Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Name of the Faculty: Science & Technology

NEP 2020 Compliant Curriculum Syllabus

ELECTRONICS & TELECOMMUNICATIONENGINEERING

Name of the Course: Honors Syllabus

(Syllabus to be implemented from w.e.f. AY-2024-25)

PUNYASHLOK AHILYADEVI HOLKARSOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE& TECHNOLOGY

Electronics & Telecommunication Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To make students competent for professional career in Electronics & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Electronics & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes

Electronics & Telecommunication Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes

1. **Solid foundation** : Graduates will be able to attain a **solid foundation** in Electronics and Tele-Communication Engineering with an ability to function in multidisciplinary environment.
2. **Techniques and Skills**: Graduates will be able to use **techniques and skills** to design, analyze,synthesize, and simulate Electronics and Communication Engineering components and systems.
3. **Developing Programs:** Graduate will be capable of **developing programs** in Assembly, Highlevel and HDL languages using contemporary tools for software development.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant

Honors Degree Curriculum With effect from 2024-2025

Honors Degree Structure: Artificial Intelligence and Machine Learning

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*		*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	
III	ENTHON-01A	Computational Statistics	3	1		4	70	30	25	125
IV	ENTHON-02A	Artificial Intelligence	3		2	4	70	30	25	125
V	ENTHON-03A	Machine Learning	3		2	4	70	30	25	125
VI	ENTHON-04A	AI Applications	3		2	4	70	30	25	125
VII	ENTHON-05A	Mini Project			4	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Artificial Intelligence and Machine Learning
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-III
ENTHON01A: Computational Statistics

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Tutorial: 1Hr/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

The goal of this course is to provide students an introduction to a variety of modern computational statistical techniques and the role of computation as a tool of discovery.

Course Prerequisite:

Student shall have knowledge of programming language python, also some background in probability and statistical inference.

Course Objectives:

1. To make students learn efficient numerical methods for solving problems in statisticalanalysis.
2. To make students use computational statistics in applications like statistical machinelearning.
3. To describe the Dimensionality reduction method.
4. To introduce basics of Learning theory.

Course Outcomes:

At the end of the course, students will be able to-

1. Describe fundamental aspects of efficient numerical methods for statistical analysis
2. Explore modern computational statistical techniques
3. Describe the role of computation as a tool of discovery.
4. Apply statistical methods for Machine learning applications

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SECTION I

Unit 1: Probability Distributions **(07)**

Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Statistics and Independence, Gaussian distribution, Conjugacy andthe Exponential Family, Change of Variables/Inverse Transform

Unit 2: Regression - linear and nonlinear (07)

Problem Formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection

Unity 3 : Matrix fundamentals (08)

Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces, Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation

SECTION II

Unit 4 : Dimensionality reduction (07)

Problem Setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low-Rank Approximations, PCA in High Dimensions, Key Steps of PCA in Practice, Latent Variable Perspective

Unit 5 : Basic learning theory (07)

- types, feasibility, training, testing, generalization, bias- variance, underfitting, overfitting etc

Unit 6: Introduction to Machine Learnin (08)

Well posed learning problem, designing a learning system, perspectives and issues in machine learning, applications of machine learning, probability theory, model selection, the curse of dimensionality, decision theory, information theory

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Internal Continuous Assessment:

ICA consists of minimum 8 tutorials based upon above curriculum.

Text books:

1. Peter Givens, G. H. and Hoeting, J. A. (2005) Computational Statistics, 2nd Edition, Wiley-Interscience
2. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, and ChengSoon Ong .

Reference Books:

1. Liu, J. (2001). Monte Carlo Strategies in Scienti_c Computing, Springer-Verlag.
2. Lange, K. (2002). Numerical Analysis for Statisticians, Springer-Verlag, 2nd Edition.
3. Hastie, T., Tibshirani, R. and Friedman, J. (2009). The Elements of Statistical Learning, 2ndEdition, Springer.
4. Goodfellow, I., Bengio, Y. and Courville, A. (2016). Deep Learning, MIT Press.

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Electronics & Telecommunication Engineering
Honors in Artificial Intelligence and Machine Learning
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-IV
ENTHON02A: Artificial Intelligence

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hr/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

Course Objectives:

1. To present to student general overview of AI with its future prospects
2. To make student understand various problem-solving methods through search techniques
3. To make student understand the various methods for knowledge representation and reasoning
4. To make student understand the various methods for decision making
5. To make student comprehend learning and knowledge acquisition concepts

Course Outcomes:

At the end of this course, student will be able to -

1. Formulate and solve sequence of actions for an agent as a search problem.
2. Infer from represented knowledge using logical and probabilistic reasoning methods
3. Solve agent decision problems using probability theory
4. Explain forms of learning and demonstrate their working.

Course Prerequisite:

Student shall have fundamental knowledge of algorithms

SECTION-I

Unit 1: Overview **(06)**

Foundations, scope, problems, and approaches of AI, intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents

Unit 2: Problem-Solving through Search **(07)**

Forward and backward, state-space, blind, heuristic, problem-reduction, A, A, AO, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications

Unit 3: Knowledge Representation and Reasoning (07)

Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; first order logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications

SECTION II

Unit 4: Representing and Reasoning with Uncertain Knowledge (07)

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, and sample applications

Unit 5: Decision-Making (06)

Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications

Unit 6: Learning and Knowledge Acquisition (07)

A bird's eye view, scalability issues and the streaming scenario, a stroll through some applicationscenarios

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Internal Continuous Assessment (ICA)

ICA shall consist of minimum 08 experiments based on above Syllabus.

Text Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition,Prentice Hall
2. A First Course in Artificial Intelligence, Deepak Khemani, McGraw Hill Education (India)
3. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.

Reference Book:

1. Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Artificial Intelligence and Machine Learning
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-V
ENTHON03A: Machine Learning

Teaching Scheme:
Lecture : 3Hrs/Week, 3 credits
Practical: 2Hr/Week, 1 credit

Examination Scheme:
ESE:70 Marks
ISE:30 Marks
ICA: 25 Marks

Course Objectives:

1. To make student learn necessity and different aspects of Machine Learning.
2. To make student understand Machine Learning Models.
3. To make student understand Classification and Regression.
4. To introduce to student real world applications of Machine Learning.

Course Outcomes:

At the end of this course, student will be able to –

1. Describe fundamental aspects of Machine Learning.
2. Distinguish between various characteristics of ML
3. Explore classification and regression algorithm
4. Design neural network for classification
5. Design and implement different Machine Learning models
6. Apply Machine learning techniques that enable to solve real world problems.

Course Prerequisite:

Student shall have knowledge of programming language like python / R, also fundamentals of probabilityand Statistics.

SECTION I

Unit 1: Introduction to Machine Learning (08)

Basics of Statistics, what is Machine learning? Examples of Machine Learning Problems, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, database and data processing for ML.

Unit 2: Theory of Machine Learning **(05)**

Definition of learning systems, Types: Supervised, Unsupervised, Semi Supervised, Reinforcement learning with examples. hypothesis space and inductive bias, evaluation, cross-validation, what is a feature? feature construction, feature extraction.

Unit 3: Supervised Learning **(08)**

Classification: Binary Classification- Assessing Classification performance.
Common classification algorithms: K Nearest Neighbor, Decision Tree, Random Forest model, Support vector machines. Probabilistic Models: Naïve Bayes Classifier.
Regression: Assessing performance of Regression- Error measures, Overfitting, underfitting, linear regression, logistic Regression. Multivariate Linear Regression.

SECTION II

Unit 4: Unsupervised Learning **(08)**

Unsupervised Vs supervised learning, Applications of unsupervised learning, Clustering, clustering as ML task, Different clustering techniques, partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN, Finding pattern using association rule, Association rule, apriori algorithm for association rule learning, Build the apriori principle rules.

Unit 5: Artificial Neural Networks **(08)**

Introduction, Exploring Artificial Neuron, Types of activation functions, Early implementations of ANN, Architectures of Neural Network, Learning process in ANN, Backpropagation, Deep learning

Unit 6: Applications of Machine Learning **(05)**

Email Spam and Malware Filtering, Image recognition, Speech Recognition, Traffic Prediction, Self-driving Cars, Virtual Personal Assistant, Medical Diagnosis.

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 practical based upon above curriculum.

Text books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition, 1997.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India,3rd Edition2014.
4. Dutt, Chandramouli, Das, "Machine Learning" Pearson publication, Eighth Impression,2022.

Reference Books:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of MachineLearning", MIT Press,2012.
2. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applicationsin R, Springer, 2nd Edition-2012.
3. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
4. Machine Learning – An Algorithmic Perspective, Second Edition, Stephen Marsland, 2015
5. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRCPress,2014.
6. Machine Learning Mastery With Python 2016 by Jason Brownlee

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Electronics & Telecommunication Engineering
Honors in Artificial Intelligence and Machine Learning
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-VI
ENTHON04A: AI Applications

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hr/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

This course is designed to provide students with an understanding of the applications of artificial intelligence (AI) in various industries. The course covers the fundamental concepts of AI, including machine learning, deep learning, natural language processing (NLP), computer vision, Expert systems, and reinforcement learning. The course also focuses on ethical considerations in AI applications.

Course Prerequisite:
Student shall have knowledge Artificial Intelligence and Machine Learning, programming language

Course Objectives:
1. To introduce students to the fundamental concepts and applications of AI
2. To enable students to apply AI techniques to real-world problems
3. To provide students with hands-on experience in developing AI applications
4. To discuss ethical considerations in AI applications

Course Outcomes:
At the end of the course, students will be able to-
1. Design and learn implementation of AI-based systems for solving real-world problems related to Expert Systems, computer vision.
2. Expose the field of natural language processing (NLP) applications such as sentiment analysis, chatbots, and speech recognition.
3. Explore computer vision techniques for image analysis, including object detection, segmentation and recognition.
4. Stay up-to-date with the latest trends and advances in AI applications by following relevantliterature and attending professional conferences and events.

Section I

Unit 1: Overview of AI Applications [6 Hours]

Introduction, definitions of AI, Man Vs Computers, Simulation of Sophisticated and Intelligent Behavior, Branches of AI, Natural Language, Automated reasoning, Visual perception, intelligent agents, Major components of Intelligent system, Important definitions and Systems.

Unit 2: Computer Vision Representation [8 Hours]

Representation and Recognition, Object recognition, Pattern Recognition, Model based Object recognition, Relaxation Labelling Methods, Graph Searching.

Unit 3: Expert Systems [8 Hours]

Introduction to Expert system, Basic architecture of an Expert system, Types of Problems solved by expert systems, Features of an Expert System, Expert system architecture, Knowledge acquisition, Expert system tools, existing expert systems.

Section II

Unit 4: Natural Language Processing (NLP) [8Hours]

Language Models, Text Classification, Information Retrieval, Information Extraction, Phrase Structure Grammars, Syntactic Analysis (Parsing), Augmented Grammars and Semantic Interpretation, Machine Translation, Speech Recognition

Unit 5: Reinforcement Learning [6 Hours]

Reinforcement Learning Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, Applications of Reinforcement Learning

Unit 6: Robotics: [8 Hours]

Introduction , Robot Hardware ,Robotic Perception ,Planning to Move ,Planning Uncertain Movements ,Moving ,Robotic Software Architectures ,Application Domains.

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 practical based upon above curriculum covering various AI Applications and Tools.

Text books:

1. “A Classical Approach to Artificial Intelligence” by Munesh Chandra Trivedi, Second Edition, Khanna Publishing.
2. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig(*Third edition*) Pearson publication
3. "Artificial Intelligence Concepts and Applications by Lavika Goel, Wiley Publications.

Reference books:

1. Artificial Intelligence by Saroj Koushik, Cengage Learning Publication
2. The Essence of Artificial Intelligence by Alison Cousey, Pearson Publication
3. Introduction to Artificial Intelligence and Expert systems by Dan W. Patterson, PearsonPublication

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant

Honors Degree Curriculum With effect from 2024-2025

Honors Degree Structure: Data Science

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*		*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	
III	ENTHON-01B	Database Management System	3	1		4	70	30	25	125
IV	ENTHON-02B	Machine Learning	3		2	4	70	30	25	125
V	ENTHON-03B	Data Analytics	3		2	4	70	30	25	125
VI	ENTHON-04B	Business Intelligence	3		2	4	70	30	25	125
VII	ENTHON-05B	Mini Project			4	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Data Science
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-III
ENTHON01B: Database Management System

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Tutorial: 1Hr/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

This course introduces a Data Base Management System, which is the system software for easy, efficient and reliable data processing and management. It covers ER Model, Relational Model, Structured Query Language, Relational Database Design and Concurrency Control techniques.

Course Objectives:

1. To understand the basics of database design, structure, implementation and applications.
2. To develop the logical design of the database using data modeling concepts such as entity relationship diagrams.
3. To understand and use Structured Query Language to query, update, and manage a database.
4. To apply normalization techniques to normalize the database.
5. To familiarize the students with the fundamentals of database transaction processing, learn techniques for concurrency control and recovery methods.

Course Outcomes:

At the end of this course, the student will be able to,

1. Apply the basic concepts of database system to design relational model and schemas.
2. Design schema using E-R model and normalization.
3. Extract data using relational algebra and SQL.
4. Access data using Indexing and Hashing techniques.
5. Apply ACID properties for transaction processing.
6. Explain concurrency control and recovery methods.

SECTION– I

Unit 1: Introduction to DBMS (03)

Database- System Applications, Purpose of Database Systems, View of data, Database Languages, Database Architectures, Database users and administrators, history of databases system.

Unit 2: E-R model **(05)**

Overview of design process, E-R Model, Constraints, E-R diagrams, E-R design issues, Weak Entity Sets, Extended E-R features, Reduction to relational schema.

Unit 3: Relational Model **(05)**

Relational Model: Basic structure of relational databases, Database schema, keys, Schema diagrams, Relational Query languages, Relational algebra-Fundamental, Additional and Extended Relational Algebra Operations.

Unit 4: Introduction to SQL **(08)**

Overview, SQL data definition, SQL data types, Integrity constraints, Basic structure of SQL Queries, Types of SQL Commands: DDL, DML, DCL and TCL statements, Basic SQL clauses [select, from, where, group by, having, order by etc.].

SECTION-II

Unit 5: Intermediate SQL **(06)**

Additional basic operations, Set operations, NULL values, Aggregate functions, Nested sub queries, Modification of the databases. Join operations, Views, Integrity constraints, Authorization.

Unit 6: Normalization **(05)**

Features of good Relational Designs, Atomic Domains, First Normal Form, Keys and Functional dependencies, Second Normal Form, Boyce-Codd Normal Form, Third Normal Form, Functional dependency theory.

Unit 7: Indexing and Hashing **(05)**

Basic Concepts, Ordered Indices, B+ Tree Index Files, B Tree Index Files, Multiple Key Access, Introduction to Indexing, Comparison of Indexing and Hashing, Index definition in SQL.

Unit 8: Transactions and Concurrency Control **(05)**

Transaction concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions. Concurrency Control - Lock based protocol: Locks, Granting of Locks, Two-Phase Locking Protocol. Time Stamp-based protocols, Deadlock handling.

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 8 assignments/tutorials based on above syllabus.

Suggestive List of Assignments/tutorials:

- Write queries in SQL using DDL and DML commands.
- Write queries in SQL to demonstrate integrity constraints.
- Write nested sub queries in SQL using Joins and Set operations.
- Write queries in SQL to create Views and demonstrate Authorization.
- Identify set of functional dependencies, find canonical cover and closure of functional dependency.
- Convert the created database into 1NF, 2NF, 3NF and BCNF

Text books:

1. Database system concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan (McGraw Hill International Edition) sixth edition.
2. Database system concepts by Peter Rob, Carlos Coronel (Cengage Learning) ninth edition.

Reference Books:

1. Fundamentals of Database systems by Ramez El Masri, S. B. Navathe (Pearson Education)5thedition.
2. Database Management Systems by Ramkrishnan Gehreke (Tata McGraw Hill) third edition.
3. Principles of Database Systems by J. D. Ullman (Galgotia Publications)
4. Advanced Database Management System by Rini Chakrabarti, Shilbhadra Dasgupta (Dreamtech Press Publication).

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Electronics & Telecommunication Engineering
Honors in Data Science
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-IV
ENTHON02B: Machine Learning

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hr/Week, 1 credit	ISE:30 Marks
	ICA:25 Marks

Course Objectives:

1. To make student learn necessity and different aspects of Machine Learning.
2. To make student understand Machine Learning Models.
3. To make student understand Classification and Regression.
4. To introduce to student real world applications of Machine Learning.

Course Outcomes:

At the end of this course, student will be able to –

1. Describe fundamental aspects of Machine Learning.
2. Distinguish between various characteristics of ML
3. Explore classification and regression algorithm
4. Design neural network for classification
5. Design and implement different Machine Learning models
6. Apply Machine learning techniques that enable to solve real world problems.

Course Prerequisite:

Student shall have knowledge of programming language like python / R, also fundamentals of probabilityand Statistics.

SECTION I

Unit 1: Introduction to Machine Learning (08)

Basics of Statistics, what is Machine learning? Examples of Machine Learning Problems, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, database and data processing for ML.

Unit 2: Theory of Machine Learning (05)

Definition of learning systems, Types: Supervised, Unsupervised, Semi Supervised, Reinforcement learning with examples. hypothesis space and inductive bias, evaluation, cross-validation, what is a feature?, feature construction, feature extraction.

Unit 3: Supervised Learning (08)

Classification: Binary Classification- Assessing Classification performance.
Common classification algorithms: K Nearest Neighbor, Decision Tree, Random Forest model, Support vector machines. Probabilistic Models: Naïve Bayes Classifier.
Regression: Assessing performance of Regression- Error measures, Overfitting, underfitting, linear regression, logistic Regression. Multivariate Linear Regression.

SECTION II

Unit 4: Unsupervised Learning (08)

Unsupervised Vs supervised learning, Applications of unsupervised learning, Clustering, clustering as ML task, Different clustering techniques, partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN, Finding pattern using association rule, Association rule, apriori algorithm for association rule learning, Build the apriori principle rules.

Unit 5: Artificial Neural Networks (08)

Introduction, Exploring Artificial Neuron, Types of activation functions, Early implementations of ANN, Architectures of Neural Network, Learning process in ANN, Backpropagation, Deep learning

Unit6: Applications of Machine Learning (05)

Email Spam and Malware Filtering, Image recognition, Speech Recognition, Traffic Prediction, Self-driving Cars, Virtual Personal Assistant, Medical Diagnosis.

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 practical based upon above curriculum.

Text books:

1. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rdEdition, 1997.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data,Cambridge University Press, Edition 2012.
3. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Prentice Hall of India,3rdEdition2014.

4. Dutt, Chandramouli, Das, “Machine Learning” Pearson publication, Eighth Impression ,2022.

Reference Books:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar “Foundations of Machine Learning”, MIT Press,2012.
2. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applicationsin R, Springer, 2nd Edition-2012.
3. Kevin P. Murphy “Machine Learning: A Probabilistic Perspective”, The MIT Press, 2012
4. MACHINE LEARNING - An Algorithmic Perspective, Second Edition, Stephen Marsland,2015.
5. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRCPress,2014.
6. Charu C. Aggarwal, “DATA CLUSTERING Algorithms and Applications”, CRC Press,2014.
7. Machine Learning Mastery With Python 2016 by Jason Brownlee.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Data Science
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-V
ENTHON03B: Data Analytics

Teaching Scheme:
Lecture : 3Hrs/Week, 3 credits
Practical: 2Hr/Week, 1 credit

Examination Scheme:
ESE:70 Marks
ISE:30 Marks
ICA: 25 Marks

This course provides foundation level training that enables immediate and effective participation in big data and other analytics projects. It includes an introduction to big data and big data analytics. The course provides grounding in basic analytic methods and an introduction to big data analytics technology and tools.

Course Prerequisite:

Student shall have knowledge of Database Management Systems

Course Objectives:

1. To provide an overview of an exciting growing field of big data analytics.
2. To apply algorithmic strategies while solving problems
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.

Course Outcomes: After successfully completing the course student will able to

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2. Use the right method to solve real problem.
3. Selecting appropriate data visualizations to clearly communicate analytic insights.
4. Use the tools and techniques to apply different algorithms and methodologies.

Section - I

Unit 1- Introduction to Data Analytics: (06)

What Can We Do With Data? Big Data and Data Science, Big Data Architectures, Small Data,

What is Data? A Short Taxonomy of Data Analytics, Examples of Data Use, A Project on Data Analytics.

Unit 2 – Descriptive Statistics and Analysis: (08)

Scale Types, Descriptive Univariate Analysis, Univariate Frequencies, Univariate Data Visualization, Univariate Statistics, Common Univariate Probability Distributions, Descriptive Bivariate Analysis, Multivariate Frequencies, Multivariate Data Visualization, Multivariate Statistics.

Unit 3 - Data Quality and Preprocessing: (07)

Data Quality, Converting to a Different Scale Type, Converting to a Different Scale, Data Transformation, Dimensionality Reduction.

Section – II

Unit 4- Basic Data Analytics methods using R (07)

Introduction to R: GUI of R, Getting data into & out of R, Data types in R, Basic operations, Basic statistics, Generic functions, Data visualization using R, Data exploration & presentation, Statistics for model building & evaluation

Unit 5- Introduction to Big Data Analytics (07)

Definition of Big Data, Big data characteristics & considerations, Data repositories- analyst perspective, Business drivers for analytics, Typical analytical architecture, Business Intelligence Vs Data science, Drivers of Big data analytics, Role of data scientist in Big data ecosystem, Applications of Big data analytics.

Unit 6 - Big Data Visualization (07)

Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in Big data visualization.

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 8 practical's based on the syllabus contents.

Text Books:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
2. A General Introduction to Data Analytics, by Joao Moreira, Andre Carvalho, Tomas Horvath, Wiley Publication.
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
4. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6

References:

1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication, ISBN: 978-1-118-16430-3
3. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
4. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Data Science
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-VI
ENTHON04B: Business Intelligence

Teaching Scheme:
Lecture : 3Hrs/Week, 3 credits
Practical: 2Hr/Week, 1 credit

Examination Scheme:
ESE:70 Marks
ISE:30 Marks
ICA: 25 Marks

Business Intelligence (BI) is the process of collecting, analyzing, and interpreting data to provide insights and decision support for organizations. This course will introduce students to the concepts, tools, and techniques used in BI, including data mining, analysis, and visualization, as well as BI applications. Students will also learn about the strategy and implementation of BI projects.

Course Prerequisite:
Student shall have knowledge of basic types of data, data preprocessing methods, data cleaning and features extractions techniques.

Course Objectives:

1. To explain the basic components that makes up a business intelligence environment.
2. To discuss the structure of the decision-making process
3. To describe the mathematical model for business intelligence analyses
4. To discuss different visualization tools and techniques for data representation and reportpreparation.
5. To illustrate various applications of Business Intelligence

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Course Outcomes:

At the end of the course, students will be able to-

1. Describe the basic components of BI environment.
2. Apply data mining techniques for data analysis.
3. Use ETL and BI tools for the decision support system.
4. Represent data using different visualization tools and techniques
5. Explicate components of Business performance measurement systems.
6. Illustrate various applications of Business Intelligence.

SECTION – I

Unit 1: Introduction to Business Intelligence (08)

Effective and timely decisions, role of mathematical models, BI architectures, ethics on BI, Introduction to data warehouse, architecture, OLAP

Unit 2: **Decision Support System (07)**

Representation of decision making system, evolution of information system, definition and development of decision support system, mathematical models for decision making

Unit 3: Data Warehousing and Data Mining (07)

Definition and architecture of data warehouse, cubes and multidimensional analysis, definition andapplications of data mining, data mining process, analysis methodologies.

SECTION – II

Unit 4: Business Reporting, Visual Analytics and Business Performance Management (08)

Business reporting definitions and concepts, data and information visualization, different types of charts and graphs, data visualization and visual analytics, performance dashboards, business performance management, performance measurement, balanced scorecards, six sigma as a performance measurement system.

Unit 5: BI applications: Marketing Models (07)

Relational marketing, Salesforce management, marketing models case studies, financial applications

Unit 6: BI applications: Logistic and Production Models (07)

Supply chain optimization, optimization models for logistics planning, revenue management system,Logistics business case studies.

Internal Continuous Assessment (ICA):

ICA shall consist of minimum of 6 practical tasks based on above syllabus and one project basedassignment to perform analysis and generate reports using any tool for a given application.

Text Book:

1. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman, Elsevier
2. Business Intelligence Data mining and optimization for Decision making by Carlo Vercellis,ISBN:978-81-265-4188-1, Wiley Publication
3. Business Intelligence and Analytics: Systems for Decision Support by Efraim Turban, RameshSharda, Dursun Delen by Pearson Education, Ltd.
4. Data Mining and Business Intelligence by S.K. Shinde and Uddagiri Chandrashekhar
5. Data Mining for Business Intelligence by Galit Shmueli, Nitin Patel, Peter Bruce, Wiley Publications.

Reference Books:

1. Data Warehousing in the Real World – Anahory& Murray, Pearson Edt.
2. Data Warehousing Fundamentals – Ponniah, Wiley Publication

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant

Honors Degree Curriculum With effect from 2024-2025

Honors Degree Structure: Internet of Things

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*		*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	
III	ENTHON-01C	Fundamentals of IoT	3	1		4	70	30	25	125
IV	ENTHON-02C	Industrial IoT	3		2	4	70	30	25	125
V	ENTHON-03C	IoT Cloud Platform	3		2	4	70	30	25	125
VI	ENTHON-04C	Architecting IoT Solutions	3		2	4	70	30	25	125
VII	ENTHON-05C	Mini Project			4	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Internet of Things
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-III
ENTHON01C: Fundamentals of IoT

Teaching Scheme:
Lecture : 3Hrs/Week, 3 credits
Tutorial: 1Hr/Week, 1 credit

Examination Scheme:
ESE:70 Marks
ISE:30 Marks
ICA: 25 Marks

The Internet of Things (IoT) refers to the system in which different devices equipped with sensors and signal processing are connected through a network to communicate with each other and/or with central servers. This course provides a thorough introduction to the different components of an IoT System. The course also introduces different communication protocols. Introduction to Raspberry Pi and its architecture is also a part of this course.

Course Objectives:

1. To make student aware of different components of an IoT System
2. To introduce to student different sensors used in IoT.
3. To make student learn usage of different sensors in IoT.
4. To make student learn different communication technologies used in IoT.
5. To make student build simple IoT applications with Raspberry Pi.

Course Outcomes:

At the end of this course students will be able to,

1. Define what Internet of Things is with suitable example.
2. Comprehend different components of an embedded System w.r.t. IoT.
3. Select appropriate sensor for a given IoT application with suitable justification.
4. Categorize different communication technologies used in IoT.
5. Construct a solution based on Raspberry Pi for the development of simple IoT application.

SECTION I

Unit 1 - Introduction to Internet of Things (06)

Introduction to IoT, different components of an IoT system: embedded system, communicationsystems, cloud, applications of IoT in various domains.

Unit 2 – Embedded Systems for IoT (07)

Introduction to embedded systems, different components of an embedded system, basics of Linux based embedded systems, various embedded platforms used in IoT, understanding the various IDEs used for embedded development.

Unit 3 – Sensors Fundamentals and Characteristics (08)

Sensors, Sensor Classification, Signals and Systems, Units of Measurements, Sensor Characteristics.

SECTION II

Unit 4 – Sensor Applications (07)

Occupancy and Motion Detectors, Position, Displacement, and Level, Velocity and Acceleration, Humidity and Moisture Sensors, Light Detectors, Temperature Sensors.

Unit 5 – Communication technologies for IoT (06)

Basics of the communication technologies (Bluetooth Low Energy (BLE), Wifi, RFID) their architecture, characteristics, limitation, power consumption parameters and applications.

Unit 6 – Development of IoT solution. (08)

Introduction to Raspberry Pi, Linux- Introduction, File System, Raspbian O.S.- Introduction, Installing Raspbian on Pi, First boot and Basic Configuration of Pi, Popular Linux Commands for shell access, remote access though Putty, features, Python programs for interfacing I/O devices like led's, switch's, LCD, etc with Raspberry Pi.

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 tutorials based on above curriculum

Text Books

1. Internet of Things: Architecture and Design Principles by Raj Kamal, First edition, McGraw HillEducation
2. The Definitive Guide to the ARM Cortex-M3 by Joseph Yiu, Second Edition, Elsevier
3. Internet of Things for Architects by Perry Lea, Packt Publishing Limited
4. Analytics for the Internet of Things (IoT) by Andrew Minteer, First edition, Packt Publishing
5. Getting Started with Python for the Internet of Things by Dr. Steven Lawrence Fernandes,SaiYamanoor, and Tim Cox, First edition, Packt Publishing
6. Internet of Things Programming Projects: Build Modern IoT Solutions with the Raspberry Pi 3and Python by Colin Dow, Packt Publishing Limited

Reference Books

1. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos, Marilyn Wolf, 1st ed. 2018 edition, Springer
2. Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi3 by Peter Waher. First edition, Packt Publishing
3. Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed by PerryXiao, 1st edition, Wiley
4. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer

Recommended Online Free Courseware /Learning Resources

1. Udemy.com
2. Introduction to ARM mbed: playlist on Youtube
3. https://www.raspberrypi.org/teach/

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Internet of Things
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-IV
ENTHON02C: Industrial IoT

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hrs/Week, 1 credit	ISE: 30 Marks
	ICA: 25 Marks

The Industrial Internet of Things (IoT) has transformed how businesses think about and interact with the world. Sensors can measure the performance of high- volume industrial manufacturing operations or the daily environmental health of a remote island. The IoT makes it possible to study the world at various levels of precision and enable data-driven decision making anywhere. Machine learning (ML) and Elastic cloud computing have accelerated our ability to understand and analyze the huge amount of data generated by the IoT. With edge computing, data analytics and ML models can process information locally at the source where the data is generated. This course introduces an approach to combine the technologies of edge computing and machine learning to deliver next-generation cyber-physical outcomes.

Course Objectives:

1. To make students aware of data driven architecture for edge devices.
2. To introduce students with machine learning at the edge.
3. To make students learn various edge topologies.
4. To make students learn the deployment of edge applications in real time.
5. To make students build edge applications on the cloud.

Course Outcomes:

At the end of this course students will be able to,

1. Define data driven architecture with machine learning for the edge.
2. Define the anatomy of edge machine learning solutions.
3. Build an edge application w.r.t. best edge topology for a given application
4. Orchestrate deployment of streaming from the edge to a data lake on the cloud.
5. Design data flow patterns on the cloud.

SECTION I

Unit 1 - Introduction to the Data-Driven Edge with Machine Learning (06)

Living on the edge, Bringing ML to the edge, Tools to get the job done, Demand for smart home and industrial IoT, Setting the scene: A modern, smart home solution, Hands-on prerequisites.

Unit 2 – Foundations of Edge Workloads (07)

The anatomy of an edge ML solution, IoT Greengrass for the win, Checking compatibility with IoT Device Tester, Installing IoT Greengrass, Your first edge component.

Unit 3 – Building the Edge (08)

Exploring the topology of the edge, Reviewing common standards and protocols, Security at the edge, Connecting your first device – sensing at the edge, Connecting your second device – actuating at the edge.

SECTION II

Unit 4 – Extending the Cloud to the Edge (07)

Creating and deploying remotely, Storing logs in the cloud, Synchronizing the state between the edge and the cloud, Deploying your first ML model.

Unit 5 – Ingesting and Streaming Data from the Edge (07)

Defining data models for IoT workloads, Designing data patterns for the edge, Getting to know Stream Manager, Building your first data orchestration workflow on the edge, Streaming from theedge to a data lake on the cloud.

Unit 6 – Processing and Consuming Data on the Cloud (07)

Defining big data for IoT workloads, Introduction to Domain-Driven Design (DDD) concepts, Design data flow patterns on the cloud, Remembering data flow anti-patterns for edge workloads.

Internal Continuous Assessment (ICA):

ICA consists of a minimum of 8 practicals based on the above curriculum.

Text Books

1. Intelligent Workloads at the Edge: Deliver cyber-physical outcomes with data and machine learning using AWS IoT Greengrass by Indraneel Mitra, Ryan Burke, Packt Publishing Limited,First Published-2022.
2. Internet of Things for Architects by Perry Lea, Packt Publishing Limited

3. Internet of Things Programming Projects: Build Modern IoT Solutions with the Raspberry Pi 3and Python by Colin Dow, Packt Publishing Limited

Reference Books

1. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos, Marilyn Wolf, 1st ed. 2018 edition, Springer
2. Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi3 by Peter Waher. First edition, Packt Publishing

Recommended Online Free Courseware /Learning Resources

1. Udemy.com
2. https://docs.aws.amazon.com/iot/index.html

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Internet of Things
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-V
ENTHON03C: IoT Cloud Platform

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hrs/Week, 1 credit	ISE: 30 Marks
	ICA: 25 Marks

The Internet of Things (IoT) cloud platforms refers to the system in which different devices equipped with sensors and processing units are connected through a network to communicate with each other and/or with central servers. This course provides a thorough introduction to the fundamental components and effective designs to be considered for a cloud based scenario along with introduction to the design cloud services, database concepts, planning and design familiarity with architectural trade-off decisions, high availability versus cost and introduction to several AWS services.

Course Objectives:

1. To make student aware of cloud computing concepts.
2. To introduce students with different identity access policies on AWS.
3. To make students learn resource allocation schemes.
4. To make students learn different compute and load balancing concepts.
5. To make students use storage services for various applications.

Course Outcomes:

At the end of this course students will be able to,

1. Define what is cloud computing.
2. Configure roles using AWS Identity and Access Management.
3. Configure resources with secured connectivity using AWS Virtual Private Cloud.
4. Architect the cloud infrastructure using Elastic compute cloud and Elastic Load Balancing.
5. Store and retrieve data using AWS S3.

SECTION I

Unit 1 - Introduction to Cloud Computing and AWS (07)

History of the cloud, Basic AWS concepts, Benefits of using AWS over traditional data center, Accessing AWS services, AWS overview, What are SaaS, PaaS, and IaaS?, Understanding virtualization, Elasticity versus scalability, Comparing AWS cloud and on-premises data centers, Total Cost of Ownership (TCO) versus Return on Investment (ROI), Creating a new AWS account, Deleting an AWS account, AWS free tier, Root user versus non-root user, AWS dashboard, Core AWS services, Shared security responsibility model, AWS soft limits, Disaster recovery with AWS.

Unit 2 – Identity and Access Management (07)

Understanding AWS root user, Elements of IAM, Introduction to AWS CLI, Group, IAM role, Policy, STS, IAM best practices.

Unit 3 – Virtual Private Cloud (07)

AWS VPC, Subnet, IP addressing, Creating a VPC, Security, VPC networking components, NAT, VPC peering, VPC endpoint, Classic Link, VPC best practices.

SECTION II

Unit 4 – Elastic compute cloud (07)

Introduction to EC2, Pricing for EC2, EC2 instance lifecycle, AMI, Introducing EBS, EC2 best practices.

Unit 5 – Elastic Load Balancing (07)

Introduction to Elastic Load balancer, ELB best practices, How Amazon CloudWatch works, Elements of Amazon CloudWatch, CloudWatch dashboards, Monitoring types – basic and detailed, CloudWatch best practices.

Unit 6 – Simple Storage Service, Glacier, and Cloud Front (07)

Amazon S3, Creating a bucket, Transfer Acceleration, Requester Pay model, Understanding objects, Versioning, Object tagging, S3 storage classes, Comparison of S3 storage classes and Glacier, Lifecycle management, Hosting static website on S3.

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 practicals based on above curriculum

Text Books

1. AWS Certified Developer Associate Guide, by Vipul Tankariya and Bhavin Parmar PacktPublishing Ltd.
2. Amazon Web Services in Action Paperback by Andreas Wittig and Michael Wittig, ManningPublisher.

Reference Books

1. AWS Cookbook: Recipes for Success on AWS (Grayscale Indian Edition) by John Culkin (Author), Mike Zazon (Author), Oreilly Publishers.

2. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos, Marilyn Wolf, 1st ed. 2018 edition, Springer

Recommended Online Free Courseware /Learning Resources

1. Udemy.com
2. https://docs.aws.amazon.com/

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Internet of Things
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-VI
ENTHON04C: Architecting IoT Solutions

Teaching Scheme:
Lecture : 3Hrs/Week, 3 credits
Practical: 2Hrs/Week, 1 credit

Examination Scheme:
ESE:70 Marks
ISE: 30 Marks
ICA: 25 Marks

This course introduces AWS well architected tool and makes an AWS-based infrastructure more efficient to increase performance and reduce costs. This further discusses the use of Well-Architected Framework to improve architectures with AWS solutions. Gain hands-on experience using computer, networking, storage and database AWS services covering IaaS and PaaS.

Course Prerequisite:
Students must have completed the Industrial IoT course.

Course Objectives:

1. To introduce students to AWS Well-Architected Framework
2. To introduce students to the important parameters of AWS Well-Architected Framework to performreliably, securely and efficiently.
3. To introduce students with various security aspects of the framework.
4. To introduce students to various workload architectures paradigms.
5. To make students aware of various performance metric to achieve tradeoff between compute andmemory reliant operations.

Course Outcomes:
At the end of the course, students will be able to

1. Experiment various paradigms offered by AWS Well-Architected Framework
2. Demonstrate the use of AWS Well-Architected Framework to review cloud operations
3. Monitor the potential risk for a given architecture
4. Measure the cloud architectures for multiple workloads for a given application
5. Assess the performance metric for a given use case

SECTION - I

Unit 1 – Introduction to Framework [4 Hrs.]

Introduction, Definitions, On Architecture, General Design Principles

Unit 2 - The Five Pillars of the Framework [10 Hrs.]

Design Principles, Definition, Best Practices, Resources of: Operational Excellence, Security, Reliability, Performance Efficiency, Cost Optimization,

Unit 3 – Operations [8 Hrs.]

Operational Excellence, Organization, Prepare, Operate, Evolve

SECTION - II

Unit 4 – Security [6 Hrs.]

Identity and Access Management, Detection, Infrastructure Protection, Data Protection, Incident Response

Unit 5 – Reliability [6 Hrs.]

Foundations, Workload Architecture, Change Management, AWS Well-Architected Framework for Failure Management.

Unit 6 – Performance [10 Hrs.]

Performance Efficiency, Selection, Review, Monitoring, Trade Offs, Cost Optimization, Practice Cloud Financial Management, Expenditure and usage awareness, Cost-effective resources, Manage demand and supply resources, Optimize over time

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Internal Continuous Assessment (ICA):

ICA shall consist of a minimum of eight experiments/assignments based on the above syllabus.

Text Book:

1. AWS for Solutions Architects: Design your cloud infrastructure by implementing DevOps, containers, and Amazon Web Services, 2021, by Alberto Artasanchez, Packs Publishers 1st edition

Reference Book:

1. AWS for System Administrators: Build, automate, and manage your infrastructure on the mostpopular cloud platform – AWS by Prashant Lakhera, Packt Publishing 1st edition

Additional Resources:

AWS Well-Architected Framework Documentation
https://docs.aws.amazon.com/wellarchitected/latest/framework/welcome.html

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant

Honors Degree Curriculum With effect from 2024-2025

Honors Degree Structure: Railway Engineering

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*		*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	
III	ENTHON-01D	Railway Engineering: A Beginner's Perspective	3	1		4	70	30	25	125
IV	ENTHON-02D	Data Communication and Signaling in Railway	3		2	4	70	30	25	125
V	ENTHON-03D	Applications of IT and Control Engineering in Railway	3		2	4	70	30	25	125
VI	ENTHON-04D	Advanced Communication and Modern Signaling in Railway	3		2	4	70	30	25	125
VII	ENTHON-05D	Mini Project			4	2			50	50
		Total	**12**	**1**	**10**	**18**	**280**	**120**	**150**	**550**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Railway Engineering
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-III

ENTHON01D: Railway Engineering: A Beginner's Perspective

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Tutorial: 1Hr/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

Railway engineering is a multi-faceted engineering discipline dealing with the design, construction and operation of all types of rail transport systems. It encompasses a wide range of engineering disciplines, including civil engineering, computer engineering, electrical engineering, mechanical engineering, industrial engineering and production engineering. In this course, there is study of Railway signaling with Electronics part. This course is help for new beginners to understand the operation of railway signaling.

Course prerequisite: Prerequisite for this course is Basic electronics and Basic Electrical Engineering.

Course Objectives:

1. To make student aware of Indian Railways System
2. To summarize Railway Transportation and Its Development
3. To understand role of Electrical, Electronics, Computer, Civil, and Mechanical Engineers in Railways
4. To discuss recent trends in Indian Railways
5. To discriminate the Indian Railways as an International Perspective

Course Outcomes:

At the end of this course students will be able to,

1. Define the Indian Railways System
2. Summarize Railway Transportation and Its Development
3. Understand the role of Electrical, Electronics, Computer, Civil and Mechanical Engineersin Railways
4. Discuss the recent trends in Indian Railways
5. Discriminate the Indian Railways as an International Perspective

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SECTION I

Unit 1-Indian Railways - A Perspective : (05)

General Features of Indian Railways, Important Statistics of Indian Railways, Organization of Indian Railways, Indian Railway Finances and their Control, Commission of Railway Safety, Recruitment Boards of Indian Railways Different Corporations in Indian Railways, Indian Railway Information Systems, Growth of Indian Railways.

Unit 2- Railway Transportation and Its Development : (07)

Terminology- Locomotive, Engine, Bogie, Coach, Freight train, Wheel Arrangement (WA), Driving Cab, Pantograph, Gauge, Transmission, Traction Motors, Coupler, Crossing, Diamond crossing, Junction, Terminal, Fishplate, Permanent way, Rolling stock

Evolution of Different Facets of the Railways

a. Rails Types of rail section: D.H. Rails, B.H. Rails and F.F. Rails, Standard rail sections, Comparison of rail types, Track structure and different gauges.
b. Sleepers , comparison of different types of sleepers and components of track
c. Bridges evolution of iron to steel, arch ,rcc, psc, steel
d. Mode of traction steam, diesel, electric
e. Locomotives evolution of locomotives of each type Various propulsion systems
f. Bogies and coaches

Unit 3- Role of Electrical, Electronics & Computer Engineering in Railways (09)

Introduction to Electrical Engines, Working of Locomotives, Overhead (OHE) Equipment's in Railways, Braking Systems in Railways, Power Supply System & Technology in Railways, Introduction to the Electronic System in Indian Railway, Electrical Switches and Relays used in Indian Railway, Display Control and Mechanism in Railway, Electronics Communication System in Railways, Safety Measures in Indian Railways, Software's in Indian Railways

SECTION II

Unit 4- Role of Civil and Mechanical Engineering in Railways (08)

Fundamentals of Geology, Tracking System, Layers of material on Tracks, Overview of Civil Engineering in Railway Systems, Introduction to Ballast, Rails, Sleepers, Points of Crossings, and Points of Switches, Maintenance of Railway Tracks.

Mechanical System used in Railway Engine & Bogies. Construction of Bogies, Material Used for Railing system, Mechanisms in Railway Locomotive, Study of Railway Engines, Maintenance of Railway Tracks

Unit 5- Recent Trends in Indian Railways (08)

Introduction, Modernization of traction, Speed trends, modernization of track, Trends in track vehicles, container transport service, Automation in operation, High powered locomotives, Miscellaneous development. Introduction to the Clean Energy in Indian Railways, Overview of Faster Trains in India, Overview of Bullet Trains and Metro, Concept of Anubhuti Coaches in Indian Railways, and Introduction to the Bio Toilets in Indian Railway.

Unit 6- Review of Railways - An International Perspective (05)

Overview of International Railways, Development of Railway Systems, Recent Trends in International Railways, and Overview of Maglev Technology.

Internal Continuous Assessment (ICA):

1. ase Study: Case Studies on Recent Trends in Railways (15 hrs)
2. Industrial Visits on Railway Workshops/Institutes/Industries (15 hrs)

References:

1. Satish Chandra and M.M. Agarwal, Railway Engineering, Oxford University Press, 2007.
2. Christos N. Pyrgidis, Railway Transportation Systems: Design, Construction and Operation, Oxford, New York, Philadelphia
3. M.A. Chowdhary and A. Sadek, Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003
4. S.C. Rangawala, Principles of Railway Engineering, Charotar Publication, 2015.
2. V. D. Kodgire, Sushil Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House
3. Handbook of Railway Vehicle Dynamics, Taylor & Francis Group
4. J. S. Mundrey, Railway Track Engineering, McGraw Hill Publication, 2009
5. R.. B. Gupte, Text Book Of Engineering Geology, Pune Vidyarthi Griha Prakashan
6. G. Shanmugam and M. S. Palanichamy, Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.
7. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
8. Robert Sneddon, Material Technology, Heinemann Library, 2002 12. James A. Jacobs & Thomas Kilduff, Engineering Materials Technology: Structures, Processing, Properties, and Selection, Pearson; 5th edition, 2004
9. David A. Dornfeld, Green Manufacturing: Fundamentals and Applications, Springer; 2012 edition
10. Nand K. Jha, Green Design and Manufacturing for Sustainability, CRC Press; first edition, 2015
11. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Education; 1st edition, 2017

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Railway Engineering
S.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-IV

ENTHON02D: Data Communication and Signaling in Railway

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical: 2Hrs/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

Course Objectives:

1. To make students aware of Data communication
2. To summarize Railway Transportation and Its Internet Facility
3. To understand the role of Electrical, Electronics in Railways
4. To discuss recent trends in signaling in Indian Railways
5. To discriminate against the Indian Railways from an International Perspective

Course Outcomes:

At the end of this course, students will be able to,

1. Define the Data communication
2. Summarize Railway Transportation and Its Internet Facility
3. Understand the role of Electrical, Electronics in Railways
4. Discuss the recent trends in signaling in Indian Railways
5. Discriminate the Indian Railways as an International Perspective

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SECTION I

Unit 1 - Data Communication **(07)**

Introduction of data communication Fundamentals such as data, signals, etc., types of Transmission Medias, Types of Network cables: Twisted Pair cable, Coaxial Cable, Fiber Optic Cable,

Unit 2 – Internet **(07)**

IP Addressing: Physical, Logical Internet & Intranet, Components of the Internet, World Wide Web, E-Mail, Telnet, FTP, Understanding the World Wide Web, Hypertext: The Motion of the Web, Retrieving Documents on the Web: The URL, Real-Time Communication

Unit 3 - Basics of Electrical and Electronics (07)

Passive Components, Basics of AC and Electrical Cables, Cells & Batteries, Transformers, AC & DC measurements, Soldering & De-soldering and switches, Rectifiers, IC Regulators, Different Batteries, 110 DC Voltage, Electromagnetic theory, Electric Discharge Different types of fuzes

SECTION II

Unit 4 - Basic Signaling in Railway (07)

Introduction to Signal, Objects of Signals, Types of Signals, Classification of Signals according to functions, Classification of Signals according to Location, Special Signals. Principles of Signaling, Concepts of points. Location of point and range of operation. Signaling Plan- Control Table, Characteristics OF Electro-Magnetic Relay, Classification Of Signaling Relay

Unit 5 - Computer Network (06)

Introduction to Computer Network, Networking Devices, Client-Server Communication, Installation & Configuration of DHCP, DNS, FTP, TELNET, Introduction to Network security & GPS

Unit 6 - Railnet (Railway Intranet) (08)

An Installation, Equipment used in Railnet, Installation of the equipment, Connectivity Diagram, IP Planning, E-Mail addressing, Software based on Railnet, Failure & Troubleshooting

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Internal Continuous Assessment (ICA):

1. ICA shall consist of minimum six to eight assignments based on entire curriculum
2. Industrial Training/Internship

References:

1. Computer Networks (Principles, Technologies and Protocols for network design) - Natalia Olifer, Victor Olifer (Wiley Publications)
2. Internetworking with TCP/IP Vol III. Client-Server Programming & Applications: Douglas E. Comer
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Electronics & Telecommunication Engineering
Honors in Railway Engineering
T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-V

ENTHON03D: Applications of IT and Control Engineering in Railway

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical:2Hrs/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

Course Objectives:

1. To make students aware of FOIS system
2. To understand PRS System
3. To understand the control engineering in Railways
4. To discuss recent trends in microprocessor and micro controller in Indian Railways
5. To discriminate against the Indian Railways from an International Perspective

Course Outcomes:

At the end of this course, students will be able to,

1. Understand and analyze the FOIS system.
2. Understand and analyze the PRS system
3. Understand the control engineering in Railway.
4. Discuss the recent trends of microprocessor and micro controller in Indian Railways

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SECTION I

Unit 1- Freight Operations Information Systems (FOIS) (07)

Introduction, Mission Statement of FOIS, Composition of FOIS system, FOIS Design Architecture, Existing FOIS Network, FOIS network topology, Introduction of IOT in Indian Railways

Unit 2 - Passenger Reservation System (PRS) (07)

PRS: Introduction, Main Frame Servers of PRS, Salient Features of PRS, Typical arrangement of PRS Terminals, Unreserved Ticketing System (UTS): Introduction, UTS Network, Basic requirements of UTS Network, Network Management System.

Unit 3 - Control Engineering **(07)**

System, Control system, Types of control systems, concept of feedback, Liquid level control system, Automobile driving system, Servomechanism for steering of antenna, Robotic control system. The transfer function of a closed-loop system, Data Loggers and Event Loggers, SCADA.

SECTION II

Unit 4 - Microcontrollers and Microprocessors in Railways **(07)**

Sensors, DSLR (digital single-lens reflex), Android Based Controller, Micro-controller, PIC Controller DATALOGGER, ACD, Train Protection & Warning System, Auxiliary Warning System, Application of Microprocessors and Micro-controllers.

Unit 5 - Telecommunications in Railway **(07)**

Provisions of the Control Communication, 4 Wire/2 Wire Train Traffic Control Communication Equipment, V F Repeaters, Interruptions and Routine Tests on Control Circuits, Telephones Used In Control Working.

Unit 6 - Communication in Railway **(07)**

Radio Propagation, Public Address System, Multiplexing (Analog &Digital), Passenger Information System, Train Information System, Train Traffic Control Data Communications and Networking, Mobile Communications (VHF, SM-R, DECT, TETRA.), TCMS(Metro)

Internal Continuous Assessment (ICA):

ICA shall consist of a minimum six to eight assignments based on the entire curriculum

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Electronics & Telecommunication Engineering

Honors in Railway Engineering

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Sem-VI

ENTHON04D: Advanced Communication and Modern Signaling in Railway

Teaching Scheme:	**Examination Scheme:**
Lecture : 3Hrs/Week, 3 credits	ESE:70 Marks
Practical:2Hrs/Week, 1 credit	ISE:30 Marks
	ICA: 25 Marks

Course Objectives:-

1. Apply the knowledge of modern signaling in railway.
2. To make Students understand the advance communication systems in railways.
3. To make students understand basics of NT domains.
4. Impart basic knowledge of modern railway communication components and their functions.

Course Outcomes:-

At the end of this course, Students will be able to

1. Students can understand modern signaling in railway.
2. Students can understand the advance communication systems in railways
3. Students can understand the basics of NT domains.
4. Students can understand modern railway communication components and their functions.

Section-I

Unit 1: Advance Communication in railway: [10 Hrs]

Future Railway Mobile Communications System, LTE for Railways (LTE-R), Broadband Internet on running trains through two-way satellite communication, VoIP based Train Control Communication System (TCCS), and Open Source VoIP based solution for augmenting the Capacity of ISDN Exchange in Railway.

Unit 2: Advance Communication in railway: [10 Hrs]

IP based Video Surveillance System (VSS) on Indian Railways, Networked PA System in Railways, IoT (Internet of Things) in Railways, UHF Digital (License free band radio) Handheld Trans-receivers, NextGen ATP for Automatic Train Operations.

Section-II

Unit 3: Modern Signaling in Railways: [8 Hrs]

Modernization of Railway Signaling & Telecom by providing ETCS L-2 and LTE based Communication network, Intermediate Block Signaling using MSDAC, Avoid Slowing down of Train While Approaching the Station: Introduction of the Fifth Aspect of Signal

Unit 4: Signaling System Maintenance & Networking: [12 Hrs]

Technologies and processes to meet the challenges of signaling system maintenance, Safety and Reliability in Software based Embedded Systems for Railway Signaling Applications, Safety Slogans for Signal Department. Introduction of Networking with Windows 98 and Window NT, NT Server Installation, NT Domains, Managing User Accounts, Directory Shares, TCP/IP on WinNT

Internal Continuous Assessment (ICA):

ICA shall consist of minimum eight practicals based on entire curriculum

List of Experiments: -

1. Study the features and components of ETCS Level 2 (European Train Control System).
2. Study the working principles and advantages of IBS in railway signaling.
3. Understand how networking protocols work in these systems.
4. Study the evolution of communication systems used in railways.
5. Understand the implementation and benefits of LTE (Long-Term Evolution) in the railway sector.
6. Study how digital and networked PA systems improve communication across large railway networks.
7. Study applications of IoT for monitoring trains, tracks, and other railway assets.
8. Study the working and benefits of NextGen ATP systems.

9. Study the latest technologies used in the maintenance of railway signaling. systems.
10. Understand the importance of fail-safe mechanisms in railway signaling. equipment.

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5. Indian Railways - Safety Performance of relevant years, published by Safety Directorate of Ministryof Railways, Govt. of India.