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			THEORY			PRACTICAL		L	T	P	CREDITS
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MTES213	DSE	Machine Learning	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
1. To know how to build simple knowledge-based systems.
2. Ability to apply knowledge representation, reasoning, and machine learning techniques to real world problems.

Course Outcomes (COs):
Upon completion of the subject, students will be able to:
1. Analyze and understand the machine learning and various algorithms
2. Student will be able to tackle real world problems in the domain of Data Mining, Big data, Information Retrieval, Computer vision, Linguistics and Bioinformatics.

Syllabus

UNIT I **7 Hrs.**
Introduction to Machine Learning
Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Different Types of Machine Learning, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks.

UNIT II **8 Hrs.**
Classification, Regression and Clustering
Supervised Learning: Classification: Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification.
Regression: Assessing performance of Regression- Error measures, Case study of Polynomial Regression.

UNIT III **7 Hrs.**
Linear Models
Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.

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UNIT IV **8 Hrs.**

Logic Based and Algebraic Models

Distance Based Models: Neighbors and Examples, Nearest Neighbors Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models, Tree Based Models

Probabilistic Models

Features, Feature types, Feature Construction and Transformation, Feature Selection, Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood.

Trends In Machine Learning

Model and Symbols- Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Deep Learning, Reinforcement Learning.

UNIT V **7 Hrs.**

Model Evaluations and Other Techniques

Model Evaluation: For Regression: MSE, RMSE, R2, Adjusted R2,
For Classification: Confusion Metrics, Accuracy, Precision, Recall, F1 Score.
Complexity: Bias/Variance Dilemma, Model Selection Procedures, Over fitting and Under fitting

Textbooks:

1. Rich E and Knight K, "Artificial Intelligence", Third Edition, TMH, 2017.
2. Nelsson N.J., "Principles of Artificial Intelligence", First Edition, Springer Verlag, Berlin.
3. Oliver Theobald ,"Machine Learning For Absolute Beginners: A Plain English Introduction" , 2nd Edition , 2017
4. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
5. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition-2012.

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MTES213	DSE	Machine Learning	60	20	20	0	0	3	0	0	3

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2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall,. 2002
3. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2010
4. Barr A, Fergenbaub E.A. and Cohen PR, "Artificial Intelligence", Addison Wesley.

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Course Educational Objectives (CEOs):
The student will have ability to:
1. Know how to build simple knowledge-based systems.
2. Know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).
3. Ability to apply knowledge representation, reasoning, and machine learning techniques to real world problems.

Course Outcomes (COs):
Upon completion of the subject, students will be able to:
1. Describe the key components of the artificial intelligence (AI) field.
2. Identify and describe artificial intelligence techniques, including search heuristics, knowledge representation, automated planning and agent systems, machine learning, and probabilistic reasoning.
3. Identify and apply AI techniques to a wide range of problems, including complex problem solving via search, knowledge-base systems, machine learning, probabilistic models, agent decision making.
4. Analyze and understand the machine learning and various algorithms

Syllabus

UNIT I **8 Hrs.**

Introduction to AI and Production Systems

Introduction to AI, Problem formulation, Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics, Specialized production system, Problem solving methods, Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

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UNIT II **8 Hrs.**

Representation of Knowledge

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation. Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III **8 Hrs.**

Knowledge Inference

Knowledge Inference -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory Bayesian Network-Dempster - Shafer theory.

UNIT IV **8 Hrs.**

Deep Learning

Deep Learning: The Neuron, Expressing Linear Perceptrons as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons, Multilayer Perceptron (MLP), Artificial Neural Networks (ANN), Convolution Neural Network, Recurrent Neural Network, GAN , LSTM, GRU,BERT.

UNIT V **6 Hrs.**

CNN Architectures

Transfer Learning like VGG16, Alexnet, Mobilnet etc, Computer Vision, Natural Language Processing (NLP).

Text books:

1. Rich E and Knight K, "Artificial Intelligence", Third Edition, TMH, 2017.
2. Nelsson N.J., "Principles of Artificial Intelligence", First Edition, Springer Verlag, Berlin.
3. Oliver Theobald ,"Machine Learning For Absolute Beginners: A Plain English Introduction" , 2nd Edition , 2017

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References:

1. S.Rajasekaran and G.A. VijayalaksmiPai "Neural Network, Fuzzy Logic, and Genetic Algorithm Synthesis and Applications", Second Edition, Prentice Hall, 2017
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall,. 2002
3. Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2010
4. Barr A, Fergenbaub E.A. and Cohen PR, "Artificial Intelligence", Addison Wesley,
5. Kos Ko B, "Neural Networks and Fuzzy system" Prentice Hall India Learning Private Limited.

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MTES233	DSE	Hardware/Software Codesign	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):
To give students a clear understanding of state-of-the-art hardware/software co-design methodology for computing systems

Course Outcomes (COs):
Student will be able to:
1. Understand the Co design model and algorithms.
2. Identify and implement design specification and verification.
3. Learn and analyze compilation technique and tool for embedded system

Syllabus

UNIT I **7 Hrs.**
Co-Design Issues: Co-Design Models, Architectures, Languages, A Generic Co-design Methodology.
Co-Synthesis Algorithms: Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

UNIT II **8 Hrs.**
Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure. Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT III **7 Hrs.**
Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

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MTES233	DSE	Hardware/Software Codesign	60	20	20	0	0	3	0	0	3

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UNIT IV **7 Hrs.**

Design Specification and Verification: Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT V **8 Hrs.**

Languages for System – Level Specification and Design-I: System – level specification, design representation for system level synthesis, system level specification languages, Level Specification and Design-II: Heterogeneous specifications and multi-language co-simulation, the cosyma system and lycos system.

Textbooks:

1. Jorgen Staunstrup, "Hardware / Software Co- Design Principles and Practice", Wayne Wolf – 2009, Springer.
2. Giovanni De Micheli, Mariagiovanna Sami, "Hardware / Software Co- Design", 2002, Kluwer Academic Publishers

References:

1. Patrick R. Schaumont, "A Practical Introduction to Hardware/Software Co-design", 2010, Springer

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MTES214	DSE	Sensors and Actuators	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):

1. Able to identify the different sensors available for specific engineering applications
2. Able to understand the construction and working of different types signal conditioning
3. Understand the various measurement techniques.
4. Understand the errors in measurements and their rectification.

Course Outcomes (COs):

Student will be able to :

1. Understand the different types of Sensor.
2. Sense and analyze different physical parameter.
3. Identify and implement different signal conditioning circuit as per the physical requirement.

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UNIT I **7 Hrs.**

Primary Sensors

Temperature sensors: Bimetals, Pressure sensors, Flow velocity and Flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors, Velocity sensors.
Materials for Sensor: Conductors, semiconductors, and dielectrics, Magnetic materials, Thick-Film technology, Thin-Film technology, Micromachining technologies.

UNIT II **8 Hrs.**

Reactance Variation and Electromagnetic Sensors its signal Conditioning

Capacitive Sensors: variable and differential capacitor. Inductive Sensors: Variable Inductance, eddy current sensor, LVDT, Electromagnetic Sensor.
Signal Conditioning for Reactance Variation Sensors: problems and alternatives, AC Bridges: Sensitivity and linearity, Capacitive bridge analog linearization, ac amplifiers and power supply decoupling, Electrostatic shields and driven shields.

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UNIT III **7 Hrs.**

Resistive Sensors and its Signal Conditioning

Resistive Sensors: Potentiometers, Strain Gauges Fundamentals: Piezoresistive effect, types and applications. Resistive Temperature Detectors (RTDs), Thermistors: Models, Thermistor Types and Application, Magneto-resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas Sensors, Liquid Conductivity Sensors.

UNIT IV **8 Hrs.**

Self-Generating Sensors and its Signal Conditioning

Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Photovoltaic Sensor, Electrochemical Sensors.

Signal Conditioning: Chopper and Low-Drift Amplifiers, Electrometer and Trans-impedance amplifiers, Charge Amplifiers.

UNIT V **8 Hrs.**

Actuators

Pneumatic and Hydraulic Actuation Systems: Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.

Mechanical Actuation Systems, Types of motion, Kinematic chains, Cams, Gears, Ratchet and pawl – Belt and chain drives, Bearings, Mechanical aspects of motor selection.

Electrical Actuation Systems, Mechanical switches, Solid-state switches Solenoids, D.C. Motors, A.C. motors, Stepper motors.

Textbooks:

1. Ramon Pallas-Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd Edition, John Wiley & Sons, 2012.
2. Walt Kester, "Practical Design Techniques for Sensor Signal Conditioning", Analog Devices, 1999.
3. D. Patranabis , "Sensors and Transducers", PHI Learning Private Limited.
4. W. Bolton , "Mechatronics" , Pearson Education Limited.

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References:

1. E.O. Doebelin, D.N. Manik, "Measurement systems", 6th Edition, Tata McGraw Hill, 2012.
2. R. Pallas-Areny and J. G. Webster, "Analog Signal Processing", John Wiley & Sons, 1999.

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MTES224	DSE	Internet of Things	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):
1. Introduce evolution of internet technology and need for IoT.
2. Discuss on IoT reference layer and various protocols and software.
3. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms.
4. Make the students to apply IoT data for business solution in various domain in secured manner.

Course Outcomes (COs):
1. Identify the IoT networking components with respect to OSI layer.
2. Build schematic for IoT solutions.
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.

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UNIT I **8 Hrs.**

Evolution of IoT:
Review of computer communication concepts: OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges, IPV6 addressing. IoT architecture reference layer.

Introduction to IoT components:
Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open-source hardware, Examples of IoT infrastructure

UNIT II **7 Hrs.**

IoT protocols:
Introduction and specifications of various protocol: MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, Features and Message format for COAP Protocol, Overview of XMPP: standards and features, Classification of gateway protocols: Interior gateway and Exterior gateway protocols.

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MTES224	DSE	Internet of Things	60	20	20	0	0	3	0	0	3

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UNIT III **7 Hrs.**

IoT point to point communication technologies:

IoT Communication Pattern, IoT protocol Architecture, Various types of Wireless technologies: 6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi

UNIT IV **7 Hrs.**

Introduction to Cloud computation and Big data analytics:

Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop.

UNIT V **9 Hrs.**

IoT security:

Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security.

IoT application and its Variants:

IoT for smart cities, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0, IoT standards.

Text Books:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
2. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

References:

1. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
2. Tanenbaum, Andrew S"Computer Networks",Pearson Education Pte. Ltd., Delhi, 4th Edition
3. Stallings, William,"Data and Computer Communications", Pearson Education Pte. Ltd., Delhi, 6th Edition.
4. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.

Chairperson	Chairperson	Controller of Examination	Joint Registrar
Board of Studies	Faculty of Studies	Shri Vaishnav Vidyapeeth	Shri Vaishnav Vidyapeeth
Shri Vaishnav Vidyapeeth	Shri Vaishnav Vidyapeeth	Vishwavidyalaya, Indore	Vishwavidyalaya, Indore
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Choice Based Credit System (CBCS) in the Light of NEP-2020
M.Tech. in Embedded System
(2021-2023)

COURSE CODE	CATE-GORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES234	DSE	Wireless Sensor Networks	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):

1. This course discusses protocols and architectures for wireless sensor network design.
2. This course covers wireless sensor node and network architectures, and communication protocols in different layers.
3. The course focuses on topics for wireless sensor networks such as time synchronization, localization, and topology management.

Course Outcomes (COs):

After the completion of this course, the student should be able to:

1. List various applications of wireless sensor networks,
2. Describe the concepts, protocols, and differences underlying the design, implementation, and use of wireless sensor networks, and
3. Propose, implement, and evaluate new ideas for solving wireless sensor network design issues.

Syllabus

UNIT I **7 Hrs.**

Introduction: Definition, challenges and constraints of Wireless Sensor Networks (WSN), Advantages of Sensor Networks, Applications of Sensor Networks, Enabling technologies for WSN, Operating systems and execution environments.

UNIT II **7 Hrs.**

Node architecture: Sensor Node Technology, sensing subsystem, processor subsystem- architectural overview, communication interfaces. Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints.

UNIT III **8 Hrs.**

Deployment and Configuration: Localization and positioning, different types of localization, Coverage and connectivity, Single-hop and multihop localization, self configuring localization systems, sensor management, ranging techniques.

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UNIT IV **7 Hrs.**

Routing protocols: Classification of routing protocols, Routing Challenges and Design issues in WSN, Routing Strategies in WSN, Data Dissemination and Gathering, Concepts of Flooding, Directed Diffusion, Negotiation and Clustering Hierarchy.

UNIT V **8 Hrs.**

Data Storage and Manipulation: Data centric and content-based routing, Energy-efficient routing, Geographical routing. Storage and retrieval in network, compression technologies for WSN, data aggregation techniques. Security attacks in wireless sensor networks.

Textbooks:

1. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007 .
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory & Practice", John Wiley and Sons.

References:

1. Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons, 2005 .
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, "Wireless Sensor Network", Springer 1st Ed. 2004.
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Network", Elsevier, 1st Ed. 2004.
4. B. Krishnamachari, "Networking Wireless Sensors", Cambridge University Press.
5. N. P. Mahalik, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications" Springer Verlag.

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