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

Name of the Course: S.Y.B.Tech (C.S.E.) with Hons.

(Syllabus to be implemented from w.e.f. June 2021)

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF SCIENCE & TECHNOLOGY
Computer Science & Engineering

Programme Educational Objectives and Outcomes

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 continueprofessional development in Computers, IT & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to besuccessful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conductingtheir 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.

Proposed Syllabus for Honors Degree – Artificial Intelligence and Machine Learning

Computer Science & Engineering

Course Code	*Year&Sem*	*CourseName*	*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
	SubTotal		12	1	12	19	120	330	175	625

*indicates contact hours

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

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hours /Week, 3 Credits	ESE – 70 Marks
Tutorial: 1 Hours /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, Typesof 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 GreedyClassification 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 byWiley, First edition).
2. Machine Learning For Dummies by John Paul Mueller, Luca Massaron (Published by For Dummies; Firstedition).

Reference Books :

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Third Year B.Tech. (CSE) 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

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 tacklealgorithms 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 acquiringintended 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 forEpisodic 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, UnifiedNotation 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.

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 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) Honors Degree in AI & Machine Learning
SEMESTER - V
Hn513 : SEMINAR

Teaching Scheme	**Examination Scheme**
Practical – 2 Hours/week, 1 Credit	ICA – 25 Marks

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
Faculty of Science and Technology
Third Year B.Tech. (CSE) Honors Degree in AI & Machine Learning
SEMESTER - VI
Hn614 : NATURAL LANGUAGE PROCESSING

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hours/Week, 3 Credit	ESE – 70 Marks
Practical : 2 Hours/Week, 1 Credit	ISE – 30 Marks
	ICA – 25 Marks

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-netTheory **(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 Probablistic 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; M ximum 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).

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, Prentice Hall,2008.
4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press,1999.

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,

Proposed Syllabus for Honors Degree–Data Science

Computer Science & Engineering

Course Code	*Semester*	*Course Name*	*Hrs./week*			*Credits*	*Examination Scheme*			
			L	*T*	*P*		*ISE*	*ESE*	*ICA*	*Total*
Hn421	B.Tech. Sem IV	Mathematics for Data Science	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
	Sub Total		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) Honors Degree in Data Science
SEMESTER - IV
Hn421:MATHEMATICS FOR DATA SCIENCE

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hours /Week, 3 Credits	ESE – 70 Marks
Tutorial:1 Hours /Week, 1 Credits	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 introducesthe 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 asmall 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 datascience 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, constraintoptimization, 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,JohnWiley & Sons, Inc., NY, USA.
2. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers, 5th 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) Honors Degree in Data Science
SEMESTER – V
Hn522 : DATA PRE-PROCESSING AND VISUALIZATION

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hours /Week, 3 Credits	ESE- 70 Marks
Practical :2 Hours /Week, 1 Credits	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 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

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)

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

Teaching Scheme	**Examination Scheme**
Practical – 2 Hours/week, 1 credit	ICA – 25 Marks

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

ProposedSyllabus for Honors Degree–Cyber Security
Computer Science & Engineering

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
	Sub Total		12	1	12	19	120	330	175	625

*indicates contact hours

Punyashlok Ahilyadevi Holkar Solapur University,Solapur
Second Year B.Tech. (CSE) Honors Degree in Cyber Security
SEMESTER - IV
Hn431 : CRYPTOGRAPHY

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/Week, 3 credits	ESE: 70 Marks
Tutorial: 1 Hour/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.Van Oorschot, 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, frameworksand best practices (WILEY)

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

Hn532 : NETWORK SECURITY AND SECURE CODING

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/Week, 3 credits	ESE: 70 Marks
Practical : 2 Hour/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 Ido Dubrawsky, 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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science and Technology
Third Year B.Tech. (CSE) Honors Degree in Cyber Security
SEMESTER - V
Hn533 : SEMINAR

Teaching Scheme	**Examination Scheme**
Practical – 2 Hours/week, 1 credit	ICA – 25 Marks

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
Faculty of Science and Technology
Third Year B.Tech. (CSE) Honors Degree in Cyber Security
SEMESTER - VI
Hn634 : CYBER FORENSIC

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/Week, 3 credits	ESE: 70 Marks
Practical : 2 Hour/Week, 1 credit	ISE: 30 marks
	ICA: 25 Marks

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

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 warms, 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.

Internal Continuous Assessment (ICA):
Minimum 8 to 10 Experiments/Assignments based on above topic

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, Johm R. Vacca

---

Reference Books :

1. 'Computer Forensics Investigating Network Intrusions & Cybercrime', EC–Council press, Cengage Learning
2. Guide to Computer Forensics & Investigations, 4th edition, Bill Nelson, Amelia Phillips & Christopher Steuart, Cengage Learning
3. 'Guide to Integrating Forensic Techniques into Incident Response', NIST, Karen Kent, Suzanne Chevalier Tim Grance, Hung Dang