



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics Engineering and
Electronics & Telecommunication Engineering

Structure for Honors Degree – Artificial Intelligence and Machine Learning
w.e.f. 2021-22

<i>Course Code</i>	<i>Semester</i>	<i>Course Name</i>	<i>Hrs./week</i>			<i>Credits</i>	<i>Examination Scheme</i>			
			<i>L</i>	<i>T</i>	<i>P</i>		<i>ISE</i>	<i>ESE</i>	<i>ICA</i>	<i>Total</i>
HET11	SY Sem II	Computational Statistics	3	1		4	30	70	25	125
HET12	TY SemI	Artificial Intelligence	3		2	4	30	70	25	125
HET13	TY SemII	Seminar			2*	1			25	25
HET14	TY SemII	Machine Learning	3		2	4	30	70	25	125
HET15	B Tech Sem I	Mini Project			4*	2		50	50	100
HET16	B Tech Sem I	AI Applications	3		2	4	30	70	25	125
Sub Total			12	1	12	19	120	330	175	625

* indicates contact hours



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Artificial Intelligence and Machine Learning

S.Y. BTech (Electronics Engineering)- Part-II

S.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET11: Computational Statistics

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Tutorial: 1Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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 statistical analysis.
 2. To make students use computational statistics in applications like statistical machine learning.
 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
-

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 and the 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 Learning (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

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 Cheng Soon Ong .

Reference Books:

1. Liu, J. (2001). Monte Carlo Strategies in Scientific 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, 2nd Edition, Springer.
4. Goodfellow, I., Bengio, Y. and Courville, A. (2016). Deep Learning, MIT Press.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Artificial Intelligence and Machine Learning

T.Y. B.Tech (Electronics Engineering)- Part-I

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-I

HET12: Artificial Intelligence

Teaching Scheme:

Lecture: 3 hr/week, 3 credits

Practical: 2 hr/week, 1 credit

Examination Scheme:

ESE : 70 Marks

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 application scenarios

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 Engineering and Electronics & Telecommunication Engineering

Honors in Artificial Intelligence and Machine Learning

T.Y. B.Tech (Electronics Engineering)- Part-II

T.Y. B. Tech (Electronics & Telecommunication Engineering)- Part-II

HET13 – Seminar

Teaching Scheme:

Practical : 2 hr/week, 1 credit

Examination Scheme:

ICA : 25 Marks

Course Objectives:

1. To expose student to the latest trends in Artificial Intelligence
 2. To develop communication Skill of the student
 3. To make student able to write technical specifications, project document
-

Course Outcomes:

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

1. Identify a seminar topic after thorough literature survey
 2. Prepare a seminar presentation to explore the latest trends in Artificial Intelligence.
 3. Demonstrate communication Skills.
 4. Inculcate presentation skills through reports and presentations while observing professional ethics
-

Course Prerequisite:

Student shall possess necessary technical report writing skills, presentation skills and shall have proficiency in software for word processing and presentation.

The objective of seminar is to enable the student to get exposed with technology, modern tools, techniques and various emerging applications of Artificial Intelligence. The students shall refer reference research papers from standard Journals from IEEE, Science Direct etc.

This is expected to provide a good initiation for the student(s) in R&D work which include:

1. Survey and study of published literature on the selected seminar topic.
2. Seminar over state-of-the-art technology to resolve problem undertaken.
3. Preparing a Written Report on the Study conducted for presentation to the Department.
4. Seminar, as oral Presentation before a departmental committee.



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Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Artificial Intelligence and Machine Learning

T.Y. B.Tech (Electronics Engineering)- Part-II

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET14 – Machine Learning

Teaching Scheme:

Lecture: 3 hr/week, 3 credits

Practical : 2 hr/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 probability and 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. EthemAlpaydin, “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. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar “Foundations of Machine Learning”, MIT Press,2012.
2. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in 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 Engineering and
Electronics & Telecommunication Engineering

Structure for Honors Degree – Data Science
w.e.f. 2021-22

<i>Course Code</i>	<i>Semester</i>	<i>Course Name</i>	<i>Hrs./week</i>			<i>Credits</i>	<i>Examination Scheme</i>			
			<i>L</i>	<i>T</i>	<i>P</i>		<i>ISE</i>	<i>ESE</i>	<i>ICA</i>	<i>Total</i>
HET21	SY Sem II	Database Management Systems	3	1		4	30	70	25	125
HET22	TYSemI	Data Processing & Feature Engineering	3		2	4	30	70	25	125
HET23	TY SemII	Seminar			2*	1			25	25
HET24	TY SemII	Machine Learning	3		2	4	30	70	25	125
HET25	B Tech Sem I	Mini Project			4*	2		50	50	100
HET26	B Tech Sem I	Business Analytics	3		2	4	30	70	25	125
	Sub Total		12	1	12	19	120	330	175	625

* indicates contact hours



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Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Data Science

S.Y. B.Tech (Electronics Engineering)- Part-II

S.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET21: Database Management System

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Tutorial: 1Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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 2: 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 RamezEl Masri, S. B. Navathe (Pearson Education)5thedition.
2. Database Management Systems by RamkrishnanGehreke (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 Engineering and Electronics & Telecommunication Engineering

Honors in Data Science

T.Y. B.Tech (Electronics Engineering)- Part-I

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-I

HET22 – Data Processing & Feature Engineering

Teaching Scheme:

Lecture: 3 hr/week, 3 credits

Practical : 2 hr/week, 1 credit

Examination Scheme:

ESE : 70 Marks

ISE : 30 Marks

ICA : 25 Marks

Course Objectives:

1. To develop skills for analysis of data quality
 2. To understand concept of dimensionality reduction and its benefits.
 3. To know automated tools for feature engineering.
-

Course Outcomes:

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

1. Identify the data quality.
 2. Select appropriate preprocessing technique for data.
 3. Identify feature engineering requirements for machine learning.
 4. Automate feature extraction.
-

Course Prerequisite:

Basics of statistics, Probability theory, data science and statistical programming Language.

SECTION I

Unit1: Data Quality and Preprocessing

(06)

Data Scale Types, Data Quality, converting to a Different Scale Type, Converting to a Different Scale, Data Transformation

Unit2: Features

(08)

Kinds of feature, Calculations on features, Categorical, ordinal and quantitative features, Structured features, Feature transformations, Thresholding and discretisation, Normalisation and calibration, Incomplete features, Feature construction and selection, Matrix transformations and decompositions.

Unit3: Dimensionality Reduction

(07)

Introduction, Subset Selection, Principal Component Analysis, Feature Embedding, Factor Analysis, Singular Value Decomposition and Matrix Factorization, Multidimensional Scaling, Linear Discriminant Analysis, Canonical Correlation Analysis

SECTION II

Unit 4: Feature Engineering for Machine Learning

(08)

Data Tasks, Models, Features, Model Evaluation, Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Log Transform in Action, Power Transforms: Generalization of the Log Transform, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling)

Unit 5: Nonlinear Featurization via K-Means

(06)

Model Stacking, k-Means Clustering, Clustering as Surface Tiling, k-Means Featurization for Classification, Alternative Dense Featurization

Unit 6: Automating the Fraternizer (07)

Image Feature Extraction and Deep Learning, Manual Feature Extraction: SIFT and HOG, Image Gradients, Gradient Orientation Histograms, SIFT Architecture, Learning Image Features with Deep Neural Networks, Fully Connected Layers, Convolutional Layers, Rectified Linear Unit (ReLU) Transformation, Response Normalization Layers, Pooling Layers, Structure of AlexNet

Internal Continuous Assessment (ICA):

Minimum eight experiments based on above Syllabus.

Text books:

1. A General Introduction to Data Analytics, by Joao Moreira, Andre Carvalho, Tomas Horvath, Wiley Publication.
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 Edition 2014.
4. Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists 1st Edition by Alice Zheng, Amanda Casari, O'REILLY publication

Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.
3. Charu C. Aggarwal, "DATA CLUSTERING Algorithms and Applications", CRC Press, 2014.
4. Machine Learning Mastery With Python 2016 by Jason Brownlee.



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Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Data Science

T.Y. B.Tech (Electronics Engineering)- Part-II

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET23 – Seminar

Teaching Scheme:

Practical: 2 hr/week, 1 credit

Examination Scheme:

ICA : 25 Marks

Course Objectives:

1. To expose student to the latest trends in Data Science
 2. To develop communication Skill of the student
 3. To make student able to write technical specifications, project document
-

Course Outcomes:

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

1. Identify a seminar topic after thorough literature survey
 2. Prepare a seminar presentation to explore the latest trends in Data Science.
 3. Demonstrate communication Skills.
 4. Inculcate presentation skills through reports and presentations while observing professional ethics
-

Course Prerequisite:

Student shall also possess necessary technical report writing skills, presentation skills and shall have proficiency in software for word processing and presentation

The objective of seminar is to enable the student to get exposed with technology, modern tools, techniques and various emerging applications of data science. The students shall refer reference research papers from standard Journals from IEEE, Science Direct etc.

This is expected to provide a good initiation for the student(s) in R&D work which include:

1. Survey and study of published literature on the selected seminar topic.
2. Seminar over state-of-the-art technology to resolve problem undertaken.
3. Preparing a Written Report on the Study conducted for presentation to the Department.
4. Seminar, as oral Presentation before a departmental committee.



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Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Data Science

T.Y. B.Tech (Electronics Engineering)- Part-II

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET24 – Machine Learning

Teaching Scheme:

Lecture: 3 hr/week, 3 credits

Practical: 2 hr/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 probability and 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, 3rd Edition, 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 Edition 2014.
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 Applications in 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", CRC Press, 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 Engineering and
Electronics & Telecommunication Engineering

Structure for Honors Degree – Internet of Things(IoT)
w.e.f. 2021-22

<i>Course Code</i>	<i>Semester</i>	<i>Course Name</i>	<i>Hrs./week</i>			<i>Credits</i>	<i>Examination Scheme</i>			
			<i>L</i>	<i>T</i>	<i>P</i>		<i>ISE</i>	<i>ESE</i>	<i>ICA</i>	<i>Total</i>
HET31	SY Sem II	Fundamentals of IoT	3	1		4	30	70	25	125
HET32	TY Sem I	Industrial IoT	3		2	4	30	70	25	125
HET33	TY Sem II	Seminar			2*	1			25	25
HET34	TY Sem II	IoT Cloud Platform	3		2	4	30	70	25	125
HET35	B Tech Sem I	Mini Project			4*	2		50	50	100
HET36	B Tech Sem I	Architecting IoT Solutions	3		2	4	30	70	25	125
Sub Total			12	1	12	19	120	330	175	625

* indicates contact hours



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Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Internet of Things(IoT)

S.Y. B.Tech (Electronics Engineering)- Part-II

S.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET31: Fundamentals of IoT

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Tutorial: 1Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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, communication systems, 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 Hill Education
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 Minter, 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 3 and Python by Colin Dow, Packt Publishing Limited

Reference Books

1. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by DimitriosSerpanos, Marilyn Wolf, 1st ed. 2018 edition, Springer
2. Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3 by Peter Waher. First edition, Packt Publishing
3. Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed by Perry Xiao, 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 Engineering and Electronics & Telecommunication Engineering

Honors in Internet of Things(IoT)

T.Y. B.Tech (Electronics Engineering)- Part-I

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-I

HET32: Industrial IoT

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Practical: 2Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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 the edge 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 3 and 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 Pi 3 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 Engineering and Electronics & Telecommunication Engineering

Honors in Internet of Things(IoT)

T.Y. B.Tech (Electronics Engineering)- Part-II

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET33 – Seminar

Teaching Scheme:

Practical : 2 hr/week, 1 credit

Examination Scheme:

ICA : 25 Marks

Course Objectives:

1. To expose student to the latest trends in cloud computing
 2. To develop communication skill of the student
 3. To make student able to write technical specifications, project document
 4. To make students follow professionalism throughout all the activities
-

Course Outcomes:

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

1. Identify a seminar topic after thorough literature survey
 2. Prepare a seminar presentation to explore the latest trends in cloud computing.
 3. Demonstrate communication skills.
 4. Inculcate presentation skills through reports and presentations while observing professional ethics
-

Course Prerequisite:

Student shall also possess necessary technical report writing skills, presentation skills and shall have proficiency in software for word processing and presentation

The objective of the seminar is to enable the student to get exposed to technology, modern tools, techniques and various emerging applications of Artificial Intelligence. The students shall refer to reference research papers from standard Journals from IEEE , ScienceDirect etc.

This is expected to provide a good initiation for the student(s) in R&D work which include:

1. Survey and study of published literature on the selected seminar topic.
2. Seminar over state-of-the-art technology to resolve problems undertaken.
3. Preparing a Written Report on the Study conducted for presentation to the Department.
4. Seminar, as oral Presentation before a departmental committee.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics Engineering and Electronics & Telecommunication Engineering

Honors in Internet of Things(IoT)

T.Y. BTech (Electronics Engineering)- Part-II

T.Y. BTech (Electronics & Telecommunication Engineering)- Part-II

HET34: IoT Cloud Platforms

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Practical: 2Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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, ClassicLink, 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 CloudFront (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 Packt Publishing Ltd.
2. Amazon Web Services in Action Paperback by Andreas Wittig and Michael Wittig, Manning Publisher.

Reference Books

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

Structure for Honors Degree – Railway Engineering
w.e.f. 2021-22

Course Code	Semester	Course Name	Hrs./week			Credits	Examination Scheme			
			L	T	P		ISE	ESE	ICA	Total
HET41	SY Sem II	Railway Engineering: A Beginner's Perspective	3	1		4	30	70	25	125
HET42	TY Sem I	Data Communication and Signaling in Railway	3		2	4	30	70	25	125
HET43	TY Sem II	Seminar			2*	1			25	25
HET44	TY Sem II	Applications of IT and Control Engineering in Railway	3		2	4	30	70	25	125
HET45	B Tech Sem I	Mini Project			4*	2		50	50	100
HET46	B Tech Sem I	Advanced Communication and Modern Signaling in Railway	3		2	4	30	70	25	125
		Sub Total	12	1	12	19	120	330	175	625

* indicates contact hours



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics & Telecommunication Engineering

Honors in Railway Engineering
S.Y. BTech (Electronics & Telecommunication Engineering)- Part-II

HET41: Railway Engineering: A Beginner's Perspective

Teaching Scheme:

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

Examination Scheme:

ISE:30 Marks
ESE:70 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 Engineers in Railways
 4. Discuss the recent trends in Indian Railways
 5. Discriminate the Indian Railways as an International Perspective
-

SECTION I

Unit1-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.

Unit2- 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. Case 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 GrihaPrakashan
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
12. V. Ganeshan, Internal Combustion Engine, McGraw Hill Education; 4th edition, 2017
13. S.C. Saxena, S.P. Arora, A Text Book Of Railway Engineering, Dhanpat Rai Publications (p) Ltd.-new Delhi, 2010.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics & Telecommunication Engineering

Honors in Railway Engineering

T.Y. BTech (Electronics & Telecommunication Engineering)- Part-I

HET42: Data Communication and Signaling in Railway

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Practical: 2Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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

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

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
3. Data Communication and Networking: Behrouz A. Forouzan
4. Satish Chandra and M.M. Agarwal, Railway Engineering, Oxford University Press, 2007.
5. Christos N. Pyrgidis, Railway Transportation Systems: Design, Construction and Operation, Oxford, New York, Philadelphia
6. S.C. Rangawala, Principles of Railway Engineering, Charotar Publication, 2015.
7. TCP/IP Protocol Suite: Behrouz A. Forouzan (Fourth Edition)
8. Internetworking with TCP/IP Vol III. Client-Server Programming & Applications: Douglas E. Comer

9. Engineering Circuit Analysis. Hayt W. H. & Kemmerly J. E. McGraw-Hill. 1993.
10. Circuits, Devices & Systems. Smith R. J. & Dorf R.C., John Wiley & Sons. 1992.
11. Electronic Devices & Circuit Theory. Boylestad R. L. & Nashelsky L. 6th Ed. Prentice Hall India. 2001.
12. Principles of Communications: Systems, Modulation & Noise. Ziemer R. E. & Tranter W. H. 5th Ed. John Wiley & Sons. 2001.
13. Communication Systems. Haykin Simon. 4th Ed. John Wiley & Sons. 2001.
14. Digital & Analog Communication Systems. Shanmugam K. Sam. John Wiley & Sons. 1979.
15. Signals and Systems A.V. Oppenheim and A. S. Wilsky, 2nd edition [Pearson Education]
16. Signals and Systems Simon Haykin and Barry Van Veen, 2nd edition [Wiley and Sons]
17. Signals and Systems, I. Ravi Kumar, PHI



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics & Telecommunication Engineering
Honors in Railway Engineering

T.Y. BTech (Electronics & Telecommunication Engineering)- Part-II

HET43: Seminar

Teaching Scheme:

Practical: 2Hr/Week, 1 credit

Examination Scheme:

ICA: 25 Marks

A student shall submit the seminar report and prepare a presentation for it.

The topic for the seminar Work may be Electronics and telecommunication Engineering, Railway Signaling, Modern communication technologies used in railway, Interlocking and interdisciplinary areas related to Railway Engineering.

Guidelines for Project contents:

a) Seminar Report: The seminar report should be 25 to 50 pages (More pages can be used if needed). The entire Report has to be segmented chapter-wise as per the requirement.

1. Introduction (History, Importance of topic, Area, Problem identification, Objective of the seminar)
2. Literature Review
3. Design/ Experimentation/ Model/Actual work carried out for the same.
4. Observation/ Analysis/ Findings/Results

b) Presentation: The group has to prepare a PowerPoint presentation on the seminar report and present it in front of the faculty of the department. One copy of the report should be submitted to Institute/ Department, and one copy should remain with each student of the project group



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Electronics & Telecommunication Engineering

Honors in Railway Engineering

T.Y. BTech (Electronics & Telecommunication Engineering)- Part-II

HET44: Applications of IT and Control Engineering in Railway

Teaching Scheme:

Lecture : 3Hrs/Week, 3 credits

Practical: 2Hr/Week, 1 credit

Examination Scheme:

ISE:30 Marks

ESE:70 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
-

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

Unit2 - 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.

Unit3- 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**Unit4- 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.

Unit5 - 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.

Unit6 - 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

References:

1. <http://railwaytrainingsandt.blogspot.com/p/week.html>.
2. <https://iriset.indianrailways.gov.in>
3. Mobile Communications – Jochen Schiller (PEARSON) (Chapters: 1, 2, 3, 5,6)
4. Qiao Jian-hua; Li Lin-sheng; Zhang Jing-gang; “Design of Rail Surface Crack-detecting System Based on Linear CCD Sensor”, IEEE Int. Conf. on Networking, Sensing and Control, 2008
5. K. Vijayakumar, S.R. Wylie, J. D. Cullen, C.C. Wright, A.I. AlShamma’a, “Non invasive rail track detection system using Microwave sensor”, Journal of App. Phy., 2009
6. White Paper- Safety on Indian Railways, April 2003, Govt. of India, Ministry of Railways.
7. Indian Railways - Safety Performance of relevant years, published by Safety Directorate of Ministry of Railways, Govt. of India
8. Development of Railway Signal & Telecom Systems on IR M C Yadav WM/Signal/SWS Sabarmati/Western Railway
9. Indian Railways Telecommunication Manual

10. Train Collision Avoidance System (TCAS). Government of India



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

**Computer Science & Engineering, Information Technology,
Electronics & Telecommunication Engineering**

**Structure for Honors Degree – Cyber Security
w.e.f. 2021-22**

Course Code	Semester	Course Name	Hrs./week			Credits	Examination Scheme			
			L	T	P		ISE	ESE	ICA	Total
HET51	SY Sem II	Cryptography	3	1		4	30	70	25	125
HET52	TY Sem I	Network Security and Secure Coding	3		2	4	30	70	25	125
HET53	TY Sem II	Seminar			2*	1			25	25
HET54	TY Sem II	Cyber Forensic	3		2	4	30	70	25	125
HET55	B Tech Sem I	Mini Project			4*	2		50	50	100
HET56	B Tech Sem I	Information Auditing and Monitoring	3		2	4	30	70	25	125
Sub Total			12	1	12	19	120	330	175	625

* indicates contact hours



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
**Computer Science and Engineering / Information Technology/
Electronics & Telecommunication Engineering**

Honors in Cyber Security

S.Y. BTech (Computer Science and Engineering)- Part-II

S.Y. BTech (Information Technology)- Part-II

S.Y. BTech (Electronics & Telecommunication Engineering)- Part-II

HET51 : Cryptography

Teaching Scheme

Lectures: 3 Hours/Week, 3 credits

Tutorial: 1 Hour/Week, 1 credit

Examination Scheme

ESE: 70 Marks

ISE: 30 marks

ICA: 25 Marks

This course provides an introduction to modern cryptography and communication security. It focuses on how cryptographic algorithms and protocols work and how to use them. The course covers the concepts of block ciphers and message authentication codes, public key encryption, digital signatures, and key establishment, as well as common examples and uses of such schemes, including the AES, RSA, and the Digital Signature Algorithm. Basic cryptanalytic techniques and examples of practical security solutions are explored to understand how to design and evaluate modern security solutions.

Course Objective:

This course aims to give students:

1. an overview of basic cryptographic concepts and methods
 2. a good knowledge of some commonly used cryptographic primitives and protocols
 3. a sound understanding of theory and implementation, as well as limitations and vulnerabilities
 4. an appreciation of the engineering difficulties involved in employing cryptographic tools to build secure systems
-

Course Outcome:

At the end of course, students will be able to

1. Apply the most common type of cryptographic algorithm ·
 2. Understand the Public-Key Infrastructure ·
 3. Analyze different security protocols for protecting data on networks
 4. Be able to compose, build and analyze simple cryptographic solutions
 5. Perform simple vulnerability assessments.
-

SECTION – I

Unit 1 : Overview

(07)

Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A model for Network Security

Unit 2 : Classical Encryption Techniques

(05)

Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography

Unit 3 : Block Cipher and Data Encryption Standard

(08)

Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles

AES: Finite field arithmetic, AES structure, AES transformation function, AES key expansion, An AES example

SECTION – II

Unit 4 : Public Key Cryptography and RSA

(07)

Principles of Public-Key Cryptosystem: Public Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements of Public-Key Cryptosystems

RSA Algorithm: Description of Algorithm, Computational aspects, The Security of RSA

Diffie Hellman Key Exchange: The Algorithm, Key Exchange Protocols, Man-in-middle Attack

Unit 5 : Cryptographic Hash Functions and Message Authentication Codes

(08)

Cryptographic Hash Functions: Applications, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA)

Message Authentication Codes: Requirements for Message Authentication Codes, Security of MACs, MACs based on Hash Functions (HMAC), Digital Signatures

Unit 6 : User Authentication

(07)

Remote user authentication principles, Remote user authentication using symmetric encryption, Kerberos, Remote user authentication using asymmetric encryption, Federated Identity management, Personal identity Verification

Internal Continuous Assessment (ICA) :

Student should implement the following:

1. Implementation of Substitution Cipher
2. Implementation of Poly alphabetic Cipher (Vigenere Cipher and Vernam Cipher)
3. Implementation of Transposition Cipher
4. Implementation of Play fair Cipher
5. Implementation of Secure file transfer in Client/Server environment (use any one of above method for encryption and decryption).
6. Write a program to simulate RSA algorithm.
7. Implement Cryptographic Hash function
8. Simulate Kerberos authentication system

Text Book:

1. Williams Stallings–Cryptography and Network security principles and practices. Pearson Education (LPE) 6th Edition (Covers all above Units)

Reference Books:

1. Menezes, A.J., P.C.Van Oorschot, and S.A.Vanstone, “Handbook of Applied Cryptography”
2. Schneir, Bruce, “Applied Cryptography: Protocols and Algorithms”
3. Nina Godbole --Information systems security-Security management, metrics, frameworks and best practices (WILEY)



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T.Y. B.Tech (Information Technology)- Part-I

T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-I

HET52 :Network Security and Secure Coding

Teaching Scheme

Lectures: 3 Hours/Week, 3 credits

Practical : 2 Hours/Week, 1 credit

Examination Scheme

ESE: 70 Marks

ISE: 30 marks

ICA: 25 Marks

Course Objectives:

1. To acquire knowledge about security attacks, services and mechanisms.
 2. To implement Internetwork security models with standards and vulnerabilities
 3. To learn the Conventional Encryption Principles and Public key cryptography principles
 4. To study attacks in simple networks
-

Course Outcomes:

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

1. Gain a complete knowledge on types of security attacks, services and mechanisms.
 2. Understand the implementation of Internetwork security model and its standards and vulnerabilities.
 3. Demonstrate the Conventional Encryption Principles and the Public key cryptography principles
 4. Identify the vulnerable points for attacks in simple networks.
-

SECTION-I

Unit 1: Security Attacks

(08)

Interruption, Interception, Modification and Fabrication, Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

Unit 2 :Conventional Encryption Principles (07)

Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication,Secure Hash Functions and HMAC.

Unit 3 : Public key cryptography principles (07)

Public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

SECTION-II

Unit 4 : Email privacy (08)

Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

Unit 5 :Basic Concepts of SNMP (07)

Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats. Firewall Design principles, Trusted Systems. Intrusion Detection Systems.

Unit 6:Secure Coding (07)

Memory safety and vulnerabilities: attacks and defenses,Memory safety and vulnerabilities: attacks and defenses,Fuzzing,Symbolic execution and static analysis, Secure Architecture Concepts and Principles

Internal Continuous Assessment (ICA) :

Minimum 8-10 assignments based on above topics.

Text Books:

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn IdoDubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech

Reference Books:

1. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
2. Network Security - Private Communication in a Public World by CharlienKaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
4. Principles of Information Security, Whitman, Cengage Learn



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T.Y. B.Tech (Electronics & Telecommunication Engineering)- Part-II

HET53 – Seminar

Teaching Scheme:

Practical : 2 hr/week, 1 credit

Examination Scheme:

ICA : 25 Marks

Course Objectives:

4. To expose student to the latest trends in cyber security
 5. To develop communication Skill of the student
 6. To make student able to write technical specifications, project document
-

Course Outcomes:

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

5. Identify a seminar topic after thorough literature survey
 6. Prepare a seminar presentation to explore the latest trends in cyber security.
 7. Demonstrate communication Skills.
 8. Inculcate presentation skills through reports and presentations while observing professional ethics
-

Course Prerequisite:

Student shall possess necessary technical report writing skills, presentation skills and shall have proficiency in software for word processing and presentation.

The objective of seminar is to enable the student to get exposed with technology, modern tools, techniques and various emerging applications of cyber security. The students shall refer reference research papers from standard Journals from IEEE, Science Direct etc.

This is expected to provide a good initiation for the student(s) in R&D work which include:

1. Survey and study of published literature on the selected seminar topic.
2. Seminar over state-of-the-art technology to resolve problem undertaken.
3. Preparing a Written Report on the Study conducted for presentation to the Department.
4. Seminar, as oral Presentation before a departmental committee.



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HET54 :Cyber Forensic

Teaching Scheme

Lectures: 3 Hours/Week, 3 credits

Practical : 2 Hours/Week, 1 credit

Examination Scheme

ESE: 70 Marks

ISE: 30 marks

ICA: 25 Marks

Course Objectives:

1. To learn computer forensics
2. To become familiar with forensics tools
3. To learn cybercrime legal investigations

Course Outcomes:

On completion of course student will able to:

1. Classify the cybercrime based on their type
2. Explore Cybercrime/Cyber Forensic concepts along with multiple tools.
3. Use Cyber forensic in cybercrime legal investigation

SECTION - I

Unit-1 Introduction to Cyber Security

(7)

Introduction, Definition and Origins of the Word, Cybercrime and Information Security, Who are Cyber Criminals, Classification of Cybercrimes, How Criminal plan the Attack, Cyberstalking.

Unit-2 Tools and Method used in cybercrime

(7)

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and spywares, Virus and worms, Trojan Horses and Backdoors, DoS and DDoS Attacks, SQL Injection, Buffer Overflow .

Unit-3 Cyber Crime : The Legal Perspectives

(6)

Introduction, Cybercrime and Legal Landscape around the World, Why do we need cyber law: the Indian Context, The Indian IT Act, Digital Signature and Indian IT Act, Amendment to the Indian IT Act.

SECTION– II

Unit - 4 Understanding Computer Forensics

(7)

Introduction, Background of Cyber Forensics , Digital Forensics Science, Need for Computer Forensics , Cyber forensics and Digital Evidence, Digital Forensics Life Cycle, Chain of Custody Concept, Challenges in Computer Forensics,

Unit- 5 Network Forensics

(8)

Network Basics for Digital Investigators: Introduction, Network basics for digital investigators: History, Technical overview, Network Technologies, Connecting networks using Internet Protocols.

Applying Forensic Science to Networks: Preparation & Authorization, Identification, Documentation Collection Preservation, Filtering Data reduction, Class / Individual characteristics, evaluation of source, evidence recovery, investigation reconstruction, reporting results.

Unit - 6 Forensics of Hand-Held Devices

(6)

Introduction, Understanding Cell Phone Working Characteristics, Hand-Held Devices and Digital Forensics, Toolkits for Hand-Held Device Forensics, Techno-Legal Challenges with Evidence from Hand-Held Devices.

Internal Continuous Assessment (ICA):

Minimum 8 to 10 Experiments/Assignments based on above topic

Textbooks

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole, SunitaBelapure
2. Digital Evidence & Computer Crime – Forensic science, Computers & The Internet’, Eoghan Casey, 3rd edition
3. ‘Computer Forensics Computer Crime scene investigation’, 2nd edition, John R. Vacca

Reference Books

- 1.‘Computer Forensics Investigating Network Intrusions & Cybercrime’, EC–Council press, Cengage Learning
2. Guide to Computer Forensics & Investigations, 4th edition, Bill Nelson, Amelia Phillips & Christopher Steuart, Cengage Learning

3. 'Guide to Integrating Forensic Techniques into Incident Response', NIST, Karen Kent, Suzanne Chevalier Tim Grance, Hung Dang