SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE
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SCHOOL OF ELECTRICAL AND ELECTRONICS

Minutes of Board of Studies Meeting held on 7th May 2022

(Virtual Meeting conducted on Zoom Platform (Time: 10.30 a.m. to 12 noon)

- Dr.N.M.Nandhitha, Prof. & Dean School of Electrical and Electronics started the meeting by welcoming both the external and the internal numbers to the Board of Studies meeting (07.05.2022, 10.00 a.m. to 12.00 noon)

- Dr.T.Ravi, Head, Dept. of Electronics and Communication Engineering informed the board that core competencies are identified from the feedback obtained from the students, faculty, Alumni and employers.

- Dr.P.Kavipriya presented the revision carried out in the course Machine Learning Techniques. Dr.M.D.Selvaraj Associate Professor, IIITDM accepted the changes and suggested to include topics such as Occam learning, accuracy and confidence boosting.

- Dr.E.Annadevi suggested to introduce 'IoT in Logistics Sector' in the course IoT for Real Time Application. Dr.N.Sivakumaran Prof.,NIT, Tirchy accepted the inclusion and also suggested to include Healthcare monitoring Technique for Diabetes Patients.

- Dr.P.Chitra suggested to include the topics 'Machine learning, Artificial neural networks and deep Architectures' in the course Digital Image Processing for Real Time Applications. Dr.Sugudev presented the syllabus revision carried in the course Wireless Communication. Dr.N.Shivakumaran accepted the changes for both the courses.

- Having discussed the revisions in the existing courses, faculty then presented the syllabus for the new courses. Dr.T.Ravi presented the syllabus 'Graphical Programming for Engineers', 'Augmented Reality and Virtual Reality' , 'Advanced Electronic Test Engineering' and 'Industry 5.0 for Electronics Engineers' for UG courses. The new syllabus introduced for PG 'Artificial Intelligence for Industrial Applications' and 'Strategies in Industry 5.0' is also briefed by HOD. Dr.M.D.Selvaraj accepted the syllabus for all the courses.

BoS members are happy that the new and the revised courses enhance employability/ Entrepreneurship/Skills of the students.

EXTERNAL MEMBERS:

1. Dr.N.Sivakumaran
2. Dr.M.D.Selvaraj
3. Mr.J.Visweswaran

INTERNAL MEMBERS:

1. Dr.N.M.Nandhitha
2. Dr.T.Ravi
3. Dr.P.Chitra
4. Dr.S.Barani
5. Dr.S.Poornapushpakala.
6. Dr.M.Sumathi
7. Dr.S.Lakshmi
8. Dr.P.Kavipriya
9. Mr M Sugadev
10. Ms.E.Anna Devi
11. Ms.S.Yogalakshmi

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SCHOOL OF ELECTRICAL AND ELECTRONICS

Minutes of Board of Studies Meeting held on 26th NOVEMBER 2021

(Virtual Meeting conducted on Zoom Platform (Time: 10.30 a.m. to 12 noon)

- Dr.N.M.Nandhitha, Prof. & Dean School of Electrical and Electronics started the meeting by welcoming both the external and the internal numbers to the Board of Studies meeting (26.11.2021, 10.00 a.m. to 12.00 noon)

- Dr.T.Ravi, Head, Dept. of Electronics and Communication Engineering informed the board that core competencies are identified from the feedback obtained from the students, faculty, Alumni and employers.

- Dr.I.Rexlin sheeba proposed to include Signalling System R2, SS7 Layers and its Protocol topic in Telecommunication and switching System. Dr.M.D.Selvaraj Associate Professor, IIITDM accepted the changes and suggested to include topics such as Techniques to improve the Quality of service, Format, Protocol in multicast and IETF Data Tracker.

- Dr.V.VijayaKumar suggested to introduce 'sensor and actuators for IoT Application' in the course Measurement and Instrument. Dr.N.Sivakumaran Prof.,NIT, Tirchy accepted the inclusion and also suggested to introduce infrared sensors.

- Dr.M.Sumathi suggested to include the topics 'Realizing application in FPGA' in the course Programming in HDL. Dr.N.Shivakumaran accepted the changes.

- Having discussed the revisions in the existing courses, faculty then presented the syllabus for the new courses. Dr.P.Chitra presented the syllabus Deep Learning for Computer Vision and Real-time System Design. Dr.M.D.Selvaraj accepted the syllabus for both the courses.

- Dr.M.Sugadev presented the syllabus for Digital System Design and Verification using System Verilog. Dr.N.Sivakumaran suggested to include Real Time implementation topic in the syllabus.

BoS members are happy that the new and the revised courses enhance employability/ Entrepreneurship/Skills of the students.

EXTERNAL MEMBERS:

1. Dr.N.Sivakumaran
2. Dr.M.D.Selvaraj
3. Mr.J.Visweswaran

INTERNAL MEMBERS:

1. Dr.N.M.Nandhitha
2. Dr.T.Ravi
3. Dr.P.Chitra
4. Dr.S.Barani
5. Dr.S.Poornapushpakala.
6. Dr.M.Sumathi
7. Dr.S.Lakshmi
8. Dr.P.Kavipriya
9. Mr M Sugadev
10. Ms.E.Anna Devi
11. Ms.S.Yogalakshmi

		L	T	P	Credits	Total Marks
SECA3002 (OLD)	TELECOMMUNICATION SYSTEMS AND SERVICES	3	0	0	3	100

COURSE OBJECTIVES

- To introduce the history and the terms of telecommunication systems.
- To study the various signalling techniques used in the telecommunication system.
- To acquire knowledge on traffic in telecommunication systems.
- To introduce the service engineering and the protocols used in telecommunication services.
- To study the various impairments in telecommunication

UNIT 1 FUNDAMENTALS OF TELECOMMUNICATION 9Hrs.

Switching system functions – strowger switching system – cross bar exchange – SPC exchange-End users, nodes and connectivity, telephone numbering and Routing, use of Tandem switches in Local area connectivity, Busy Hour and Grade of Service, Simplex, Half duplex and full duplex, One-way and two-way circuits, Network topologies**, variations in traffic flow, quality of service.**

UNIT 2 SIGNALLING IN TELECOMMUNICATION SYSTEMS 9Hrs.

Introduction, purpose of signalling, Defining the functional areas-supervisory signalling, address signalling and Call Progress-audio and visual. Signalling techniques - conveying signalling information, evolution of signalling subscriber call progress tones and push button codes, compelled signalling, concepts of Link-by-link and end-to-end signalling, effects of numbering on signalling, associated and disassociated channel signalling, signalling in the subscriber loop-**background and purpose, functional signalling, Object-oriented signalling.**

UNIT 3 TRAFFIC ENGINEERING 9Hrs.

Network traffic load and parameters-Unit of Traffic-Erlang, Centum call second-Grade of Service and blocking probability- Modelling the switching systems, Blocking Models and Loss Estimate-Lost calls cleared system, lost calls returned system, lost calls Held system, Delay Systems.

UNIT 4 TELECOMMUNICATION SERVICES ENGINEERING 9Hrs.

Introduction, definition for service and service engineering. Telecommunication services engineering-Telecommunication services on broadband networks-basics of ATM, connection oriented and connectionless services.

UNIT 5 QUALITY OF SERVICE AND TELECOMMUNICATION IMPAIRMENTS 9Hrs.

QoS (voice, data and image) - signal-to-noise ratio, voice transmission, data circuits, video. Basic impairments – amplitude distortion, phase distortion and noise. Level- typical levels, echo and singing. QoS issues in video transmission- problems and solutions. Protocols for QoS support for audio and video applications - RSVP applications, Real-Time Streaming Protocol Applications and Active Streaming Format, Internet **stream protocol(version2) , IP Multicast.**

Max.45Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-Analyze various terminologies of the telecommunication systems.

CO2-Analyze the classical signalling with the advanced signalling techniques in telecommunication systems

CO3-Apply the Supporting protocols for various applications.

CO4-Implement and regulate the performance of telecommunication networks using various models

CO5-Analyze and predict the importance of Service engineering.

CO6-Develop the impairments in telecommunication systems

TEXT/REFERENCEBOOKS

1. Roger L. Free man, "FundamentalsofTelecommunications",4thEdition, JohnWiley&Sons,2010.
2. JyrkiJ.Penttinen," The Telecommunications Handbook: Engineering Guidelines for Fixed, Mobile and Satellite Systems",1st Edition, Wiley,2015.
3. Thiagarajan Viswanathan, Mana Bhatnagar," Telecommunication Switching Systems and Networks",2nd Edition, PHIlearning,2015.

SECA3025 (Revised)	TELECOMMUNICATION SYSTEMS AND SERVICES	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: Nil	Co Requisite: Nil

Course Objectives

- To introduce the history and the terms of telecommunication systems.
- To study the various signalling techniques used in the telecommunication system.
- To acquire knowledge on traffic in telecommunication systems.
- To introduce the service engineering and the protocols used in telecommunication services.
- To study the various impairments in telecommunication

UNIT	CONTENTS	HOURS
I	**FUNDAMENTALS OF TELECOMMUNICATION** Models of telecommunication system. The concept of information volume. Characteristics of analogue audio and video signals. Analogue modulations and their implementations: amplitude and angle modulation, Frequency Division Multiplexing, switching system functions – strowger switching system – cross bar exchange – SPC exchange-End users, nodes and connectivity, telephone numbering and Routing, use of Tandem switches in Local area connectivity, Busy Hour and Grade of Service, Simplex, Half duplex and full duplex, One-way and two-way circuits, Network topologies.	9
II	**SIGNALLING IN TELECOMMUNICATION SYSTEMS** Introduction, purpose of signalling, Defining the functional areas-supervisory signalling, address signalling and Call Progress-audio and visual. Signalling techniques - conveying signalling information, evolution of signalling subscriber call progress tones and pushbutton codes, compelled signalling, concepts of Link-by-link and end-to-end signalling, effects of numbering on signalling, associated and disassociated channel signalling, signalling in the subscriber loop, Signalling System R2, SS7 Layers and its Protocol. Synchronous digital hierarchy. Multiplexing PDH signals into SDH STM-1 transport module	9
III	**TRAFFIC ENGINEERING** Network traffic load and parameters-Unit of Traffic -Erlang, Centum call second-Grade of Service and blocking probability- Modeling the switching systems, Blocking Models and Loss estimate- Lost calls cleared system, lost calls returned system, lost calls Held system, Delay Systems	9
IV	**TELECOMMUNICATION SERVICES ENGINEERING** Introduction, definition for service and service engineering. Telecommunication services engineering-Telecommunication services on broad band networks- basics of ATM, connection oriented and connectionless services.	9
V	**QUALITY OF SERVICE AND TELECOMMUNICATION IMPAIRMENTS** QoS (voice, data and image)-signal-to-noise ratio, voice transmission, data circuits, video. Basic impairments-amplitude distortion, phase distortion and noise. Level- typical levels, echo and singing. QoS issues in video transmission- problems and solutions. Protocols for QoS support for audio and video applications - RSVP applications, Real-Time Streaming Protocol	9

	Applications and Active Streaming, Techniques to improve the Quality of service, Format, Protocol in multicast, IETF Data Tracker.	

Maximum Hours: 45

Course Outcomes

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

CO1 – Analyse the terminologies, and various modulation techniques in telecommunication systems.
CO2-Analyze the classical signalling with the advanced signalling techniques in telecommunication systems.
CO3 - Apply the Supporting protocols and to implement various applications.
CO4 -Implement and regulate the performance of telecommunication networks using various models
CO5 – Analyse and predict the importance of Service engineering.
CO6 - Develop the impairments and quality of service in telecommunication systems.

TEXT/REFERENCEBOOKS

1. Roger L. Freeman, "Fundamentals of Telecommunications", 4th Edition, John Wiley & Sons, 2010.
2. Jyrki T. J. Penttinen," The Telecommunications Handbook: Engineering Guidelines for Fixed, Mobile and Satellite Systems", 1st Edition, Wiley, 2015.
3. Thiagarajan Viswanathan, Manav Bhatnagar," Telecommunication Switching Systems and Networks", 2nd Edition, PHI learning, 2015.

SEIA3001 (OLD)	**Measurements and Instrumentation**	**3**	**0**	**0**	**3**	**100**

COURSEOBJECTIVES

- To learn about various measurement concepts.
- To learn about signal generators and signal analysers.
- To know about the data acquisition systems.
- To know about the measurement in optical domain.

UNIT 1 BASIC MEASUREMENT **9 Hrs.**

Measurement systems – Static and dynamic characteristics – units and standards of measurements – error :- accuracy and precision, types, statistical analysis – moving coil, moving iron meters – Electrodynamo meter type wattmeter- Energy meter multimeters – Bridge measurements : – Maxwell, Hay, Schering, Anderson and Wien bridge.

UNIT 2 BASIC ELECTRONIC MEASUREMENTS 9 Hrs.

Electronic multimeters – Cathode ray oscilloscopes – block schematic – applications – special oscilloscopes - delayed time base oscilloscopes, analog and digital storage oscilloscope, sampling oscilloscope – Q meters – Vector meters – RF voltage and power measurements – True RMS meters.

UNIT 3 SIGNAL GENERATORS AND ANALYZERS **9 Hrs.**

Function generators – pulse and square wave generators, RF signal generators –Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer–spectrum analyzer :- digital spectrum analyzer, Vector Network Analyzer – Digital L,C,R measurements, Digital RLC meters

UNIT 4 DIGITAL INSTRUMENTS **9 Hrs.**

Comparison of analog and digital techniques – digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval – extension of frequency range – Automation in digital instruments, Automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments, Computer controlled test systems, Virtual instruments.

UNIT 5 ACQUISITION MEASUREMENT SYSTEMS AND FIBER OPTIC DATA **9 Hrs.**

Elements of a digital data acquisition system – interfacing of transducers – multiplexing – data loggers –computer controlled instrumentation – IEEE 488 bus – fiber optic measurements for power and system loss – optical time domains reflectometer.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basics of measurement system.

CO2 - Design a measuring instrument and study about various oscilloscopes.

CO3 - Choose proper method for analysing the signals using signal generators. CO4 - Identify the latest technology for modern digital instruments.

CO5 - Evaluate the various digital measurement techniques.

CO6 - Develop a data acquisition system and measurement system.

TEXT / REFERENCE BOOKS

1. Albert D.Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Pearson / Prentice Hall of India, 2007.
2. Ernest O. Doebelin, "Measurement Systems- Application and Design", TMH, 2007.
3. Joseph J.Carr, "Elements of Electronics Instrumentation and Measurement", Pearson Education, 2003.
4. Alan S. Morris, "Principles of Measurements and Instrumentation", 2nd Edition, Prentice Hall of India, 2003.
5. David A. Bell, "Electronic Instrumentation and measurements", Prentice Hall of India Pvt. Ltd., 2003.
6. B.C. Nakra and K.K. Choudhary, "Instrumentation, Measurement and Analysis", 2nd Edition, TMH, 2004.
7. James W. Dally, William F. Riley, Kenneth G. McConnell, "Instrumentation for Engineering Measurements", 2nd Edition, John Wiley, 2003.

ENDSEMESTEREXAMINATIONQUESTIONPAPERPATTERN

SEIA3014	MEASUREMENTS AND INSTRUMENTATION	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: Nil	Co Requisite: Nil

Course Objectives

- To learn about various measurement concepts.
- To learn about various types of instruments.
- To know about the data acquisition systems.
- To know about the sensors and actuators in IoT applications.

UNIT	CONTENTS	HOURS
I	**BASIC MEASUREMENT** Methods of Measurement, Measurement System, Classification of instrument system, Functional Elements of measurement system –Characteristics of instruments: Static and Dynamic characteristic - Types of errors - sources of errors - methods of elimination- Analysis of data - Limiting errors - Relative limiting error - Combination of Quantities with limiting errors - Statistical treatment of data: Histogram, Mean, Measure of dispersion from the mean, Range, Deviation, Average deviation, Standard Deviation, Variance-Calibration and Standards - Process of Calibration.	9
II	**ANALOG MEASUREMENTS** Measurement of Voltage and Current: PMMC and PMMI – Measurement of Voltmeter ammeter method, Ammeter voltmeter method, Electro-dynamic wattmeter - Low power factor wattmeter Power, Energy - Measurement of Passive Components: DC and AC Bridges.	9
III	**DIGITAL INSTRUMENTS** Comparison of analog and digital techniques – Digital L,C,R measurements, Digital RLC meters -digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval – extension of frequency range – Automation in digital instruments, Automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments, Computer controlled test systems, Virtual instruments	9
IV	**SENSORS AND ACTUATORS FOR INTERNET OF THINGS** Sensors for measurement of Temperature, Humidity, Pressure, Gas, Level Sensor – Accelerometer – Gyroscope – Proximity Sensors – Optical Sensors – Infrared Sensors – Electrical Actuators.	9
V	**ACQUISITION MEASUREMENT SYSTEMS AND FIBER OPTIC DATA** Elements of a digital data acquisition system – interfacing of transducers – multiplexing – data loggers –computer-controlled instrumentation – IEEE 488 bus – fiber optic measurements for power and system loss – optical time domains reflectometer.	9

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply statistical analysis for a measurement data.

CO2 – Apply suitable instruments for specific applications.

CO3 – Identify the latest technology for modern digital instruments.

CO4 – Choose appropriate sensors and actuators for specific IoT applications.

CO5 - Design a data acquisition system and measurement system.

CO6 - Develop a measurement system for real - time applications.

TEXT / REFERENCE BOOKS

1. Albert D.Helfrick and William D.Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Pearson / Prentice Hall of India, 2007.

2. Ernest O. Doebelin, “Measurement Systems- Application and Design”, TMH, 2007.

3. Joseph J.Carr, “Elements of Electronics Instrumentation and Measurement”, Pearson Education, 2003.

4. Alan. S. Morris, “Principles of Measurements and Instrumentation”, 2nd Edition, Prentice Hall of India, 2003.

5.David A. Bell, “Electronic Instrumentation and measurements”, Prentice Hall of India Pvt Ltd, 2003.

6. B.C. Nakra and K.K. Choudhry, “Instrumentation, Measurement and Analysis”, 2nd Edition, TMH, 2004.

7. James W. Dally, William F. Riley, Kenneth G. McConnell, “Instrumentation for Engineering Measurements”, 2nd Edition, John Wiley, 2003.

SECA1602 (OLD)	PROGRAMMING IN HDL	L	T	P	Credits	TotalMarks
		3	0	0	3	100

COURSE OBJECTIVES

- To focus on the basic concept of VHDL and Verilog HDL
- To introduce the style of modeling in VHDL and Verilog HDL
- To focus advanced features of Verilog HDL
- To outline the formal procedures for testing and verification of HDL
- To introduce the design of switch level modeling and high level architecture

UNIT1 BASIC CONCEPTS IN VHDL **9Hrs.**

Digital system design process - Hardware simulation - Introduction to VHDL - Language elements of VHDL - Data objects - Data types - Operators - Signal assignments - Inertial delay mechanism - Transport delay mechanism - Variable assignments - Concurrent and Sequential assignments- Delta delay.

UNIT2 MODELING IN VHDL **9Hrs.**

Data flow modeling - Concurrent Signal Assignment statements - Structural modeling - Component declaration - Component Instantiation - Behavioral modeling - Process statement - wait statement - Conditional and loop statements

- Generics and configurations - Examples for modeling.

UNIT3 INTRODUCTION TO VERILOG HDL **9Hrs.**

Basic concepts - Levels for design description - Module - Delays - Language elements - Compiler directives - value set - data types - Parameters - Expressions - Operands - operators in Verilog HDL.

UNIT4 STYLES OF MODELING **9Hrs.**

Gate level modeling -Primitive Gates- Multiple input and multiple output gates - User Defined Primitives - Combination UDP - Sequential UDP- Data flow modeling - Behavioral modeling - procedural constructs - procedural assignments - conditional and loop statements - Structural Modeling - Examples for modeling.

UNIT5 FEATURES IN VERILOG HDL **9Hrs.**

Tasks- Functions -systems tasks and functions - Verification - Modeling a test bench - timing and delays - Switch level modeling - state machine modeling - Moore FSM – Me lay FSM - Design of memories - Design of microcontroller CPUs.

Max:45Hrs.

COURSEOUTCOME

Oncompletionofthecourse,studentwillbeableto

On completion of the course, student will be able to

CO1 – Infer the needs of VHDL and Verilog HDL design flow.

CO2 – Interpret the Verilog language elements and its relevance to digital design

CO3 – Articulate different Modelling in HDL for Simulation, Synthesis and Test Bench Creation.

CO4 – Categorize the characteristics of Combinational and Sequential logic design using HDL.

CO5 – Evaluate and validate the digital logic circuits by State Machines.

CO6 – Design and verify the digital logic circuits in FPGA's.

TEXT/REFERENCE BOOKS

1 J.Bhaskar, “A VHDL Primer”, Prentice Hall of India Limited. 3rd edition 2004
2 Stphen Brown, "Fundamental of Digital logic with Verilog Design",3rd edition, Tata McGraw Hill, 2008
3 J.Bhaskar, “A Verilog HDL Primer”, Prentice Hall of India Limited. 3rd edition 2004
4 Samir Palnitkar” Verilog HDL: A Guide to Digital Design and Synthesis”, Star Galaxy Publishing; 3rd edition,2005
5 Michael D Ciletti - Advanced Digital Design with VERILOG HDL, 2nd Edition, PHI, 2009.
6 Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

SECA1605	PROGRAMMING IN HDL	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: Digital Logic Circuits	Co Requisite: Nil

Course Objectives

- To focus on the basic concept of VHDL and Verilog HDL
- To introduce the style of modeling in VHDL and Verilog HDL
- To focus advanced features of Verilog HDL
- To outline the formal procedures for testing and verification of HDL
- To introduce the design of switch level modeling and high level architecture

UNIT	CONTENTS	HOURS
I	**CONCEPTS IN VHDL** Introduction to VHDL - Language elements of VHDL -Concurrent and Sequential assignments -Data flow modeling - Concurrent Signal Assignment statements – Structural modeling - Component declaration - Component Instantiation - Behavioral modeling - Process statement - Examples for VHDL modeling.	9
II	**INTRODUCTION TO VERILOG HDL** Basic concepts - Levels for design description - Module - Delays - Language elements - Compiler directives – value set - data types - Parameters - Expressions - Operands - operators in verilog HDL.	9
III	**STYLES OF MODELING** Gate level modeling -Primitive Gates- Multiple input and multiple output gates – User Defined Primitives - Combination UDP - Sequential UDP- Data flow modeling – Behavioral modeling - procedural constructs – procedural assignments - conditional and loop statements - Structural Modeling - Examples for modeling.	9
IV	**FEATURES IN VERILOG HDL** Tasks- Functions -systems tasks and functions - Verification - Modeling a test bench – timing and delays -Switch level modeling - state machine modeling - Moore FSM - Melay FSM - Design of RAM, ROM.	9
V	**REALIZING APPLICATIONS IN FPGA** FPGA Design Flow - Architecture of Xilinx Artix7 FPGA - Configurable Logic Blocks (CLB)- Slice Description- LUT - Storage element - Programmable Interconnect - Internal Hard macros - Realizing applications in FPGA - combinational functions - N-bit functions, Encoder, Decoders - Sequential functions - N-bit register, shift registers, up/down counters- N-bit processor. Case Study**:** study of protocols I2C, SPI and UART.	9

Maximum Hours: 45

Course Outcomes

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

CO1 – Infer the needs of VHDL and Verilog HDL design flow.
CO2 – Interpret the Verilog language elements and its relevance to digital design
CO3 – Articulate different Modelling in HDL for Simulation, Synthesis and Test Bench Creation.
CO4 – Categorize the characteristics of Combinational and Sequential logic design using HDL.
CO5 – Evaluate and validate the digital logic circuits by State Machines.
CO6 – Design and verify the digital logic circuits in FPGA's.

TEXT / REFERENCE BOOKS

1. J.Bhaskar, "A VHDL Primer", Prentice Hall of India Limited. 3rd edition 2004
2. Stphen Brown, "Fundamental of Digital logic with Verilog Design",3rd edition, Tata McGraw Hill, 2008
3. J.Bhaskar, "A Verilog HDL Primer", Prentice Hall of India Limited. 3rd edition 2004
4. Samir Palnitkar" Verilog HDL: A Guide to Digital Design and Synthesis", Star Galaxy Publishing; 3rd edition,2005
5. Michael D Ciletti - Advanced Digital Design with VERILOG HDL, 2nd Edition, PHI, 2009.
6. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

SEC1629	IoT FOR REAL TIME APPLICATIONS	L	T	P	Credits	Total marks
		2	0	2	3	100

Pre requisite: NIL | **Co Requisite:** NIL

Course Objectives

- To design products related to IoT based Health care applications
- To design IoT enable smart cities considering various energy harvesting techniques
- To develop IoT based system for supporting farmers and agriculture
- To develop IoT based system for industrial automation
- To analyze various IoT based system considering societal benefits
- To develop an IoT based wearable device for measuring physiological parameters and physical movements

UNIT	CONTENTS	HOURS
I	**IoT FOR HEALTHCARE** Architecture of IoT for Healthcare , IoT based Health Monitoring System using Arduino, Smart continuous glucose monitoring (CGM) and insulin pens, Remote Patient Monitoring- IoT Heart Rate Monitoring, remote monitoring of physiological parameters, ECG, EEG, Diabetics and BP.	9
II	**IoT ENABLED SMART CITIES** Energy Consumption Monitoring, Smart Energy meters to minimize power consumptions, Smart home powered by IoT, Smart Grid and Solar Energy Harvesting, Intelligent Parking System	9
III	**IoT FOR SMART AGRICULTURE** Animal Intrusion detection in farms, soil moisture detection and Irrigation system, Pest monitoring and control, Livestock monitoring system, IoT based Greenhouse Environment Monitoring and controlling	9
IV	**IoT BASED INDUSTRIAL AUTOMATION** IoT based gas leakage monitoring system, Temperature and liquid level monitoring in boilers, Fire detection system, wireless video surveillance robot, Automatic Solar Tracker	9
V	**IoT FOR SOCIETY** Medical Waste Management, Weather update system with IoT, Women security system, GPS Smart Sole, wearable glove to enable sign to speech conversation, IoT based air pollution meter	9

Maximum Hours: 45

Course Outcomes

On completion of the course, the student should be able to

CO1 - Design remote data sensing and aggregation system for health care

CO2 - Develop energy efficient IoT systems for smart cities

CO3 – Design Precision agricultural systems

CO4 - Develop smart automation system for Industries

CO5 - Investigate various IoT based innovative systems for societal benefits

CO6 - Develop multipurpose wearable devices

TEXT / REFERENCE BOOKS

1. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849
2. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
3. Krishna P. Venkata, Sasikumar Gurumoorthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare Systems , Springer-2019.
4. Pattnaik, Prasant Kumar, Mohanty, Suneeta, Mohanty, Satarupa, Smart Healthcare Analytics in IoT Enabled Environment, Springer-2020.
5. Avijit Mathur, Thomas Newe, Walid Elgenaidi, Muzaffar Rao, Elfed Lewis and Daniel Toal, Medical IoT systems: architecture and security by Wearable Sensors, 2017.
6. Verónica Saiz-Rubio , Francisco Rovira-Mas ,From Smart Farming towards Agriculture 5.0: A Review on Crop Data Management, Agronomy 2020, 10, 207; doi:10.3390/ agronomy 10020207

SECA3027 **REVISED**	**IoT FOR REAL TIME APPLICATIONS**	**L**	**T**	**P**	**Credits**	**Total marks**
		2	0	2	3	100

Pre requisite: NIL	**Co Requisite:** NIL

Course Objectives

- To design products related to IoT based Health care applications
- To design IoT enable smart cities considering various energy harvesting techniques
- To develop IoT based system for supporting farmers and agriculture
- To develop IoT based system for industrial automation
- To analyze various IoT based system considering societal benefits
- To develop an IoT based wearable device for measuring physiological parameters and physical movements

UNIT	CONTENTS	HOURS
I	**IoT FOR HEALTHCARE** Architecture of IoT for Healthcare , IoT based Health Monitoring System using Arduino, Healthcare monitoring Technique for Diabetes Patients, Remote Patient Monitoring- IoT Heart Rate Monitoring, remote monitoring of physiological parameters, ECG, EEG, and BP.	9
II	**IoT ENABLED SMART CITIES** Smart Energy meters, , , Smart home powered by IoT, Smart Lightining, Smart Traffic Control ,Smart Grid and Solar Energy Harvesting, Intelligent Parking System.	9
III	**IoT FOR SMART AGRICULTURE** Smart Agriculture, IoT Based Agriculture,Animal Intrusion detection in farms, soil moisture detection and Irrigation system, Livestock monitoring system, IoT based Greenhouse Environment Monitoring and controlling	9
IV	**IoT BASED INDUSTRIAL AUTOMATION** IoT based gas leakage monitoring system, Temperature and liquid level monitoring in boilers, Wireless video surveillance robot, Automatic Solar Tracker, IoT in Logistics Sector	9
V	**IoT FOR SOCIETY** Medical Waste Management, Weather update system with IoT, Women security system,wearable glove to enable sign to speech conversation, IoT based air pollution meter, Improved productivity of staff and reduced human labor	9

Maximum Hours: 45

Course Outcomes

On completion of the course, the student should be able to

CO1 - Design remote data sensing and aggregation system for health care

CO2 - Develop energy efficient IoT systems for smart cities

CO3 – Design Precision agricultural systems

CO4 - Develop smart automation system for Industries

CO5 - Investigate various IoT based innovative systems for societal benefits

CO6 - Develop multipurpose wearable devices

TEXT / REFERENCE BOOKS

1. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849

2. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.

3. Krishna P. Venkata, Sasikumar Gurumoorthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare Systems , Springer-2019.

4. Pattnaik, Prasant Kumar, Mohanty, Suneeta, Mohanty, Satarupa, Smart Healthcare Analytics in IoT Enabled Environment, Springer-2020.

5. Avijit Mathur, Thomas Newe, Walid Elgenaidi, Muzaffar Rao, Elfed Lewis and Daniel Toal, Medical IoT systems: architecture and security by Wearable Sensors, 2017.

6. Verónica Saiz-Rubio , Francisco Rovira-Mas ,From Smart Farming towards Agriculture 5.0: A Review on Crop Data Management, Agronomy 2020, 10, 207; doi:10.3390/ agronomy 10020207

SEC1630	MACHINE LEARNING TECHNIQUES	L	T	P	Credits	Total marks
		2	0	2	3	100

Pre Requisite: NIL | **Co Requisite:** NIL

Course Objectives

- To Recognize Different Key Paradigms For Machine Learning Concepts
- To Familiarize With Various Classifiers Used For Machine Learning
- To Understand And Differentiate Among Various Supervised Learning Concepts
- To Become Familiarize With Data Reduction And Feature Extraction Methods
- To Apply Suitable Machine Learning Algorithms For Simple Engineering Problems

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO MACHINE LEARNING** Machine Learning vs Statistical Modelling, Applications of Machine Learning, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning Classification, Python libraries suitable for Machine Learning.	9
II	**CLASSIFIERS** Classification, K- nearest neighbour, Decision Trees, Implementing Decision Tree, building a Tree, Random Forests - Working of Random Forest, Pros and Cons of Random Forest, Naiver Bayes, building model Using Naiver Bayes	9
III	**SUPERVISED LEARNING** Regression, Types of Regression model, Building a Regressor in Python, Types of ML Algorithm, Linear Regression, Multiple Linear Regression, Non-linear Regression, Model evaluation methods.	9
IV	**K-MEANS CLUSTERING** Working of K-Means Clustering Algorithm, Advantages and Disadvantages, Applications of K-Means Clustering Algorithm, Hierarchical Clustering, Steps to Perform Agglomerative Hierarchical Clustering, Role of Dendrograms Agglomerative Hierarchical Clustering, Density-Based Clustering.	9
V	**DIMENSIONALITY REDUCTIONS & COLLABORATIVE FILTERING** Dimensionality Reduction, Feature Extraction & Selection, Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Least Squares Optimization, Collaborative Filtering & Its Challenges.	9

Maximum Hours: 45

Course Outcomes

On completion of the course, student should be able to

CO 1 - Classify supervised and unsupervised learning

CO 2 - Apply appropriate machine learning strategies for any given problem

CO 3 - Recommend supervised and unsupervised learning algorithms for any given problem

CO 4 - Apply the Bayesian concepts to machine learning

CO 5 – Evaluate existing machine learning algorithms

CO 6 - Develop an appropriate machine learning approach for Real World Problems

TEXT / REFERENCE BOOKS

1. Chris Albon : Machine Learning with Python Cookbook , O"Reilly Media, Inc.2018
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
4. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
5. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.
6. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series , 2nd edition
7. Sebastian Raschka, "Python Machine Learning",Second Edition.Packt Publication

SECA3028 **(Revised)**	**MACHINE LEARNING TECHNIQUES**	**L**	**T**	**P**	**Credits**	**Total marks**
		2	0	2	3	100

Pre Requisite: NIL | **Co Requisite:** NIL

Course Objectives

- To Recognize Different Key Paradigms For Machine Learning Concepts
- To Familiarize With Various Classifiers Used For Machine Learning
- To Understand And Differentiate Among Various Supervised Learning Concepts
- To Become Familiarize With Data Reduction And Feature Extraction Methods
- To Apply Suitable Machine Learning Algorithms For Simple Engineering Problems

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO MACHINE LEARNING** Machine Learning vs Statistical Modelling, Applications of Machine Learning, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning Classification, Python libraries suitable for Machine Learning.	9
II	**CLASSIFIERS** Classification, K- nearest neighbour, Decision Trees, Implementing Decision Tree, building a Tree, Random Forests - Working of Random Forest, Pros and Cons of Random Forest, Naiver Bayes, building model Using Naiver Bayes	9
III	**SUPERVISED LEARNING** Regression, Types of Regression model, Building a Regressor in Python, Types of ML Algorithm, Linear Regression, Multiple Linear Regression, Non-linear Regression, Model evaluation methods.	9
IV	**K-MEANS CLUSTERING** Working of K-Means Clustering Algorithm, Advantages and Disadvantages, Applications of K-Means Clustering Algorithm, Hierarchical Clustering, Steps to Perform Agglomerative Hierarchical Clustering, Role of Dendrograms Agglomerative Hierarchical Clustering, Density-Based Clustering.	9
V	**ML- Models and Computational Learning** Parameter Estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers. Computational Learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting	9

Maximum Hours: 45

Course Outcomes

On completion of the course, student should be able to

CO 1 - Classify supervised and unsupervised learning

CO 2 - Apply appropriate machine learning strategies for any given problem

CO 3 - Recommend supervised and unsupervised learning algorithms for any given problem

CO 4 - Apply the Bayesian concepts to machine learning

CO 5 – Evaluate existing machine learning algorithms

CO 6 - Develop an appropriate machine learning approach for Real World Problems

TEXT / REFERENCE BOOKS

1. Chris Albon : Machine Learning with Python Cookbook , O"Reilly Media, Inc.2018
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
4. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
5. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.
6. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series , 2nd edition
7. Sebastian Raschka, "Python Machine Learning",Second Edition.Packt Publication

SEC1628 (old)	DIGITAL IMAGE PROCESSING FOR REAL TIME APPLICATION	L	T	P	Credits	Total marks
		2	0	2	3	100

Pre requisite: NIL	Co Requisite: NIL

Course Objectives

- To explore the fundamental concepts of Image Processing
- To become conversant with various Image Enhancement techniques
- To study and understand various Morphological and segmentation concepts and techniques
- To analysis the pattern classifier techniques for image understanding
- To design Artificial Intelligence (AI) based image classification and object detection systems

UNIT	CONTENTS	HOURS
I	**DIGITAL IMAGE FUNDAMENTALS** Image acquisition and storage; Basic Relationships between Pixels; Monochromatic Vision Models; Colour Vision Models; Colour Fundamentals; Colour Models; Image resizing; Image noise- additive and multiplicative noises; Image quality indicators (Quality Metrics)- PSNR, SSIM, VIF, accuracy, Correlation. Case study: Develop a software program to measure the quality of the given image.	9
II	**IMAGE ENHANCEMENT** Introduction; Point Processing - Image Negatives, Log transformations, Power Law Transformations, Piecewise-Linear Transformation Functions; Arithmetic/Logic Operations - Image Subtraction, Image Averaging; Histogram Processing - Histogram Equalization, Histogram Matching; Spatial filtering - Smoothing, Sharpening; Smoothing Frequency Domain Filters - Ideal Low Pass, Butterworth Low Pass, Gaussian Low Pass; Sharpening Frequency Domain Filters - Ideal High Pass, Butterworth High Pass, Gaussian High Pass; Image denoising- Wavelet Transform(DWT), Case study: Develop a program for the image denoising using DWT.	9
III	**MORPHOLOGICAL PROCESSING & SEGMENTATION** Morphological Image Processing - Logic Operations involving Binary Images; Dilation and Erosion; Opening and Closing; Basic Morphological Algorithms - Boundary Extraction, Region Filling, Thickening, Thinning; Image Segmentation - Detection of Discontinuities; Edge Linking; Boundary Detection; Thresholding - Global and Adaptive; Region based Segmentation, Case study: Develop a program for segmentation of an objects from the background and transfer them from one image to another.	9
IV	**PATTERN CLASSIFIER** Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation– Problems with Bayes approach– Pattern classification by distance functions –Minimum distance pattern classifier, Template matching – probabilistic approach- K-nearnest neighbour (KNN), Path Forest- Fuzzy logic – Fuzzy Pattern Classifiers, Case study: Fuzzy clustering algorithm.	9
V	**AI IN IMAGE PROCESSING** Design and execute image classification, object recognition, object detection and object localization systems using machine learning, deep learning and transfer learning techniques.	9

Course Outcomes

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

CO1- Apply Suitable Mathematical Concepts For The Measurement Of Quality In Digital Images.

CO2-Analyze The Performance Of Spatial And Frequency Domain Filters In Image Enhancement.

CO3-Analyze Various Morphological Image Processing And Segmentation Techniques

CO4-Identify Suitable Pattern Classifier For Object Classification Problems.

CO5-Implement Ai Based Image Classification And Object Detection Systems.

CO6-Solve Real World Problems Using AI

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods," Digital Image Processing", Pearson , Second Edition, 2004
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson 2002
3. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches",John Wiley & Sons Inc., New York, 1992
4. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001
5. Himanshu Singh. "Practical Machine Learning and Image Processing", Apress, 2019
6. Francois Chollet "Deep Learning with Python", Manning Publications Co., NY, 2018
7. Phil Kim. "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",
8. Apress, 2017.
9. Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images
10. Valentina Zharkova, Lakhmi C. Jain, "Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images", Springer, 2007

SECA3030 (Revised)	DIGITAL IMAGE PROCESSING FOR REAL TIME APPLICATIONS	L	T	P	Credits	Total marks
		2	0	2	3	100

Pre requisite: NIL	Co Requisite: NIL

Course Objectives

- To explore the fundamental concepts of Image Processing
- To become conversant with various Image Enhancement and restoration techniques
- To study and understand various Morphological and segmentation concepts and techniques
- To analysis the pattern classifier techniques for image understanding
- To design Artificial Intelligence (AI) based image classification systems

UNIT	CONTENTS	HOURS
I	**DIGITAL IMAGE FUNDAMENTALS** Image acquisition and storage; Basic Relationships between Pixels; Monochromatic Vision Models; Colour Vision Models; Colour Fundamentals; Colour Models; Image resizing; Image noise- additive and multiplicative noises; Image quality indicators (Quality Metrics)- PSNR, SSIM, VIF, accuracy, Correlation. Case study: Develop a software program to measure the quality of the given image.	9
II	**IMAGE ENHANCEMENT AND IMAGE RESTORATION** Histogram Matching Introduction; Point Processing - Image Negatives, Log transformations, Power Law Transformations, Piecewise-Linear Transformation Functions; Arithmetic/Logic Operations - Image Subtraction, Image Averaging; Histogram Processing - Histogram Equalization,; Spatial filtering - Smoothing, Sharpening; Wavelet Transform(DWT), Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Case study: Develop a program for the image denoising using DWT.	9
III	**MORPHOLOGICAL PROCESSING & SEGMENTATION** Morphological Image Processing - Logic Operations involving Binary Images; Dilation and Erosion; Opening and Closing; Basic Morphological Algorithms - Boundary Extraction, Region Filling, Thickening, Thinning; Image Segmentation - Detection of Discontinuities; Edge Linking; Boundary Detection; Thresholding - Global and Adaptive; Region based Segmentation, Case study: Develop a program for segmentation of an objects from the background and transfer them from one image to another.	9
IV	**PATTERN CLASSIFIER** Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation– Problems with Bayes approach– Pattern classification by distance functions –Minimum distance pattern classifier, Template matching – probabilistic approach- K-nearnest neighbour (KNN), Path Forest- Fuzzy logic – Fuzzy Pattern Classifiers, Case study: Fuzzy clustering algorithm.	9
V	**AI IN IMAGE PROCESSING** Image processing with machine Learning-machine learning workflow for image processing- Introduction to software tools for image processing and machine learning- Artificial neural networks, deep architectures. Design and execute image classification	9

	using machine learning and deep learning techniques.	

Course Outcomes

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

CO1- Apply Suitable Mathematical Concepts For The Measurement Of Quality In Digital Images.

CO2-Analyze the Performance of Image enhancement and image restoration techniques.

CO3-Analyze Various Morphological Image Processing and Segmentation Techniques.

CO4-Identify Suitable Pattern Classifier for Object Classification Problems.

CO5-Implement AI Based Image Classification Systems.

CO6-Solve Real World Problems Using AI

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods," Digital Image Processing", Pearson , Second Edition, 2004
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson 2002
3. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches",John Wiley & Sons Inc., New York, 1992
4. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001
5. Himanshu Singh. "Practical Machine Learning and Image Processing", Apress, 2019
6. Francois Chollet "Deep Learning with Python", Manning Publications Co., NY, 2018
7. Phil Kim. "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",
8. Apress, 2017.
9. Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images
10. Valentina Zharkova, Lakhmi C. Jain, "Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images", Springer, 2007

SECA1702 (old)	WIRELESS COMMUNICATION	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: NIL	Co Requisite: NIL

Course Objectives

- To impart knowledge on various generations of wireless communication and standards.
- To classify different types of air interface used in different standards.
- To understand international standardizing structure for the effective usage of spectrum, according to it.
- To analyze the characteristics of different protocol structures in different cable replacement devices.
- To quantify and review the advances in higher generations of wireless schemes

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO CELLULAR MOBILE SYSTEM** Cellular system concepts- Frequency reuse- Practical reuse factor- cell splitting - Channel Assignment - channel models- Flat fading and frequency selective fading – Diversity reception techniques - Mobility Management: Types of Hand off	9
II	**EVOLUTION OF MOBILE NETWORKS** GSM /GPRS Architecture (2G) - UMTS and CDMA 2000 (3G) - Wideband CDMA (WCDMA) and EDGE (3.5G) - LTE and LTE advanced (4G) - Network architecture – Modulation – Coding schemes – Network Control - 5G systems: specifications and applications	9
III	**WIRELESS LAN (WI-FI AND WI-MAX)** IEEE 802 Standards – IEEE 802.11 WLAN Standards – Comparison of IEEE 802.11 a, b and g standards – WiFi and WiMAX – VOIP and WAP- OFDMA and Mobile WiMAX - Concepts of MIMO - Block diagram description of OFDM system combined with MIMO-advantages.	9
IV	**PERSONAL AREA NETWORK** Bluetooth -Piconet, Scatternet- BLE - Zig-Bee (Wireless Sensor Networks)- UWB – RFID.	9
V	**SATELLITE MOBILE AND SPECIALIZED SERVICES** Introduction, Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium and Teledesic system.	9

Maximum Hours: 45

Course Outcomes

On completion of the course, student will be able to

CO1 - Classify various generations of wireless communication and standards.

CO2 - Summarize different types of air interface used in different standards.

CO3 - Demonstrate the applications of different international standards in wireless communication.

CO4 - Describe the behavior of different protocol structures in different cable replacement devices.

CO5 - Appraise and report on advances in higher generations of wireless schemes.

CO6 - Design conceptually a mobile communication system according to the required standard.

TEXT BOOKS / REFERENCE BOOKS

1. William C.Y. Lee., "Wireless and Cellular Telecommunications", 3rd Edition revised reprint McGraw Hill.2011.
2. Iti saha Mishra , “Wireless Communications and Networks: 3G and Beyond” 2nd Edition McGraw Hill 2013.
3. Nishith D. Tripathi and Jeffrey H. Reed,"Cellular Communications A Comprehensive and Practical Guide" Wiley 2014.
4. Rajpandya " Mobile and Personal Communication Services and Systems”, IEEE Inc., New York, 2014.
5. Gordon L. Stuber “Principles of Mobile communications”, 3rd Edition 2011 Springer.
6. Louis. E. Frenzel, “Communication Electronics Principles and applications”, 3rd Edition, Tata Mc.Graw Hill, 2015.

SECA1704	CONTEMPORARY WIRELESS COMMUNICATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

Pre requisite: NIL	Co Requisite: NIL

Course Objectives

- To impart knowledge on evolution of mobile communication and standards.
- To understand current trends in wireless LAN protocols.
- To study about personal area network and M2M communication standards.
- To impart knowledge on role of satellites in mobile and internet services.
- To study about underwater wireless communication techniques.

UNIT	CONTENTS	HOURS
I	**EVOLUTION OF CELLULAR MOBILE NETWORKS** UMTS and CDMA 2000 (3G) - Wideband CDMA (WCDMA) - LTE and LTE advanced (4G) - Network architecture – Modulation – Coding schemes – 5G systems: specifications and applications.	9
II	**WIRELESS LAN STANDARDS** IEEE 802 Standards – IEEE 802.11 WLAN Standards – Comparison of IEEE 802.11 a, b and g standards, WiFi-5 and WiGig - Concepts of MIMO, Massive MIMO and MU MIMO -Principle of Li-Fi based WLAN..	9
III	**PERSONAL AREA NETWORK PROTOCOLS** Bluetooth -Piconet, Scatternet- Bluetooth Low Energy(BLE) - Zig-Bee- Z-wave – UWB- LoRA Wireless Standards, LoRA WAN Gateway, LORA Applications	9
IV	**SATELLITE MOBILE AND SPECIALIZED SERVICES** Types of Satellites – LEO, MEO and GEO – Satellite services in Cellular Mobile communication - Satellite Phones – Satellite IoT services - Satellite Internet Service: Starlink and Viasat – GPS Services: GLONASS, IRNSS and NAVIC.	9
V	**UNDERWATER WIRELESS COMMUNICATION** Underwater Communication: IEEE Standards, Frequency Spectrum, Modulation Techniques - Underwater Channel models for wireless Communication – Role of Digital signal processing in Underwater Communication- Underwater localization.	9

Maximum Hours: 45

COURSE OUTCOMES:

On completion of this course, students are able to

CO1: Classify various generations of wireless communication and standards
CO2: Demonstrate the applications of different international standards in wireless LAN and PAN
CO3: Develop an energy efficient system level model for IoT applications
CO4: Appraise and report on advances in higher generations of wireless communication systems.
CO5: Design conceptually a mobile communication system according to the required standard.
CO6: Develop system level models for underwater communication.

TEXT / REFERENCE BOOKS

[1] William C.Y. Lee., "Wireless and Cellular Telecommunications", 3rd Edition revised reprint McGraw Hill.2011.
[2] Iti saha Mishra , “Wireless Communications and Networks: 3G and Beyond” 2nd Edition McGraw Hill 2013.
[3] Nishith D. Tripathi and Jeffrey H. Reed,"Cellular Communications A Comprehensive and Practical Guide" Wiley 2014.
[4] Rajpandya " Mobile and Personal Communication Services and Systems”, IEEE Inc., New York, 2014.
[5] Nitin Goyal, Luxmi Sapra, Jasminder Kaur Sandhu,” Energy-Efficient Underwater Wireless Communications and Networking”, 1st Edition, Business Science Reference , 2020