SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE
www.sathyabama.ac.in

SCHOOL OF ELECTRICAL AND ELECTRONICS

Minutes of Board of Studies Meeting held on 28thNOVEMBER 2020

(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 (28.11.2020, 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 proposed to remove the following topics in Electronic Circuits I (3rd Semester) course: 'Approximate Model- Analysis of CE, CC and CB amplifiers using Approximate model equivalent circuits to obtain gain, input impedance and output impedance'. Dr.M.D.Selvaraj, Associate Professor, IIITDM accepted the changes and suggested to include Frequency response of the Differential amplifier in unit V instead of power supply and amplifiers.

- Dr.S.Lakshmi suggested to introduce 'Antenna for 5G application and Software Tools for Antenna Design and Analysis' in the course Antenna and Wave Propagation. Dr.N.Sivakumaran, Prof.,NIT, Trichy accepted the inclusion and also suggested to introduce simulation through HFSS in the class.

- Dr.M.Sumathi suggested to include the topics Li-Fi in the course Optical Communications. Dr.N.Shivakumaran accepted and suggested to remove WDM, SONET/SDH, ATM,IP over WDM.

- Dr.Sugadev presented the syllabus revision for 'Embedded Processors'.Board accepted the change and Mr.J.Visweswaran suggested to include System on Chip concept in the syllabus.

- Syllabus revision proposed in 'High Performance Computing' by Dr.Dr.S.Poorna Pushpa Kala was accepted by Dr.M.D.Selvaraj.

- Dr.S.Barani suggested to remove 'Basics of Spark-Programming in Scala'for the course 'Real Time Data Analytics'. Mr.J.Visweswaran accepted the changes and

suggested to include function programming in Scala. Dr.N.Sivakumaran suggested to include Case studies on influx and Grafana.

- Having discussed the revisions in the existing courses, faculty then presented the syllabus for the new courses. Dr.P.Chitra presented the syllabus for Digital Image Processing for Real Time Applications and Deep Learning Neural Networks. Dr.M.D.Selvaraj accepted the syllabus for both the courses.

- Dr.M.Sugadev presented the syllabus for 5G communication. Dr.N.Sivakumaran suggested to include mmWave communication in the syllabus.

- Dr,S.Poornapushpakala presented the syllabus for Machine Learning using Python. Mr.Visweswaran suggested that Least Squares Optimization, Collaborative Filtering and related topics can be included.

- Dr.S.Barani presented the syllabus for IoT for Real time Applications. Dr.N.Sivakumaran accepted the syllabus and he suggested that students can be made to do miniprojects in this course.

- Dr.M.Sugadev presented the syllabus for Drone Electronics. Syllabus was accepted by the board and Dr.M.D.Selvaraj suggested that this course can be offered to all branches of Engineering.

- Dr.P.Kavipriya presented the syllabus for Industrial Internet of Things. Mr.Visweeswaran suggested that Middleware Software protocol can be included.

- Dr.S.lakshmi presented the syllabus for eHealth and Dr.N.Sivakumaran suggested that mobile application development for biomedical applications can be included as part of the syllabus.

- Dr.N.M.Nandhitha informed the Board that part of the syllabus in SEC1320 Embedded Systems will be delivered by the industry expert so as to make the students understand the applications of embedded systems in industries. Mr.J.Visweswaran appreciated the initiative and suggested that at least one course in each semester can be identified for partial delivery of syllabus by expert from industry.

Table 1. Revision Carried out in the courses

SL NO	COURSE CODE	COURSE NAME	DELETED TOPICS	ADDED TOPICS
1	SECA1307	ELECTRONIC CIRCUITS I	**UNIT 5** Linear mode power supply - Rectifiers - Half-Wave Rectifier - Full-Wave Rectifier - Filters-L,C, LC, CLC Filter- Regulators -Zener Diode regulator- Linear series, shunt voltage Regulators - Switched mode power supply (SMPS) – Large Signa Amplifiers – Class A, Class B, Class C, Class D- Distortion	**UNIT 5** Current sources for biasing – Current steering circuits – Current mirror with improved performance (Cascode mirror, Wilson, Widlar). Large and small signal operation of Differential pair circuit Differential pair with active load

			in power amplifiers	
2	SECA1505	ANTENNA AND WAVE PROGRAGATION	**UNIT 5** Anechoic Chamber-Radiation Pattern Measurement-Gain measurement-Beamwidth and Directivity Measurement-Impedance Measurement - Measurement of radiation efficiency- Ionospheric measurements - Vertical incidence measurements of the ionosphere - Relation between oblique and vertical incidence transmission - System Issues – antenna noise.	UNIT 5 Concepts and Benefits of Smart antennas - Fixed weight beamforming-Adaptive beamforming – Design of Planar array antennas for Beamforming applications – Feed techniques for Planar arrays - Role of Smart Antennas in Green Communications and 5G wireless communications – Software Tools for Antenna Design and Analysis
3	SEC1407	OPTICAL COMMUNICATIONS	**UNIT 5** Applications- Military	**UNIT 3** Vertical cavity surface emitting laser,Resonant cavity enhancement **UNIT 5** Optical OFDM, High-speed Light-Waveguides, Reconfigurable optical add/drop multiplexer, Light-Fidelity (Li-Fi) Technology-Introduction, working principle, Comparison of Li-Fi and Wi-Fi, Li-Fi networks, Applications.Case study: Evaluation of building a Fiber Optic network
4	SECA3019	EMBEDDED PROCESSORS	**UNIT 5** Introduction - fixed and floating point –Core architecture of ADSP218X-Arithmetic Logic Unit (ALU) – Multiplier and Accumulator (MAC) Unit- Barrel Shifter-Data Address Generator (DAG)- Program Sequencer-Functional Diagram of TMS320C54XX.	**UNIT 5** Introduction to ARM CORTEX series, improvement over classical series and advantages for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, need of operating system in developing complex applications in embedded system, Firmware development for ARM Cortex, Survey of CORTEX M3 based controllers, its features and comparison
5	SECA7020	HIGH PERFORMANCE COMPUTING	**UNIT 4** Intrusion Detection and Prevention, Intrusion Risks, Security Policy, Monitoring and Reporting of Traffics, Traffic Shaping, Investigating and Verifying Detected Intrusions,	**UNIT 4** Scheduling Parallel Jobs on Clusters, Parallel Programming Models, Parallel and High Performance programming

			Reporting and Documenting Intrusions. **UNIT- 5** Define the Types of Intrusion Prevention Systems, Intrusion Prevention System Basics, and Limitations of Intrusion Prevention System, Spoof Prevention, Denial of Service (DoS), and Quality of Service (QoS) Policy, Web Application Firewall, Packet Signature and Analysis.	languages, Dependence Analysis of Data arrays **UNIT- 5** Quantum computing and its issues
6	SECA7023	REAL TIME DATA ANALYTICS	**UNIT 1** Basics of Spark-Programming in Scala	**UNIT 1** Expressions-Functions – Classes- File I/O – Exceptions – Combining UNIT-2 Distributed Storage-Parallelism, Regression. Classification and Clustering with Spark UNIT-4 Kafka Architecture and Components, Kafka Cluster, Kafka Producer, Kafka Consumer

- Dr.Lalithakumari.S, suggested few modifications in the course 'Industrial Unit Operations'. She proposed the inclusion of topics leaching and extraction. It has been accepted by Dr.Sivakumaran, and he suggested to include the same along with mixing and separation unit operations. Dr. D.Marshiana suggested that 'Humidification, de-humidification' can be added. Dr. Sivakumaran agreed for the inclusion.

- Dr.Lalithakumari presented the syllabus for an elective course 'Optimal Control Systems'. Dr.Sivakumaran accepted the syllabus change suggested that students may be asked to do mini projects in this course.

COURSE CODE	COURSE NAME	DELETED TOPICS	INCLUDED TOPICS
SEIA1402	Industrial Unit Operations	--	Unit-4 Humidification, De-humidification Unit-2 Leaching and extraction

- Dr.V.Sivachidambaranathan, Prof.& Head, Dept. of Electrical and Electronics Engineering requested the board to shift the course "Applied Thermodynamics" to elective. Dr.M.D.Selvaraj accepted the suggestions.

- Dr.A.Ramesh babu and Dr.S.D.Sundar Singh Jebaseelanputforth the syllabus of the new courses, 'Modern Power Converters'and'Distributed Generation and Microgridss' for the approval of the board. Dr N Sivakumaran approved the Syllabus for these new 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. Dr M Sugadev
10. Dr .E.Anna Devi
11. Ms.S.Yogalakshmi
12. Dr.LalithaKumari.S
13. Dr.Pandian.R
14. Dr.Marshiana.D
15. Dr.V.Sivachidambaranathan
16. Dr.D.Susitra
17. Dr.R.Vanitha
18. Mrs.D.Ramya
19. Mrs.P.Sivagami

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NEW COURSES

SL.NO	COURSE CODE	COURSE NAME
1.	SEC1628	DIGITAL IMAGE PROCESSING FOR REAL TIME APPLICATION
2.	SECA3020	5G COMMUNICATIONS
3.	SEC1630	MACHINE LEARNING TECHNIQUES
4.	SEC1629	IoT FOR REAL TIME APPLICATIONS
5.	SECA4003	DRONE ELECTRONICS
6.	SECA4002	DEEP LEARNING NEURAL NETWORKS
7.	SECA4005	INDUSTRIAL INTERNET OF THINGS
8.	SECA4004	eHEALTH
9.	S13ADPROJ	DESIGN THINKING

SEC1628	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 –	9

	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.	
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

Maximum Hours: 45

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 Processin", 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. François Chollet "Deep Learning with Python", Manning Publications Co., NY, 2018
7. Phil Kim. "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017
8. Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images
9. Valentina Zharkova, Lakhmi C. Jain, "Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images", Springer, 2007

SECA3020	5G COMMUNICATIONS	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: Nil **Co Requisite:** Nil

Course Objectives

- To learn about wireless mobile communication standards and co-existence of 4G and 5G.
- To learn 5G network architecture, components, features and their benefits.
- To learn channel access methods, modulation and spectrum sensing techniques used in 5G wireless systems.
- To understand advanced wireless concepts such as Massive MIMO, Virtualized RAN and Network Slicing.
- To learn about mmWave communication systems and its use cases.

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO 5G** 3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.	9
II	**5G CHANNEL ACCESS METHODS** OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.	9
III	**RADIO ACCESS NETWORK FOR 5G NR** 5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G.	9
IV	**CHANNEL MODELS FOR 5G NR** Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G.	9
V	**ENABLING TECHNOLOGIES FOR 5G** Device-to-Device (D2D) Communication - 5G for Massive Machine Type	9

	Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication - mmWave Communications -Massive MIMO and Beamforming Techniques.	

Maximum Hours: 45

Course Outcomes:

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

CO1 - Distinguish major mobile communication standards such as 3G, 4G and 5G

CO2 - Analyze various modulation and multiplexing techniques like OFDM, NOMA etc.

CO3 - Design system level architecture of 5G communication systems.

CO4 - Analyze spectrum sensing and sharing techniques in 5G systems.

CO5 - Assess the potential of mmWave spectrum for 5G applications.

CO6 - Apply the concepts of green communications in real life applications.

TEXT / REFERENCE BOOKS

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
2. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
3. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
4. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
5. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
6. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

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

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

SECA4003	DRONE ELECTRONICS	L	T	P	Credits	Total marks
		3	1	0	3	100

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

Course Objectives

- To Introduce The Concepts Of Applying Aerodynamics To Drone Design
- To Familiarize The Student's Ability To Analyze The Concepts Of Drone
- To Understand The Basic Operation Of Various Sensors In Drone Application
- To Design Drone For The Mission Control Application

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO DRONE** Definition of drones , History of drones , Classification of drones based on structure- Fixed wing structure, Lighter than air systems and Rotary-wing aircraft, Application of drones, Parts of Drone system, System design, Mechanical design, hardware design, software architecture, Logistic and Operations Management.	9
II	**DYNAMICS AND STABILITY** Forces of flight, Principal axes and rotation of aerial systems - Longitudinal axis, Lateral(transverse) axis and Perpendicular axis, Equilibrium, Stability - Stable system, Unstable system and Neutrally stable system, Control – Roll, Pitch, Yaw and Throttle.	9
III	**SENSORS IN DRONE** Sensors – Accelerometer, Barometer, Gyro Sensor, Magnetometer, Distance sensors , Time of Flight (ToF) Sensors, Thermal sensors, Chemical Sensors and thermal sensors. Sensor Testing – Test Philosophies and methodologies, Test equipment, Performance testing of sensors	9

IV	**GLIDING DRONES** Glider, Lift, Drag, Airfoil and its type, Incident and decalage angle, Three axis motion (roll, pitch, and yaw), Thrust, Aspect ratio and glide ratio, Glide or dive and descent, gliding angle, Climb, Center of pressure, Pitching moment, Load factor, Angle of attack, Build our own glider drone.	9
V	**DRONES FOR MISSION CONTROL APPLICATION** ESP8266, Downloading and installing APM Planner or Mission Planner, Configuring the quadcopter - Frame type selection, Compass calibration, Access calibration, Radio calibration, Flight mode calibration and Failsafe calibration, Surveying with a drone, tweaks with the Flight Plan screen. Future of Drone Systems	9

Maximum Hours: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply the mathematical/engineering concepts in building drones

CO2 –Analyze the mathematical relation between force, equilibrium, stability and the movement of drones

CO3 – Select appropriate sensors and actuators for specific applications

CO4 – Design gliding drones for real world applications

CO5 – Appraise the performance of subunits in drones

CO6 – Design a drone for mission control application.

TEXT / REFERENCE BOOKS

1. Syed Omar Faruk Towaha, "Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266" Packt Publishing, 2018
2. Aaron Asadi, "Drones The Complete Manual. The essential handbook for drone enthusiasts", Imagine Publishing Limited, 2016
3. Neeraj Kumar Singh, Porselvan Muthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing", Apress, 2019
4. Felipe Gonzalez Toro, Antonios Tsourdos, "UAV or Drones for Remote Sensing Applications"2018.
5. K R Krishna, "Agricultural Drones: A Peaceful Pursuit", Apple Academic Press; CRC Press, 2018

SECA4002	DEEP LEARNING NEURAL NETWORKS	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: Engineering Mathematics II

Co Requisite: NIL

Course Objectives

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO DEEP LEARNING** Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates	9
II	**DEEP NETWORKS** History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning	9
III	**DIMENTIONALITY REDUCTION** Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization	9

IV	**OPTIMIZATION AND GENERALIZATION** Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience	9
V	**APPLICATIONS OF DEEP LEARNING** Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions	9

Maximum Hours: 45

Course Outcomes

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

CO1 – Select suitable model parameters for different machine learning techniques

CO2 – Evaluate the performance of existing deep learning models for various applications

CO3 – Realign high dimensional data using reduction techniques

CO4 – Analyze the performance of various optimization and generalization techniques in deep learning

CO5 – Modify the existing architectures for domain specific applications

CO6 – Develop a real time application using deep learning neural networks

TEXT / REFERENCE BOOKS

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

SECA4005	INDUSTRIAL INTERNET OF THINGS	L	T	P	Credits	Total Marks
		3	0	0	3	100

Pre requisite: NIL

Co Requisite: NIL

Course Objectives

- To focus on basics of Industrial Internet
- To modify the various existing industrial systems
- To get an idea about IIoT Architectures
- To acquire the knowledge about various Network Protocols
- To extract the backend Middleware Protocols

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO INDUSTRIAL INTERNET** Innovation and IIoT – Intelligent Devices – Industrial Internet – Health care – Oil and Gas Industry – Smart Office – Logistics – IoT Innovations in Retail.	9
II	**TECHNICAL AND BUSINESS INNOVATORS OF INDUSTRIAL INTERNET** Miniaturization – Cyber Physical Systems – Wireless technology – IP Mobility – Network Functionality Virtualization – Cloud and Fog - Big Data and Analytics – M2M Learning and Artificial Intelligence.	9
III	**IIOT REFERENCE ARCHITECTURE** Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.	9

IV	**INDUSTRIAL INTERNET SYSTEMS** Introduction-Proximity Network Protocols – WSN Edge Node – Legacy Industrial Protocols –RS232 Serial Communications, 40-20ma Current Loop, Field Bus Technologies – Modern Communication Protocols – Industrial Ethernet – Industrial Gateways.	9
V	**MIIDDLEWARE TRANSPORT PROTOCOL** TCP/IP, UDP, RTP, CoAP –Middleware Software patterns –Software Design patterns – Application Programming Interface (API) – CAN Protocol-Web Services – Middleware IIoT – Securing the IIoT- Identity Access Management.	9

Maximum Hours: 45

Course Outcomes

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

CO1 –Enhance the company's performance using IoT

CO2 –Demonstrate the different styles of technical and business innovators

CO3 –Examine various IIoT Architectures related to data management system

CO4 –Organize the design of Industrial Internet Systems

CO5 –Select various Software design patterns using API

CO6 –Construct a Middleware software system related to proximity edge networks.

Text/Reference Books

1. S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020
3. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014
4. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

SECA4004	eHealth	L	T	P	Credits	Total marks
		3	1	0	3	100

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

Course Objectives

- To introduce the concepts of eHealth
- To have an in-depth knowledge on medical data analytics and wearable devices used in eHealth systems
- To assess the advantages of eHealth
- To explore the usage of AI in eHealth
- To design and develop applications for eHealth

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO eHealth** Overview and introduction to eHealth and flow of health information- International regulations in eHealth-Advantages, Challenges and future of eHealth.	9
II	**MEDICAL DATA ANALYTICS AND WEARABLE DEVICES** Health care data and Electronic Health Records (EHR) systems- Medical data bases –Wearable devices-Data collection from wearable devices- Clinical use of personal health data- Big data in the field of Medicine.	9
III	**DIGITAL HEALTH** Introduction to health care digital transformation- Digital health: Tools, Strategies of digital health-Technologies in digital health-Implementation of Digital health- Advantages and challenges of Digital health.	9
IV	**ARTIFICIAL INTELLIGENCE IN eHealth**	9

	History of AI in health care-Impacts and Aspects of AI in health care-Current research in AI in eHealth-Regulations and Ethical concerns in using AI in eHealth.	
V	**APPLICATION DEVELOPMENT FOR eHEALTH** Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for eHealth applications.	9

Maximum Hours: 45

Course Outcomes

On Completion Of The Course, Student Should Be Able To

Co1 – Articulate Ehealth And Its Regulations

Co2 – Explore Medical Data Analytics And Records

Co3 – Appraise Digital Transformation In The Field Of Medicine

Co4 – Analyse Ai In Health Care Systems

Co5 – Design System Level Architecture For Health Information Systems

Co6 – Deploy Android Application On Devices

TEXT / REFERENCE BOOKS

1. Shortliffe, Edward H and Cimino James J. Biomedical Informatics, Computer Applications in Health Care and Biomedicine, Springer-Verlag London 2014.
2. Lavis, JN (ed). Ontario's Health System: Key Insights for Engaged Citizens, Professionals and Policymakers. 2016.
3. Hoyt RE, Yoshihashi A, Bailey N. Health informatics: Practical guide for healthcare and information technology professionals. Lulu Press. 2014 Seventh edition.
4. Gaddi A, Capello F, Manca M. eHealth, Care and Quality of Life. 2014 electronic library holding in the Health Science Library