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

Department of ECE
School of Electrical and Electronics
Sathyabama Institute of Science and Technology

Academic Year (2021-22)

New Course	New Course Name
SECA4006	Deep Learning for Computer Vision
SECA4007	Real-time System Design
SECA3021	Digital System Design and Verification using System Verilog
SECA3022	Graphical Programming for Engineers
SECA3023	Augmented Reality and Virtual Reality
SECA3024	Advanced Electronic Test Engineering
SECA1404	Industry 5.0 for Electronics Engineers

SECA4006	DEEP LEARNING FOR COMPUTER VISION	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 computer vision
- To become conversant with ANN
- To understand various CNNs
- To analyze deep learning concepts and techniques for computer vision
- To evaluate the solutions for real world problems in classification, detection and recognition

UNIT	CONTENTS	HOURS
I	**COMPUTER VISION FOUNDATIONS** Image Formation, Representing Images, Linear Filtering, Correlation, Convolution, Edge, Blobs, Corner Detection; Scale Space, Feature Detectors, Image Segmentation, Feature Matching.	9
II	**UNDERSTANDING DEEP LEARNING** Perceptron, Activation Functions, Artificial Neural Networks, Training Neural Networks, Convolutional Neural Networks, Recurrent Neural Networks.	9
III	**CONVOLUTIONAL NEURAL NETWORKS** Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets.	9
IV	**DEEP LEARNING FOR COMPUTER VISION** Classification, Detection or Localization and Segmentation, Similarity Learning, Image Captioning, Generative Models – Concepts and Techniques.	9
V	**APPLICATIONS** Image Classification, Object Detection, Face Recognition – Practical Approach to solve real world problems	9

Maximum Hours: 45

Course Outcomes

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

CO1-Apply mathematical concepts for understanding digital Images

CO2-Analyze the deep learning concepts

CO3-Analyze various convolutional neural networks

CO4-Identify suitable deep learning techniques for classification and detection problems

CO5-Implement image classification and object detection systems using deep learning

CO6-Solve real world problems in classification, detection and recognition using deep learning

TEXT / REFERENCE BOOKS

1. Mahmoud Hassaballah and Ali Ismail Awad, “Deep Learning in Computer Vision: Principles and Applications”, CRC Press, Taylor & Francis Group, 2020.
2. Jason Brownlee, “Deep Learning for Computer Vision: Image Classification, Object Detection and Face Recognition in Python”, Machine Learning Mastery, 2019.
3. Himanshu Singh. “Practical Machine Learning and Image Processing”, Apress, 2019.
4. RajalingappaaShanmugamani“Deep Learning for Computer Vision : Expert techniques to train advanced neural networks usingTensorFlow and Keras”,Packt Publishing, 2018.
5. François Chollet “Deep Learning with Python”, Manning Publications Co., NY, 2018
6. Dr. Adrian Rosebrock, “Deep Learning for Computer Vision with Python”, I Edition, PyImageSearch, 2017.
7. Phil Kim. “MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
8. Jan Erik Solem, “Programming Computer Vision with Python”, Creative Commons, 2012.
9. Valentina Zharkova, Lakhmi C. Jain, “Artificial Intelligence in Recognition and Classification of Astrophysical and Medical Images”, Springer, 2007

SECA4007	REAL-TIME SYSTEM DESIGN	L	T	P	Credits	Total marks
		2	0	2	3	100

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

Course Objectives

- To explain the features of real-time applications.
- To learn different task scheduling algorithms for real-time systems.
- To discuss various fault-tolerance techniques available for real- time systems.
- To learn about real-time operating systems and their characteristics.
- To study about various software tools for development of real-time embedded systems

UNIT	CONTENTS	HOURS
I	**INTRODUCTION TO REAL-TIME SYSTEMS** Real-time system characteristics-Hard real-time and soft real-time systems -Timing Constraints- Modelling Timing Constraints of typical real-time systems- Safety airbag - Aircraft Flight controller.	9
II	**REAL-TIME TASK SCHEDULING** Task Modelling -Types of Schedulers – Preemptive and Non-Preemptive scheduling - Cyclic schedulers- Rate Monotonic Algorithm (RMA-Earliest Deadline First Algorithm (EDFA)- Handling Resource sharing among real-time tasks – Priority Inversion – Priority Inheritance and Priority Ceiling Protocol for Deadlock prevention.	9
III	**REAL-TIME OPERATING SYSTEMS** Introduction to RTOS –Survey of real-time OS:Vxworks, QNX, Micrium OS, RT Linux and freeRTOS – Creating Tasks –Multitasking using RTOS - Interprocess Communication using mailbox, message queues – Task Synchronisation and Resource management using semaphores–Timers and Interrupts in RTOS-Memory Management in RTOS	9
IV	**REAL-TIME SYSTEM MODELLING** Model based system design frameworks - Petrinets and applications in real-time modeling, Vending Machine - Air traffic controller system – Distributed air defense system– Evaluation of system performance - In the loop Testing - Hardware in the loop testing-Software in loop testing	9
V	**CASE STUDY OF REAL-TIME SYSTEMS** Real-time PID controller-Real-time Multimedia communication-Real-time Databases-Aircraft Avionics-ECU in Automobiles	9

Maximum Hours: 45

Course Outcomes

On completion of this course, students are able to

CO1- Identify timing constraints of real-time systems

CO2- Apply appropriate scheduling algorithms for timely execution of real-time tasks

CO3- Develop real-time applications using RTOS

CO4- Apply model based design approach for given real-time application

CO5- Apply fault tolerant design techniques in developing real-time systems.

CO6-Evaluate performance of real-time systems using model based design frameworks.

TEXT / REFERENCE BOOKS

1. Philip. A Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 4th Edition.2012.
2. Jane W. S Liu, “Real Time Systems” Pearson Higher Education, 4th Edition, 2014.
3. Richard Barry, “Mastering the Free RTOS: Real Time Kernel”, Real Time Engineers Ltd, 1st Edition, 2016.
4. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2nd Edition, 2014.
5. Warren Gay, “Beginning STM32: Developing with Free RTOS”,Apress, 1st Edition, 2018.
6. Li Q, Yao C, "Real-Time Concepts for Embedded Systems", CMP Books, 1st Edition, 2003.

SECA3021	Digital System Design and Verification using System Verilog	L	T	P	Credits	Total marks
		2	0	2	3	100

Pre requisite: HDL Programming

Co Requisite: NIL

Course Objectives

- To explore the fundamental concepts of verilog
- To understand systemVerilog data types and capabilities
- To enumerate system Verilog RTL and abstraction
- To analyze dynamic types and arrays for behavioral modeling
- To evaluate System Verilog Assertions for design and verification

UNIT	CONTENTS	HOURS
I	**Digital Design using Verilog HDL** Hardware modeling with the Verilog HDL: Encapsulation, modeling primitives, Types of Modelling. Logic system, Data types and operators. Behavioral descriptions in verilog HDL. Styles for Synthesis of combinational logic and sequential logic.HDL based Synthesis – Technology independent design	9
II	**Introduction to System Verilog** SystemVerilog standards, Key SystemVerilog enhancements for hardware design.Advantages of System Verilog over Verilog, Data Types: Verilog data types, System Verilog data types, 2 - State Data types, Bit, byte, shortint, int, longint. 4 - State data types. Logic, Enumerated data types, User Defined data types, Struct data types, Strings, Packages, Type Conversion: Dynamic casting, Static Casting, Memories: Arrays, Dynamic Arrays, Multidimensional Arrays, Packed Arrays, Associative Arrays, Queues, Array Methods, Tasks and Functions: Verilog Tasks and Functions	9
III	**Connecting the Test bench and Design** Verilog interface signals - Limitations of Verilog interface signals, SystemVerilog interfaces, SystemVerilog port connections, Interface instantiation, Interfaces Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event Scheduler, SystemVerilog Event Scheduler, Clocking Block, Input and Output Skews, Typical Testbench Environment, Verification plan	9
IV	**Constrained Randomization** Random Variables - rand and randc, Randomize( ) Method - Pre/Post Randomize( ) methods, Constraints in the class, Rand_mode and constraint_mode, Constraint and Inheritance, Constraint Overriding, Set Membership, Distribution Constraints, Conditional Constraints - .implication (->), if/else, Inline Constraints	9
V	**Functional Coverage and Assertion Based Verification** Coverage Definition, Code Coverage, Functional Coverage: Cover Group, Creating Cover Group Instances, Coverpoints, Bins - implicit bins, . Explicit bins, Bin creation, Vector and Scalar bins, Cross products, Intersect, Select Expressions, Conditional Expression (iff), Illegal bins, Ignore bins, Coverage Analysis, Covergroup Built-in Methods - .Sample(), . get_coverage(), .get_instance_coverage(), .set_instance_name(string), .start(), . stop()	9

Maximum Hours: 45

Course Outcomes

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

CO1: Understand the digital system designs skills using VERILOG HDL based on IEEE-1364 standards and managed by Open Verilog International (OVI)

CO2: Model digital systems in Verilog HDL at different levels of abstraction

CO3: Know the simulation techniques and test bench creation.

CO4: Demonstrate the skill on writing test-benches for design of digital systems and connecting them with the design.

CO5 Analyze the complete systems through robust verification methods such as assertion based verification.

CO6 Design the digital systems such as FIFOs, memories, ATM interfaces, etc. using the learnt methods and demonstrate the skills.

TEXT / REFERENCE BOOKS

1. Advanced Digital Design With the Verilog HDL, Michael D. Ciletti, 2nd Edition, PHI, ISBN: 978–0– 07–338054–4 2015.
2. Digital Systems Design Using Verilog, Charles Roth, Lizy K. John, Byeong KilLee,Cengage Learning, ISBN-10: 1285051076, 2015.
3. Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, 6th Edition, McGraw Hill publication, ISBN: 978–0–07–338054–4, 2014.
4. System Verilog for Design - A Guide to Using System Verilog for Hardware Design and Modeling, Stuart Sutherland, Simon David mann and Peter Flake, 2E, Springer Science, ISBN-13: 978-0387-3339-91, 2006.
5. System Verilog for Verification-A Guide to Learning the Testbench Language Features, C Spear, Springer Science, IEEE press, ISBN-13: 978-0387-2703-64,2006.
6. SystemVerilog golden reference guide-A concise guide to System Verilog Doulos ,IEEE Standard-1800-2009, Version 5.0,ISBN: 0-9547345-9-9, 2012.
7. Step-by-Step Functional Verification with System Verilog and OVM, SasanIman, Hansen Brown Publishing Company,ISBN-13: 978-0-9816-5621-2, 2008.

SECA3022	Graphical Programming for Engineers	L	T	P	Credits	Total marks
		2	0	2	3	100

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

Course Objectives

- Students will understand each topic by doing exercise
- Two sessions will be handled by industry people towards project
- This is a learning by doing course
- The learner can use this tool to understand any subjects by implementing or simulating the concept using LabVIEW
- Students can able to do their project in short span of time

UNIT	CONTENTS	HOURS
I	**LabVIEW FOUNDATIONS** LabVIEW Operating Environment-Front Panels, Controls and Indicators, Block Diagrams, LabVIEW Projects, Creating Vis, Basic Controls and Indicators, Debugging Techniques, Creating SubVIs.	9
II	**CONTROLLING PROGRAM EXECUTION WITH STRUCTURES** For and While Loops, Shift Registers, Case Structure, Sequence Structure, Timed Structures, Formula and Expression Nodes, Combining While Loops with Case Structure.	9
III	**ARRAYS AND CLUSTERS & CHARTS AND GRAPHS** Array Controls and Indicators, Auto-Indexing, Two Dimensional Arrays, Compound Arithmetic, Cluster Controls and Indicators, Interchangeable Arrays and Clusters, Error Clusters and Error Handling Functions., Waveform Charts, Waveform Graphs, X-Y Graphs, Time Stamps.	9
IV	**SIGNAL CONDITIONING & DATA ACQUISITION SYSTEMS** Introduction- Basic Signal Conditioning Requirements of Common Transducers- Thermocouple- RTDs- Strain Gauges- Current Signals- General Signal Conditioning Functions- Amplification- Filtering and Averaging- Isolation- Multiplexing- Digital Signal Conditioning.	9
V	**APPLICATION USING GRAPHICAL PROGRAMMING** Logging Temperature data to a text file , Signal noise removal, water tank control, Function Generator, Equalizer design, Signal spectrum measurement, PAM ,FM,ASK, FSK modulation	9

Maximum Hours: 45

Course Outcomes

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

CO1- Develop and edit functional block diagrams and front panels.

CO2- Develop codes to load, save, and debug VIs.

CO3- Analyze program execution through structures such as 'For-While' loops and 'Case Structures

CO4- Analyze composite data in the form of Arrays and Clusters

CO5- Implement techniques to acquire and process signals and can able to realize engineering concept using LabVIEW

CO6- Develop solutions to the given problem using LabVIEW

TEXT / REFERENCE BOOKS

1. Jeffrey Travis, Jim Kring, Labview for Everyone: Graphical Programming Made Easy and Fun, 3rd Edition, 2009.
2. www.ni.com
3. **http://www.learnni.com/getting-started/Home/Index/91**
4. **https://www.halvorsen.blog/documents/tutorials/tutorials.php**

SECA3023	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	Credits	Total marks
		2	0	2	3	100

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

Course Objectives

- To explore the basic of AR/VR technology and devices
- To understand the various elements and components used in AR/VR Hardware and Software
- To explore the industrial application of AR/VR technology
- To analyze the difference between AR and VR
- To enable working on real life projects using AR/VR technology

UNIT	CONTENTS	HOURS
I	**AUGMENTED REALITY** Introduction to Augmented Reality, Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems	9
II	**DEVELOPMENT OF AR MODELS** Unity, Basics of Unity, Understanding different panels in Unity, Moving, rotating & scaling Game objects in Unity, Game Panel in Unity, Physics in Unity, Increasing the light intensity, Adding colors to Game object, Adding textures to Game object, Parent and child Game objects in Unity, Local/Global and Pivot/Center tools in Unity, Prefabs in Unity, Scripts, Rotating the spheres, Revolving the spheres	9
III	**AUGMENTED REALITY ONE (ARONE) SECTION INTRODUCTION** Augmented Reality One (AROne) Section Introduction, Importing Vuforia package inside Unity, Importing Vuforia package via Vuforia Core Samples, Web Camera output and creating the ARONE License Key, Capturing an Image, Creating a Vuforia Database and uploading Image Targets, Projecting Barbarian 3D Model on Image Target, Testing the output on an Android smartphone, Testing the output on iPhone or iPad.	9
IV	**VIRTUAL REALITY** Introduction of Virtual Reality, Fundamental Concept and Components of Virtual Reality, Difference between AR and VR, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark, Primary Features and Present Development on Virtual Reality, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection	9
V	**AR / VR APPLICATIONS** Engineering, Entertainment – Movies, Game development, Science, Medical applications, military applications, robotics application, Case study - CRO based experiment, Building Electronic circuit using AR/VR.	9

Maximum Hours: 45

Course Outcomes

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

CO1-Apply mathematical concepts for understanding Augmented reality and Virtual Reality

CO2-Analyze the development of AR models

CO3-Analyze various Vuforia package inside Unity

CO4-Develop a Virtual reality Model

CO5-Implement AR/VR in game development

CO6-Build any Electronic circuit using AR/VR

TEXT / REFERENCE BOOKS

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009
3. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016
4. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, . 2015.
5. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg& Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
6. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015.

SECA3024	ADVANCED ELECTRONIC TEST ENGINEERING	L	T	P	Credits	Total marks
		3	0	0	3	100

Pre requisite: NIL	Co Requisite: NIL

Course Objectives

- To impart knowledge on various types of printed circuit boards.
- To understand component level and board level automated testing methodologies.
- To impart knowledge on automated test equipment system architecture.
- To understand the principle of fault simulation and test fixture design for automated testing
- To disseminate the importance of design for testability.
- Study about the applications of computer vision in automated PCB testing

UNIT	CONTENTS	HOURS
I	**PCB TECHNOLOGYAND TESTING METHOD** Printed Circuit Boards(PCB) - Construction - Types of PCB - Multilayer - Surface Mount technology – PCBManufacturing process -Fault types and causes in circuits during manufacturing- PCB Inspection methods - Bare Board Testing - Optical and X-Ray Inspection.	9
II	**ELECTRICAL TESTING OF ASSEMBLED PCB** Symptom Recognition - Component failure Analysis - Manual trouble shooting technique - Electrical tests -Text fixtures - Bed of nails fixtures - Cross talk test - Mock up test - In circuit test – Burn-in-test - Fault diagnostic methods- Electromagnetic compatibility testing of electronic components, subassemblies.	9
III	**AUTOMATED TROUBLE SHOOTING TECHNIQUES** ATE Techniques - CPU Emulator technique - ROM and ROM Emulators - In circuit Comparator - In Circuit Functional test - Trouble shooting digital gates - Testing Linear Integrated Circuits - Guarding Technique - VI trace Technique - Bus Cycle Signature System - Board functional test methods - Boundary scan test basics.in RTOS	9
IV	**ATE SYSTEM ARCHITECTURE** Automated Test Equipment (ATE) System Components - Digital Pin Electronics - Drive data formats - Digital High way - Analog Highway – Test Vector Generation - Creating test patterns - Fault Simulations. Technique - Bus Cycle Signature System - Board functional test methods - Design for Testability.	9
V	**COMPUTER VISION IN AUTOMATED PCB TESTING** Elements of Computer vision - Image Acquisition- Image Pre-processing-Component Detection and Text recognition methods-Template matching- Faster RCNN – Software Tools for Computer Vision- OpenCV, Tensorflow and Keras	9

Maximum Hours: 45

Course Outcomes

On completion of this course, students are able to

CO1- Identify various types of printed circuit boards and effectively use testing tools

CO2- Perform manual trouble shooting of assembled PCBs.

CO3- Identify faults in assembled PCBs using automated test equipment both at component level and board level

CO4- Design board fixtures to carry out customized board level testing

CO5- Develop test vectors and test patterns for fault identification in custom PCBs

CO6- Apply computer vision techniques in automated electronic testing

TEXT / REFERENCE BOOKS

1 Michael L.Bushnell et al., "Essentials of Electronic testing for digital, memory and mixed signal VLSI circuit",1st edition, Academic Press, 2018.

2 Parag.K.lala, "Digital circuit Testing and Testability", 2nd edition, Academic press, 2015.

3 Alfred L.Crouch, "Design for test for Digital ICs and Embedded core systems", 3rd edition, PHI, 2010.

4 Sabapathy S.R., "Test Engineering for electronic hardware", Qmax publishers, 1st Edition, 2007

5 Steve Holden"Computer Vision: Advanced Techniques and Applications" Clanrye International, 1st Edition, 2019.

SECA7041	Artificial Intelligence for Industrial 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 Artificial Intelligence (AI)
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation
- To impart machine learning techniques
- To understand various CNNs
- To develop the solutions for real world problems using AI

UNIT	CONTENTS	HOURS
I	**OVERVIEW OF AI** Evolution of AI, Applications of AI, Classification of AI systems, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems, Problem solving by Search, Problem space, State space, Blind Search, Types, Performance measurement.	9
II	**KNOWLEDGE REPRESENTATION** First Order Predicate Logic, Prolog Programming, Unification, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.	9
III	**FOUNDATIONS FOR MACHINE LEARNING** ML Techniques overview, Dimensionality Reduction, Clustering, Regression, Classification – Naïve Bayes; K-nearest Neighbours; SVM; Decision Trees, Ensemble methods	9
IV	**UNDERSTANDING DEEP LEARNING** Perceptron, Activation Functions, Artificial Neural Networks, Training Neural Networks, Convolutional Neural Networks, Evolution of CNN Architectures: AlexNet, VGG, ResNets, DenseNets, Recurrent Neural Networks.	9
V	**APPLICATIONS** AI applications, Information Retrieval, Machine Translation, Classification, Object Detection, Artificial Intelligence Techniques for Cyber-Physical, Digital Twin Systems and Engineering Applications	9

Maximum Hours: 45

Course Outcomes

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

CO1-Evaluate Artificial Intelligence methods.

CO2- Demonstrate knowledge of reasoning and knowledge representation for solving real world problems

CO3-Analyze various machine learning techniques

CO4-Identify suitable deep learning techniques for real world problems

CO5-Implement image classification and object detection systems

CO6-Solve real world problems in cyber physical systems using AI

TEXT / REFERENCE BOOKS

1. Phil Kim. "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
2. Jan Erik Solem, "Programming Computer Vision with Python", Creative Commons, 2012.
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition, 2015.
4. Alpaydin, E., "Introduction to Machine Learning", 2nd edition, MIT Press, 2010.
5. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
6. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; 1st Edition, 2008.
7. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.

SECA1406 (NEW)	INDUSTRY 5.0 FOR ELECTRONICS ENGINEERS	L	T	P	Credits	Total marks
		2	0	0	2	100

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

Course Objectives

- To acquaint with the digital transformation of Industry 5.0
- To recognize the power of industry to achieve societal goals beyond jobs and growth
- To understand the design of personalized electronics products
- To focus on methods of interaction between humans and machines
- To develop the concept of electronics manufacturing beyond automation and optimization

UNIT	CONTENTS	HOURS
1	**INDUSTRY 4.0** Introduction to Industry 4.0, Industry 4.0: The Fourth Industrial Revolution, History of Industry 4.0, Industry 4.0 by definition, Component of Industry 4.0, The opportunities in Industry 4.0, Industrial Internet, Smart Factory, Smart Buildings, Smart Manufacturing, Smart Farming.	9
2	**INDUSTRY 5.0** Evolution from Industry 1.0 to 5.0, Introduction to Industry 5.0, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Healthcare and Human computer interactions, Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Big Data and Advanced Analysis.	9
3	**DIGITAL TRANSFORMATION TO SOCIETY 5.0** Digital Transformation, Introduction to Digital Transformation, Digital business transformation, Causes of disruption and transformation, Digital transformation myths and realities, Digital transformation across various industries, Retail industry, Urban Development, e-Governance and the public sector, Insurance industry, Healthcare, Food, Manufacturing, Disaster Control, Elements of Society 5.0, Data Driven to Society, Humanity Vs Society 5.0.	9
4	SMART WORLD Introduction: Sensing & actuation, Communication, Electronics in Smart city, 5G Technology, Communication protocols, Integration of Sensors in Robots and Artificial Intelligence, Human-Machine Interaction, Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control,	9

	Plant Safety and Security (Including AR and VR safety applications), Facility Management., Intellectual Property Rights- Case Studies - Milk Processing and Packaging Industries.	
5	**CYBER SECURITY IN INDUSTRY 5.0** Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Intellectual Property Rights (IPR) : Case Studies- Augmented Reality Virtual Reality	9

Maximum Hours: 4

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the digital transformation power of Industry 5.0 to achieve societal goals beyond jobs and growth
CO2 – Analyze enhanced new production models in electronics
CO3 – Implement various electronics manufacturing technologies beyond automation and optimization
CO4 – Design suitable sensors for smart world real time applications
CO5 – Evaluate the performance of various cyber physical systems
CO6 – Create personalized electronics products combining the various industry 5.0 Applications with deep knowledge on Intellectual Property Rights

TEXT / REFERENCE BOOKS

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability:https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press. Availability:https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3
3. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, ”SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies”, Studylab Publications, 2016.
5. Alasdair Gilchrist, “INDUSTRY 4.0: Industrial Internet of Things”, Apress, 2016.