

# **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



NAAC Accredited-2015'B' Grade (CGPA 2.62)

## **Name of the Faculty: Science and Technology**

### **CHOICE BASED CREDIT SYSTEM**

## **Structure and Syllabus**

### **Computer Science & Engineering and Information Technology**

Name of the Course: S.Y. B.Tech with Honors

Name of the Course: T.Y. B.Tech with Honors

Name of the Course: Final Year B.Tech with Honors

(Syllabus for Final Year B. Tech to be implemented w.e.f. June- 2023-24)



### A. Program Educational Objectives

1. To make students competent for professional career in Computers, IT & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Computers, IT & 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 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 in diverse 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 the 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 (PSOs)**

1. Graduate has an ability to use technical skills necessary for design, maintenance, development and implementation of database systems and networking applications.
2. Graduate has an ability to provide IT solutions, develop mobile applications in multi-disciplinary areas using standard tools and techniques.
3. Graduate has an ability to utilize and apply software engineering tools for design and realization of projects in various domains of Computer Science and Engineering.

## Syllabus for Honors Degree – Artificial Intelligence and Machine Learning



### Computer Science & Engineering and Information Technology

| Course Code | Year&Sem        | Course Name                 | Hrs./week |   |    | Credits | Examination Scheme |     |     |       |
|-------------|-----------------|-----------------------------|-----------|---|----|---------|--------------------|-----|-----|-------|
|             |                 |                             | L         | T | P  |         | ISE                | ESE | ICA | Total |
| Hn411       | B.Tech. Sem IV  | Machine Learning            | 3         | 1 |    | 4       | 30                 | 70  | 25  | 125   |
| Hn512       | B.Tech. Sem V   | Reinforcement Learning      | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
| Hn513       | B.Tech. Sem V   | Seminar                     |           |   | 2* | 1       |                    |     | 25  | 25    |
| Hn614       | B.Tech. Sem VI  | Natural Language Processing | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
| Hn715       | B.Tech. Sem VII | Mini Project                |           |   | 4* | 2       |                    | 50  | 50  | 100   |
| Hn716       | B.Tech. Sem VII | Deep Learning               | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
|             |                 | <b>Sub Total</b>            | 12        | 1 | 12 | 19      | 120                | 330 | 175 | 625   |

\*indicates contact hours



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Second Year B.Tech. (CSE & IT) Honors Degree in AI & Machine Learning**  
**SEMESTER - IV**  
**Hn411 : MACHINE LEARNING**

**Teaching Scheme**

Lecture: 3 Hours /Week, 3 Credits

Tutorial: 1 Hours /Week, 1 Credit

**Examination Scheme**

ESE – 70 Marks

ISE – 30 Marks

ICA - 25 Marks

**COURSE OBJECTIVES:**

1. To introduce various types of machine learning algorithms.
2. To enable designing of a model selecting appropriate machine learning algorithms for a given problem.
3. To study methods to validate previously designed machine learning models.
4. To introduce methods to evaluate and tune machine learning models.

**COURSE OUTCOMES:**

At the end of the course students will be able to

1. Demonstrate types of machine learning algorithms.
2. Design a model by selecting appropriate machine learning algorithm for a given problem.
3. Validate designed machine learning model.
4. Evaluate and tune machine learning model based on various parameters.
5. Design various applications using machine learning algorithm.

**SECTION I**

**Unit 1: Introduction to Machine learning**

**(08)**

Understanding Machine Learning: What Is Machine Learning?, Leveraging the Power of Machine Learning, The Roles of Statistics and Data Mining with Machine Learning, Putting Machine Learning in Context, Types of machine Learning, Applications of Machine Learning. Applying Machine Learning: Getting Started with a Strategy, Applying Machine Learning to Business Needs, Understanding Machine Learning Techniques, Tying Machine Learning Methods to Outcomes.

**Unit 2: Offerings of Machine learning**

**(05)**

Looking Inside Machine Learning: The Impact of Machine Learning on Applications, Data Preparation, The Machine Learning Cycle.

Getting Started with Machine Learning: Understanding How Machine Learning Can Help, Focus on the Business Problem, Requirement of Collaboration in Machine Learning, Executing a Pilot Project, Determining the Best Learning Model.

**Unit 3: Basic mathematics for Machine Learning**

**(10)**

Getting Started with The Math Basics, Working with Data, Exploring the World of Probabilities, Describing the Use of Statistics, Interpreting Learning As Optimization, Exploring Cost Functions, Descending the Error Curve, Updating by Mini-Batch and Online.

**SECTION II**

**Unit 4: Validating Machine Learning Models**

**(10)**

Validating Machine Learning: Checking Out-of-Sample Errors, Getting to Know the Limits of Bias, Keeping Model Complexity in Mind and Solutions Balanced, Training,

Validating, and Testing, Resorting to Cross-Validation. Looking for Alternatives in Validation. Optimizing Cross-Validation Choices, Avoiding Sample Bias and Leakage Traps, Discovering the Incredible Perceptron

**Simplest learning strategies to learn from Data:** Discovering the Incredible Perceptron, Growing Greedy Classification Trees, Taking a Probabilistic Turn

**Unit 5: Improving Machine Learning Models (08)**

Improving Machine Learning Models, Studying Learning Curves, Using Cross-Validation Correctly, Choosing the Right Error or Score Metric, Searching for the Best Hyper-Parameters, Testing Multiple Models, Averaging Models, Stacking Models, Applying Feature Engineering, Selecting Features and Examples, Looking for More Data.

**Unit 6: Applications of Machine Learning (04)**

Applying Learning to Real Problems, Classifying Images, Scoring Opinions and Sentiments, Recommending Products and Movies, Using Machine Learning to Provide Solutions to Business Problems, Future of Machine Learning.

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**Internal Continuous Assessment (ICA):**

Student should implement the following:

1. Basic mathematics for Machine Learning – Simulating solutions using Python to
  - i. Matrix operations
  - ii. Problems using Probability
  - iii. Statistical Estimations.
2. Introduction to Jupyter Notebook and Colab.
3. Working with data.
4. Data Exploration and Preprocessing.
5. Linear Regression
6. Introduction to Dimensionality Reduction
7. Logistic Regression
8. Decision Trees
9. Ensemble Models
10. Clustering (Unsupervised Learning)

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**Text Books:**

1. Machine Learning For Dummies, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch (Published by Wiley, First edition).
2. Machine Learning For Dummies by John Paul Mueller, Luca Massaron (Published by ForDummies; First edition).

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**Reference Books :**

1. Introduction to Machine Learning (Second Edition) by Ethem Alpaydm (published by The MIT Press Cambridge, Massachusetts London, England
2. Machine Learning by Tom M. Mitchell (Publisher: McGraw Hill Education; First edition + New Chapters from Second edition).



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Third Year B.Tech. (CSE & IT) Honors Degree in AI & Machine Learning**  
**SEMESTER - V**

**Hn411 : REINFORCEMENT LEARNING**

**Teaching Scheme**

Lecture : 3 Hours /Week, 3 Credits

Practical : 2 Hours /Week, 1 Credit

**Examination Scheme**

ESE – 70 Marks

ISE – 30 Marks

ICA - 25 Marks

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**Introduction :**

Reinforcement learning is an area of machine learning, where an agent or a system of agents learns to archive a goal by interacting with their environment. In recent years there has been success in reinforcement learning research in both theoretical and applied fields. This course primarily focuses on training students to frame reinforcement learning problems and to tackle algorithms from dynamic programming, Monte Carlo and temporal-difference learning.

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**Course Prerequisite:**

A basic course on Artificial Intelligence & Machine learning

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**Course Outcomes:**

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

1. Demonstrate the fundamental mathematical models and algorithms in the field of NLP.
2. Apply these mathematical models and algorithms in applications of software design and implementation for NLP.
3. Use tools to analyze language resource annotation and apply to data for acquiring intended information.
4. Design and implement various NLP applications.

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**SECTION I**

**Unit 1 Introduction**

**(05)**

Reinforcement Learning, Examples, Elements of Reinforcement Learning, History of Reinforcement Learning

**Unit 2 Evaluative Feedback**

**(05)**

A k-armed Bandit Problem, Action-value Methods, The 10-armed Test-bed, Incremental Implementation

**Unit 3 The Reinforcement Learning Problem**

**(06)**

The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, Value Functions, Optimal Value Functions, Optimality and Approximation

**Unit 4 Finite Markov Decision Processes**

**(06)**

The Agent–Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions.

## SECTION II

### **Unit 5 Dynamic Programming (05)**

Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming, Introduction to Monte Carlo Methods.

### **Unit 6 Temporal-Difference Learning (05)**

TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), SARSA: On-policy TD Control, Q-learning: Off-policy TD Control.

### **Unit 7 Planning and Learning (06)**

Models and Planning, Dyna: Integrating Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Expected vs. Sample Updates.

### **Unit 8 Applications and Case Studies (06)**

TD-Gammon, Samuel's Checkers Player, Watson's Daily-Double Wagering, Mastering the Game of Go and AlphaGo.

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#### **Internal Continuous Assessment (ICA) :**

Analysis and implementation of

1. Flappy Kernel Markov Decision Process
2. Implementation of Performance Difference Lemma.
3. Implementation of Pong with Deep Q Learning.
4. Estimation of Warfarin Dose
5. Implementing Bayesian regret bound for Thomson Sampling

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#### **Text Books:**

1. Reinforcement Learning: An Introduction (Second edition + Upcoming Edition) by: Richard S. Sutton and Andrew G. Barto, MIT Press Publication  
(The book is available at <http://incompleteideas.net/book/the-book-2nd.html>  
Upcoming edition's January 2018 draft available at  
<http://incompleteideas.net/book/bookdraft2018jan1.pdf>)

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#### **Reference Books:**

1. Reinforcement Learning: With Open AI, TensorFlow and Keras Using Python By Abhishek Nandy, Manisha Biswas. Apress Publication
2. Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds.
3. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville.



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



**Faculty of Science and Technology**  
**Third Year B.Tech. (CSE &IT) Honors Degree in AI & Machine Learning**  
**SEMESTER - V Hn513 : SEMINAR**

**Teaching Scheme**

Practical – 2 Hours/week, 1 Credit

**Examination Scheme**

ICA – 25 Marks

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**Course Objectives:**

1. To study, analyze & prepare a topic for presentation on emerging technology.
2. To exhibit effective communication.
3. To work in teams having brainstorming session for group discussion.

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**Course Outcomes:**

At the end of the course students will be able to

1. Explore research areas and conduct literature survey to decide seminar topic.
2. Compile information and knowledge effectively
3. Effectively communicate their work in writing and oral presentation
4. Inculcate habit of self study and lifelong learning

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Every student of Honors Degree will give a seminar on a topic related to their domain from the honors degree. Seminar should consist of a presentation of about 30-40 minutes. The seminar should be based on topics in the emerging area in which the student has carried out the literature survey. The student will also propose a problem which he intends to give a solution in his project work to be carried out in subsequent semesters. A report on the seminar should be submitted to the department. Assessment should be jointly done by panel of teachers consisting of respective guide and other teachers from the department working in the area of the domain included in the respective honors degree.



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**Faculty of Science and Technology**

**Third Year B.Tech. (CSE & IT) Honors Degree in AI & Machine Learning**  
**SEMESTER - VI**

**Hn614 : NATURAL LANGUAGE PROCESSING**

**Teaching Scheme**

Lectures : 3 Hours/Week, 3 Credit

Practical : 2 Hours/Week, 1 Credit

**Examination Scheme**

ESE – 70 Marks

ISE – 30 Marks

ICA – 25 Marks

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**SECTION-I**

**Unit 1 Introduction**

**(06)**

Introduction to NLP, Machine Learning and NLP, Biology of Speech Processing; Place and Manner of Articulation, Word Boundary Detection, Arg-Max Computation, Lexical Knowledge Networks.

**Unit 2 Word-net Theory**

**(06)**

Semantic Roles, Word Sense Disambiguation (WSD): Word-Net, Word-net Application in Query Expansion, Wiktionary, semantic relatedness, Measures of Word-Net Similarity, Similarity Measures. Resnick's work on Word-Net Similarity, Indian Language Word-nets and Multilingual Dictionaries, Multi-linguality, Metaphors, Co references

**Unit 3 Theories of Parsing**

**(06)**

Parsing Algorithms, Evidence for Deeper Structure, Top-Down Parsing Algorithms, Noun Structure, Non-noun Structure and Parsing Algorithms, Robust and Scalable Parsing on Noisy Text in Web documents, Probabilistic parsing, Hybrid of Rule Based and Probabilistic Parsing sequence labeling, Training issues, Arguments and Adjuncts inside-outside probabilities, Scope Ambiguity and Attachment Ambiguity resolution

**SECTION-II**

**Unit 4 Speech**

**(06)**

Phonetics, HMM, Morphology, Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning ; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

**Unit 5 Semantic Relations**

**(06)**

UNL, Towards Dependency Parsing, Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm, HMM and Speech Recognition. HMM training, Baum Welch Algorithm; HMM training

**Unit 6 Applications**

**(06)**

Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

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**Internal Continuous Assessment (ICA) :**

Minimum 8 to 10 assignments on the above topics.

**Text Books:**

1. Allen, James, “Natural Language Understanding”, Second Edition, Benjamin/Cumming,1995.
  2. Charniack, Eugene, “Statistical Language Learning”, MIT Press,1993.
  3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, PrenticeHall,2008.
  4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural LanguageProcessing, MIT Press,1999.
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**Reference Books:**

1. Jurafsky, D., and Martin, J.H. (2008). “Speech and Language Processing” (2nd Edition). Upper Saddle River, NJ: PrenticeHall
2. Bird, S., Klein, E., Loper, E. (2009). “Natural Language Processing with Python”. Sebastopol



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**Faculty of Science and Technology**  
**Final Year B.Tech. (CSE & IT) Honors Degree in AI & Machine Learning**  
**SEMESTER – VII**  
**HN715 : MINI PROJECT**

**Teaching Scheme**

Practical: 4 Hours/Week, 2 credits

**Examination Scheme**

ESE - 50 Marks

ICA - 50 Marks

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**Introduction :**

Project based learning is a paradigm which is becoming time-honored now a days. To keep abreast with this, Project course is included in the curriculum which is spread over both semesters of final year. For this course, students carry out a project as a team that allows them to demonstrate their abilities and to develop skills within their chosen area of interest. Hardware realization as well software projects with focus on design and research aspects are accepted. Also communicating effectively, both in oral and written form are an important skill for engineering graduates in many different contexts. This course also aims to foster these skills.

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**Course Prerequisite:**

Student shall have technical competency as well as behavioral facet to carry project as a part of a team. Student shall have an adept knowledge of hardware and software architecture and associated programming skills. Student shall also possess necessary technical report writing skills, presentation skills.

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**Course Objectives :**

1. Explore project identification process and carryout literature survey for real world problem.
2. Evaluate alternative approaches, and justify the use of selected tools and methods.
3. Consider relevant social, ethical and legal issues.
4. Give an exposure to planning and designing a project.
5. Enhance team working and leadership skills.
6. Enhance presentation and technical documentation skills.

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**Course Outcomes :**

1. Study and select problem of societal relevance.
2. Select an appropriate solution design with due consideration for society.
3. Carry out impact analysis for environment and sustainability consideration(s).
4. Design a system using software engineering techniques and modern tools.
5. Engage in teamwork and communicate effectively, while observing professional ethics.



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**

**Faculty of Science and Technology**

**Final Year B.Tech. (CSE & IT) Honors Degree in AI & Machine Learning**

**SEMESTER – VII**

**HN716 : DEEP LEARNING**

**Teaching Scheme**

Lectures: 3 Hours/Week, 3 credits

Practical: 2 Hour/Week, 1 credit

**Examination Scheme**

ESE - 70 Marks

ISE - 30 Marks

ICA - 25 Marks

**Introduction:**

Deep Learning is one of the most exciting and promising segments of Artificial Intelligence and machine learning technologies. Advancements in deep learning are being seen in various real world applications. This course is designed to help master deep learning techniques and build using Tensor Flow, an open-source software library developed by Google for the purpose of conducting machine learning and deep neural networks. It is one of the most popular software platforms used for deep learning and contains powerful tools to help you build and implement artificial neural networks. With this Tensor flow course, you'll build expertise in deep learning models, learn to operate Tensor Flow to manage neural networks and interpret the results.

**Course Prerequisite:**

A basic course in Artificial Intelligence, Machine Learning, Theory of computation and parsers.

**Course Objectives:**

1. Learn how to use Tensor Flow for building and testing Deep Learning models
2. Compare various CNN architectures
3. Know the importance of Regularization and Optimization techniques in Deep Learning networks
4. Learn Deep Learning models for working with sequential data
5. Get motivated to deal with functioning of the most common types of Auto encoders and apply such mechanisms to various learning problems.

**Course Outcomes:**

After successful completion of the course student will be able to:

1. Demonstrate the fundamentals of Deep Learning
2. Describe the concepts of Tensor Flow, its main functions, operations and the execution pipeline
3. Improve deep learning models using Regularization and Optimization techniques
4. Compare the Convolution Neural Network architectures and use them as per the application
5. Design and implement Sequence Neural Network systems and solve real-world problems
6. Demonstrate the working of Auto encoders and use them for real-life applications

## SECTION – I

### **Unit 1 - Introduction to Deep learning (05)**

History of Deep Learning- A Probabilistic Theory of Deep Learning, Introduction to Deep Feed forward Networks, Gradient Based Learning, Hidden Units Architecture-Design, Back propagation Algorithm

### **Unit 2 – Tensor Flow for Deep learning (08)**

Introduction to TensorFlow using Python: Computational Graph, Key Highlights, Creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras, Preprocessing and Data Augmentation of Images and Datasets using TensorFlow

### **Unit 3 – Regularization and Optimization Techniques (08)**

**Regularization:** Need of Regularization, L2 Regularization, L1 Regularization, Early Stopping and Dropout,

**Optimization:** Challenges in NN Optimization, Gradient Descent Approaches, Parameter Initialization Approach, Adaptive Approaches - AdaGrad, RMSProp and Adam, Introduction to Batch Normalization

## SECTION – II

### **Unit 4 – Evolution of CNN in Deep Learning (08)**

Review of CNN Architecture, Introduction of various CNN Architectures: LeNet, AlexNet, VGG, GoogleNet, ResNet and UNet, Comparison of CNN Architectures, Evaluation Parameters, Applications of CNN in Image Classification and Object Detection

### **Unit 5 – Sequence Modeling (08)**

Recurrent and Recursive Nets: Recurrent Neural Networks, Bidirectional RNN, Encoder Decoder Architectures, Introduction to Long Short-Term Memory (LSTM) and Temporal Dependencies, Gated Recurrent Units (GRUs), Applications of RNN in Real World- Image Captioning and Time Series Forecasting and Prediction

### **Unit 6 – Encoder Decoder Models (08)**

Autoencoder: Encoder-Decoder Model, Training & Learning Manifold Space, Regularized Autoencoders: Sparse, De-noising and Contractive, Deep Autoencoder: Architecture and Working, Variational Autoencoders: Limitations of Autoencoders, Loss Function, Re-parameterization Trick, Latent Space Visualization, Applications of Autoencoders and Variational Autoencoders-Dimensionality Reduction, Image De-noising and Compression

**Text Books:**

1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing, 2018.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

**Reference books**

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer-Verlag, 2006.
2. Duda, Richard, Peter Hart, and David Stork, Pattern Classification, 2<sup>nd</sup> edition, Wiley-Interscience, 2000.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
4. Reza Zadeh, Bharath Ramsundar, TensorFlow for Deep Learning, 1<sup>st</sup> edition, O'Reilly Media Inc, 2018.
5. Zaccone, Giancarlo, Deep Learning with TensorFlow, 2<sup>nd</sup> edition, Packt Publishing, 2018.

**Online Resources:**

1. [https://www.tensorflow.org/tutorials/images/data\\_augmentation](https://www.tensorflow.org/tutorials/images/data_augmentation)
2. <https://towardsai.net/p/machine-learning/improving-artificial-neural-network-with-regularization-and-optimization>
3. <https://towardsdatascience.com/regularization-techniques-for-neural-networks-e55f295f2866>
4. <https://www.kaggle.com/sid321axn/regularization-techniques-in-deep-learning>
5. <https://medium.com/@minions.k/optimization-techniques-popularly-used-in-deep-learning-3c219ec8e0cc>
6. <https://www.jeremyjordan.me/variational-autoencoders/>

**Internal Continuous Assessment (ICA):**

ICA shall include at least eight of the following:

1. Introduction to Google Colab, TensorFlow 2.0, Keras API
2. Introduction to Tensorflow , Overview of Machine Learning (Process and Techniques)
3. Demonstration of ML concepts with Deep Playground.
4. Data Input and Preprocessing with Tensorflow.
5. Machine Learning Model Building.
6. Prediction with Tensorflow
7. Monitoring and evaluating models using Tensorboard
8. Advance Tensorflow (Building custom models - CNNs, Scaling up for large datasets) and Distributed training with hardware accelerators



## Structure and Syllabus for Honors Degree–Data Science

### Computer Science & Engineering and Information Technology

| <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> |
| Hn421              | B.Tech. Sem IV  | Mathematics for DataScience        | 3                | 1        |          | 4              | 30                        | 70         | 25         | 125          |
| Hn522              | B.Tech. Sem V   | Data Preprocessing & Visualization | 3                |          | 2        | 4              | 30                        | 70         | 25         | 125          |
| Hn523              | B.Tech. Sem V   | Seminar                            |                  |          | 2*       | 1              |                           |            | 25         | 25           |
| Hn624              | B.Tech. Sem VI  | Machine Learning                   | 3                |          | 2        | 4              | 30                        | 70         | 25         | 125          |
| Hn725              | B.Tech. Sem VII | Mini Project                       |                  |          | 4*       | 2              |                           | 50         | 50         | 100          |
| Hn726              | B.Tech. Sem VII | Predictive Analytics               | 3                |          | 2        | 4              | 30                        | 70         | 25         | 125          |
| <b>Sub Total</b>   |                 |                                    | 12               | 1        | 12       | 19             | 120                       | 330        | 175        | 625          |

\*indicates contact hours





**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Second Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER - IV**

**Hn421 : MATHEMATICS FOR DATA SCIENCE**

**Teaching Scheme**

Lecture: 3 Hours /Week, 3 Credits

Tutorial: 1 Hours /Week, 1 Credits

**Examination Scheme**

ESE – 70 Marks

ISE – 30 Marks

ICA -25 Marks

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**Introduction:**

Data science is a field of study and application that has been growing rapidly for the past several decades. As a growing field, it is gaining a lot of attention in both the media as well as in the job market. This course introduces the fundamentals of mathematics which are used by data scientists to solve the real time problems.

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**Course Prerequisite:** Basics of Linear algebra, Probability, Statistics

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**COURSE OUTCOMES:**

Students will be able to:

1. Use the properties of Linear Maps in solving problems on Linear Algebra
2. Build a strong statistical foundation and learn how to ‘infer’ insights from a huge population using a small sample.
3. Demonstrate various random variables, discrete and continuous distributions and their usage
4. Use optimization techniques and formulate hypotheses for a population to solve real-life business problems.

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**SECTION-I**

**Unit 1–Basics of Data Science:**

**(04)**

Introduction to data science, Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective, Structured thinking for solving data science problems.

**Unit 2–Linear Algebra**

**(10)**

Vectors, Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigen values and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyper planes; half-planes.

**Unit 3- Statistics**

**(08)**

Describing a Single Set of Data, Central Tendencies, Dispersion, Correlation, Simpson’s Paradox, Correlation & causation.

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**SECTION-II**

**Unit 4- Probability**

**(08)**

Dependence and Independence, Conditional Probability, Bayes’s Theorem, Random Variables Continuous Distributions, The Normal Distribution, The Central Limit Theorem.

**Unit 5- Hypothesis and Inference**

**(06)**

Statistical Hypothesis Testing, Confidence Intervals, P- hacking, Bayesian Inference

**Unit 6: Optimization****(08)**

Unconstraint optimization ,necessary and sufficiency conditions for optima, gradient descent methods, constraint optimization, KKT condition, Introduction to non-gradient techniques, Introduction to least squares optimization, Optimization view of machine learning,

**Internal Continuous Assessment (ICA):**

ICA should consist of Solving 8- 10 assignments on above units

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**Text Books :**

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media
  2. David G. Luenberger (1969), Optimization by Vector Space Methods, John Wiley & Sons (NY).
  3. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
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**Reference Books:**

1. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures, 4thEdition,JohnWiley & Sons, Inc., NY, USA.
2. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers, 5<sup>th</sup> Edition,JohnWiley & Sons, Inc., NY,USA.
3. Cathy O'Neil and Rachel Schutt (2013). Doing Data Science, O'Reilly Media
4. Data Sciences, Jain V.K., Khanna Publishing House, Delhi



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Third Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER – V**

**Hn522 : DATA PRE-PROCESSING AND VISUALIZATION**

**Teaching Scheme**

Lecture: 3 Hours /Week, 3 Credits  
Practical :2 Hours /Week, 1 Credits

**Examination Scheme**

ESE- 70 Marks  
ISE – 30 Marks  
ICA -25 Marks

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**Introduction:**

Data science is a field of study and application that has been growing rapidly for the past several decades. As a growing field, it is gaining a lot of attention in both the media as well as in the job market. This course will introduce students to data pre-processing and visualization techniques and tools.

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**Prerequisite:**

Fundamentals of Python Programming

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**COURSE OUTCOMES:**

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

1. Identify the different types of data
2. Transform raw data into understandable format
3. Use python libraries for data pre processing and visualization
4. Represent the data in various graphical forms.

---

**SECTION - I**

**Unit 1 - Introduction and Describing Data (6)**

Overview, Sources of Data ,Process for Making Sense of Data, Observations and Variable , Types of Variables, Central Tendency, Distribution of the Data, Confidence Intervals, Hypothesis Tests

**Unit 2 - Preparing Data Tables (8)**

Overview, Cleaning the Data, Removing Observations and Variables, Generating Consistent Scales Across Variables, New Frequency Distribution, Converting Text to Numbers, Converting Continuous Data to Categories, Combining Variables, Generating Groups, Preparing Unstructured, Data Visualizing Relationships between Variables, Calculating Metrics about Relationships.

**Unit 3 - Introduction to NumPy (8)**

Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything in Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing ,Sorting Arrays, Structured Data: NumPy's Structured Arrays

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**SECTION-II**

**Unit 4 - Data Manipulation with Pandas (7)**

Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and

Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance Pandas.

**Unit 5 - Data Visualization**

**(6)**

Overview, Visualization Design Principles, Tables, Univariate Data Visualization, Multivariate Data Visualization, Visualizing Groups, Dynamic Techniques

**Unit 6 - Visualization with Matplotlib and Seaborn**

**(9)**

General Matplotlib Tips, Two Interfaces for the Price of One, Simple Line Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Matplotlib: Configurations and Stylesheets, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Introduction to Seaborn: Seaborn functionalities and usage, Spatial Visualizations and Analysis in Python with Folium, Case Study.

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**Internal Continuous Assessment (ICA):**

ICA should consist of Solving 8- 10 practical assignments on above units.

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**Text Book:**

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and DataMining, John Wiley Publishers, 2014. (Unit- I and II)
2. Glenn J. Myatt, Making sense of Data: A practical Guide to Data Visualization, Advanced DataMining Methods and Applications, John Wiley Publishers, 2009.(Unit-V)
3. Python Data Science Handbook – Essential Tools for working with Data : Jake VanderPlas,O’rielly (Unit III, IV, VI)



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Third Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER - V**  
**Hn523 : SEMINAR**

**Teaching Scheme**

Practical – 2 Hours/week, 1 credit

**Examination Scheme**

ICA – 25 Marks

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**Course Objectives:**

1. To study, analyze & prepare a topic for presentation on emerging technology.
  2. To exhibit effective communication.
  3. To work in teams having brainstorming session for group discussion.
- 

**Course Outcomes:**

At the end of the course students will be able to

1. Explore research areas and conduct literature survey to decide seminar topic.
  2. Compile information and knowledge effectively
  3. Effectively communicate their work in writing and oral presentation
  4. Inculcate habit of self study and lifelong learning
- 

Every student of Honors Degree will give a seminar on a topic related to their domain from the honors degree. Seminar should consist of a presentation of about 30-40 minutes. The seminar should be based on topics in the emerging area in which the student has carried out the literaturesurvey. The student will also propose a problem which he intends to give a solution in hisproject work to be carried out in subsequent semesters. A report on the seminar should be submitted to the department. Assessment should be jointly done by panel of teachers consisting of respective guide and other teachers from the department working in the area of the domain included in the respective honors degree.



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Third Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER - VI**  
**Hn624 : MACHINE LEARNING**

**Teaching Scheme**

Lecture: 3 Hours /Week, 3 Credits

Practical : 2 Hours /Week, 1 Credit

**Examination Scheme**

ESE – 70 Marks

ISE – 30 Marks

ICA - 25 Marks

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**COURSE OBJECTIVES:**

1. To introduce various types of machine learning algorithms.
2. To enable designing of a model selecting appropriate machine learning algorithms for a given problem.
3. To study methods to validate previously designed machine learning models.
4. To introduce methods to evaluate and tune machine learning models.

---

**COURSE OUTCOMES:**

At the end of the course students will be able to

1. Demonstrate types of machine learning algorithms.
2. Design a model by selecting appropriate machine learning algorithm for a given problem.
3. Validate designed machine learning model.
4. Evaluate and tune machine learning model based on various parameters.
5. Design various applications using machine learning algorithm.

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**SECTION I**

**Unit 1: Introduction to Machine learning (08)**

Understanding Machine Learning: What Is Machine Learning?, Leveraging the Power of Machine Learning, The Roles of Statistics and Data Mining with Machine Learning, Putting Machine Learning in Context, Types of machine Learning, Applications of Machine Learning. Applying Machine Learning: Getting Started with a Strategy, Applying Machine Learning to Business Needs, Understanding Machine Learning Techniques, Tying Machine Learning Methods to Outcomes.

**Unit 2: Offerings of Machine learning (05)**

Looking Inside Machine Learning: The Impact of Machine Learning on Applications, Data Preparation, The Machine Learning Cycle.

Getting Started with Machine Learning: Understanding How Machine Learning Can Help, Focus on the Business Problem, Requirement of Collaboration in Machine Learning, Executing a Pilot Project, Determining the Best Learning Model.

**Unit 3: Basic mathematics for Machine Learning (10)**

Getting Started with The Math Basics, Working with Data, Exploring the World of Probabilities, Describing the Use of Statistics, Interpreting Learning As Optimization, Exploring Cost Functions, Descending the Error Curve, Updating by Mini-Batch and Online.

## SECTION II

### **Unit 4: Validating Machine Learning Models (10)**

Validating Machine Learning: Checking Out-of-Sample Errors, Getting to Know the Limits of Bias, Keeping Model Complexity in Mind and Solutions Balanced, Training, Validating, and Testing, Resorting to Cross-Validation. Looking for Alternatives in Validation. Optimizing Cross-Validation Choices, Avoiding Sample Bias and Leakage Traps, Discovering the Incredible Perceptron

**Simplest learning strategies to learn from Data:** Discovering the Incredible Perceptron, Growing Greedy Classification Trees, Taking a Probabilistic Turn

### **Unit 5: Improving Machine Learning Models (08)**

Improving Machine Learning Models, Studying Learning Curves, Using Cross-Validation Correctly, Choosing the Right Error or Score Metric, Searching for the Best Hyper-Parameters, Testing Multiple Models, Averaging Models, Stacking Models, Applying Feature Engineering, Selecting Features and Examples, Looking for More Data.

### **Unit 6: Applications of Machine Learning (04)**

Applying Learning to Real Problems, Classifying Images, Scoring Opinions and Sentiments, Recommending Products and Movies, Using Machine Learning to Provide Solutions to Business Problems, Future of Machine Learning.

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#### **Internal Continuous Assessment (ICA):**

Student should implement the following:

1. Basic mathematics for Machine Learning –
  - i. Simulating solutions using Python to
  - ii. Matrix operations
  - iii. Problems using Probability
  - iv. Statistical Estimations.
2. Introduction to Jupyter Notebook and Colab.
3. Working with data.
4. Data Exploration and Preprocessing.
5. Linear Regression
6. Introduction to Dimensionality Reduction
7. Logistic Regression
8. Decision Trees
9. Ensemble Models
10. Clustering (Unsupervised Learning)

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#### **Text Books:**

1. Machine Learning For Dummies, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch (Published by Wiley, First edition).
2. Machine Learning For Dummies by John Paul Mueller, Luca Massaron (Published by ForDummies; First edition).

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#### **Reference Books :**

1. Introduction to Machine Learning (Second Edition) by Ethem Alpaydm (published by The MIT Press Cambridge, Massachusetts London, England
2. Machine Learning by Tom M. Mitchell (Publisher: McGraw Hill Education; First edition + New Chapters from Second edition).



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Final Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER – VII**  
**HN725 : MINI PROJECT**

**Teaching Scheme**

Practical: 4 Hours/Week, 2 credits

**Examination Scheme**

ESE - 50 Marks

ICA - 50 Marks

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**Introduction :**

Project based learning is a paradigm which is becoming time-honored now a days. To keep abreast with this, Project course is included in the curriculum which is spread over both semesters of final year. For this course, students carry out a project as a team that allows them to demonstrate their abilities and to develop skills within their chosen area of interest. Hardware realization as well software projects with focus on design and research aspects are accepted. Also communicating effectively, both in oral and written form are an important skill for engineering graduates in many different contexts. This course also aims to foster these skills.

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**Course Prerequisite:**

Student shall have technical competency as well as behavioral facet to carry project as a part of a team. Student shall have an adept knowledge of hardware and software architecture and associated programming skills. Student shall also possess necessary technical report writing skills, presentation skills.

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**Course Objectives :**

1. Explore project identification process and carryout literature survey for real world problem.
2. Evaluate alternative approaches, and justify the use of selected tools and methods.
3. Consider relevant social, ethical and legal issues.
4. Give an exposure to planning and designing a project.
5. Enhance team working and leadership skills.
6. Enhance presentation and technical documentation skills.

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**Course outcomes :**

1. Study and select problem of societal relevance.
2. Select an appropriate solution design with due consideration for society.
3. Carry out impact analysis for environment and sustainability consideration(s).
4. Design a system using software engineering techniques and modern tools.
5. Engage in teamwork and communicate effectively, while observing professional ethics.





**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
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**Final Year B.Tech. (CSE & IT) Honors Degree in Data Science**  
**SEMESTER – VII**  
**HN726 : PREDICTIVE ANALYTICS**

**Teaching Scheme**

Lectures: 3 Hours/Week, credits  
Practical: 2 Hour/Week, 1credit

**Examination Scheme**

ESE - 70 Marks  
ISE - 30 Marks  
ICA - 25 Marks

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**COURSE OUTCOMES:**

**At the end of the course the student will able to**

1. Explore the predictive analytics and identify common use cases.
  2. Analyze and interpret data.
  3. Identify and apply appropriate algorithms for developing predictive model.
  4. Make the decision using data classification algorithms.
- 

**SECTION-I**

**Unit 1 – Entering the Arena**

**(06)**

Exploring predictive analysis, adding business values, starting predictive analytic project, ongoing predictive analysis, surveying the marketplace,

**Unit 2 – Predictive analytics in the wild**

**(04)**

Online marketing and retail, implementing a recommender system, Target marketing, personalization.

**Unit 3 – Data types and associated techniques**

**(06)**

Recognizing your data types, Identifying data categories, generating predictive analytics, connecting to related disciplines,

**Unit 4 – Complexities of data**

**(06)**

Finding value in your data, constantly changing your data, complexities in searching your data, exploration of raw data.

**SECTION-II**

**Unit 5 – Applying Models**

**(06)**

Modeling data: Models and simulations, categorizing model. Healthcare analytics case studies: Google flu trends, Cancer survivability predictors, Social and marketing analytics case studies : Target store predicts pregnant women, Twitter-based predictors of earthquakes, Twitter-based predictors of political campaign outcomes, Twitter-based predictors of the stock market.

**Unit 6 – Identifying similarities in data**

**(06)**

Explaining data clustering, Converting raw data into matrix: Creating a matrix of terms in documents, term selection, identifying groups in data: K-means clustering algorithm, clustering by nearest neighbors, Finding Association in data items.

**Unit 7 –Predicting the future using data classification**

**(06)**

Explaining data classification, introducing data classification to business, exploring the data classification process, using data classification predict the future: Decision tree, algorithm for generating decision trees, support vector machines.

**Unit 8 Developing a Road map for predictive analytics model (07)**

Ensemble methods to boost prediction accuracy: naïve bayes classification algorithms, the markov model, linear regression, neural networks, Listing the objectives, Processing the data: Identifying the data, cleaning the data, generating the derive data, reducing the dimensionality of data, applying principal component analysis, structuring the data: extracting, transforming and loading the data, keeping the data up to date, outlining testing and test

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**Internal Continuous Assessment (ICA) :**

Develop a predictive analysis model using the any dataset for the real time case studies. Tasks to be performed are:

Data exploration and analysis

1. Data preprocessing improve the quality of data for model building.
  2. Train classification algorithm or consider any machine learning algorithm.
  3. Split data into training and testing data.
  4. Evaluate the performance of the model based on prediction on testing data sets.
  5. Select the best suitable model for the given data set based on evaluation result
  6. Tune the selected model to improve its performance.
  7. Use hyper parameter tuning process using grid search technique.
  8. Develop the interface for prediction of new data.
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**Text Book :**

1. Predictive Analytics for dummies A Wiley brand: Anasse Bari, Mohamed Chaouchi, Tommy Jung. 2<sup>nd</sup> edition, published by John Wiley & Sons.
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**Reference Books :**

1. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die 2nd Edition, Kindle Edition by Eric Siegel (Author) Format: Kindle Edition
2. Olivia Parr Rud “Data Mining Cookbook: Modeling Data for Marketing, Risk, and Customer Relationship Management”, Wiley,2001.
3. Risk Management in Global Supply Chains", Wiley,2012.



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Structure & Syllabus for Honors Degree–Cyber Security**  
**Computer Science & Engineering and Information Technology**

| Course Code      | Semester        | Course Name                         | Hrs./week |   |    | Credits | Examination Scheme |     |     |       |
|------------------|-----------------|-------------------------------------|-----------|---|----|---------|--------------------|-----|-----|-------|
|                  |                 |                                     | L         | T | P  |         | ISE                | ESE | ICA | Total |
| Hn431            | B.Tech. Sem IV  | Cryptography                        | 3         | 1 |    | 4       | 30                 | 70  | 25  | 125   |
| Hn532            | B.Tech. Sem V   | Network Security and Secure Coding  | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
| Hn533            | B.Tech. Sem V   | Seminar                             |           |   | 2* | 1       |                    |     | 25  | 25    |
| Hn634            | B.Tech. Sem VI  | Cyber forensic                      | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
| Hn735            | B.Tech. Sem VII | Mini Project                        |           |   | 4* | 2       |                    | 50  | 50  | 100   |
| Hn736            | B.Tech. Sem VII | Information Auditing and Monitoring | 3         |   | 2  | 4       | 30                 | 70  | 25  | 125   |
| <b>Sub Total</b> |                 |                                     | 12        | 1 | 12 | 19      | 120                | 330 | 175 | 625   |

\*indicates contact hours



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Second Year B.Tech. (CSE & IT) Honors Degree in Cyber Security**  
**SEMESTER - IV**

**Hn431 : 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

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**SECTION – I**

**Unit 1 : Overview (06)**

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

**Unit 2 : Classical Encryption Techniques (06)**

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

**Unit 3 : Block Cipher and Data Encryption Standard (07)**

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 (08)**

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

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**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) 6<sup>th</sup> 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)



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Third Year B.Tech. (CSE & IT) Honors Degree in Cyber Security**  
**SEMESTER - V**

**Hn532 : NETWORK SECURITY AND SECURE CODING**

**Teaching Scheme**

Lectures: 3 Hours/Week, 3 credits

Practical : 2 Hour/Week, 1 credit

**Examination Scheme**

ESE: 70 Marks

ISE: 30 marks

ICA: 25 Marks

**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)**

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.

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**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 Ido Dubrawsky, Steve W. Manzuik and Ryan Permech, Wiley Dreamtech
- 

**Reference Books:**

1. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
2. Network Security - Private Communication in a Public World by Charlien Kaufman, 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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**Faculty of Science and Technology**  
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**SEMESTER - V**  
**Hn533 : SEMINAR**

**Teaching Scheme**

Practical – 2 Hours/week, 1 credit

**Examination Scheme**

ICA – 25 Marks

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**Course Objectives:**

1. To study, analyze & prepare a topic for presentation on emerging technology.
  2. To exhibit effective communication.
  3. To work in teams having brainstorming session for group discussion.
- 

**Course Outcomes:**

At the end of the course students will be able to

1. Explore research areas and conduct literature survey to decide seminar topic.
  2. Compile information and knowledge effectively
  3. Effectively communicate their work in writing and oral presentation
  4. Inculcate habit of self study and lifelong learning
- 

Every student of Honors Degree will give a seminar on a topic related to their domain from the honors degree. Seminar should consist of a presentation of about 30-40 minutes. The seminar should be based on topics in the emerging area in which the student has carried out the literature survey. The student will also propose a problem which he intends to give a solution in his project work to be carried out in subsequent semesters. A report on the seminar should be submitted to the department. Assessment should be jointly done by panel of teachers consisting of respective guide and other teachers from the department working in the area of the domain included in the respective honors degree.





**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
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**Third Year B.Tech. (CSE & IT) Honors Degree in Cyber Security**  
**SEMESTER - VI**  
**Hn634 : CYBER FORENSIC**

**Teaching Scheme**

Lectures: 3 Hours/Week, 3 credits  
Practical : 2 Hour/Week, 1 credit

**Examination Scheme**

ESE: 70 Marks  
ISE: 30 marks  
ICA: 25 Marks

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**Course Outcome (CO):**

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

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**SECTION - I**

**Unit-1 Introduction to Cyber Security (07)**

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 (07)**

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 (06)**

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 (07)**

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 (08)**

**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****(06)**

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.

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**Internal Continuous Assessment (ICA):**

Minimum 8 to 10 Experiments/Assignments based on above topic

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**Text Books :**

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole, Sunita Belapure
  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 Stuart, Cengage Learning
3. 'Guide to Integrating Forensic Techniques into Incident Response', NIST, Karen Kent, Suzanne Chevalier Tim Grance, Hung Dang



**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**Faculty of Science and Technology**  
**Final Year B.Tech. (CSE & IT) Honors Degree in Cyber Security**  
**SEMESTER – VII**  
**HN735 : MINI PROJECT**

**Teaching Scheme**

Practical: 4 Hours/Week, 2 credits

**Examination Scheme**

ESE - 50 Marks

ICA - 50 Marks

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**Introduction :**

Project based learning is a paradigm which is becoming time-honored now a days. To keep abreast with this, Project course is included in the curriculum which is spread over both semesters of final year. For this course, students carry out a project as a team that allows them to demonstrate their abilities and to develop skills within their chosen area of interest. Hardware realization as well software projects with focus on design and research aspects are accepted. Also communicating effectively, both in oral and written form are an important skill for engineering graduates in many different contexts. This course also aims to foster these skills.

---

**Course Prerequisite:**

Student shall have technical competency as well as behavioral facet to carry project as a part of a team. Student shall have an adept knowledge of hardware and software architecture and associated programming skills. Student shall also possess necessary technical report writing skills, presentation skills.

---

**Course objectives :**

1. Explore project identification process and carryout literature survey for real world problem.
2. Evaluate alternative approaches, and justify the use of selected tools and methods.
3. Consider relevant social, ethical and legal issues.
4. Give an exposure to planning and designing a project.
5. Enhance team working and leadership skills.
6. Enhance presentation and technical documentation skills.

---

**Course Outcomes :**

1. Study and select problem of societal relevance.
2. Select an appropriate solution design with due consideration for society.
3. Carry out impact analysis for environment and sustainability consideration(s).
4. Design a system using software engineering techniques and modern tools.
5. Engage in teamwork and communicate effectively, while observing professional ethics.



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**Final Year B.Tech. (CSE & IT) Honors Degree in Cyber Security**  
**SEMESTER – VII**

**HN736 : INFORMATION AUDITING AND MONITORING**

**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

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**COURSE OUTCOMES:**

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

1. Apply the Audit and Audit trails techniques.
2. Make use of monitoring and traffic analysis.
3. Have the desired knowledge on penetration testing and vulnerability assessment.
4. Apply the desired knowledge on penetration testing and vulnerability assessment.
5. Come up with counter measure techniques.

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**SECTION– I**

**Unit 1: AUDITING AND AUDIT TRAILS**

**(6)**

Accountability, Compliance, Audit Trails, Reporting timeline, Record Retention, External Auditors, Laws.

**Unit 2 : MONITORING**

**(6)**

Monitoring tools, Warning banner, Traffic analysis, Trend analysis.

**Unit 3: Information Security Performance Metrics and Audit:**

**(6)**

Security Metrics and Reporting, Common Issues and Variances of Performance Metrics, Introduction to Security Audit, Servers and Storage devices, Infrastructure and Networks, Communication Routes, Information Security Methodologies (Black-box, White-box, Greybox), Phases of Information Security Audit and Strategies, Ethics of an Information Security Auditor etc.

**SECTION– II**

**Unit 4 : PENETRATION TESTING & VULNERABILITY ASSESSMENT**

**(6)**

Customers and Legal Agreements, Rules of Engagement, Penetration Testing Planning and Scheduling, Pre-Penetration Testing Checklist, Information Gathering, Vulnerability Analysis, External Penetration Testing

**Unit 5 : PENETRATION TESTING & VULNERABILITY ASSESSMENT-2**

**(6)**

Internal Network Penetration Testing, Penetration testing for Denial of Service, Password Cracking, Social-Engineering, Stolen Laptop, PDAs and Cell phones, Application, Physical Security, Database, VoIP, VPN, War Dialing, Virus and Trojan Detection, Log Management, File Integrity Checking, BlueTooth and Handheld Device, Telecommunication and Broadband Communication.

**Unit 6 : COUNTER MEASURES****(6)**

Email Security, Security Patches, Data Leakage, Penetration Testing Deliverables and Conclusion, Penetration Testing Report and Documentation Writing, Penetration Testing Report Analysis, PostTesting Actions, Ethics of a Penetration Tester, Standards and Compliance.

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**Internal Continuous Assessment (ICA):**

ICA shall consist of minimum 8-10 practical assignment problems.

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**Text Book:**

1. Assessing Information Security (strategies, tactics, logic and framework) by A Vladimirov, K.Gavrilenko, and A. Michajlowski
  2. Information Security Audit & Monitoring (IBM ICE Publication)
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**Reference Book:**

1. <https://www.sans.org/readingroom/whitepapers/threats/implementing-vulnerability-management-process-34180>
2. <http://csrc.nist.gov/publications/nistpubs/800-40-Ver2/SP800-40v2.pdf>