Multidisciplinary Minor - I

Theme: Internet of Things
Total Credits: 14
Number of courses: 04

Sr. No.	Subject	Title of the course	Total credits	Offered in semester
1	ETMDM5001	Digital Electronics and Microcontroller	3 + 0 + 0 = 03	III
	ETMDM5002	Lab- Digital Electronics and Microcontroller	0 + 0 + 1 = 01	III
2	ETMDM5003	Introduction to IoT	3 + 0 + 0 = 03	IV
3	ETMDM5004	Microcontroller Based System for IoT	3 + 0 + 0 = 03	V
	ETMDM5005	Lab - Microcontroller Based System for IoT	0 + 0 + 1 = 01	V
4	ETMDM5006	IoT Applications	3 + 0 + 0 = 03	VI

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ETMDM5001: Digital Electronics and Microcontroller		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs/ week	**ISE I**	**15**
	ISE II	**15**
Credits: 03	**ISE III**	**10**
	End Semester Examination	**60**

Course Description:

After completing this course, students will have a clear and fundamental understanding of digital systems and Microntroller. Topics range from an overview of basics of Digital Electronics, types of digital logics, combinational and sequential circuits. It will also cover basics of 8051 Microcontroller, architectures, internal organization and their functions. It also caters to interfacing peripherals to 8051.

Course Objectives:

- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expressions.
- To introduce the methods for simplifying Boolean expressions.
- To present the digital fundamentals, Boolean algebra, design of combinational and sequential circuits.
- To get acquainted with the architecture of 8051 microcontrollers.
- To understand the addressing modes and instruction set of 8051 and concept of assembly language programming
- To understand interfacing of different peripherals and develop systems using the same.

Course Outcomes

After completing the course, students will be able to:

CO1	Understand Boolean algebraic theorems and reduce the Boolean expressions.
CO2	Implement combinational circuits that solve binary logic tasks.
CO3	Implement synchronous and asynchronous sequential circuits.
CO4	Describe the architecture of the microcontroller, memory organization and functions of its allied blocks.
CO5	Study instruction set of 8051 and write programs in assembly language.
CO6	Implement interfacing applications with different peripherals and write programs in embedded ‘C’.

Detailed Syllabus:

Unit 1	**Minimization Techniques and Logic Gates** Boolean postulates and laws, De-Morgan’s Theorem,Principle of Duality,Boolean expression,conversion of basic logic gates to universal logic gates,Implementations of Logic Functions using gates,NAND-NOR implementationsMinimization of Boolean expressions, Minterm, Maxterm, Sum of Products (SOP), Product of Sum (POS), Karnaugh map Minimization,Don’t care condition.
Unit 2	**Combinational Circuits** Design procedure, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel binary adder, Parallel binary Subtractor, BCD adder, Multiplexer/Demultiplexer, decoder, encoder, code converters, magnitude comparator.

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Unit 3	**Sequential Circuits** Latches, Flip-Flops, SR,JK,D,T and Master-Slave, Characteristic Table and equation, Application table, Edge triggering, Level Triggering, Counters, Asynchronous and Synchronous counters, Ring Counter, Johnson counter, Registers, shift registers.
Unit 4	**Introduction to 8051 and Counter Timer** Differentiation between Microprocessors and Microcontrollers, Functional block diagram, architecture, pin configuration, SFRs special function registers, stack and stack pointer, Internal memory organization, I/O ports, addressing modes, instruction set. Programming 8051 Using Assembly Language: Introduction to 8051 assembly language programming, Data types & directives, Programs - addition, subtraction, multiplication, division, block transfer, finding smallest/ largest, positive/ negative numbers from a set of numbers, 0s/1s in a byte.
Unit 5	**Peripheral Interfacing** Interfacing LED, 7-segment LED, LCD, relay, optocoupler, Applications of 8051(block diagram)

Text and Reference Books:

1. M.Morris Mano,Digital Design, 4th Edition,Prentice Hall of India Pvt.Ltd., 2008
2. W.H.Gothman,Digital Electronics-An introduction to theory and practice,PHI, 2006
3. A.P.Malvino,D.P.Leach,digital Principle and Applications,4thEdition,MGH, 2018
4. R.P.Jain,Modern Digital Electronics,4thEdition,Tata McGraw Hill, 2009
5. M.A.Mazidi,J.G.Mazidi and R.D.McKinlay, "The Microcontroller and Embedded Systems'', 2ndEdition, Prentice Hall India Learning Private Limited.
6. K.J.Ayala, "8051 Microcontroller:Architecture,Programming and applications'', 2nd Edition Delmar Cengage Learning.
7. M.Predko, Programming and customizing the 8051 Microcontroller, McGraw Hill Education.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1							1	1	1	
CO2	2	2			2				1	1	1	1
CO3	2	2	1	2	2				1	1	2	2
CO4	2	2	1	1					1	1	1	
CO5	2	2	2	2	2				1	1	2	1
CO6	2	2	2	2	2				2	2	3	2

3 – High **2 – Medium** **1 - Low**

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Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE 1	ISE II	ISE III	ESE
K1	Remember	05	05	-	10
K2	Understand	10	05	05	30
K3	Apply	-	05	05	20
K4	Analyze	-	-	-	-
K5	Evaluate	-	-	-	-
K6	Create	-	-	-	-
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K2	K2	K3	K2	K2	K3
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I (15 Marks)	05	10	00	00	00	00
ISE II (15 Marks)	05	05	05	00	00	00
ISE-III(10 Marks)	00	00	05	00	00	05
ESE (60 Marks)	10	10	10	10	10	10

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ETMDM5002: Lab Digital Electronics and Microcontroller		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/Week	**ISE III**	**25**
Credits: 01		

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Implement Logical operations using basic and universal logic gates
CO2	Perform and realize arithmetic, logic circuits using ICs
CO3	Write simple assembly language programs using 8051 microcontroller
CO4	Write embedded 'C' programs to interface peripherals

List of Experiments (Any 8)

4 practicals of DE and 4 practicals of 8051

1	To verify of logic gates such as AND,OR,NOT,NAND,NOR,EX-OR,EX-NOR
2	To realize logic operation using NAND/NOR
3	To reduce Karnaugh Map(SOP/POS) ● Realize a code converter binary to gray ● Realize a circuit to detect prime numbers in a 4-bit binary numbers ● Realize a circuit to detect the numbers divisible by 03 in 4-bit binary numbers
4	To develop Adder/Subtractor Study of 4-bit adder using IC7483
5	Multiplexer-Demultiplexer Study of 4-Bit Adder using 4:1 MUX
6	Practice IDE software and universal programmer to program 8051.
7	Write and execute ALP for addition, subtraction, block transfer ● Addition of two 8-bit no's stored in internal RAM ● Subtraction of two 8-bit no's stored in external RAM ● Block transfer of N bytes of data ● Bit manipulation programs
8	Write an embedded 'C' program to interface LED, keys Generate various patterns on LED (Flash, alternate flash, n-bit counter, ring counter)
9	Write an embedded 'C' Program to interface relay, buzzer.
10	write a program to interface LCD and display messages
11	Write an embedded 'C' Program to interface Switches and LEDs
12	Write an embedded 'C' Program to interface Seven segment LED

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1		1	1				1	1		
CO2	1	1		1	1				1	1		
CO3	2	2		2	2				1	2		
CO4	2	2		2	2				1	2		

3 – High 2 – Medium 1- Low

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Assessment: **ISE III:** Shall be based on the assessment of submission work and interaction with students till the end of the term.

Assessment Pattern Level No	Knowledge level	ISE III
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	-
S5	Naturalization	-
Total Marks		25

Assessment table:

Assessment Tool	**S1**	**S2**	**S3**
	CO1	**CO3**	**CO2,CO4**
ISE III (25)	**05**	**10**	**10**

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ETMDM5003: Introduction to IoT		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs/ week	**ISE I**	**15**
	ISE II	**15**
Credits: 03	**ISE III**	**10**
	End Semester Examination	**60**

Course description:
After completing this course, students will have a broad and fundamental understanding of IoT. Topics range from an overview of basics IoT, network and communication aspect, M2M with necessary protocols, interfacing of peripherals to Arduino and discussion on applications of loT.

Course Objectives:

- To provide a clear view of the Internet of Things (IoT).
- To get accustomed with building blocks of IoT and its characteristics.
- To acquaint with the communication model and connectivity technologies of IoT.
- To introducethe concepts of M2M with necessary protocols.
- To understand Arduino use to develop IoT applications.
- To get familiarized with various applications of loT.

Course Outcomes
After completing the course, students will able to:

CO1	Understand the building blocks of the Internet of Things and characteristics.
CO2	Describe the concepts of M2M and the basics of modern networking with the concepts of SDN and NFV.
CO3	Understand different network protocols, challenges in IoT and basics of python programming
CO4	Develop interfacing between different sensors, actuators and Arduino
CO5	Describe IoT applications in different domain

Detailed Syllabus

Unit 1	**Introduction to IoT** Defining IoT, Characteristics of IoT, physical design of IoT, logical design of IoT, Functional blocks of IoT, Design and security challenges
Unit 2	**Network & communication** Basics of networking, Connectivity technologies - communication protocols, sensor networks, machine to machine communication, IoT communication model and protocols.
Unit 3	**IoT and M2M** A Basic Perspective – Introduction, M2M Value Chains, IoT Value Chains, Differences between IoT and M2M, SDN and NFV for IoT, IoT Systems Management with NETCONF-YANG.
Unit 4	**Developing IoT** Interoperability in IoT, Introduction to Arduino programming, Sensor and actuator types, Integration of sensor and actuators with Arduino, Introduction to embedded programming.
Unit 5	**IoT Case Studies and Future Trends:** home automation, Smart Cities, Smart Environment, Other IoT applications.

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Text and Reference Books

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things A Hands-On-Approach",2014
2. Adrian McEwen, "Designing the Internet of Things", WileyPublishers,2013,
3. Daniel Kellmereit, "The Silent Intelligence: The Internet of Things" 2013
4. IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT by David Etter
5. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless sensor Networks: Theory and Practice"

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	-	1
CO2	1	1	1	1	1	-	-	-	-	-	-	1
CO3	1	1	1	1	1	-	-	-	-	-	-	1
CO4	1	1	2	2	3	-	-	-	-	-	-	1
CO5	2	2	2	2	2	-	-	-	-	-	-	1

3 - High 2– Medium 1– Low

Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	05	05	00	06
K2	Understand	10	10	05	42
K3	Apply	00	00	05	12
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

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Assessment table

Assessment Tool					
	CO1	CO2	CO3	CO4	CO5
ISE–I(15 Marks)	05	10	00	00	00
ISE–II (15 Marks)	00	05	10	00	00
ISE III(10 Marks)	00	00	10	00	00
ESE Assessment (60 Marks)	12	12	12	12	12

ETMDM5004: Microcontroller Based System for IoT		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**15 Marks**
Credits: 3	**ISE II**	**15 Marks**
	ISE III	**10 Marks**
	ESE	**60 Marks**

Course description: The course provides an overview of embedded systems and microcontroller esp32, Raspberry Pi, in the context of IoT using micro python. This course covers the microcontroller architecture, sensor interfacing with a micro python IDE. It will give basic exposure to sensor data uploading to Server, MQTT protocol and Broker and developing applications.

Course objectives: The course has the following objectives:

- To develop understanding of architecture of esp32, esp8266 and Raspberry Pi boards
- To interface sensors to microcontrollers boards
- To acquire the sensor data from the board, process it on local machines/cloud platform and publish the result in text and graphics format.
- To study different prospective fields for IoT applications through case studies.

Course Outcomes: After completing the course, the students will be able to:

CO1	Learn IoT environment through different IoT boards and programming.	K2
CO2	Write software to interface devices for accessing sensor data and display on web.	K2
CO3	Implement an IoT based applications using RESTful Web API	K2
CO4	Explore the different IoT application areas through case studies.	K3

Detailed Syllabus:

Unit	Content
Unit-1	**Python Programming** Introduction, Data Types, Operators, decision making- branching and looping, functions and modules, Exception handling, file I/O. Use of various libraries in writing IoT applications-NumPy, pandas, matplotlib, device specific libraries.
Unit-2	**Hardware for IoT applications** Introduction to Arduino board, NodeMCU-ESP32, ESP8266, Raspberry pi board and Linux fundamentals. Micro python- GPIO programming, Interfacing and programming of sensors and actuators.
Unit-3	**Data Acquiring and analytics** Data acquiring, organizing, processing and analytics with boards and publishing the results on the Web through RESTful API, Server-Client Configuration.
Unit-4	**IoT Platform** Opensource and commercial cloud platforms.Prototyping and writing programs for IoT. Introduction to Industry 4.0, fog computing, edge computing and Industrial IoT, Big data analytics and machine learning with IoT.
Unit 5	**Case Studies** Building simple IoT applications: Creation of webpage, Publishing LED status,

	DHT11 Sensor data, ultrasonic data, temperature sensor on cloud. Control actuators through cloud. Home Automation system, Agricultural IoT applications, UAVs/Drones-Based IoT Services.

Text and Reference Books

1. MicroPython for the Internet of Things (A Beginner's guide to programming with Python on microcontrollers) By. Charles Bell, Apress
2. Vijay Madisetti, Arshdeep Bahga, "Internet of Things A Hands-On-Approach",2014
3. Adrian McEwen, "Designing the Internet of Things", WileyPublishers,2013,
4. Daniel Kellmereit, "The Silent Intelligence: The Internet of Things" 2013
5. IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT by David Etter
6. Simon Monk, "Programming the Raspberry Pi: Getting Started with Python", January 2012, McGraw Hill Professional.
7. Raspberry Pi with Java: Programming the Internet of Things (IoT) (Oracle Press) 1st Edition.
8. The official raspberry Pi Projects Book, https://www.raspberrypi.org/magpiissues/Projects_Book_v1.pdf
9. Michael Margolis, "Arduino Cookbook", First Edition, March 2011, O'Reilly Media, Inc.

Mapping of course outcome with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	1	2	1	-	1	1	1	1
CO2	1	1	2	2	1	2	-	-	-	-	-	-
CO3	2	-	2	-	2	2	1	-	3	2	1	-
CO4	2	-	2	-	3	3	-	-	2	2	1	1

3-High 2-Medium 1-low

Assessment:

ISE I:	Shall be based on Class Tests/Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be based on Class Tests/Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	05	0	0	00
K2	Understand	10	15	05	42
K3	Apply	0	0	05	18
K4	Analyse	0	0	0	0
K5	Evaluate	0	0	0	0
K6	Create	0	0	0	0

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Total Marks (100)	**15**	**15**	**10**	**60**

Assessment Table

Assessment Tool	**K2**	**K2**	**K2**	**K3**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15)	05	10	00	00
ISE II (15)	00	10	05	02
ISE III (10)	00	00	05	05
ESE Assessment (60)	12	18	12	18

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ETMDM5005: Lab Microcontroller Based System for IOT		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/Week	**ISE III**	**25**
Credits: 01		

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Write programs to interface sensors and actuators to microcontrollers.
CO2	Write programs to send sensor data, SMS, email for cloud communications.
CO3	Implement Web based applications.

List of Experiments (any 8)

Sr. No.	Details
1	Interface LED, Push button to microcontroller.
2	Write python programs to program GPIO of Raspberry Pi.
3	Write python programs to program ESP boards.
4	Write a program to interface humidity/temperature sensors.
5	Write a program to send key/ LED/distance of an objectdata to cloud.
6	Write a program to send the humidity and temperature data to cloud.
7	Write a program to alert the user through SMS notification when sensor data is above or below than a certain threshold value using cloud.
8	Write a program to send emails with the IOT node using an SMTP Server
9	Build a temperature monitoring system. (Interfacing Push Button, LED, Temperature sensor, 7-segment display/LCD display/cloud, messaging)
10	Write a program to use MQTT communication protocol to publish messages and subscribe to topics.
11	To make HTTP GET requests to decode JSON data from OpenWeatherMap.org and plot values in charts.
12	To create a web-based control panel to monitor and control remote devices.
13	To create e-health monitoring system for remote patient health monitoring

Mapping of Course outcome with Program Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	1	1	-	1	2	2	2
CO2	1	1	1	1	3	1	1	-	1	2	2	2
CO3	1	1	-	1	2	2	1	-	2	2	2	3

3-High 2-Medium 1-Low

Assessment Table

Assessment Tool	S1	S3	S4	S2
	C01	CO2	CO3	CO2
ISE III (25)	05	05	10	05

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Assessment Pattern

Assessment Pattern Level No.	Skill Level	ISE III
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
S5	Naturalization	00
Total		25

Multidisciplinary Minor -II

Theme: Automation
Total Credits: 14
Number of courses: 04

Sr. No.	Subject	Title of the course	Total credits	Offered in semester
1	ETMDM6001	Instrumentation	3 + 0 + 0 = 03	III
	ETMDM6002	Lab – Instrumentation	0 + 0 + 1 = 01	III
2	ETMDM6003	Industrial Automation	3 + 0 + 0 = 03	IV
3	ETMDM6004	Robotics & Mechatronics	3 + 0 + 0 = 03	V
	ETMDM6005	Lab – Robotics & Mechatronics	0 + 0 + 1 = 01	V
4	ETMDM6006	Industry 4.0	3 + 0 + 0 = 03	VI

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ETMDM6001 : Instrumentation		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs/ week	**ISE I**	**15**
	ISE II	**15**
Credits: 03	**ISE III**	**10**
	End Semester Examination	**60**

Course description:

This course is electronics - based course dealing with measurements and instrumentation designed for students in Electronics Engineering. It is a theory course based on the use of electrical and electronics instruments for measurements. The course deals with topics such as Principle of measurements, Errors, Accuracy, Units of measurements and electrical standards, Q- meters, Watt-meters, Digital voltmeters, recorders, the principles of operation of transducers used for measurement.

Course Outcomes

After completing the course, students will be able to:

CO1	Identify elements of setup for measurement of physical quantities and parameters.
CO2	Understand various techniques for parameter measurement & study of signals.
CO3	Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.
CO4	Select appropriate signal conditioning, devices and instruments

Detailed Syllabus:

Unit 1	**Instrumentation Basics and bridge measurement** Sensing and Transduction, Block diagram of Instrumentation system, Errors in measurements, Static and Dynamic performance characteristics of measuring Transducer, Bridge measurement: Measurement of Voltage, Current, AC /DC
Unit 2	**Sensors** Definition, classification, selection criterion, Resistive, Capacitive and Inductive Transducers, Hall Effect Transducer, Thermocouple, strain gauge, Transducers for measurement of Flow, Viscosity, Humidity, Pressure, level, ultrasonic sensors, Accelerometer, Optical Sensors, Linear and Rotary Encoders, Magnetic Encoders, Tachometers, Linear and Angular Displacement Transducers, Concept of Smart Sensors
Unit 3	**Signal Conditioning:** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.
Unit 4	**Measuring Devices:** AC voltmeters using rectifiers, True RMS voltmeter, Vector voltmeter, Digital voltmeter, Electronic multimeter, Wattmeter, Sound level meter, RF Voltage / power measurement, Recorders, Signal generators,
Unit 5	**Signal Analysis Instrumentation:** CRO-principle and its working, Dual trace CRO, DSO, Wave analyzers, Harmonic distortion analyzer, Spectrum analyzer, logic analyzer, Network Analyzer.

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Text and Reference Books

1. W D. Cooper, A .D. Helfrick, Modern Electronic Instrumentation and Measurements, 3rd Edition, Prentice-Hall of India, 1985
2. H.S.Kalsi, Electronic Instrumentation and Measurements,4th Edition, TMH,2019
3. B.Oliver, J.Cage, Electronic Measurements and Instrumentation, McGraw Hill, 2017
4. J.J. Carr, Elements of Electronics Instrumentation and Measurement Handbook, 3rd Edition,Pearson Education, 2002
5. B.C. Nakra, K.K. Chaudhary, Instrumentation Measurement and Analysis, 2nd Edition, Tata McGraw Hill

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	-	-	-	-	1
CO2	1	1	-	1	1	-	-	-	-	3	-	1
CO3	2	2	1	1	1	-	-	-	-	3	-	1
CO4	-	1	1	1	2	-	-	-	-	-	-	1

3 – High **2 – Medium** **1 - Low**

Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE 1	ISE II	ISE III
K1	Remember	05	05	10
K2	Understand	10	05	30
K3	Apply	-	-	20
K4	Analyze	-	-	-
K5	Evaluate	-	-	-
K6	Create	-	-	-
Total Marks 40		15	15	10

Assessment table

Assessment Tool	K1	K2	K3	K3
	C01	C02	C03	CO4
ISE I (15 Marks)	05	10	-	-
ISE II (15 Marks)	05	05	05	-
ISE-III (10 Marks)	-	-	05	05
ESE (60 Marks)	10	30	10	10

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ETMDM6002 : Lab –Instrumentation		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/Week	**ISE III**	**25**
Credits: 01		

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will be able to:

CO1	Implement the setup for obtaining characteristics of various transducers.
CO2	Perform experiments for parameter measurements by different instruments.
CO3	To learn how to visualize and work on multidisciplinary tasks.
CO4	Use simulation tools.

List of Experiments

1	Study of Error measurement.
2	Measurement of Resistance using Wheatstone bridge, Capacitance using Schering bridge, Inductance using Maxwell bridge
3	Measurement of Temperature using Thermocouple, RTD(PT100)
4	Measurement of Strain Using strain gauges, Determine linear range of operation, Sensitivity
5	Characteristics of Photovoltaic cell , Photoconductive cell, PIN photodiode, Phototransistor
6	Study of Input output characteristics of LVDT , Linear range of operation, Sensitivity
7	Study Pressure transducer characteristics
8	Measurement of Signal Frequency using Digital Oscilloscope
9	Study of Flow Measurement
10	Study of Spectrum Analyzer

Mapping of Course outcome with Program Outcomes

Course Outcome	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	3	2	-	-	-	-	2	-	-
CO2	1	1	-	3	2	-	-	-	-	2	-	-
CO3	1	1	-	1	2	-	-	-	3	2	-	2
CO4	1	1	-	3	2	-	-	-	1	2	-	2

3 – High 2 – Medium 1- Low

Assessment: **ISE III:** Shall be based on the assessment of submission work and interaction with students till the end of the term.

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ETMDM6003 : Industrial Automation		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs/ week	**ISE I**	**15**
	ISE II	**15**
Credits: 03	**ISE III**	**10**
	End Semester Examination	**60**

Course description: After completing this course, students will have a broad and fundamental understanding of industrial automation. Topics range from an overview of common automation industries to an introduction of basic automated system components, such as controllers, I/O, drives, and HMI (Human Machine Interface). In addition, students will learn common automation terminology, tools used in industrial automation, and career options available within this field

Course Objectives:

- To provide a clear view on (PLC),SCADA and DCS
- To accustom with various methods involved in automation control and monitoring
- To impart knowledge about robotics, fuzzy Neuro controllers used in automation
- To familiarize with industrial communication protocols

Course Outcomes

After completing the course, students will able to:

CO1	Develop the PLC program for various timing and sequencing operations.
CO2	Identify the necessity of using DAS, SCADA, DCS & PLC for Complex projects.
CO3	Understand the interfacing methods and industrial communication protocols
CO4	Understand the process control systems through basic principles and case studies

Detailed Syllabus

Unit 1	Concept of relay and contactors, Programmable logic controllers (PLC), Programming techniques - One Line Diagrams and Ladder language
Unit 2	SCADA, Distributed Control Systems (DCS), Human Machine Interface, Signal Conditioning Systems Data Acquisition systems, Data Loggers
Unit 3	Introduction to industrial communication protocols- TCP/IP protocol- HART communicator protocol Wireless communication(Ip56, Ip58) LAN – PROFI bus, PROFI Net, Modbus, CAN bus, field bus architecture, I/O Link and Industrial Ethernet
Unit 4	Process Control system principles, Basic concepts of Electro-pneumatic and Electro-hydraulic systems
Unit 5	Introduction to Advanced topics in Automation: Robotics, Computer vision. Fuzzy Neuro Controllers Development of automation systems to industrial processes, IoT, Case studies

Text and Reference Books

1. Bela G. Liptak, Instrumentation Engineer "s HandBook, CRC Press
2. H. S. Kalsi, Electronic Instrumentation, TMH
3. J.Nagrath&M.Gopal,Control System Engineering, Third edition, New Age International Publication
4. Rangan and Sarma, Instrumentation Systems, TMH
5. Helfrick A.D & Cooper W.D, Modern Electronic Instrumentation &Measurement Techniques, Pearson Education
6. Curtis D Johnson, Process Control; Instrumentation Technology, Pearson Education, 2008
7. PLC manuals from Siemens G.C.Goodwin, S.R.Graebe, M.E. Salgado, Control System Design, Pearson Education

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	1	-	-	-	-	-	-	2
CO2	1	1	1	-	2	-	-	-	1	2	-	2
CO3	2	1	1	-	2	-	-	-	2	2	-	2
CO4	-	1	-	1	3	1	-	-	2	2	-	2

3 – High 2– Medium 1– Low

Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	05	05	00	15
K2	Understand	10	10	15	45
K3	Apply	00	00	10	00
K4	Analyze	00	00	00	00

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K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K2	K2
	CO1	CO2	CO3	CO4
ISE–I(15Marks)	05	10	00	00
ISE–II (15Marks)	00	00	10	05
ISE III(10Marks)	00	00	05	05
ESE Assessment (60Marks)	15	15	15	15

ETMDM6004 : Robotics & Mechatronics		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**15 Marks**
Credits : 3	**ISE II**	**15 Marks**
	ISE III	**10 Marks**
	ESE	**60 Marks**

Course description: The course gives exposure to fundamentals of Robotics- Mechanical Systems, Microprocessors and Microcontrollers, Sensors and Actuators, Image Acquisition and Processing, Speech Processing. This course introduces Robot Operating System and Programming is C. This course discusses the applications of Robot in Industry and Home.

Course objectives: The course has the following objectives:

- To develop understanding Robotics components
- To know the classification of Robots
- To impart knowledge of Microprocessors and Microcontrollers
- To expose the students to Robot control and Robot Operating System

Course Outcomes: After completing the course, the students will able to:

CO1	Learn classification and mechanics and controls involved in Robot	**K1**
CO2	Explore role of Sensors and Actuators in Robotics	**K2**
CO3	Understand the types of Robotic control systems & use of Machine vision	**K2**
CO4	Explore the automation through case studies	**K2**

Detailed Syllabus:

Unit	Content
Unit-1	**Motion Control Systems** Motion Control Classification, Open and Closed Loop Systems, Mechanical Components, Motors and Motor Drives- Servo Motors and Stepper Motors, Brushless DC Motors
Unit-2	**Actuators** Solenoids, Power Transfer Mechanisms- Belts, Chains, Gears, Worm Gears, Rocker and Cam, Rack and Pinion, Walkers- Leg Actuators, Leg Geometry, Walking Techniques, Hydraulic and Pneumatic drives
Unit-3	**Robotic Vision System** Camera Specifications, Camera SOC, Image Formats, Multi-resolution Images, Compression Formats, introduction to segmentation and classification, introduction to Open CV system. Introduction to Speech acquisition and storage, Speech Synthesis.
Unit-4	**Robotic Control Systems** Wheeled Robotic System, feedback control systems, study and application of PID controller to motion control, stability analysis, Study of Robotic Arm
Unit-5	**Application examples:** Case studies Examples of Mechatronics Systems from Robotics Manufacturing, Machine Diagnostics and Road vehicles.

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Text and Reference Books

1. Robot Mechanisms and Mechanical Devices – *Paul E. Sandin,* McGraw Hill, New York
2. Embedded C Programming and the Atmel AVR – *Richard H. Barnett, Sarah Cox, Larry O'Cull,* Thomson Delmar Learning, Canada
3. Mastering STM32, *Carmine Noviello*, Learn Pub
4. Robot Operating System (ROS), *Anis Koubaa*, Springer International Publishing
5. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).
6. Mechatronics: A Multi disciplinary Approach ,William Bolton, Pearson Education
7. A Textbook of Mechatronics, R. K. Rajput, S. Chand &Company Private Limited
8. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.

Mapping of course outcome with program outcomes:

PO / CO	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1								2		1
CO2	2	1	1	1						2		1
CO3	2	1	1	1						2		1
CO4	2	2				2		1	2	2		1

3-High **2-Medium** **1-low**

Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	5	5	0	10
K2	Understand	10	10	10	50
K3	Apply	0	0	0	0
K4	Analyse	0	0	0	0
K5	Evaluate	0	0	0	0
K6	Create	0	0	0	0
Total Marks (100)		**15**	**15**	**10**	**60**

Assessment Table

Assessment Tool	**K1**	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15)	05	10	00	00
ISE II (15)	05	00	10	00
ISE III (10)	00	00	00	10
ESE Assessment(60)	10	20	20	10

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ETMDM6005 : Lab –Robotics & Mechatronics		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs/Week	**ISE III**	**25**
Credits: 01		

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Explore controllers, motors, actuators, encoders, sensors used in robots.
CO2	Understand internals of Robotic Operating System and programming
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open-ended robotic system.

List of Experiments

Sr. No.	Details
1	Implement Stepper Motor and Servo Motor Interface to ATMEGA 328p
2	Implement interface of various sensors to ATMEGA 328p and STM32
3	Implement Interface to 3-axis accelerometer to ATMEGA 328p and plot response of the sensor to walking, running, and Turn
4	Implement Camera Interface to ATMEGA 328p and STM32/Raspberry Pi, acquire image and perform photometric corrections
5	Study of Robotic Operating System on Raspberry Pi, Installation and simple programming in C
6	Acquire various hand gestures on to computer using flex sensors and ATMEGA 328p and the nerve impulses and correlate the signals for Robotic Arm
7	Acquire sensor data using ATMEGA 328p and upload on cloud through 4G gateway
8	Control a stepper motor using command on HTML Page through cloud interface
9	Introduction to Open CV on Raspberry Pi- Basic Photometric and Geometric Processing

Mapping of Course outcome with Program Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		2	3				1	3		1
CO2	2	1		2	3				1	3		1
CO3	2	1		2	3	2	1	1	2	3	2	2

3-High **2-Medium** **1-Low**

Assessment Table

Assessment Tool	S1	S3	S4
	C01	CO2	CO3
ISE III (25)	10	05	10

Assessment Pattern

Assessment Pattern Level No.	Skill Level	ISE III
S1	Imitation	05
S2	Manipulation	05
S3	Precision	15
S4	Articulation	00
S5	Naturalization	00
Total		25

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ETMDM6006 : Industry 4.0		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs/ week	**ISE I**	**15**
Credits: 03	**ISE II**	**15**
	ISE III	**10**
	End Semester Examination	**60**

Course description: The course gives exposure to current industry practices. The Industry environment digitally connected data, people, processes, services, systems, and IoT enabled industrial assets across cyber and physical worlds. The term Industry 4.0 is labelled for the fourth industrial revolution which builds on three earlier technological shifts: steam power, electrification of production and assembly lines, and the integration of automation principles. This development has become possible due to advances in sensor technology and connectivity modules which enabled data gathering throughout industrial processes and the central conversion into decision-relevant information.

Course objectives: The course has the following objectives:

- To explore the concepts of Industry 4.0
- To know the components of Industry 4.0
- To develop understanding of advantages of Industry 4.0
- To impart knowledge through case studies

Course Outcomes: After completing the course, the students will able to:

CO1	Understand the nature of the fourth industrial revolution & its scope	**K2**
CO2	Comprehend the components of Industry 4.0	**K2**
CO3	Learn the features and advantages of Industry 4.0	**K2**
CO4	Explore the Industry 4.0 automation through case studies	**K2**

Detailed Syllabus:

Unit 1	Industrial Evolution, Industry 4.0, Technologies that Drive Industry 4.0, Challenges for Industry 4.0, Quality 4.0, Supply Chain 4.0, Data Standardization Internet and Ethernet, Machine to Machine Interface (Cyber Physical Systems)
Unit 2	Industrial Control Systems, Virtual Reality, Augmented Reality, Mixed Reality and Artificial Intelligence and Machine Learning, Advanced Simulation
Unit 3	Introduction to Big Data for Industry 4.0: Introduction to Big Data, Characteristics of Big Data and Dimensions of Scalability, Data Analysis Visualization of Data, Predictive Analytics and Modelling Machine Learning, Distributed File systems (HADOOP & SPARK), Introduction to SQL
Unit 4	Implementing IoT, Design Modularity in Smart Manufacturing, Industrial IoT Reference Architecture (IIRA), IoT Protocols and Standards
Unit 5	Introduction to Smart Factories and Assembly Line, Additive Manufacturing, Vertical and horizontal integration, Inventory Management & Quality Control, Plant Security and Safety, Facility Management, Autonomous Robots, Cyber Security, Cloud Services.

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Text and Reference Books:

1. Christoph Jan Bartodziej, *The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics*
2. Springer, *Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape*
3. Bartolo, P J , *Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping*, Taylor and Francis
4. Hopkinson, N, Haque, R., and Dickens, P., *Rapid Manufacturing: An Industrial Revolution for a Digital Age*, Wiley Publications
5. http://www.mqtt.org
6. https://opcfoundation.org/about/opc-technologies/opc-ua/

Assessment:

ISE I:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects
ISE II:	Shall be based on class test
ISE III:	Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects

Mapping of course outcome with program outcomes:

PO / CO	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										1
CO2	2	1	1	1								1
CO3	2	1	1	1								1
CO4	2	2				2		1	2	2		1

3-High **2-Medium** **1-low**

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	5	5	0	10
K2	Understand	10	10	10	50
K3	Apply	0	0	0	0
K4	Analyse	0	0	0	0
K5	Evaluate	0	0	0	0
K6	Create	0	0	0	0
Total Marks (100)		**15**	**15**	**10**	**60**

Assessment Table

Assessment Tool	**K1**	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15)	05	10	00	00
ISE II (15)	05	00	10	00
ISE III (10)	00	00	00	10
ESE Assessment(60)	10	20	20	10

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Institute Multidisciplinary Minor -III

Theme: **Digital & Multimedia Forensics**

Total Credits: 14

Number of courses: 04

Sr. No.	Course Code	Title of the course	Total credits	Offered in semester
01	**INMDM9001**	**Introduction to Multimedia Forensics**	3 + 0 + 0 = 03	III
	INMDM9002	**Lab Multimedia Forensics**	0 + 0 + 1 = 01	III
02	**INMDM9003**	**Introduction to Digital Forensics**	3 + 0 + 0 = 03	IV
03	**INMDM9004**	**Digital Forensics and Incident Response**	3 + 0 + 0 = 03	V
	INMDM9005	**Lab Digital Forensics and Incident Response**	0 + 0 + 1 = 01	V
04	**INMDM9006**	**Forensic Identifications and Legal Framework**	3 + 0 + 0 = 03	VI

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INMDM9001: Introduction to Multimedia Forensics		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs./week	**ISE I**	**15 marks**
Credits: 3	**ISE II**	**15 marks**
	ISE III	**10 marks**
	ESE	**60 marks**

Prerequisites: Knowledge of programming

Course Description

The course is designed to give the basic concepts of Multimedia Forensics. The course will make the students understand the possible ways of tampering with multimedia files, such as images, video, and audio, and a systematic approach for their detection. The course will also help students to understand the basics of CCTV.

Course Outcomes

After completing the course, students will able to:

CO1	Understand the concepts of multimedia forensics and its landscape
CO2	Develop an understanding and familiarity with various types of tampering in multimedia evidence and subsequent challenges
CO3	Apply suitable techniques for the detection of tampering in images, video, and audio
CO4	Analyze and evaluate the proper framework for the detection of alteration in images, video, and audio

Detailed Syllabus

Unit-I	**Foundation to Multimedia Forensics** • Introduction to digital signals: audio, image, and, video • Digitization process: sampling and quantization • Image Enhancement Techniques: Spatial and frequency domain • Image Compression Techniques: Introduction and techniques • Image description and representation techniques • Pattern clustering and classification
Unit-II	**Introduction to Multimedia Forensics** • Introduction and scope of Multimedia Forensics • Basics of Multimedia • Devices for capturing images and video • Devices for capturing audio • Standard and best practices in Multimedia Forensics
Unit-III	**Image Forensics** • Image Forensics: Introduction and scope • Active and passive image forensics • Blind and non-blind image forensics • Methods of source camera identification • Methods for tampering with digital images • Forensic authentication of digital image
Unit-IV	**Video Forensics** • Video forensics: Introduction and scope • Standards for video transmission • Methods of tampering with digital video

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	• Forensic authentication of digital video • CCTV Forensics: Basics of CCTV, Data retrieval from CCTV/DVR, Enhancement of CCTV footage, Biometric identification from CCTV footage, other measurements from CCTV footage
Unit-V	**Audio Forensics** • Audio Forensics: Introduction and scope • Methods of tampering with digital audio • Forensic authentication of digital audio • Microphone Forensics • Enhancement of digital audio

Text and Reference Books

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Prentice-Hall, Inc. Upper Saddle River, NJ, USA, 2006
2. Alan Bovik, Handbook of Image and Video Processing, Academic Press, USA, 2000
3. Husrev Taha Sencar and Nasir Memon, Digital Image Forensics: There is More to a Picture than Meets the Eye, Springer Science and Business Media, New York, 2013
4. Anthony T.S. Ho and Shujun Li, Handbook of digital forensics of multimedia data and devices, John Wiley & Sons, Ltd., UK, 2015.
5. Hany Farid, Photo Forensics, The MIT Press, Cambridge, First Edition, 2016
6. Robert C. Maher, Principles of Forensic Audio Analysis, Springer, 2018

INMDM9002: Lab Multimedia Forensics		
Teaching Scheme	**Examination Scheme**	
Practical: 02 hrs./week	**ISE III**	**25 marks**
Credits: 01		

Laboratory course outcomes

After completing the course, students will able to:

CO1	Implement the digital signal concepts
CO2	Perform experiments for multimedia data analysis
CO3	Learn how to proceed in a real forensic scenario
CO4	Use forensic tools

List of experiments

1. Reading, writing, and displaying images, video, and audio
2. Understanding the effect on image/video/audio due to various sampling and quantization level
3. Applying various enhancement methods on image/ video/ audio
4. Understanding the effect of compression on image/ video/ audio
5. Detection of tampering in images utilizing various characteristics
6. Linking images with the source camera
7. Detection of tampering in video utilizing various characteristics
8. Linking video with the source camera
9. Data retrieval from CCTV/DVR
10. Enhancement of CCTV footage
11. Detection of tampering in audio utilizing various characteristics
12. Linking audio with the source camera

INMDM9003: Introduction to Digital Forensics		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs./week	**ISE I**	**15 marks**
Credits: 3	**ISE II**	**15 marks**
	ISE III	**10 marks**
	ESE	**60 marks**

Prerequisites: No prerequisite

Course Description

The course covers the basics of digital forensics. The course will introduce students to many digital forensic concepts like acquisition, data recovery, mobile forensics, registry, and logs.

Course Outcomes

After completing the course, students will able to:

CO1	Define and describe various terms related to digital forensics
CO2	Understand the various tools and techniques for digital forensics
CO3	Apply digital forensic tools for forensic analysis
CO4	Analyze forensic scenarios for data analysis and acquisition

Detailed Syllabus

Unit-I	**Introduction** • Introduction to Digital Forensics, Locard's Principle of exchange in Digital Forensics, Branches of Digital Forensics, Phases of digital/computer forensics investigation, Identification of digital evidence, necessary documentation, such as chain of Custody, Digital evidence handling at the crime scene as per standards, Collection/Acquisition and preservation of digital evidence, Processing & analysis, Compilation of findings & Reporting, Pre-requisite for setting up Digital Forensic lab and global standards.
Unit-II	**Acquisition and Data Recovery** • Acquisition of digital evidence, integrity of the evidence, Introduction to storage media, imaging software and hardware, imaging file extensions, data recovery, and carving tools
Unit-III	**Forensic Analysis** • Introduction to open-source analysis tools like Autopsy and DFF, commercial tools like Encase and FTK, creating and managing cases using Autopsy, working with timelines, keywords, bookmarks, and reports
Unit-IV	**Registry and Logging** • Understanding and analysis of registry in various operating systems, Log analysis with respect to standalone machine and server, which includes system logs, kernel logs, event logs, ftp/sftp, application Web Servers/ Proxy logs.
Unit-V	**Mobile Forensics** • Introduction to Mobile Forensics, the need for mobile forensics, Understanding mobile forensics, Challenges in mobile forensics, Mobile operating systems overview, Mobile forensic system, Data acquisition methods

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Text and Reference Books

1. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by Sammons
2. Digital Forensics Workbook: Hands-on Activities in Digital Forensics by Michael K Robinson
3. Computer Forensics and Cyber Crime: An Introduction by Marjie T. Britz
4. Digital Forensics with Open-Source Tools by Cory Altheide, Harlan Carvey
5. Handbook of Digital Forensics and Investigation by Eoghan Casey