# COURSE STRUCTURE(R20)
# AND
# DETAILED SYLLABUS
# (IV YEAR)

## COMPUTER SCIENCE & SYSTEMS ENGINEERING

**For**
**B.Tech., Four Year Degree Course**
**(Applicable for the batches admitted from 2020-21)**


**LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY**
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (CSE,ECE, EEE & ME)
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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSSE)**

**B. Tech IV-Year Course Structure and Syllabus –R20**

| IV Year - I Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **1** | R20CSS-PE4101.1<br>R20CSS-PE4101.2<br>R20CSS-PE4101.3 | **Professional Elective Course– 3**<br>1. Cryptography & Network Security<br>2. Cyber Security & Forensics<br>3. Security in Wireless Ad Hoc Networks | PE | 3 | 0 | 0 | 3 |
| **2** | R20CSS-PE4102.1<br>R20CSS-PE4102.2<br>R20CSS-PE4102.3<br>R20CSS-PE4102.4 | **Professional Elective – 4**<br>1. Artificial Intelligence & Machine Learning<br>2. Artificial Neural Networks<br>3. Fuzzy Logic Applications<br>4. NPTEL | PE | 3 | 0 | 0 | 3 |
| **3** | R20CSS-PE4103.1<br>R20CSS-PE4103.2<br>R20CSS-PE4103.3<br>R20CSS-PE4103.4 | **Professional Elective – 5**<br>1. Big Data Analytics<br>2. Fundamentals of Data Science<br>3. Business Intelligence<br>4. NPTEL | PE | 3 | 0 | 0 | 3 |
| **4** | R20ECE-OE4101<br>R20CSS-OE4103<br>R20CSS-OE4104<br>R20CSS-OE4105 | **Open Elective Course / Job Oriented Elective-3**<br>1. Digital Image Processing<br>2. Virtual Reality<br>3. Pattern Recognition<br>4. NPTEL | OE | 3 | 0 | 0 | 3 |
| **5** | R20CSE-OE4101<br>R20CSS-OE4106<br>R20CSE-OE4107<br>R20CSS-OE4108 | **Open Elective Courses/ Job Oriented Elective-4**<br>1. Software Testing Methodologies<br>2. Digital Marketing<br>3. Ethical Hacking<br>4. NPTEL | OE | 3 | 0 | 0 | 3 |
| **6** | R20BSH-HM4101 | Universal Human Values 2: Understanding Harmony | PC | 3 | 0 | 3 | 3 |
| **7** | R20CSS-SC4101 | Data Science using Python **(Skill Oriented Course-5)** | SC | 1 | 0 | 2 | 2 |
| **8** | R20CSS-SI4101 | **Summer Internship-2 (Evaluation)** | SI | 0 | 0 | 0 | 3 |
| | | | **Total** | **19** | **0** | **5** | **23** |

| Honors Course -4 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Track No.** | **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| **1** | R20CSS-HN4101 | Internet of Things (Track-1) | HN | 3 | 0 | 2 | 4 |
| **2** | R20CSS-HN4102 | Vulnerability Assessment & Penetration Testing (Track-2) | HN | 3 | 0 | 2 | 4 |
| **3** | R20CSS-HN4103 | J2EE Framework (Track-3) | HN | 3 | 0 | 2 | 4 |
| **4** | R20CSS-HN4104 | Deep Learning (Track-4) | HN | 3 | 0 | 2 | 4 |
| **Minor Course-4** | | | | | | | |

| IV Year - II Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Course Code** | **Course Title** | **Category** | **L** | **T** | **P** | **Credits** |
| 1 | R20CSS-PJ4201 | Project Work | PJ | 0 | 0 | 0 | 12 |
| | | | **Total** | 0 | 0 | 0 | 12 |

## HONOR DEGREE IN COMPUTER SCIENCE AND SYSTEMS ENGINEERING

**Track-I (Networks)**

| S.No | Year & Semester | Course Code | Subject Title | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | II-II | R20CSS-HN2201 | Data Communication | HN | 3 | 0 | 2 | 4 |
| 2 | III-I | R20CSS-HN3101 | TCP/IP Protocol Suite | HN | 3 | 0 | 2 | 4 |
| 3 | III-II | R20CSS-HN3201 | Wireless Sensor Networks | HN | 3 | 0 | 2 | 4 |
| 4 | IV-I | R20CSS-HN4101 | Internet of Things | HN | 3 | 0 | 2 | 4 |
| 5 | II Year to IV Year | R20CSS-HNMS01.1 | Honors MOOCS-1 | HN | 0 | 0 | 0 | 2 |
| 6 | II Year to IV Year | R20CSS-HNMS01.2 | Honors MOOCS-2 | HN | 0 | 0 | 0 | 2 |
| | | | | | | | **Total** | **20** |

**Track- II (Cyber Security)**

| S.No | Year & Semester | Course Code | Subject Title | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | II-II | R20CSS-HN2202 | Information Security | HN | 3 | 0 | 2 | 4 |
| 2 | III-I | R20CSS-HN3102 | Secure Coding | HN | 3 | 0 | 2 | 4 |
| 3 | III-II | R20CSS-HN3202 | Blockchain Technologies | HN | 3 | 0 | 2 | 4 |
| 4 | IV-I | R20CSS-HN4102 | Vulnerability Assessment & Penetration Testing | HN | 3 | 0 | 2 | 4 |
| 5 | II Year to IV Year | R20CSS-HNMS02.1 | Honors MOOCS-1 | HN | 0 | 0 | 0 | 2 |
| 6 | II Year to IV Year | R20CSS-HNMS02.2 | Honors MOOCS-2 | HN | 0 | 0 | 0 | 2 |
| | | | | | | | **Total** | **20** |

**Track III (Web Frameworks)**

| S.No | Year & Semester | Course Code | Subject Title | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | II-II | R20CSS-HN2203 | Web UI Framework | HN | 3 | 0 | 2 | 4 |
| 2 | III-I | R20CSS-HN3103 | Angular Framework | HN | 3 | 0 | 2 | 4 |
| 3 | III-II | R20CSS-HN3203 | .Net Framework | HN | 3 | 0 | 2 | 4 |
| 4 | IV-I | R20CSS-HN4103 | J2EE Framework | HN | 3 | 0 | 2 | 4 |
| 5 | II Year to IV Year | R20CSS-HNMS03.1 | Honors MOOCS-1 | HN | 0 | 0 | 0 | 2 |
| 6 | II Year to IV Year | R20CSS-HNMS03.2 | Honors MOOCS-2 | HN | 0 | 0 | 0 | 2 |
| | | | | | | | **Total** | **20** |

**Track IV (Data Science)**

| S.No | Year & Semester | Course Code | Subject Title | Category | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | II-II | R20CSS-HN2204 | Advanced Python Programming | HN | 3 | 0 | 2 | 4 |
| 2 | III-I | R20CSS-HN3104 | Mathematical Essential For Data Science | HN | 3 | 1 | 0 | 4 |
| 3 | III-II | R20CSS-HN3204 | Natural Language Processing | HN | 3 | 0 | 2 | 4 |
| 4 | IV-I | R20CSS-HN4104 | Deep Learning | HN | 3 | 0 | 2 | 4 |
| 5 | II Year to IV Year | R20CSS-HNMS03.1 | Honors MOOCS-1 | HN | 0 | 0 | 0 | 2 |
| 6 | II Year to IV Year | R20CSS-HNMS03.2 | Honors MOOCS-2 | HN | 0 | 0 | 0 | 2 |
| | | | | | | | **Total** | **20** |

**IV Year-I Semester**

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4101.1 | Cryptography & Network Security **(Professional Elective – 3)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- In this course the following principles and practice of cryptography and network security are covered:
- Classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers)
- Public-key cryptography (RSA, discrete logarithms),
- Algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes,
- Email and web security, viruses, firewalls, digital right management, and other topics.

**Course Outcomes:**

1. Understand and analyse the importance of information security awareness.
2. Understand the fundamentals of secret and public cryptography
3. Implementation of protocols for security services
4. Understand the network security threats and counter measures
5. Understand and apply network security designs using available secure solutions (such as PGP,• SSL, IPSec, etc)

**UNIT- I:**

**Basic Principles:** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography

**Learning Outcomes:** student will be able to

- Analyse security goals (L4)
- Understand various cryptographic attacks (L1)
- Understand and Apply some mathematical formulae for cryptography (L1, L3)

**UNIT- II:**

Symmetric Encryption: Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

**Learning Outcomes:** student will be able to

- Understand Symmetric key Cryptography methods (L1)
- Understand fundamentals of symmetric cryptographic algorithms like DES, AES (L1)

**UNIT- III:**

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

**Learning Outcomes:** student will be able to

- Understand the asymmetric cryptography algorithms like RSA, Elliptical Cryptography (L1)
- Understand protocols for security services (L1)

**UNIT- IV:**

**Data Integrity, Digital Signature Schemes & Key Management:** Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

**Learning Outcomes:** student will be able to

- Understand the Authentication functions, the way Message Authentication Codes and Hash Functions work. (L1)
- Understand the concepts of Digital Signature and Key Management (L1)

## UNIT -V:

**Network Security-I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS

**Network Security-II:** Security at the Network Layer: IPSec, System Security

**Learning Outcomes:** student will be able to

Understand existing system security protocols like Kerberos, PGP, SSL, TLS and IPSEC

## TEXTBOOKS:


1. Cryptography and Network Security, Behrouz A Forouzan, Debdeep Mukhopadhyay, (3e) Mc Graw Hill.
2. Cryptography and Network Security, William Stallings, (6e) Pearson.
3. Everyday Cryptography, Keith M.Martin, Oxford.


## REFERENCE BOOKS:


1. Network Security and Cryptography, Bernard Meneges, Cengage Learning.
2. Cryptography and Network Security: AtulKahate, Mc Graw Hill, 2nd Edition.
3. Information Security, Principles and Practice : Mark Stamp, Wiley India.
4. Principles of Computer Sceurity: WM.Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
6. Principles of Information security by Michael E Whitman and Herbert J.Mattord.
7. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1 st Edition

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4101.2 | Cyber Security & Forensics **(Professional Elective – 3)** | 3 | 0 | 0 | 3 |

**Course Objectives**

- Able to identify security risks and take preventive steps
- To understand the forensics fundamentals
- To understand the evidence capturing process
- To understand the preservation of digital evidence

**Course Outcomes**

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

1. Enumerate the computer forensics fundamentals
2. Describe the types of computer forensics technology
3. Analyze various computer forensics systems
4. Illustrate the methods for data recovery, evidence collection and data seizure
5. Identify the Role of CERT-In Security

**Unit - 1**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

**Unit - 2**

Tools and Methods : Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares,Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

**Unit - 3**

Cyber Crime Investigation: Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

**Unit - 4**

Computer Forensics and Investigations: Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

**Unit - 5**

Cyber Crime Legal Perspectives: Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario.

**Cyber security & forensics Text Books**


1. Sunit Belapure Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY, 2011.
2. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009

**Cyber security & forensics Reference Books**


1. Michael T. Simpson, Kent Backman and James E. Corley, “Hands on Ethical Hacking and Network Defence”, Cengage, 2019.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
3. Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar “Cyber Security and Cyber Laws” , Cengage,2018.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4101.3 | Security in Wireless Ad Hoc Networks **(Professional Elective – 3)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

Prerequisite: Computer networking concepts

**Course Outcomes:**

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

1. Identify different issues in wireless ad hoc and sensor networks.
2. To analyze protocols developed for ad hoc and sensor networks.
3. To identify and address the security threats in ad hoc and sensor networks.
4. Establish a Sensor network environment for different type of applications.

**UNIT I**

**MAC & TCP IN AD HOC NETWORKS:** Fundamentals of WLANs, IEEE 802.11 Architecture, Self-configuration and Auto configuration,
Issues in Ad-Hoc Wireless Networks, MAC Protocols for Ad-Hoc Wireless Networks, Contention Based Protocols-TCP over Ad-Hoc networks, TCP protocol overview-TCP and MANETs, solutions for TCP over Ad-Hoc Networks.

**UNIT II**

**ROUTING IN AD HOC NETWORKS:** Routing in Ad-Hoc Networks, Introduction, Topology based versus Position based Approaches, Proactive, Reactive, Hybrid Routing Approach, Principles and issues ,Location services ,DREAM ,Quorums based location service, Grid–Forwarding strategies, Greedy packet forwarding ,Restricted directional flooding, Hierarchical Routing, Issues and Challenges in providing QoS.

**UNIT III**

**MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS:** Introduction, Architecture, Single node architecture, Sensor network design considerations ,Energy Efficient Design principles for WSNs, Protocols for WSN, Physical Layer : Transceiver Design considerations, MAC Layer Protocols ,IEEE802.15.4 Zigbee, Link Layer and Error Control issues-Routing Protocols, Mobile Nodes and Mobile Robots, Data Centric & Contention Based Networking ,Transport Protocols & QOS, Congestion Control issues , Application Layer support.

**UNIT IV**

**SENSOR MANAGEMENT:** Sensor Management, Topology Control Protocols and Sensing Mode Selection Protocols, Time synchronization, Localization and positioning, Operating systems and Sensor Network programming, Sensor Network Simulators.

**UNIT V**

**SECURITY IN AD HOC AND SENSOR NETWORKS:** Security in Ad-Hoc and Sensor networks, Key Distribution and Management, Software based Anti-tamper techniques, water marking techniques, Defence against routing attacks, Secure Adhoc routing protocols, Broadcast authentication WSN protocols, TESLA, Biba, Sensor Network Security Protocols, SPINS.

**Text Books**


1. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.
3. C.Siva Ram,Murthy and B.S.Manoj, “Ad Hoc Wireless Networks–Architectures and Protocols”, Pearson Education, 2004.
4. C.K.Toh, “Ad Hoc Mobile Wireless Networks”, Pearson Education, 2002.
5. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, JohnWiley and Sons, 2009.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4102.1 | Artificial Intelligence & Machine Learning **(Professional Elective – 4)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language
- To understand the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs
- To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning

**Course Outcomes:**

1. Outline problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
2. Apply the language/framework of different AI methods for a given problem
3. Implement basic AI algorithms- standard search algorithms or dynamic programming
4. Understand the characteristics of machine learning that make it useful to real-world Problems.
5. Remember machine learning algorithms as supervised, semi-supervised, and Unsupervised.

**UNIT- I:**

Introduction: history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends.

**Learning Outcomes:** student will be able to

- Understand Intelligent systems
- Analyze the foundation of AI
- Understand tic-tac-toe gaming problem

**UNIT -II:**

Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening A*, constraint satisfaction.

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha beta pruning, two-player perfect information games.

**Learning Outcomes:** student will be able to

- Understand state-space search and control strategies
- Learns about heuristic search techniques
- Understand problem reduction and game playing

**UNIT –III:**

Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

**Learning Outcomes:** student will be able to

- Understand the Logic concepts like proportional calculus and logic
- Apply the techniques on some of the examples

**UNIT -IV:**

The ingredients of machine learning: Tasks: the problems that can be solved with machine learning, Models: the output of machine learning, Features, the workhorses of machine

learning. Binary classification and related tasks: Classification, Scoring and ranking,

**Learning Outcomes:** student will be able to

- Understand machine learning algorithms as supervised, semi-supervised, and Unsupervised.
- Understand Binary classification and its related concepts

**UNIT- V:**

Beyond binary classification: Handling more than two classes, Regression, Unsupervised and descriptive learning. Tree models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction.

**Learning Outcomes:** student will be able to

- Understand how to handle more than two classes
- Understand Decision tree construction and its probability estimation

**TEXTBOOKS:**

1. Artificial Intelligence- Saroj Kaushik, CENGAGELearning
2. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig,PEA
3. Machine Learning: The art and science of algorithms that make sense of data, Peter Flach, Cambridge.
4. Machine Learning, Tom M. Mitchell, MGH.

**REFERENCE BOOKS:**

1. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz, Shai Bend avid, Cambridge.
2. Machine Learning in Action, Peter Harington, 2012, Cengage.
3. Artificial Intelligence- Deepak Khemani, TMH,2013
4. Introduction to Artificial Intelligence, Patterson,PHI
5. Atificial intelligence, structures and Strategies for Complex problem solving,-George F Lugar, 5thed, PEA

**E-RESOURCES:**

1. https://nptel.ac.in/courses/106/105/106105077/
2. http://aima.cs.berkeley.edu/

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4102.2 | Artificial Neural Networks **(Professional Elective – 4)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
- Provide knowledge of supervised learning in neural networks
- Provide knowledge of computation and dynamical systems using neural networks
- Provide knowledge of reinforcement learning using neural networks.
- Provide knowledge of unsupervised learning using neural networks.
- Provide hands-on experience in selected applications

**Course Outcomes:**

- Outline problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
- Apply the language/framework of different AI methods for a given problem
- Implement basic AI algorithms- standard search algorithms or dynamic programming
- Understand the characteristics of machine learning that make it useful to real-world Problems.
- Remember machine learning algorithms as supervised, semi-supervised, and Unsupervised.

**UNIT-1**

Introduction and ANN Structure. Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

**UNIT-2**

Mathematical Foundations and Learning mechanisms.Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.

**UNIT-3**

Single layer perceptrons. Structure and learning of perceptrons. Pattern classifier – introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptrons.

**UNIT-4**

Feed forward ANN. Structures of Multi-layer feed forward networks. Back propagation algorithm. Back propagation – training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.

**UNIT-5**

Radial Basis Function Networks. Pattern separability and interpolation. Regularization Theory. Regularization and RBF networks.RBF network design and training. Approximation properties of RBF.

**TEXT BOOKS:**

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

**REFERENCE BOOKS:**

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4102.3 | Fuzzy Logic Applications<br>**(Professional Elective – 4)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To develop the fundamental concepts such as fuzzy sets, operations and fuzzy relations.
- To lean about the fuzzification of scalar variables and the defuzzification of membership functions.
- To learn three different inference methods to design fuzzy rule based system.
- To develop fuzzy decision making by introducing some concepts and also Bayesian decision methods
- To learn different fuzzy classification methods.

**Course Outcomes:**

After successful completion of the course, the students are able to

1. Understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.
2. Understand the basic features of membership functions, fuzzification process and defuzzification process.
3. Design fuzzy rule based system.
4. Know about combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decision making process.
5. Gain the knowledge about fuzzy C-Means clustering.

**UNIT I**

Classical sets : Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations : Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

**UNIT II**

Fuzzification and Defuzzification : Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation.

**UNIT III**

Fuzzy Systems : Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

**UNIT IV**

Fuzzy decision making : Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions.

**UNIT V**

Fuzzy Classification : Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.

**TEXT BOOK(s):**

1. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.
2. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.

**REFERENCE BOOK(s):**


1. S.Rajasekaran, G.A.Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms,
2. Synthesis and Applications, PHI, New Delhi,2003.


**WEB RESOURCES:**

1. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=111106048

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4103.1 | Big Data Analytics<br>**(Professional Elective – 5)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Optimize business decisions and create competitive advantage with Big Data analytics
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- To introduce programming tools PIG & HIVE in Hadoop echo system.

**Course Outcomes:**

1. Understands data summarization, query, and analysis.
2. Applying data modelling techniques to large data sets
3. Creating applications for Big Data analytics
4. Creating a complete business data analytic solution

**UNIT-I**

Data structures in Java: Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

**Learning Outcomes:** student will be able to

- Understands sets and maps
- Understands Generic classes and wrapper classes

**UNIT-II**

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop (Name node, Data node, Secondary Name node, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

**Learning Outcomes:** student will be able to

- Understand HDFS and its basic building blocks
- Understand configuring Hadoop cluster and XML files

**UNIT III**

Hadoop I/O: The Writable Interface, Writable Comparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections, implementing a Custom Writable: Implementing a Raw Comparator for speed, Custom comparators

**Learning Outcomes:** student will be able to

- Understand and implement Hadoop I/O

**UNIT IV**

Writing MapReduce Programs: A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner

**Learning Outcomes**: student will be able to

- Understand Hadoop API for Map Reduce Framework
- Apply Map Reduce on applications

**UNIT-V**

Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive

Clients

**Learning Outcomes:** student will be able to

- Understand programming tools PIG & HIVE in Hadoop echo system.
- Creating a complete business data analytic solution

**TEXT BOOKS:**

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

**REFERENCE BOOKS:**

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, SrinathPerera, ThilinaGunarathne

**SOFTWARE LINKS:**

1. Hadoop:http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4103.2 | Fundamentals of Data Science **(Professional Elective – 5)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. Learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration
2. Understand the basic types of data and basic statistics
3. Identify the importance of data reduction and data visualization techniques

**Course Outcomes:**

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

1. Understand basic terms what Statistical Inference means.
2. Identify probability distributions commonly used as foundations for statistical modelling.
3. Fit a model to data describe the data using various statistical measures
4. utilize R elements for data handling
5. perform data reduction and apply visualization techniques.

**UNIT - I**

**Introduction:** Definition of Data Science- Big Data and Data Science hype – and getting past the hype - Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model – Over fitting. Basics of R: Introduction, R Environment Setup, Programming with R, Basic Data Types.

**UNIT - II**

**Data Types & Statistical Description:** Types of Data: Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data.

**UNIT - III**

**Vectors:** Creating and Naming Vectors, Vector Arithmetic, Vector sub setting, Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Class. Factors and Data Frames: Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames.

Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List

Elements, Merging Lists, Converting Lists to Vectors

**UNIT - IV**

**Conditionals and Control Flow:** Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. Iterative Programming in R: Introduction, While Loop, For Loop, Looping Over List. Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Recursion, Loading an R Package, Mathematical Functions in R.

**UNIT - V**

**Data Reduction:** Overview of Data Reduction Strategies, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation. Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization

Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

**TEXT BOOKS:**


1. Doing Data Science, Straight Talk from The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly, 2014
2. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd ed.
3. The Morgan Kaufmann Series in Data Management Systems.
4. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.


**REFERENCE BOOKS:**


1. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
2. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.
3. Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media, 2008.
4. Paul Teetor, "R Cookbook", O'Reilly, 2011.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-PE4103.3 | Business Intelligence **(Professional Elective – 5)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

The objective of this course is to

- learn Business Intelligence.

**Course Outcomes**

On completion of this course, the students will be able to

1. Gain knowledge of Business Intelligence
2. Build business projects
3. Generate and manage BI reports
4. Do BI Deployment, Administration & Security.

**Unit I:**

**Introduction to Business Intelligence:** Understanding the scope of today's BI solutions and how they fit into existing infrastructure Assessing new options such as SaaS and cloud-based technology. Describe BI, its components & architecture, previewing the future of BI Crafting a better experience for all business users, End User Assumptions, Setting up Data for BI, The Functional Area of BI Tools, Query Tools and Reporting, OLAP and Advanced Analytics, Supporting the requirements of senior executives, including performance management.

**Unit II:**

**Elements of Business Intelligence Solutions:** Reports & ad hoc queries; Analyse OLAP data; Dashboards & Scorecards development, Metadata Models; Automated tasks & events; Mobile & disconnected BI; Collaboration capabilities; Real time monitoring capabilities; Software development kit; Consume BI through portals, web applications, Desktop applications.

**Unit III:**

**Building the BI Project:** Planning the BI project, Project Resources; Project Tasks, Risk Management and Mitigation, Cost-justifying BI solutions and measuring success,
Collecting User Requirements, Requirements-Gathering Techniques; Prioritizing & Validating BI Requirements, Changing Requirements; BI Design and Development, Best Practices for BI Design; Post-Implementation Evaluations, Maintaining Your BI Environment.

**Unit IV:**

**Reporting authoring:** Building reports with relational vs Multidimensional data models ; Types of Reports – List, crosstabs, Statistics, Chart, map, financial etc; Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Drill up, drill- down, drill-through capabilities. Run or schedule report, different output forms – PDF, excel, csv, xml etc.

**Unit V:**

**BI Deployment, Administration & Security:** Centralized Versus Decentralized Architecture, BI Architecture Alternatives, phased & incremental BI roadmap, System Sizing, Measurements and Dependencies, System Sizing, Measurements, and Dependencies. Setting Early Expectations and Measuring the Results. End-User Provisos. OLAP Implementations. Expanding BI Authentication Authorization, Access Permissions, Groups and Roles, Single-sign on Server Administration, Manage Status & Monitoring, Audit, Mail server & Portal integration, Back Up and Restore.

**TEXT BOOKS**

1. Business Intelligence (IBM ICE Publication).

## REFERENCE BOOKS


1. http://en.wikipedia.org/wiki/Business_intelligence.
2. http://www.webopedia.com/TERM/B/Business_Intelligence.html.
3. Http://www.cio.com/article/40296/Business_Intelligence_Definition_and_Solutions.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20ECE-OE4101 | Fundamentals of Digital Image Processing **(Open Elective Course/Joh Oriented Elective-4)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

The objective of this course is to

- Comprehend the relation between human visual system and machine perception and processing of digital images.
- Understand the image enhancement techiniques in frequency &time domain.
- Familarize the image restoration model.
- Identify the morphology operation for image segmentation.
- Understand about the image comprasion model.

**Course Outcomes:**

1. Apply the spatial and frequency domain concepts on various types of images.
2. Apply various types of image enhancement techniques to improve quality of images.
3. Understand the process of restoration of image from degraded image.
4. Understand by using morphological operations of images.
5. Compare the various types of image compression techniques and standards.

**UNIT - I**

**Digital Image Fundamentals**: Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.

**Image Transforms**: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete CosineTransform, Haar Transform, Slant Transform, Hotelling Transform.

**Learning outcomes:** Student should be able to

- understand the basic concepts of digital image.
- compare various types of image transform.

**UNIT - II**

**Image Enhancement (Spatial Domain):** Introduction, Image Enhancement in Spatial Domain,Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighbourhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

**Image Enhancement (Frequency Domain**): Filtering in Frequency Domain, Low Pass (Smoothing)And High Pass (Sharpening) Filters in Frequency Domain.

**Learning outcomes:** Student should be able to

- Understand the various process of image enhancement properties.
- Analyze spatial &frequency domain image filtering techniques.

**UNIT - III**

**Image Restoration:** Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

**Learning outcomes:** Student should be able to

- Explain the image restoration model.
- Apply the restoration techniques on degraded image.

**UNIT – IV**

**Image Segmentation:** Detection of Discontinuities, Edge Linking and BoundaryDetection, thresholding, Region Oriented Segmentation.

**Morphological Image Processing:** Dilation and Erosion: Dilation, Structuring ElementDecomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss transformation.

**Learning outcomes:** Student should be able to

- Understand various edge linking techniques.
- Explain the basic morphological operation techniques.

**UNIT - V**

**Image Compression:** Redundancies and their Removal Methods, Fidelity Criteria, ImageCompressionModels, Huffman and Arithmetic Coding, Error Free Compression, LossyCompression, Lossy andLossless Predictive Coding, Transform Based Compression, JPEG 2000Standards.

**Learning outcomes:** Student should be able to

- Define the compression ratio,redundancies.
- Compare the various types of compression coding techniques.

**Text Books:**


1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson.
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- MC GRAW HILL EDUCATION.


**References:**


1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIPTools - ScotteUmbaugh, 2nd Ed, CRC Press, 2011
2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L.Eddings, 2nd Edition, MC GRAW HILL EDUCATION, 2010.
3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indianedition) 2008.
4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2008,2 nd Edition.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-OE4103 | Virtual Reality<br>**(Open Elective Course/Joh Oriented Elective-4)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Design a virtual environment and compelling virtual reality experience.
- Create compelling virtual experiences.
- Comprehend and analyze the fundamental issues of virtual reality.
- Comprehend the IEEE VR proceedings

**Course Outcomes:**

1. Demonstrate an understanding of techniques, processes, technologies and equipment used in immersive virtual reality;
2. Exploit the characteristics of materials and processes in an individual and conceptually developed way;
3. Show critical awareness of historical and theoretical contexts relevant to immersive virtual reality;
4. Apply critical, analytical and self-reflective practice;
5. Identify and develop personal topics for individual research in immersive virtual reality.

**UNIT-I**

**Introduction :** The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. (1.1, 1.3 and 1.5 of Text Book (1))

**Learning Outcomes:** student will be able to

- Understanding Virtual Reality
- Understand Components of VR System.

**UNIT – II**

**Input Devices :** (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. (2.1, 2.2 and 2.3 of Text Book (1)).

**Learning Outcomes:** student will be able to

- Understanding about VR Input Devices
- Understand about Interfaces and Gesture Interfaces.

**UNIT - III**

**Output Devices:** Graphics displays, sound displays & haptic feedback. (3.1,3.2 & 3.3 of Text Book (1))

Modeling : Geometric modeling, kinematics modeling, physical modeling, behaviour modeling, model management. (5.1, 5.2 and 5.3, 5.4 and 5.5 of Text Book (1)).

**Learning Outcomes:** student will be able to

- Understanding Output Devices and Graphics Displays

**UNIT – IV**

**Human Factors:** Methodology and terminology, user performance studies, VR health and safety issues. (7.1, 7.2 and 7.3 of Text Book (1)).

**Applications**: Medical applications, military applications, robotics applications. (8.1, 8.3 and 9.2 of Text Book (1)).

**Learning Outcomes:** student will be able to

- Applications which are using VR System

**UNIT – V**

**VR Programming-I :** Introducing Java 3D, loading and manipulating external models, using a lathe to make shapes. (Chapters 14, 16 and 17 of Text Book (2))

**Learning Outcomes:** student will be able to

- Understanding VR Programming using JAVA 3D.

**Text Books:**

1. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc.,
2. Killer Game Programming in Java, Andrew Davison, Oreilly-SPD, 2005.

**References:**

1. Understanding Virtual Reality, interface, Application and Design, William R.Sherman, Alan Craig, Elsevier(Morgan Kaufmann).
2. 3D Modeling and surfacing, Bill Fleming, Elsevier(Morgan Kauffman).
3. 3D Game Engine Design, David H.Eberly, Elsevier.
4. Virtual Reality Systems, John Vince, Pearson Education.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-OE4104 | Pattern Recognition<br>**(Open Elective Course/Joh Oriented Elective-4)** | 3 | 0 | 0 | 3 |

**Course Objective:**

After completing this course, the students should be able to:

1. Understand basic concepts in pattern recognition
2. Gain knowledge about state-of-the-art algorithms used in pattern recognition research
3. Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
4. Apply pattern recognition techniques in practical problems.

**Course Outcomes:**

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

Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.

Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.

Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.

Apply pattern recognition techniques to real-world problems such as document analysis and recognition.

Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

**Unit- I**

Pattern Classifier: Overview of Pattern Recognition, Discriminant Functions, Estimation of unknown probability density functions, Bayesian estimates.

**Unit -II**

Feature Extraction and Selection: Karhunen Loeve Transformation, Regional Features, Features for text, shape and size characterization, Features for speech and audio classification.

**Unit -III**

Introduction to Neural Networks: Elementary Neural Network for Pattern Recognition, Hebbnet, Perceptron, ADALINE, Back Propagation.

**Unit- IV**

Fuzzy Classification: Fuzzy Set Theory, Fuzzy and Crisp Classification, Fuzzy Clustering, Fuzzy Pattern Recognition

**Unit - V**

Markov Chain Models, Hidden Markov Models, HMM with State Duration Modeling, Training Markov Models via Neural Networks

**Text-books:**


1. Pattern recognition, Sergios Theodoridis, Konstantinos Koutroumbas, 4th edition, Academic press [Elsevier], ISBN- 978-1-59749-272-0.
2. Menahem Friedman, Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2000.
3. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.


**References :**


1. Andrew Webb, “Statistical Pattern Recognition”, Arnold publishers, London, 1999.
2. R. O. Duda, P. E. Hart, D. G. Stork, “Pattern Classification”, John Wiley, 2001.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSE-OE4101 | Software Testing Methodologies<br>**(Open Elective Course/Joh Oriented Elective-5)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To learn and understand the tools and techniques of software testing and its practice in the industry.
- To be aware of the differences between the various testing strategies.
- To know the taxonomy and purpose of software testing tools.

**Course Outcomes:**

1. Ability to test a process for continuous quality improvement
2. Generation of test cases from requirements
3. Analysis of modeling techniques: UML: FSM and State charts, combinatorial design etc.
4. Test generation from models.
5. Test adequacy assessment.

**UNIT I:**

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs

**UNIT II:**

Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing. Transaction Flow Testing: Transaction flows, transaction flow testing techniques. Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of data flow testing.

**UNIT III:**

Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domains and testability.

**UNIT IV:**

Paths, Path products and Regular expressions : Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic Based Testing: Overview, decision tables, path expressions, kv charts, specifications.

**UNIT V:**

State, State Graphs and Transition testing : State graphs, good & bad state graphs, state testing, Testability tips. Graph Matrices and Applications: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

**TEXT BOOKS:**

1. Software Testing techniques – Boris Beizer, Dreamtech, secondedition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad,Dreamtech.

**REFERENCES:**

1. The craft of software testing - Brian Marick, PearsonEducation.
2. Software Testing Techniques –SPD(Oreille)
3. Software Testing in the Real World – Edward Kit,Pearson.
4. Effective methods of Software Testing, Perry, JohnWiley.
5. Art of Software Testing – Meyers, JohnWiley

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-OE4106 | Digital Marketing<br>**(Open Elective Course/Joh Oriented Elective-5)** | 3 | 0 | 0 | 3 |

**Course Objective:**

- The objective of this course is to understand the importance of digital marketing and its applications.

**Course Outcome:**

Students will be understand

1. the applications of digital marketing in the globalized market
2. Channels of Digital Marketing
3. digital marketing plan
4. Search engine marketing
5. Online Advertising

**UNIT - I:**

**Understanding Digital Marketing:** Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends.

**UNIT - II:**

**Channels of Digital Marketing:** Digital Marketing, Website Marketing, Search Engine Marketing, Online Advertising, Email Marketing, Blog Marketing, Social Media Marketing, Audio, Video and Interactive Marketing, Online Public Relations, Mobile Marketing, Migrating from Traditional Channels to Digital Channels.

**UNIT - III:**

**Digital Marketing Plan:** Need of a Digital Marketing Plan, Elements of a Digital Marketing Plan – Marketing Plan, Executive Summary, Mission, Situational Analysis, Opportunities and Issues, Goals and Objectives, Marketing Strategy, Action Plan, Budget, Writing the Marketing Plan and Implementing the Plan.

**UNIT - IV:**

**Search Engine Marketing and Online Advertising:** Importance of SEM, understanding Web Search – keywords, HTML tags, Inbound Links, Online Advertising vs. Traditional Advertising, Payment Methods of Online Advertising – CPM (Cost-per-Thousand) and CPC (Cost-per-click), Display Ads - choosing a Display Ad Format, Landing Page and its importance.

**UNIT - V:**

**Social Media Marketing:** Understanding Social Media, Social Networking with Facebook, LinkedIn, Blogging as a social medium, Microblogging with Twitter, Social Sharing with YouTube, Social Media for Customer Reach, Acquisition and Retention. Measurement of Digital Media: Analyzing Digital Media Performance, Analyzing Website Performance, Analyzing Advertising Performance.

**Text Books:**


1. Michael Miller, B2B Digital Marketing, 1e, Pearson, 2014.
2. Vandana Ahuja, Digital marketing, Oxford University Press 2015
3. Michael R Solomon, Tracy Tuten, Social Media Marketing, Pearson, 1e, 2015.
4. Judy Strauss & Raymond Frost, E-Marketing, Pearson, 2016


**Reference Books:**


1. Richard Gay, Alan Charles worth and Rita Esen, Online marketing – A customer led approach Oxford University Press 2007.
2. Arup Varma, Pawan S. Budhwar, Angelo S. De Nisi, Digital Marketing, Wiley, 2016.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-OE4107 | Ethical Hacking<br>**(Open Elective Course/Joh Oriented Elective-5)** | 3 | 0 | 0 | 3 |

**Course Objectives:**

- The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security.
- The course includes-Impacts of Hacking; Types of Hackers; Information Security Models;
- Information Security Program; Business Perspective; Planning a Controlled Attack; Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration)

**Course Outcomes:**

1. Gain the knowledge of the use and availability of tools to support an ethical hack
2. Gain the knowledge of interpreting the results of a controlled attack
3. Understand the role of politics, inherent and imposed limitations and metrics for planning of a test
4. Comprehend the dangers associated with penetration testing

**UNIT- I**

**Introduction:** Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration. Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture Information **Security Program:** The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking.

**UNIT - II**

**The Business Perspective:** Business Objectives, Security Policy, Previous Test Results, Business Challenges. Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement.

**UNIT - III**

**Preparing for a Hack:** Technical Preparation, Managing the Engagement. Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance.

**UNIT - IV**

**Enumeration:** Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase. Exploitation: Intutive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, ap plications, Wardialing, Network, Services and Areas of Concern.

**UNIT - V**

**Deliverable:** The Deliverable, The Document, Overal Structure, Aligning Findings, Presentation.

**Integration:** Integrating the Results, Integration Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion.

**TEXT BOOK:**

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", Auerbach Publications, CRC Press.

**REFERENCE BOOKS:**

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning.
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning.

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20BSH-HM3101 | Universal Human Values-2:Understanding Harmony | 3 | 0 | 0 | 3 |

**Course Objectives:**

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.(L3)
- Relate the harmony in the human being, family, society and nature/existence(L4)
- Outline and strengthening of self-reflection.(L2)
- Improvement of commitment and courage to act.(L5)
- Integrate the humanistic constitution and humanistic universal order.(L2)

**Course Outcomes:** At the end of the course, student will able to

1. Enriches the knowledge on need of Value Education. (L2)
2. Considerate Human being as the Co-existence of the Self and the Body.(L2)
3. Identify the basic unit of human interaction(L3)
4. Comprehend the harmony in the nature (L2)
5. Analyze and exploring Ethical Human Conduct.(L4)

**UNIT-I :**

**Introduction to Value Education:** Understanding Value Education- Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity – Basic Human Aspirations- Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario.

**Learning Outcomes:**

- Apply Human values to balance their life and profession (L3)
- Identify and incorporate the levels of human values(L2)

**Application:**

- Natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

**UNIT-II:**

**Harmony in the Human Being:** Understanding Humanbeing as the Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self -Understanding Harmony in the Self - Harmony of the Self with the Body.

**Learning Outcomes:**

- Distinguish physical facilities the self and body (L4)
- Related to proper upkeep of the body and practice them in their daily routine. (L2)

**Application:**

- Differentiate between prosperity and accumulation.
- Discuss program for ensuring health vs dealing with disease

**UNIT-III:**

**Harmony in the Family and Society:** Harmony in the Family –Basic Unit of Human Interaction - Values in Human-to-Human Relationship - 'Trust' – Foundational Value in Relationship-'Respect'–Right Evaluation -Understanding Harmony in the Society -Vision for the Universal Human Order.

**LearningOutcomes:**

- Interpreting Natural acceptance is always for living in harmony(L2)
- Exemplifying Right evaluation leads to fulfilment in relationship(L3)

**Application:**

- Reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc., Gratitude as a universal

value in relationships.

**UNIT-IV:**

**Harmony in the Nature/Existence:** Understanding Harmony in the Nature - Inter connected ness, self-regulation and Mutual Fulfilment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perceptionof Harmony in Existence.

**Learning Outcomes:**

- Organizing Confident that they can understand the whole existence made appropriate and holistic.(L2)
- Differentiate between the characteristics and activities of different orders able to see the interconnectedness in the nature(L3)

**Application:**

- Human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**UNIT-V:**

**Implications of the Holistic Understanding – a Look at Professional Ethics :** Natural Acceptance of HumanValues - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models.

**LearningOutcomes:**

- Present sustainable solutions to the problems in society and nature. (L2)
- Able to grasp the right utilization of their knowledge in their streams of Technology to ensure mutual fulfilment.(L3)

**Application:**

- DiscussExercises and Case Studies will be taken up in Practice

**Text Book**


1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, RAsthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN978-93-87034-47-1


**Reference Books**


1. JeevanVidya:EkP arichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, NewAge Intl.Publishers, NewDelhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful -E. FSchumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj -Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj o rIndian Home Rule-by Mohandas K.Gandhi
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland (English)
13. Gandhi-Romain Rolland(English)


**E-Resources**:

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAIC4003.pdf
2. https://gyansanchay.csjmu.ac.in/wp-content/uploads/2022/09/UHVE-2.0-Class-Notes-Part-1-of-4-1.pdf

| Subject Code | Subject Name | L | T | P | C |
|---|---|---|---|---|---|
| R20CSS-SC4101 | Data Science using Python **(Skill Oriented Course-5)** | 1 | 0 | 2 | 2 |

**Course Objective:**

- Learn the intricacies of logistic regression, evaluate its outputs, and comprehend how a link function works
- Handle a data set to produce a specified set of results
- Present a start-to-finish analysis with meaningful insights on a data set using exploratory analysis, dimension reduction, linear models, and classification models

**Course Outcome:**

1. Solve data science problems and prepare to take the next steps in the world of machine learning
2. Gain confidence handling and manipulating data
3. Interpret data and be able to communicate it effectively

**Unit 1:**

**Data Science Introduction:** What is Data, DS Database Table, Python, Data Frames, Functions, Data Preparation

**Unit 2:**

**Data Math & Data Statistics:** Data Science Linear Functions, Data Science Plotting Functions, Data Science Slop and Intercept, Stat Introduction, Stat Percentiles, Standard Deviation, Variance, Correlation, Correlation Matrix, Correlation vs Causality

**Unit 3:**

**Statistical Data Handling:** Organizing Data, Grouping Data, Pie Chart, Chance and Probability, Introduction to Graphs, Linear Graphs, Presentation of Data, Graphical representation of Data, Bar graphs and Histograms

**Unit 4:**

**DS Advanced:** DS Linear Regression, Regression Table, Regression Information, Regression Coefficients, Regression P-Value, Regression R-Squared, Linear Regression Case.

**Unit 5:**

**Experiments:**

1. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. Bivariate Analysis: Linear and Logistic Regression modeling Multiple Regression Analysis. Also compare the results of the above analysis for the two data sets
2. Use the Education Statistics from UCI and Indian School Education Statistics data set for performing the following: Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. Bivariate Analysis: Linear and Logistic Regression modeling Multiple Regression Analysis Also compare the results of the above analysis for the two data sets

**Text Book:**

1. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce, O.REILLY
2. Introduction to Statistics and Data Analysis, Third Edition, Roxy Peck, Chris Oisen, Jay Devore, Thomson

**Sample Datasets:**

1. Pima Indians Diabetes Dataset
2. https://www.kaggle.com/datasets/uciml/pima-indians-diabetes-database
3. Indian School Education Statistics:
4. https://www.kaggle.com/datasets/vidyapb/indian-school-education-statistics