A. Honors in Artificial Intelligence and Machine Learning

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*		
III	CSEHON-01A	Machine Learning	3	1		4	70	30	25		125
IV	CSEHON-02A	Reinforcement Learning	3		2	4	70	30	25		125
V	CSEHON-03A	Natural Language Processing	3		2	4	70	30	25		125
VI	CSEHON-04A	Deep Learning	3		2	4	70	30	25		125
VII	CSEHON-05A	Mini Project			4*	2			50		50
		Total	12	1	10	**18**	280	120	150		550

*indicates contact hours

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
Second Year B.Tech (Computer Science and Engineering)
Semester – III

CSEHON-01AMACHINE LEARNING

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	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.

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)

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 For Dummies; First edition).

Reference Books : 1. Introduction to Machine Learning (Second Edition) by EthemAlpaydın (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).

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Second Year B.Tech (Computer Science and Engineering)
Semester – IV

CSEHON-02A: Reinforcement Learning

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

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.

Course Prerequisite: A basic course on Artificial Intelligence & Machine learning

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.

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

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.

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

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]

Reference Books:

1. Reinforcement Learning: With Open AI, TensorFlow and Keras Using Python By AbhishekNandy, ManishaBiswas. 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, YoshuaBengio, and Aaron Courville.

B. Honors in Cyber Security

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*		
III	CSEHON-01B	Cryptography	3	1		4	70	30	25		125
IV	CSEHON-02B	Network Security and Secure Coding	3		2	4	70	30	25		125
V	CSEHON-03B	Cyber forensic	3		2	4	70	30	25		125
VI	CSEHON-04B	Information Auditing and Monitoring	3		2	4	70	30	25		125
VII	CSEHON-05B	Mini Project			4*	2			50		50
		Total	12	1	10	**18**	280	120	150		550

*indicates contact hours

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Second Year B.Tech (Computer Science and Engineering)
Semester – III

CSEHON-01B: Cryptography

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

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

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 Cryptopgraphic 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.VanOorschot, and S.A.Vanstone, “Handbook of Applied Cryptography”
2. Schneir, Bruce, “Applied Cryptography: Protocols and Algorithms”
3. Nina Godbbole --Information systems security-Security management, metrics, frameworks and best practices (WILEY)

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Semester – IV

CSEHON-02B:Network Security and Secure Coding

Teaching Scheme	**Examination Scheme**
Lectures : - 2 Hrs/Week, 2 credits	ESE : 70 Marks
Practical : - 2 Hrs/Week, 1 credit	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.

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

C. Honors in Data Science

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*		
III	CSEHON-01C	Mathematics for Data Science	3	1		4	70	30	25		125
IV	CSEHON-02C	Data Pre-processing& Visualization	3		2	4	70	30	25		125
V	CSEHON-03C	Machine Learning	3		2	**4**	70	30	25		125
VI	CSEHON-04C	Predictive Analytics	3		2	**4**	70	30	25		125
VII	CSEHON-05C	Mini Project			4*	**2**			50		50
		Total	12	1	10	**18**	280	120	150		550

*indicates contact hours

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Semester – III

CSEHON-01C:Mathematics for Data Science

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

Introduction:

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

Course Prerequisite: Basics of Linear algebra, Probability, Statistics

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.

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.

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.

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.

Reference Books:
1. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures, 4th Edition,John Wiley & Sons, Inc., NY, USA.
2. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers, 5th Edition, John Wiley & 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

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Semester – IV

CSEHON-02C:Data Pre-processing& Visualization

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

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.

Prerequisite:

Fundamentals of Python Programming

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 preprocessing 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

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.

Internal Continuous Assessment (ICA):

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

Text Book:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2014. (Unit- I and II)
2. Glenn J. Myatt, Making sense of Data: A practical Guide to Data Visualization, Advanced Data Mining 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)