structure – Fibre materials and properties. Signal degradation in optical fibers: Overview of attenuation - Attenuation units - scattering and absorption losses - core & cladding losses - Bending losses.

Unit:5	Optical Sources	12 hours

LED: LED structures, Light source materials, Quantum efficiency, Modulation Capability, Transient response, Power-Bandwidth Product. LASER Diodes: Modes and threshold conditions, resonant frequencies, structure and radiation pattern, Single mode laser, modulation of Laser Diodes, Temperature Effects.

Unit:6	Contemporary Issues	2 hours
Photo detectors, Fourier series		
	Total Lecture hours	60 hours

Text Book(s)

1	Electronic Communication Systems, George Kennedy, Bernard Davis & SRM Prasanna, Tata McGraw Hill , 2011
2	Optical Fiber Communications, Gerd Keiser, McGraw Hill, 2017

Reference Books

1	Communication systems, Simon S. Haykin, Wiley Publication, 2011
2	Optical Fiber Communication, J M Senior, Principles & Practice by–Prentice Hall of India-2010

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/108/104/108104113/
2	https://nptel.ac.in/courses/117/105/117105143/

Course Designed By: Dr. Sujith Raman

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	M	M	S	S
CO2	S	S	S	M	S	M	M	S	S	S

*S-Strong; M-Medium; L-Low

<table>
<tr><td>Course code</td><td>2EB</td><td colspan="2">COMPUTER AIDED INSTRUMENTATION</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">Core/Elective/Supportive</td><td colspan="2">Elective</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Basic knowledge of analog and digital electronics</td><td>Syllabus Version</td><td colspan="4">2021-22</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td colspan="8">The main objectives of this course are to:
1. Familiarize with various data transmission and computer aided tools that can be implemented in various industrial applications
2. Develop a thorough understanding of the common instrument interfaces, different transmission protocols and Ethernet.</td></tr>
<tr><td colspan="8">Expected Course Outcomes:</td></tr>
<tr><td colspan="8">On the successful completion of the course, student will be able to:</td></tr>
<tr><td>1</td><td colspan="5">Use computer aided tools for various industrial applications.</td><td colspan="2">K5</td></tr>
<tr><td>2</td><td colspan="5">Create a new communication protocol with PC in real time, different common instruments interface and idea about Ethernet.</td><td colspan="2">K6</td></tr>
<tr><td colspan="8">K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit:1</td><td colspan="4">Data Acquisition Systems and Digital Signal Transmission</td><td colspan="3">12 hours</td></tr>
<tr><td colspan="8">General Configuration – single and multichannel DAS – A/D and D/A converters – Digital data Acquisition Systems – Sample and Hold Circuit – Anti-aliasing filter –Introduction to noise and ground/ shielding – Introduction to protocols and standards - Data Transmission systems – Pulse code formats – Analog and Digital modulation Techniques .</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit:2</td><td colspan="4">Telemetry and Industrial Ethernet</td><td colspan="3">12 hours</td></tr>
<tr><td colspan="8">Telemetry systems – RF network analyzer – Higher frequency signal sources – Introduction to wireless communication - Introduction-IEEE standards – Ethernet MAC layer – IEEE 802.2 and Ethernet SNAP – OSI and IEEE 802.3 standard. Ethernet transceivers, Ethernet types, switches & switching hubs, 10 Mbps Ethernet, 100 Mbps Ethernet, Gigabit Ethernet. TCP/IP overview- Internet layer protocols – Host-to-Host layer.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit:3</td><td colspan="4">Common Instrument Interfaces</td><td colspan="3">12 hours</td></tr>
<tr><td colspan="8">Current loop, RS 232c/RS485, GPIB, interface buses: USB, PCMCIA, VXI, SCXI and PXI: Networking Basics for industrial automation instrumentation Bus – HART, RS 422, IEC/ISA Field Bus, ZigBee and Bluetooth - Open System interconnection (OSI) model – MOD BUS.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit:4</td><td colspan="4">Devicenet</td><td colspan="3">11 hours</td></tr>
<tr><td colspan="8">Overview – layers. Profibus-overview-protocol stack. HART protocol –Foundation field bus-layers – Error Detection and Diagnostics. Local interconnect networks, Redundancy Overview – Actuator- sensor Interface- CAN bus – overview-layers. Device Net and SDS (Smart Distributed Systems)-Physical Layer and Wiring Rules- The Data link Layer- The Application Layer.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit:5</td><td colspan="4">PC in Real Time Environment and Programming</td><td colspan="3">11 hours</td></tr>
<tr><td colspan="8">Introduction-PC system and facilities – PC BUS and signals – Interrupts – Interfacing PC to outside world – PC in real time environment - Real-Time applications of PC – PC based distributed control systems – Real time programming: Introduction – Multi-Tasking – Task Management – Inter-Task communication – Real-time operating systems versus Real-time programming languages.</td></tr>
</table>

Unit:6	Contemporary Issues	2 hours
Wireless CCTV - ZigBee based monitoring through internet		
	Total Lecture hours	60 hours

Text Book(s)	
1	John Park, Steve Mackey and Edwin Wright, "Data Communications for Instrumentation and Control", Elsevier, 2003.
2	Steve Mackay, Edwin Wright and Deon Reynders, "Practical Industrial data networks: Design, Installation and troubleshooting", Elsevier international projects ltd., 2004.
3	Krishna Kant, "Computer Based Industrial Control", Prentice Hall India Ltd., 2004.
Reference Books	
1	Bouwens, A.J., "Digital instrumentation", McGraw Hill, Reprint 2007.
2	S. Gupta and J.P Gupta, "PC Interfacing for Data Acquisition and Process Control", 2nd Edition 2002.
3	M.M.S.,Anand, Electronic Instruments and Instrumentation Technology, Prentice Hall, 2004.
4	Doeblin, "Measurement and system, Application and Design", McGraw-Hill, 5th Edition 2003.
5	John lenk, D., "Handbook of Microcomputer based Instrumentation and control", Prentice Hall, 1984.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/108/105/108105064/
2	https://nptel.ac.in/courses/108/105/108105153/
3	https://nptel.ac.in/courses/112/105/112105232/
Course Designed By: Dr.S.Rathinavel	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	2EB	ROBOTICS AND AUTOMATION	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Basic mathematics, mechanical knowledge is Important	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Study the various parts of robots and fields of robotics.
2. Study the various kinematics and inverse kinematics of robots.
3. Study the Euler, Lagrangian formulation and trajectory planning of Robot dynamics.
4. Study the control of robots for some specific applications.
5. educate on various path planning techniques and dynamics and control of manipulators

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the evolution of robot technology and mathematically represent different types of robot.	K2
2	Get exposed to the case studies and design of robot machine interface.	K3
3	Familiarize various control schemes of Robotics control	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basic Concepts	12 hours

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots

Unit:2	Power Sources, Sensors and Actuators	12 hours

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

Unit:3	Manipulators and Grippers Differential Motion	12 hours

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

Unit:4	Kinematics and Path Planning	12 hours

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.

Unit:5	Dynamics and Control and Applications	10 hours

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation - Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Multiple robots – machine interface – robots in manufacturing and non-manufacturing applications – robot cell design – selection of robot.

Unit:6	**Contemporary Issues**	**2 hours**
application of Robotic Painting, application of part transfer and machine tending		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2	Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications Prentice Hall, 3 edition 2104.

Reference Books

1	Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2	Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3	Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4	R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005
5	JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
6	Issac Asimov I Robot, Ballantine Books, New York, 1986.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/112/101/112101098/
2	https://nptel.ac.in/courses/112/105/112105249/
3	https://nptel.ac.in/courses/112/101/112101099/

Course Designed By: Dr.J.Vijayakumar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	S	M	S	S
CO2	S	M	M	S	M	M	S	S	S	S
CO3	S	M	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	3EC	ANALYTICAL INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Student should have the basic knowledge on Instrumentation	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Provide a various techniques and methods of analysis which occur in the various regions of the spectrum.
2. Study important methods of analysis of industrial gases.
3. Provide the important radio chemical methods of analysis

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To explore the instrumentation techniques for the various industrial applications	K1
2	Able to understand the applications of biomedical instruments	K3
3	Will be familiarized with functions and feature of the instruments	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Colorimetry and Spectrophotometry	12 hours

Special methods of analysis- Beer-Lambert law-colorimeters-UV-ViS Spectrophotometers-Single and double beam Instruments-Sources and detectors-IR Spectrophotometers-Types-Attenuated total reflectance flame photometers- Atomic absorption spectrophotometers-sources and detectors-FTIR Spectrophotometers-Flame emission photometers.

Unit:2	Chromotography	10 hours

Different techniques - Gas chromatography – Detectors - Liquid chromatographs – Applications - High pressure liquid chromatographs - Applications.

Unit:3	Industrial Gas Analyzers and Pollution Monitoring Instruments	12 hours

Types of gas Analyzers-Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation-dust and smoke measurements. .

Unit:4	pH Meters And Dissolve Component Analyzers	12 hours

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer-sodium analyzer-silicon analyzer.

Unit:5	Radio Chemical And Magnetic Resonance Techniques	12 hours

Nuclear radiations Detectors-GM Counter-Proportional Counter-Solid state Detector-Gamma cameras X-ray spectroscopy-Detectors-Diffract meters-Absorption meters-Detectors NMR-Basic principles NMR spectrometer-Applications. Mass Spectrometers-Different Types-Applications.

Unit:6	Contemporary Issues	2 hours
Blood Gas Analysers, Blood Cell Counters,		
	Total Lecture hours	60 hours

Text Book(s)	
1	R.S. Khandpur, "Handbook of Analytical Instruments" Tata Mc Graw Hill publishing Co.Ltd.2006.
2	H.H.Willard, L.L.Merrit, J.A.Dean, F.A.Settle, "Instrumental methods of analysis" CBS publishing & distribution, 1995.
Reference Books	
1	Robert D.Braun, "Introduction to Instrumental Analysis" Mc Graw Hill, Singapore, 1987.
2	G.W. Ewing, "Instrumental Methods of Analysis" Mc Graw Hill 1992.
3	DA Skoog and D.M.West, "Principles of Instrumental Analysis" Harper and Row publishers, 1974.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Academy-Online/pdf
2	lecturenotes.in/instrumentation.pdf
3	https://nptel.ac.in/courses/103/108/103108100/
Course Designed By: Dr.K.G.Padmasine	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	S	S	S
CO2	S	M	M	S	S	S	M	M	S	S
CO3	S	S	M	S	S	M	S	M	S	S

*S-Strong; M-Medium; L

Course code	3EC	DATA COMMUNICATION NETWORKS	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Basic knowledge of analog and digital electronics	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Understand interfacing of different communication buses.
2. Familiarize with different transmission protocols used and made to understand the concept of multiplexing
3. Depth knowledge over different interfacing of instruments

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Competency to apply different transmission protocols and interface buses	K3
2	Capable to analyze the concept of multiplexing, TCP/IP standards and IEEE standards.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction	12 hours

Modern Instrumentation and Control Systems – Introduction to Networks –232-overview - EIA-485-overview – current loop & EIA converters GPIB, interface buses:USB, PCMCIA, VXI, SCXI and PXI: Networking Basics for industrial automation instrumentation Bus – MOD BUS, HART, RS 422, IEC/ISA Field Bus.

Unit:2	Transmission	12 hours

D/D conversion: Line coding, A/D conversion, PCM, Delta modulation, Parallel and serial transmission. D/A conversion: ASK, FSK, PSK, DPSK and QPSK. MODEM.

Unit:3	Multiplexing	12 hours

FDM, WDM and TDM. Multiple accesses: CSMA/CD, Polling and token passing. Channelization: FDMA, TDMA and CDMA. LAN, WAN and MAN

Unit:4	Internet and Wireless Data Network	11 hours

TCP/IP standards, IPv4, IPv6, Worldwide web. Wireless LAN, IEEE standards: 802.11a/b/g/n, ZigBee and Bluetooth.

Unit:5	Devicenet	11 hours

DEVICENET

Overview – layers. Profibus -overview-protocol stack. HART protocol – overview-layers. Foundation field bus- layers – Error Detection and Diagnostics. Local interconnect networks, Redundancy Overview – Actuator- sensor Interface- CAN bus – overview-layers. Device Net and SDS (Smart Distributed Systems)-Physical Layer and Wiring Rules- The Data link Layer- The Application Layer.

Unit:6	Contemporary Issues	2 hours

IoT things and CAN Protocol

	Total Lecture hours	**60 hours**

Text Book(s)	
1	John Park, Steve Mackey and Edwin Wright, "Data Communications for Instrumentation and Control", Elsevier, 2003.
2	Steve Mackay, Edwin Wright and Deon Reynders, "Practical Industrial data networks: Design, Installation and troubleshooting", Elsevier international projects ltd., 2004.
3	Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, Delhi, 2006.
Reference Books	
1	William Buchanan, "Computer Buses-Design and Application", CRC Press, 2000
2	Theodore S Rappaport, "Wireless Communications: Prentice and Practice", Prentice Hall PTR, second edition, 2002.
3	Perry Marshall and John Rinaldi, "Industrial Ethernet", The Instrumentation, Systems and Automation Society, 2005
4	Richard Zurawski ,"Industrial Communications Technology Handbook", CRC Press, 2005
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105082/
2	https://nptel.ac.in/courses/117/105/117105076/
3	https://swayam.gov.in/nd1_noc20_cs23/preview
Course Designed By: Dr.S.Rathinavel	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	3EC	MICROWAVE THEORY AND TECHNIQUES	L	T	P	C
Core/Elective/Supportive		Elective	4	0	0	4
Pre-requisite		Basic mathematics	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Understand the concept of wave propagation especially in the microwave frequency range.
2. Understand the concept of transmission lines and various analysis technique
3. Introduce various microwave components, devices and oscillators used in the field of microwave electronics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge about EM field propagation in free space and guided media	K2
2	Understands the generation, transmission and modification of microwave signals	K5
3	Know the various components and devices used for microwave research and microwave generation.	K3
4	Analyze and evaluate various transmission lines parameters	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction To Microwaves	8 hours

History of Microwaves, Frequency spectrum, Microwave frequency bands, Applications of microwaves in different fields , Plane waves and free space propagation, TE and TM waves, TEM (Transverse electromagnetic) waves, group and phase velocities

Unit:2	Microwave Transmission Lines And Analysis	12 hours

Review of transmission lines, characteristic impedance-open circuit, closed circuit, quarter wavelength and half wavelength lines, Standing wave ratio, VSWR, Reflection coefficient, Impedance matching, coaxial, strip and microstrip transmission lines (introduction).

Unit:3	Waveguides And Devices	13 hours

Introduction to waveguides, Propagation through wave guides, Guided waves slow waves and fast waves, rectangular and circular wave guides, cut off frequency, group velocity, Waveguide Tees, Magic Tees, Rat Race, Directional couplers, Isolators, attenuators, resonator and circulators.

Unit:4	Microwave Linear Beam Tubes And Cross Field Devices	13 hours

Introduction, Microwave tubes, limitations of conventional tubes, Transit time effects, Multi cavity Klystron, re-entrant cavities, Velocity modulation and beam bunching, bunching diagrams, reflex klystron, magnetron, working of magnetron, travelling wave tubes-slow wave structures-amplification mechanism.

Unit:5	**Transferred Electron Devices And Transit Time Devices**	**12 hours**
Gunn Effect and Gunn diode-modes of operation, Microwave Semiconductor devices, Tunnel diodes- negative resistance-band theory for forward and reverse biasing, Schottky diodes, Point contact diodes, Varactor diodes, IMPATTT diode-structure-negative resistance-efficiency and output power, TRAPATT diode-principle of operation and performance.		
Unit:6	**Contemporary Issues**	**2 hours**
Smith chart, Impedance matching		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Microwave Engineering, D. M. Pozar, John Wiley & Sons Inc, 2013.
2	Foundations for Microwave Engineering-2nd Edition, R. E. Collin, Wiley-IEEE Press, 2007.
3	Microwave Engineering, A. Das and S. K. Das, Tata McGraw-Hill, 2007
Reference Books	
1	Microwave devices and circuits, Samuel Y. Lio, (Prentice Hall)-2003
2	Electronic communication systems, Kennedy and Davis, – (Tata Mc Graw Hill) - 2011
3	Microwave Engineering Passive Circuits, P. A. Rizzi, Pearson, 1998.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/108/103/108103141/
2	https://nptel.ac.in/courses/117/105/117105122/
3	https://nptel.ac.in/courses/108/101/108101112/
Course Designed By: Dr.Sujith Raman	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	L	L	M	M	S	M
CO2	S	S	S	L	S	M	L	M	S	M
CO3	S	S	S	S	S	L	S	S	S	M
CO4	S	S	S	S	L	S	L	M	S	M

*S-Strong; M-Medium; L-Low

Supportive Course

Course code	GS	DIGITAL ELECTRONICS AND MICROPROCESSOR	L	T	P	C
Core/Elective/Supportive		Supportive	2	0	0	2
Pre-requisite		Graduate level Electronics knowledge	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Expose the students to the fundamentals of Digital Electronics.
2. Develop skill in simple applications development with microprocessors.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and analyze the concept of linear and digital electronic circuits.	K2
2	Apply computing platform and software to create specific microprocessor applications.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Logic Gates	6 hours

Different Logic gates such as AND, OR, NOT, NAND, NOR, EXOR, Symbol and Truth Table, De Morgan‟s Theorems: Statement, verification and applications, Half-adder. Full adder, Half Subtractor and full subtractor, Shift register

Unit:2	Number Systems	6 hours

Introduction to Decimal, Binary, Octal, Hexadecimal Number Systems, BCD Codes, Inter conversions of Decimal, Binary, and BCD Numbers, Parity, Excess-3.

Unit:3	Microprocessor	6 hours

Architecture and Programming of 8085 - functional Block diagrams, bus systems, Instruction set and addressing modes- timing diagram and assembly level programme- Interfacing RAM and ROM sections.

Unit:4	Contemporary Issues	2 hours

Introduction to ARM, Introduction to 8086

	Total Lecture hours	20 hours

Text Book(s)

1	Microprocessor Architecture Programming and applications with 8085, Ramesh Gaonkar, Penram International Publishing house,-2013
2	Digital Principles and Applications, Donald P. Leach, Albert Paul Malvino, TataMcGraw Hill Company – 2010

Reference Books

1	Electronic Devices and Circuits, Salivahanan ,Tata-McGraw Hill Company-2011

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/108/105/108105102/
2	https://nptel.ac.in/courses/106/108/106108100/
3	https://nptel.ac.in/courses/108/103/108103157/

Course Designed By: Dr. Sujith Raman

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	M	M	M	M
CO2	M	S	S	M	S	S	M	M	M	M

*S-Strong; M-Medium; L-Lo

Course code	GS	MEDICAL ELECTRONICS AND INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Supportive	2	0	0	2
Pre-requisite		Awareness study of the instruments related with the medical field to the other department students	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters.
2. Study about the various assist devices used in the hospitals.
3. Gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basics of medical instruments and its applications	K2
2	Measure biochemical and various physiological information.	K3
3	Know the bio potential recorders and its functions.	K4
4	Gain knowledge about the patient monitoring devices	K1K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Medical Instrumentation Basics	6 hours

Cells and their structure – Transport of ions through the cell membrane – Resting and action potentials Characteristics of Resting potential - Bio-electric potentials – Design of Medical Instruments – Components of the Bio-Medical Instrument System.

Unit:2	Biopotential Recorders	6 hours

Electrocardiography (ECG) - Electroencephalography (EEG)–Electromyography (EMG) - Electroretinography (ERG) – Electrooculography (EOG)

Unit:3	Specialized Medical Equipment	6 hours

Angiography – Endoscopes – Different types of endoscopes -Computer tomography – Application of Computer tomography - Ultrasonic imaging systems.

Unit:4	Contemporary Issues	2 hours

X-ray machine- Magnetic resonance imaging

	Total Lecture hours	20 hours

Text Book(s)

1	M.Arumugam, " Biomedical Instrumentation" Anuradha Publications,
2	R.Anandanatarajan, " Biomedical Instrumentation" PHI learning, 2009

Reference Books

1	R.S.Khandpur, " Handbook of Biomedical Instrumentation" Tata Mc Graw Hill, New Delhi, 2nd Edition, 2003
2	Ason, "Principles of Biomedical Instrumentation and measurements" Mc Graw Hill publishing Co. 1990

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/127/106/127106134/
2	https://nptel.ac.in/courses/108/105/108105101/
3	https://swayam.gov.in/nd1_noc19_ge33/preview
4	https://swayam.gov.in/nd1_noc19_bt28/preview
Course Designed By: Dr. Azha. Periasamy	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	M	M	M	M
CO2	S	S	S	S	M	S	M	M	M	M
CO3	S	S	S	S	M	S	M	M	M	M
CO4	S	S	S	S	M	S	M	M	M	M

*S-Strong; M-Medium; L-Low

Course code	GS	ANALYTICAL INSTRUMENTATION	L	T	P	C
Core/Elective/Supportive		Supportive	2	0	0	2
Pre-requisite		Student should have the basic knowledge on Instrumentation	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Provide a various techniques and methods of analysis which occur in the various regions of the spectrum.
2. To Study important methods of analysis of industrial gases.
3. Understand the important radio chemical methods of analysis.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To explore the instrumentation techniques for the various industrial applications	K1
2	Able to understand the applications of biomedical instruments	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Calorimetry and Spectrophotometry**	**8 hours**

Electromagnetic Radiation-Electromagnetic Spectrum-Interaction of radiation with Matter-Beer Lambert Law-Absorption instruments-UV-ViS spectrophotometers- Single beam null type (Beckman model), Spectronic 21 Spectrophotometer- IR Spectrophotometers-Block diagram of double beam IR Spectrophotometer- Atomic absorption spectrophotometers-FTIR Spectrophotometers-Flame Photometers-Principle- Essential Parts- Block Diagram- Emission System.

Unit:2	**Chromatography**	**5 hours**

Gas chromatography-Block diagram-Basic parts-Sample injection system chromatography columnsThermal conductivity detector - Liquid chromatographs-Types of liquid chromatography- High pressure liquid chromatographs

Unit:3	**Industrial Gas Analyzers and Pollution Monitoring Instruments**	**5 hours**

Types of gas Analyzers-Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation-dust and smoke measurements. .

Unit:4	**Contemporary Issues**	**2 hours**

Blood Gas Analysers, Blood Cell Counters,

	Total Lecture hours	**20 hours**

Text Book(s)

	R.S. Khandpur, “Handbook of Analytical Instruments” Tata Mc Graw Hill publishing Co.Ltd.2006.

Reference Books	
1	Robert D.Braun, “Introduction to Instrumental Analysis” Mc Graw Hill, Singapore, 1987.
2	G.W. Ewing, “Instrumental Methods of Analysis” Mc Graw Hill 1992.
3	DA Skoog and D.M.West, “Principles of Instrumental Analysis” Harper and Row publishers, 1974.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Academy-Online/pdf
2	lecturenotes.in/instrumentation.pdf
3	https://nptel.ac.in/courses/103/108/103108100/
Course Designed By: Dr. K. G. Padmasine	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	S	S	S
CO2	S	M	M	S	S	S	M	M	S	S

*S-Strong; M-Medium; L

Annexure

M. Sc., Electronics and Instrumentation

Syllabus
(With effect from 2020-21)

Program Code :

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION

Bharathiar University
(A State University, Accredited with "A" Grade by NAAC and13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY : : COIMBATORE 641046 DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION

MISSION

To impart theoretical and practical training in advanced areas of Electronics and Instrumentation for acquiring knowledge through research which encourages innovation, creativity, insight development and a passion for science towards technological development.

ONLINE COURSES						
NPTEL online course	2	--	--	--	--	--

ELECTIVE & SUPPORTIVE SUBJECTS

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
1EA	Electronic Test Instruments	4	4	--	25	75	100
1EA	Bio-Medical Instrumentation	4	4	--	25	75	100
1EA	Power Plant Instrumentation	4	4	--	25	75	100
SECOND SEMESTER							
2EB	Communication System and Fiber Optics	4	4	--	25	75	100
2EB	Computer Aided Instrumentation	4	4	--	25	75	100
2EB	Robotics and Automation	4	4	--	25	75	100
THIRD SEMESTER							
3EC	Analytical Instrumentation	4	4	--	25	75	100
3EC	Data Communication Networks	4	4	--	25	75	100
3EC	Microwave Theory and Techniques	4	4	--	25	75	100
SUPPORTIVE SUBJECTS							
GS	Digital Electronics and Microprocessor	2	2	--	12	38	50
GS	Medical Electronics and Instrumentation	2	2	--	12	38	50
GS	Analytical Instrumentation	2	2	--	12	38	50

CERTIFICATE AND VALUE ADDED COURSES

Title of the Course	Credits	Hours		Maximum Marks		
		Theory	Practical	Theory	Practical	Total
CERTIFICATE COURSES (Approved by UGC under the National Skills Qualifications Framework (NSQF)						
DSP Using MATLAB	2	40	40	50	50	100
Embedded System Design Using ARM/Cortex Microcontroller	2	40	40	50	50	100
VALUE ADDED COURSES						
Digital Tools (Lab Integrated Theory)	2	15	15	25	25	50
NLP and NLP (Theory)	2	30	--	50	-	50