



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

## **COURSE STRUCTURE AND SYLLABUS**

**For UG –R20**

**B. TECH - COMPUTER SCIENCE & ENGINEERING**

*(Applicable for batches admitted from 2020-2021)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**

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<b>IV B. Tech –I Semester</b>						
S.No	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	PE	<b>Professional Elective-III</b> 1.Cloud Computing 2.Neural Networks and Soft Computing 3.Ad-hoc and Sensor Networks 4.Cyber Security & Forensics	3	0	0	3
2	PE	<b>Professional Elective-IV</b> 1. Deep Learning Techniques 2. Social Networks & Semantic Web 3. Computer Vision 4.MOOCs-NPTEL/SWAYAM%	3	0	0	3
3	PE	<b>Professional Elective-V</b> 1.Block-Chain Technologies 2.Wireless Network Security 3.Ethical Hacking 4.MOOCs-NPTEL/SWAYAM%	3	0	0	3
4	Open Elective /Job Oriented	<b>Open Elective-III</b> Open Electives offered by other departments/ API and Microservices (Job Oriented Course)	3	0	0	3
5	Open Elective /Job Oriented	<b>Open Elective-IV</b> Open Electives offered by other departments/ Secure Coding Techniques (Job Oriented Course)	3	0	0	3
6	HS	Universal Human Values 2: Understanding Harmony	3	0	0	3
7	SO	1.PYTHON: Deep Learning <b>OR</b> 2.MEAN Stack Technologies-Module II- Angular JS and MongoDB <b>OR</b> 3.APSSDC offered Courses	0	0	4	2
8	PR	<b>Industrial/Research Internship 2 months (Mandatory) after third year (to be evaluated during VII semester)</b>	0	0	0	3
<b>Total credits</b>						<b>23</b>
11	Minor	Software Engineering <sup>\$</sup> / any other from PART-B (For Minor)	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4
<b>Minor course through SWAYAM</b>						<b>2</b>

\$- Integrated Course

% - MOOC Course



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<b>IV B. Tech –II Semester</b>						
<b>S.No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week</b>			<b>Credits</b>
			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	Project	Major Project Work, Seminar Internship	-	-	-	<b>12</b>
<b>Total credits</b>						<b>12</b>

Note:

1. **For integrated courses:** Theory and laboratory exams will be conducted separately, and the student concern will get credits if successfully completes both theory and laboratory. Only external exam will be conducted for Laboratory component. Credit based weightage shall be considered while awarding the grade.
2. **For MOOC courses:** Based on the students interest, student can register and complete a 12 week course one year in advance, by prior information to the concern.



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**SUGGESTED COURSES FOR HONORS PROGRAM**

<p><b>POOL1- AI &amp; ML</b></p> <ol style="list-style-type: none"> <li>1. Mathematics for Machine Learning</li> <li>2. Text Mining and Time Series Analysis</li> <li>3. Natural Language Processing</li> <li>4. Reinforcement Learning</li> </ol>	<p><b>POOL2- Systems Engineering</b></p> <ol style="list-style-type: none"> <li>1. Internet of Things</li> <li>2. Data Communications and Information Coding Theory</li> <li>3. Service Oriented Architectures</li> <li>4. Design of Secure Protocols</li> <li>5. Network Coding</li> </ol>
<p><b>POOL3- Information Security</b></p> <ol style="list-style-type: none"> <li>1. Principles of Cyber Security</li> <li>2. Computational Number Theory</li> <li>3. Cryptanalysis</li> <li>4. Elliptic Curve Cryptography</li> <li>5. Introduction to Quantum Computing and Quantum Cryptography</li> <li>6. Public Key Infrastructure and Trust Management</li> <li>7. Information Security Analysis and Audit</li> <li>6. Cloud and IoT Security</li> <li>7. Web Security</li> <li>8. Block Chain Architecture Design and Use Cases</li> </ol>	<p><b>POOL4 – Data Science</b></p> <ol style="list-style-type: none"> <li>1. Data Visualization</li> <li>2. Statistical Foundations for Data Science</li> <li>3. Mining Massive Data Sets</li> <li>4. Medical Image Data Processing</li> </ol>



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**SUGGESTED COURSES MINOR ENGINEERING IN CSE**

**Note:**

1. Any THREE courses need to be studied from PART-A.
2. Any ONE course need to be studied from PART-B.
3. TWO, NPTEL courses of EIGHT week duration covering a total of 4 credits (offered by CSE Department only), Student can register at any time after the completion of II B.Tech. I Sem.
4. Students can pursue suggested MOOC Courses via NPTEL from II B.Tech II Sem and onwards, by prior information to the concern.

**Eligibility for Minor in CSE:**

<b>PART A</b>					
S.No	Subject	L-T-P	Credits	Course available in NPTEL	NPTEL Link
1	Operating Systems	3-0-2	4	Operating Systems	<a href="https://onlinecourses.swayam2.ac.in/cec21_cs20/preview">https://onlinecourses.swayam2.ac.in/cec21_cs20/preview</a>
2	Data Structures and Algorithms	3-0-2	4	Data Structures Programming, Data Structures and Algorithms using Python	<a href="https://onlinecourses.swayam2.ac.in/cec22_cs10/preview">https://onlinecourses.swayam2.ac.in/cec22_cs10/preview</a> <a href="https://onlinecourses.nptel.ac.in/noc22_cs26/preview">https://onlinecourses.nptel.ac.in/noc22_cs26/preview</a>
3	Software Engineering	3-0-2	4	Software Engineering	<a href="https://onlinecourses.swayam2.ac.in/cec21_cs21/preview">https://onlinecourses.swayam2.ac.in/cec21_cs21/preview</a>
4	Computer Networks	3-0-2	4	Computer Networks	<a href="https://onlinecourses.swayam2.ac.in/cec22_cs05/preview">https://onlinecourses.swayam2.ac.in/cec22_cs05/preview</a>
5	Database Management Systems	3-0-2	4	Data Base Management System (noc22-cs51)	<a href="https://onlinecourses.nptel.ac.in/noc22_cs51/preview">https://onlinecourses.nptel.ac.in/noc22_cs51/preview</a>
<b>PART B</b>					
S.No	Subject	L-T-P	Credits	Course available in NPTEL	NPTEL Link
1	Computational Thinking	4-0-0	4	Physics through Computational Thinking	<a href="https://onlinecourses.nptel.ac.in/noc22_ph12/preview">https://onlinecourses.nptel.ac.in/noc22_ph12/preview</a>
2	Object Oriented Programming through JAVA	3-0-2	4		
3	Data Analytics using Python	3-0-2	4	Data Analytics with Python	<a href="https://onlinecourses.nptel.ac.in/noc22_cs8/preview">https://onlinecourses.nptel.ac.in/noc22_cs8/preview</a>
4	Artificial Intelligence	4-0-0	4	Artificial Intelligence: Knowledge Representation And Reasoning	1. <a href="https://onlinecourses.nptel.ac.in/noc22_cs56/preview">https://onlinecourses.nptel.ac.in/noc22_cs56/preview</a> 2. <a href="https://onlinecour">https://onlinecour</a>



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				(noc22-cs02), An Introduction to Artificial Intelligence (noc22-cs56), AI: Constraint Satisfaction (noc22-cs06)	ses.swayam2.ac.i n/cec21_cs08/pre view
<b>5</b>	Unix and Shell Programming	3-0-2	4		
<b>6</b>	Cloud Computing	4-0-0	4	Cloud Computing and Distributed Systems (noc22- cs18), Cloud computing(noc22- cs20)	1. <a href="https://onlinecourses.nptel.ac.in/noc22_cs18/preview">https://onlinecourses.nptel.ac.in/noc22_cs18/preview</a> 2. <a href="https://onlinecourses.nptel.ac.in/noc22_cs20/preview">https://onlinecourses.nptel.ac.in/noc22_cs20/preview</a>



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**Open Electives to be offered by CSE for other Branches:**

<p><b>Open Elective-I:</b></p> <ol style="list-style-type: none"> <li>1. Data Structures</li> <li>2. Object Oriented Programming through JAVA</li> <li>3. Data Base Management Systems</li> <li>4. Computer Graphics</li> <li>5. Advanced UNIX Programming</li> <li>6. Computer Organization and Architecture</li> <li>7. Operating Systems</li> </ol>	<p><b>Open Elective-II:</b></p> <ol style="list-style-type: none"> <li>1. Python Programming</li> <li>2. Web Technologies</li> <li>3. Soft Computing</li> <li>4. Distributed Computing</li> <li>5. AI and ML for Robotics</li> <li>6. Computer Networks</li> <li>7. Big Data Analytics</li> <li>8. Computational Tools</li> </ol>
<p><b>Open Elective-III:</b></p> <ol style="list-style-type: none"> <li>1. AI Tools &amp; Techniques</li> <li>2. Image Processing</li> <li>3. Information Security</li> <li>4. Mobile Application Development</li> <li>5. Data Science</li> <li>6. Cyber Security</li> <li>7. Introduction to Internet of Things</li> </ol>	<p><b>Open Elective-IV:</b></p> <ol style="list-style-type: none"> <li>1. MEAN Stack Technologies</li> <li>2. Deep Learning Techniques</li> <li>3. Cloud computing with AWS</li> <li>4. Block Chain Technologies</li> <li>5. Cryptography &amp; Network Security</li> <li>6. Introduction to Machine Learning</li> <li>7. Machine Learning with Python</li> </ol>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>CLOUD COMPUTING (Professional Elective-III)</b>					

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

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

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNIT I: Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNIT II: Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNIT III: Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV: Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNIT V: Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.

**Reference Books:**

1. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madiseti, University Press
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
3. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH





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<b>NEURAL NETWORKS AND SOFT COMPUTING</b> <b>(Professional Elective-III)</b>					

**Course Objectives:** The main objective of the course is

- To introduce the foundations of Artificial Neural Networks.
- To acquire the knowledge on Soft Computing Concepts.
- To learn various types of Genetic algorithms and its applications.
- To gain knowledge to apply optimization strategies.

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

- Understand the concepts of Artificial intelligence and soft computing techniques
- Analyze the concepts of Neural Networks and select the Learning Networks in modeling real world systems.
- Implement the concepts of Fuzzy reasoning and concepts of Genetic algorithm and its applications to soft computing.
- Classify Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization.
- Design hybrid system incorporating neural network, genetic algorithms, fuzzy systems.

**UNIT I: Soft Computing and Artificial Intelligence:** Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Inference, Semantic Networks, Frames, Objects, Hybrid Models.

**UNIT II: Artificial Neural Networks and Paradigms:** Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons, Back propagation Networks, Kohonen's self organizing networks, Hopfield network, Applications of NN.

**UNIT III: Fuzzy Logic:** Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, relations, rule based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.

**UNIT IV: Genetic Algorithms and Swarm Optimizations:** Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization.

**UNIT V: Hybrid Systems:** Neuro fuzzy hybrid systems, Adaptive neuro fuzzy inference systems, Fuzzy backpropagation network, Genetic neuro hybrid system, Genetic algorithm based backpropagation network, Genetic-fuzzy hybrid systems.

**Text Books:**

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. S. Rajasekaran & G. A. Vijayalakshmi Pai “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications”, PHI, 2003.



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**Reference Books:**

1. S. N. Sivanandam & S. N. Deepa "Principles of Soft Computing" Wiley – India, 2nd Edition, 2007.
2. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall, 1998.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, 1994
4. Zimmermann, "Fuzzy Set Theory and its Application", 3rd Edition.
5. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y, 1989.
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, 3rd edition 2009.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>AD-HOC AND SENSOR NETWORKS</b> <b>(Professional Elective-III)</b>					

**Course Objectives:**

From the course the student will learn

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and has a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

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

- Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks.
- Determine the principles and characteristics of wireless sensor networks.
- Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc sensor networks.
- Illustrate the various sensor network Platforms, tools and applications.
- Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs.

**UNIT I: Introduction to Ad Hoc Wireless Networks-** Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet, MAC protocols for Ad hoc Wireless Networks-Issues, Design Goals and Classifications of the MAC Protocols.

**UNIT II: Routing Protocols for Ad Hoc Wireless Networks-** Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.

**UNIT III: Security protocols for Ad hoc Wireless Networks-** Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

**UNIT IV: Basics of Wireless Sensors and Applications-** The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks-Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

**UNIT V: Security in WSNs-** Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware-Components of Sensor Mote, Sensor Network Operating Systems–TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language-nesC, **Dataflow Style Language-TinyGALS**, Node-Level Simulators, NS-2 and its sensor network extension, TOSSIM.



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**Text Books:**

1. Ad Hoc Wireless Networks – Architectures and Protocols, 1<sup>st</sup> edition, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2004
2. Ad Hoc and Sensor Networks – Theory and Applications, 2<sup>nd</sup> edition *Carlos Corderio Dharma P. Aggarwal*, World Scientific Publications / Cambridge University Press, March 2006

**Reference Books:**

1. Wireless Sensor Networks: An Information Processing Approach, 1<sup>st</sup> edition, *Feng Zhao, Leonidas Guibas*, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009
2. Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, 1<sup>st</sup> edition, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008
3. Ad hoc Networking, 1<sup>st</sup> edition, *Charles E. Perkins*, Pearson Education, 2001
4. Wireless Ad hoc Networking, 1<sup>st</sup> edition, *Shih-Lin Wu, Yu-Chee Tseng*, Auerbach Publications, Taylor & Francis Group, 2007
5. Wireless Sensor Networks – Principles and Practice, 1<sup>st</sup> edition, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>CYBER SECURITY &amp; FORENSICS</b> <b>(Professional Elective-III)</b>					

**Course Objectives:**

The aim of the course is to

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

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

- Explain the Cybercrime Fundamentals
- Describe the types of attacks on networks
- Analyze various tools available for Cybercrime Investigation
- Explain the Computer Forensics and Investigation Fundamentals and tools
- Analyze the legal perspectives of Cybercrime

**UNIT I: 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 II: 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 III: 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 IV: 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 V: 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.



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**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.

**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.

**E-Resources:**

1. CERT-In Guidelines- <http://www.cert-in.org.in/>
2. <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks> [ Online Course]
3. <https://computersecurity.stanford.edu/free-online-videos> [ Free Online Videos]
4. Nikolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, <https://ocw.mit.edu> License: Creative Commons BY-NC-SA.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DEEP LEARNING TECHNIQUES</b> <b>(Professional Elective-IV)</b>					

**Course Objectives:** The main objective of the course is to make students:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
- Discuss the Neural Network training, various random models.
- Explain the Techniques of Keras, TensorFlow, Theano and CNTK
- Classify the Concepts of CNN and RNN
- Implement Interactive Applications of Deep Learning.

**UNIT I:**

**Fundamentals of Deep Learning:** Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, **Fundamentals of Machine Learning:** Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. [**Text Book 2**]

**UNIT II: Introducing Deep Learning:** Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [**Text Book3**]

**UNIT III: Neural Networks:** Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. [**Text Book 2**]

**UNIT IV:**

**Convolutional Neural Networks:** Nerual Network and Representation Learning, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [**Text Book 3**]

**UNIT V:**

**Interactive Applications of Deep Learning:** Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [**Text Book 1**]

**Deep Learning Research:** Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [**Text Book 1**]

**Text Books:**

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821



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4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412

**Reference Books:**

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

**Web Link:**

1. Swayam NPTEL: Deep Learning: [https://onlinecourses.nptel.ac.in/noc22\\_cs22/preview](https://onlinecourses.nptel.ac.in/noc22_cs22/preview)





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SOCIAL NETWORKS &amp; SEMANTIC WEB</b> <b>(Professional Elective-IV)</b>					

**Course Objectives:**

- To learn Web Intelligence
- To learn Knowledge Representation for the Semantic Web
- To learn Ontology Engineering
- To learn Semantic Web Applications, Services and Technology
- To learn Social Network Analysis and semantic web

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate social network analysis and measures.
- Analyze random graph models and navigate social networks data
- Apply the network topology and Visualization tools.
- Analyze the experiment with small world models and clustering models.
- Compare the application driven virtual communities from social network Structure.

**UNIT I: Web Intelligence:** Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today’s Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

**UNIT II: Knowledge Representation for the Semantic Web:** Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

**UNIT III: Ontology Engineering:** Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

**UNIT IV: Semantic Web Applications, Services and Technology:** Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,

**UNIT V: Social Network Analysis and semantic web:** What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks, Building Semantic Web Applications with social network features.

**Text Books:**

1. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.



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**Reference Books:**

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
3. Information sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web, T. Segaran, C. Evans, J. Taylor, O'Reilly, SPD.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>COMPUTER VISION (Professional Elective-IV)</b>					

**Course Objectives:**

To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications.

**Course Outcomes:** After completing the course Student will be able to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision,
2. Describe known principles of feature detection and matching,
3. Describe basic methods of computer vision related to image stitching, photography like high dynamic range imaging and blur removal.
4. Suggest a design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

**UNIT I: Introduction:** Image Formation: Geometric Primitives and Transformation, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, More Neighborhood Operators, Fourier Transforms, Pyramids and Wavelets, Geometric Transformations, Global Optimization.

**UNIT II: Feature Detection and Matching:** Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature-Based Alignment: 2D and 3D Feature-based Alignment, Pose Estimation, Geometric Intrinsic Calibration.

**UNIT III: Structure and Motion:** Triangular, Two-frame Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion, Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline-based Motion, Optical Flow, Layered motion

**UNIT IV: Image Stitching:** Motion Models, Global Alignment, Composing, Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super-Resolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.

**UNIT V: 3D Reconstruction:** Shape From X, Active Range Finding, Surface Representation, Point-based Representation, Volumetric Representation, Model-based Reconstruction, Recovering Texture Maps and Albedos, Image- based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumigraphs, Environment Mattes, Video-based Rendering.

**Text Books:**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.
2. Simon J.D Prince, Computer Vision: Models, Learning and Inference, 1<sup>st</sup> Edition, 2012.

**Reference Books:**

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Haralick & Shapiro, "Computer and Robot Vision", Vol II
3. Gerard Medioni and Sing Bing Kang "Emerging topics in computer vision" 166

**NPTEL LINK:** [https://onlinecourses.nptel.ac.in/noc22\\_ee48/preview](https://onlinecourses.nptel.ac.in/noc22_ee48/preview)



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>BLOCK-CHAIN TECHNOLOGIES</b> <b>(Professional Elective-V)</b>					

**Course Objectives:**

To understand block chain technology and Cryptocurrency works

**Course Outcomes:**

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

- Demonstrate the block chain basics, Crypto currency
- To compare and contrast the use of different private vs. public block chain and use cases
- Design an innovative Bit coin Block chain and scripts, Block chain Science on varies coins
- Classify Permission Block chain and use cases – Hyper ledger, Corda
- Make Use of Block-chain in E-Governance, Land Registration, Medical Information Systems and others

**UNIT I: Introduction:** Introduction, basic ideas behind block chain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Block chain or distributed trust, Currency, Cryptocurrency, How a Cryptocurrency works, Financial services, Bitcoin prediction markets.

**UNIT II:** Hashing, public key cryptosystems, private vs public block chain and use cases, Hash Puzzles, Extensibility of Block chain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Block chain Environment

**UNIT III: Introduction to Bitcoin :** Bitcoin Block chain and scripts, Use cases of Bitcoin Blockchain scripting language in micropayment, escrow etc Downside of Bit coin mining, Block chain Science: Grid coin, Folding coin, Block chain Genomics, Bit coin MOOCs.

**UNIT IV:** Ethereum continued, IOTA, The real need for mining, consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Coming to private or permissioned block chains, Introduction to Hyper ledger, Currency, Token, Campus coin, Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency

**UNIT V:** Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations, Uses of Block chain in E-Governance, Land Registration, Medical Information Systems.

**Text Books:**

1. Blockchain Blue print for Economy by Melanie Swan

**Reference Books:**

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition, by Daniel Drescher



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<b>WIRELESS NETWORK SECURITY</b> <b>(Professional Elective-V)</b>					

**Course Objectives:**

The objective of this course is to understand the importance of Wireless networks security and its application

**Course Outcomes:** After the completion of the course, student will be able to

- Explain the Threats in networks and provide Authentication to real time problems.
- Identify and investigate in-depth both early and contemporary threats to wireless networks security
- Ability to analyze and determine for any organization the database security requirements and appropriate solutions
- Determined IP Security Issues and solve real time problems.
- Build wireless Development Strategies in real time issues

**UNIT I: Introduction to Wireless:** History of Wireless Technologies, History of Wireless Security, State of the Wireless Security Industry, 2001 **Wireless Threats:** Uncontrolled Terrain, Communications Jamming, DoS Jamming, Injections and Modifications of Data, Man-in-the-Middle (MITM) Attack, Rogue Client, Rogue Network Access Points, Attacker Equipment,

**UNIT II: Introduction to Wireless Security Protocols and Cryptography:** Recovery the FUD, OSI Model, OSI Simplified, Internet Model, Wireless LAN Security Protocols, Cryptography, SSL/TLS, Secure Shell Protocols, Terminal Access and File Transfer, Port Forwarding a Word of Caution, Man-in-the-Middle of SSL/TLS and SSH, WTLS, WEP, 802.1x, IP Security

**UNIT III:**

**Security Considerations to Wireless Devices:** Wireless Device Security Issues, Physical Security, Information Leakage, Device Security Features, Application Security, Detailed Device Analysis, Laptops, Personal Digital Assistants (PDAS), Wireless Infrastructure **Wireless Technologies and Applications:** Introduction to Cellular Networks- FDMA, TDMA, CDMA, Spread Spectrum Primer, Analogy, TDMA Vs CDMA, PDC, Security Threats

**UNIT IV:**

**Introduction to Wireless Data Networks:** Cellular Digital Packet Data (CDPD), CDPD Architecture, CDPD Security, Mobitex- Mobitex Architecture, Mobitex Security Architecture, Security Issues, Gateway, Security Model **Wireless Standards and Technologies:** Current and Future Technologies- Infrared, Radio, Spread Spectrum, OFDM, Current and Future Standards- IEEE 802 Standards, ETSI, Home RF, Ultra-wide band Radio (UWB)

**UNIT V: Wireless Deployment Strategies:** Implementing Wireless LAN's- Security Considerations Common Wireless Network Applications, Enterprise Campus Designs, Wireless IST Design, Retail and Manufacturing Design, Small Office/Home Office Design (SOHO)

**Text Books:**

1. Wireless Security, Merritt Maxim and David Pollino, Osborne/McGraw Hill, New Delhi, 2005
2. Wireless Security Models: Threats and Solutions, Nichols and Lekka, Tata McGraw Hill, New Delhi 2006



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**Reference Books:**

1. Behrouz A.Forouzan, —Cryptography & Network Securityl, Tata McGraw Hill, India, New Delhi, 2009
2. William Stallings, —Cryptography and Network Security, Prentice Hall, New Delhi, 2006
3. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons, New York, 2004



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>ETHICAL HACKING</b> <b>(Professional Elective-V)</b>					

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

- Explain the concepts related to hacking, ports and protocols, pen testing and virtualization
- Determine the applicable footprinting techniques and scanning methods
- Explain the process of system hacking and Explain the concepts Trojans, backdoors, worms and virus and it's countermeasures
- Demonstrate systematic understanding of the concepts of Sniffing and Social Engineering and it's attacks
- Determine the applicable methods of cryptography, steganography and Vulnerability Assessment

**UNIT I:**

**Introduction to Hacking:** Hacking, Types and phases of hacking, **Introduction to Ports & Protocols:** Ports, Protocols, Primary Network Types, **Virtualization & Introduction to Kali Linux:** Virtualization, Virtualization software, supported platforms, **Introduction to Penetration Testing:** Penetration test, Categories and Types of Penetration tests, Structure of Penetration Test Report.

**UNIT II:**

**Footprinting:** Footprinting, Types, Using ping and ns Lookup commands in Windows command line, **Scanning:** Scanning, Basics of Scanning, Basic Techniques of Scanning, Enumerating DNS using dnsenum, Performing flag scan using hping3.

**UNIT III:**

**Hacking into System:** System Hacking, Password Cracking, Default password databases, Manual and Automated Password Cracking, Process of System Hacking, Using Keyloggers, **Trojans & Backdoors:** Trojans, Working of Trojan, Infection Techniques, Attack, Lifecycle and Classification of Virus, Worms, Virus Construction Kit.

**UNIT IV:**

**Sniffing, Packet Analysis & Session Hijacking:** Sniffing, Packet Analysis, Types of Sniffing, Active and Passive Sniffing Techniques, Session Hijacking, **Social Engineering:** Social Engineering, Process, Identity Theft, Human and Computer Based Social Engineering Techniques, Phishing Process, Types of Phishing Attacks, Social Engineering Toolkit (SET)

**UNIT V:**

**Cryptography:** Cryptography, Digital Signature, Hash Functions, **Steganography:** Steganography Process, watermarking, Steganography Methods and Attacks, Steganography tools, **Vulnerability Assessment:** Vulnerability, The Open Web Application Security Project (OWASP), Prevention, Damn Vulnerable Web Application (DVWA), installation and testing of DVWA



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**Text Books:**

1. Hacking: Be a Hacker with Ethics, Harsh Bothra, Khanna Publications, 2019
2. Ethical Hacking and Penetration Testing Guide, Rafay Baloch, 2014

**Reference Books:**

1. Kali Linux Wireless Penetration Testing Beginner's Guide, Vivek Ramachandran, Cameron Buchanan, Packt Publishing, 2015
2. SQL Injection Attacks and Defense, 1<sup>st</sup> Edition, Justin Clarke-Salt, Syngress Publication
3. Mastering Modern Web Penetration Testing, Prakhar Prasad, Packt Publishing, October 2016





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>API AND MICROSERVICES</b> <b>(Job Oriented Course)</b>					

**Course Outcomes:**

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

- Develop a Spring Data JPA application with Spring Boot
- Implement CRUD operations using Spring Data JPA
- Implement pagination and sorting mechanism using Spring Data JPA
- Implement query methods for querying the database using Spring Data JPA
- Implement a custom repository to customize a querying mechanism using Spring Data JPA
- Understand update operation using query approaches in Spring Data JPA
- Implement Spring Transaction using Spring Data JPA
- Develop RESTful endpoints using Spring REST Processing URI parameters
- Write RESTful services using Spring REST that consumes and produces data in different formats
- Handle exceptions and errors in Spring REST endpoints
- Write Spring based REST clients to consume RESTful services programmatically
- Create secure RESTful endpoints using Spring Security Document and version the Spring REST endpoints Implement CORS in a Spring REST application

**UNIT I:**

**Spring 5 Basics :** Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is AutoScanning

**UNIT II:**

**Spring Boot:** Creating a Spring Boot Application, Spring Boot Application Annotation, What is Autowiring , Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices : Spring Boot Application

**UNIT III:**

**Spring Data JPA with Boot:** Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices - Spring Data JPA

**UNIT IV:**

**Web Services:** Why Web services, SOA - Service Oriented Architecture, What are Web Services, Types of Web Services, SOAP based Web Services, RESTful Web Services, How to create RESTful Services

**UNIT V:**

**Spring REST:** Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and ResponseEntity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

**Hardware and software configuration**

- 4 or 8 GB RAM/126 GB ROM
- Swagger tool suite(opensource)
- OpenJDK 17 or Java 11,Maven 3.2 or above and MySQL 8.0 or above, Spring Tool suite, Postman



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**Text Books:**

1. Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning books

**Web Links [Courses mapped to Infosys Springboard platform]:**

**Infosys Springboard courses:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01296689056211763272\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview) [Spring 5 Basics with Spring Boot]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_4313461831752789500\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_4313461831752789500_shared/overview) [Spring Data JPA with Boot]
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012731900963905536190\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012731900963905536190_shared/overview) [Spring REST]

**Web references:**

1. <a href="#">Dependency Injection in spring - javatpoint</a>
2. <a href="#">Autowiring in Spring - javatpoint</a>
3. <a href="https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html">https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html</a>
4. <a href="#">Autowiring in Spring - javatpoint</a> , <a href="https://www.baeldung.com/spring-bean-scopes">https://www.baeldung.com/spring-bean-scopes</a>
5. <a href="#">Spring Boot Logging   How does logging works in spring boot with example (educba.com)</a>
6. <a href="#">Spring AOP Tutorial   Aspect Oriented Programming - javatpoint</a>
7. <a href="#">Spring Boot Best Practices (javaguides.net)</a>
8. <a href="#">Introduction to Spring Data JPA   SpringHow</a>
9. <a href="https://asbnotebook.com/spring-data-jpa-crud-example/">https://asbnotebook.com/spring-data-jpa-crud-example/</a> , <a href="https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/">https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/</a>
10. <a href="#">Pagination and Sorting using Spring Data JPA - PagingAndSortingRepository (javaguides.net)</a>
11. <a href="https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html">https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html</a> , <a href="https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html">https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html</a>
12. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
13. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
14. <a href="https://javabeat.net/spring-data-custom-repository/">https://javabeat.net/spring-data-custom-repository/</a>
15. <a href="https://www.jrebel.com/blog/jpa-application-performance-best-practices">https://www.jrebel.com/blog/jpa-application-performance-best-practices</a>
16. <a href="https://www.javatpoint.com/service-oriented-architecture">https://www.javatpoint.com/service-oriented-architecture</a> , <a href="https://www.javatpoint.com/web-services-tutorial">https://www.javatpoint.com/web-services-tutorial</a>
17. <a href="https://www.javatpoint.com/soap-web-services">https://www.javatpoint.com/soap-web-services</a> , <a href="https://www.javatpoint.com/restful-web-services">https://www.javatpoint.com/restful-web-services</a>
18. <a href="#">RESTful Web Services - javatpoint</a>
19. <a href="https://www.javatpoint.com/restful-web-services-spring-boot">https://www.javatpoint.com/restful-web-services-spring-boot</a>
20. <a href="https://www.javatpoint.com/restful-web-services-spring-boot">https://www.javatpoint.com/restful-web-services-spring-boot</a> <a href="https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring">https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring</a>
21. <a href="https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful">https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful</a>
22. <a href="https://www.baeldung.com/exception-handling-for-rest-with-spring">https://www.baeldung.com/exception-handling-for-rest-with-spring</a>
23. <a href="https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/">https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/</a>
24. <a href="https://www.javatpoint.com/restful-web-services-versioning">https://www.javatpoint.com/restful-web-services-versioning</a>



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25. <https://spring.io/guides/gs/rest-service-cors/>

26. <https://www.javatpoint.com/restful-web-services-basic-authentication-with-spring-security>

27. <https://www.springboottutorial.com/rest-api-best-practices-with-java-and-spring>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SECURE CODING TECHNIQUES</b> <b>(Job Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, student will be able to:

- Differentiate the objectives of information security
- Understand the trend, reasons and impact of the recent Cyber attacks
- Understand OWASP design principles while designing a web application
- Understand Threat modelling
- Importance of security in all phases of SDLC
- Write secure coding using some of the practices in C/C++/Java and Python programming languages

**UNIT I:**

**Network and Information security Fundamentals:** Network Basics, Network Components, Network Types, Network Communication Types, Introduction to Networking Models, Cyber Security Objectives and Services, Other Terms of Cyber Security, Myths Around Cyber Security, Myths Around Cyber Security, Recent Cyber Attacks, Generic Conclusion about Attacks, Why and What is Cyber Security, Categories of Attack

**UNIT II:**

**Introduction to Cyber security:** Introduction to OWASP Top 10, A1 Injection, A1 Injection Risks Root Causes and its Mitigation, A1 Injection, A2 Broken Authentication and Session Management, A7 Cross Site Scripting XSS, A3 Sensitive Data Exposure, A5 Broken Access Control, A4 XML External Entity (XEE), A6 Security Misconfiguration, A7 Missing Function Level Access Control, A8 Cross Site Request Forgery CSRF, A8 Insecure Deserialization, A9 Using Components With Known Vulnerabilities, A10 Unvalidated Redirects and Forwards, A10 Insufficient Logging and Monitoring, Secure Coding Practices, Secure Design Principles, Threat Modeling, Microsoft SDL Tool

**UNIT III:**

**Secure coding practices and OWASP Top 10:** Declarative Security, Programmatic Security, Concurrency, Configuration, Cryptography, Input and Output Sanitization, Error Handling, Input Validation, Logging and auditing, Session Management, Exception Management, Safe APIs, Type Safety, Memory Management, Tokenizing, Sandboxing, Static and dynamic testing, vulnerability scanning and penetration testing

**UNIT IV:**

**Secure coding practices in C/C++ and Java:** Potential Software Risks in C/C++, Defensive coding, Preventative Planning, Clean Code, Iterative Design, Assertions, Pre Post Conditions, Low level design inspections, Unit Tests

Java- Managing Denial of Service, Securing Information, Data Integrity, Accessibility and Extensibility, Securing Objects, Serialization Security

**UNIT V:**

**Secure coding in Python:** Interactive Python Scripting, Python Variables, Conditionals, Loops, Functions, External Modules, File operations, Web requests



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**Text Books:**

1. Networking Fundamentals, 2019 edition, Packt, Author: Gordon Davies
2. Principles of Information Security, Authors: Michael E. Whitman and Herbert J. Mattord, Course technology incorp.
3. CSSLP SECURE SOFTWARE LIFECYCLE PROFESSIONAL ALL-IN-ONE EXAM GUIDE, Third Edition, 3rd Edition, Authors: Wm. Arthur Conklin, Daniel Paul Shoemaker, Released February 2022, Publisher(s): McGraw-Hill, ISBN: 9781264258215
4. OCP Oracle Certified Professional Java SE 11 Programmer II Study Guide: Exam 1Z0-816 and Exam 1Z0-817 Paperback – 6 August 2020, Authors: Scott Selikoff , Jeanne Boyarsky
5. OWASP 2017 Handbook,

[https://owasp.org/www-pdf-archive/OWASP\\_Top\\_10\\_2017\\_RC2\\_Final.pdf](https://owasp.org/www-pdf-archive/OWASP_Top_10_2017_RC2_Final.pdf)

**Web Links:**

**Infosys Springboard courses**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012683751296065536354\\_shared/contents](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683751296065536354_shared/contents) [Network Fundamentals]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_3388902307073574000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_3388902307073574000_shared/overview) [Introduction to cybersecurity]
3. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015696571596809160](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015696571596809160) [Certified Secure Software Lifecycle Professional (CSSLP) 2019: Secure Coding Practices]
4. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015689927557129660](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015689927557129660) [OWASP Top 10: Web Application Security]
5. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159304097792013093](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159304097792013093) [Defensive coding fundamentals in C and C++]
6. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159172969267213125](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159172969267213125) [Java SE 11 Programmer II: Secure Coding in Java SE 11 Applications]
7. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01350158164493107211192/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01350158164493107211192/overview) [Security Programming: Python Scripting Essentials]

**Web references:**

1. <https://www.stealthlabs.com/blog/infographic-top-15-cybersecurity-myths-vs-reality/>
2. <https://microage.ca/cybersecurity-layering-approach/>
3. <https://www.synopsys.com/glossary/what-is-threat-modeling.html#:~:text=Threat%20modeling%20is%20a%20structured,An%20abstraction%20of%20the%20system>
4. <https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling>
5. <https://www.checkpoint.com/cyber-hub/threat-prevention/what-is-sandboxing/>
6. <https://www.skillsoft.com/course/defensive-coding-fundamentals-for-cc-f44c02f9-1bcc-11e7-b15b-0242c0a80b07#:~:text=Defensive%20Programming%20is%20a%20methodology,%20C%20testing%20and%20input%20validation.>
7. <https://www.oracle.com/java/technologies/javase/seccodeguide.html>
8. <https://www.skillsoft.com/course/security-programming-python-scripting-essentials-be99adad-1f65-47a8-a4b5-6b5346072b8e>



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<b>IV Year – I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY</b>					

### Human Values Courses

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as “H-102 Universal Human Values 2: Understanding Harmony” is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

### Universal Human Values 2: Understanding Harmony

Course code: HSMC (H-102)

Credits: L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits

Pre-requisites: None. Universal Human Values 1 (desirable)

#### 1. Objective:

**The objective of the course is four fold:**

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

#### 2. Course Topics:

**The course has 28 lectures and 14 practice sessions in 5 modules:**

#### Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss 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

#### Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

4. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
5. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
6. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
7. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
8. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
9. Programs to ensure Sanyam and Health.



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Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

**Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

10. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
11. Understanding the meaning of Trust; Difference between intention and competence
12. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
13. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
14. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to 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. Discuss with scenarios. Elicit examples from students' lives

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

**3. READINGS:**

**3.1 Text Book**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010



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**3.2 Reference Books**

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

**4. MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits)**

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the student explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

**5. ASSESSMENT:**

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks

Self-assessment: 10 marks

Assessment by peers: 10 marks

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 50 marks





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The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

**6. OUTCOME OF THE COURSE:**

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

- a) faculty-student or mentor-mentee programs throughout their time with the institution
- b) Higher level courses on human values in every aspect of living. E.g. as a professional



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		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>PYTHON: DEEP LEARNING (Skill Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Demonstrate the basic concepts fundamental learning techniques and layers.
- Discuss the Neural Network training, various random models.
- Apply various optimization algorithms to comprehend different activation functions to understand hyper parameter tuning
- Build a convolutional neural network, and understand its application to build a recurrent neural network, and understand its usage to comprehend auto encoders to briefly explain transfer learning

**Pre-requisite knowledge :**

- Exploratory data analysis: Collecting, importing, pre-processing, organizing, exploring, analyzing data and deriving insights from data  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012666909428129792728\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012666909428129792728_shared/overview)
- Data visualization using Python: Data visualization functions and plots  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0126051913436938241455\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051913436938241455_share_d/overview)
- Regression analysis: Regression, types, linear, polynomial, multiple linear, Generalized linear regression models  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01320408013336576065\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01320408013336576065_shared/overview)
- Clustering using Python: Clustering, techniques, Assessment and evaluation  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0130441799423426561190\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130441799423426561190_share_d/overview)
- Machine learning using Python: Machine learning fundamentals, Regression, classification, clustering, introduction to artificial neural networks  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012600400790749184237\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012600400790749184237_shared/overview)
- Time series analysis : Patterns, decomposition models, smoothing time, forecasting data  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0126051804744253441280\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051804744253441280_share_d/overview)

**List of Exercises:**

**Note:** There are online courses indicated in the reference links section. Learners need to go through the contents in order to perform the given exercises

**Exercise 1:**

Course name : .Build a Convolution Neural Network for Image Recognition.

Go through the modules of the course mentioned and answer the self-assessment questions given in the link below at the end of the course.

[Self Assessment - Deep Learning - Viewer Page | Infosys Springboard \(onwingspan.com\)](#)



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**Exercise 2:**

Module name : Understanding and Using ANN : Identifying age group of an actor

Exercise : Design Artificial Neural Networks for Identifying and Classifying an actor using Kaggle Dataset.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012776492416663552259\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012776492416663552259_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 3:**

Module name : Understanding and Using CNN : Image recognition

Exercise: Design a CNN for Image Recognition which includes hyperparameter tuning.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012785694443167744910\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012785694443167744910_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 4:**

Module name : Predicting Sequential Data

Exercise: Implement a Recurrence Neural Network for Predicting Sequential Data.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_01279144948849868822\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_01279144948849868822_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 5:**

Module Name: Removing noise from the images

Exercise: Implement Multi-Layer Perceptron algorithm for Image denoising hyperparameter tuning.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012792058258817024272\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012792058258817024272_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 6:**

Module Name: Advanced Deep Learning Architectures

Exercise: Implement Object Detection Using YOLO.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013102923373297664873\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013102923373297664873_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 7:**

Module Name: Optimization of Training in Deep Learning

Exercise Name: Design a Deep learning Network for Robust Bi-Tempered Logistic Loss.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013107917226680320184\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013107917226680320184_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)

**Exercise 8:**

Module name: Advanced CNN

Exercise: Build AlexNet using Advanced CNN.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013111844422541312984\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013111844422541312984_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course)



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**Exercise 9:**

Module name: Autoencoders Advanced
Exercise: Demonstration of Application of Autoencoders.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131164551289896962081_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131164551289896962081_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 10 :**

Module name: Advanced GANs
Exercise: Demonstration of GAN.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131155456664289281901_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131155456664289281901_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 11:**

Module name : Capstone project
Exercise : Complete the requirements given in capstone project
Description: In this capstone, learners will apply their deep learning knowledge and expertise to a real world challenge.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 12:**

Module name : Capstone project
Exercise : Complete the requirements given in capstone project
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Reference Books:**

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

**Hardware and software configuration:**

Experimental Environment	Configuration Instructions	
Hardware Environment	CPU	Intel® Core™ i7-6700 CPU 4GHz
	GPU	Nvidia GTX 750, 4GB
	Memory	8 GB
Software Environment	Operating System	Ubuntu 14.04, 64 bit
	Programming Environment	Tensorflow deep learning framework and Python language

**Web Links: [Courses mapped to Infosys Springboard platform]**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012782105116811264219\\_shared/contents](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012782105116811264219_shared/contents) [Introduction to Deep Learning]
2. [https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013119291805696000651\\_shared](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared) [Deep learning for Developers]



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<b>IV Year – I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>MEAN STACK TECHNOLOGIES-MODULE II- ANGULAR JS, MONGODB (Skill Oriented Course)</b>					

**Course Outcomes:**

- Build a component-based application using Angular components and enhance their functionality using directives.
- Utilize data binding for developing Angular forms and bind them with model data.
- Apply Angular built-in or custom pipes to format the rendered data.
- Develop a single page applic
- ation by using synchronous or asynchronous Angular routing.
- Make use of MongoDB queries to perform CRUD operations on document database.

**List of Exercises:**

<b>1.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Angular Application Setup
	Observe the link <a href="http://localhost:4200/welcome">http://localhost:4200/welcome</a> on which the mCart application is running. Perform the below activities to understand the features of the application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>1.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Components and Modules
	Create a new component called hello and render Hello Angular on the page
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>1.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Elements of Template
	Add an event to the hello component template and when it is clicked, it should change the courseName.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>1.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Change Detection
	progressively building the PoolCarz application
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_25609816371207710000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_25609816371207710000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>
<b>2.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Structural Directives - ngIf
	Create a login form with username and password fields. If the user enters the correct credentials, it should render a "Welcome <<username>>" message otherwise it should render "Invalid Login!!! Please try again..." message
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637402260439042595_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637402260439042595_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>



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<b>2.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngFor
	Create a courses array and rendering it in the template using ngFor directive in a list format.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>2.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngSwitch
	Display the correct option based on the value passed to ngSwitch directive.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>2.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Structural Directive
	Create a custom structural directive called 'repeat' which should repeat the element given a number of times.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>3.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Attribute Directives - ngStyle
	Apply multiple CSS properties to a paragraph in a component using ngStyle.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>3.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngClass
	Apply multiple CSS classes to the text using ngClass directive.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>3.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Attribute Directive
	Create an attribute directive called 'showMessage' which should display the given message in a paragraph when a user clicks on it and should change the text color to red.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>4.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Property Binding
	Binding image with class property using property binding.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>4.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Attribute Binding
	Binding colspan attribute of a table element to the class property.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>



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<b>4.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Style and Event Binding
	Binding an element using inline style and user actions like entering text in input fields.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>5.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Built in Pipes
	Display the product code in lowercase and product name in uppercase using built-in pipes.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>5.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing Parameters to Pipes
	Apply built-in pipes with parameters to display product details.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>5.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Nested Components Basics
	Load CourseslistComponent in the root component when a user clicks on the View courses list button.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing data from Container Component to Child Component
	Create an AppComponent that displays a dropdown with a list of courses as values in it. Create another component called the CoursesList component and load it in AppComponent which should display the course details. When the user selects a course from the
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing data from Child Component to ContainerComponent
	Create an AppComponent that loads another component called the CoursesList component. Create another component called CoursesListComponent which should display the courses list in a table along with a register .button in each row. When a user clicks on th
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_20858515543254600000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_20858515543254600000_0_shared&amp;collectionType=Course</a>
<b>6.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Shadow DOM
	Apply ShadowDOM and None encapsulation modes to components.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Component Life Cycle



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	Override component life-cycle hooks and logging the corresponding messages to understand the flow. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>7.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Template Driven Forms Create a course registration form as a template-driven form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>7.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Model Driven Forms or Reactive Forms Create an employee registration form as a reactive form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>7.c</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Custom Validators in Reactive Forms Create a custom validator for an email field in the employee registration form ( reactive form) <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Custom Validators in Template Driven forms Create a custom validator for the email field in the course registration form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Services Basics Create a Book Component which fetches book details like id, name and displays them on the page in a list format. Store the book details in an array and fetch the data using a custom service. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.c</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> RxJS Observables Create and use an observable in Angular. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>9.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Server Communication using HttpClient Create an application for Server Communication using HttpClient <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>
<b>9.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Communicating with different backend services using Angular





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	<p>HttpClient</p> <p>Create a custom service called ProductService in which Http class is used to fetch data stored in the JSON files.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p>
a	<p><b>Module Name:</b> Routing Basics, Router Links</p> <p>Create multiple components and add routing to provide navigation between them.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p>
b	<p><b>Module Name:</b> Route Guards</p> <p>Considering the same example used for routing, add route guard to BooksComponent. Only after logging in, the user should be able to access BooksComponent. If the user tries to give the URL of Bookscomponent in another tab or window, or if the user tries</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p>
c	<p><b>Module Name:</b> Asynchronous Routing</p> <p>Apply lazy loading to BookComponent. If lazy loading is not added to the demo, it has loaded in 1.14 s. Observe the load time at the bottom of the browser console. Press F12 in the browser and click the Network tab and check the Load time</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p>
d	<p><b>Module Name:</b> Nested Routes</p> <p>Implement Child Routes to a submodule.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a></p>
11.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p>
a	<p><b>Module Name:</b> Installing MongoDB on the local computer, Create MongoDB Atlas Cluster</p> <p>Install MongoDB and configure ATLAS</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a></p>
11.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p>
b	<p><b>Module Name:</b> Introduction to the CRUD Operations</p> <p>Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a></p>
12.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p>
a	<p><b>Module Name:</b> Create and Delete Databases and Collections</p> <p>Write MongoDB queries to Create and drop databases and collections.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654</a></p>



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_013177169294712832113_shared&amp;collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">119219230121 shared?collectionId=lex_auth_013177169294712832113 shared&amp;collectionType=Course</a>
<b>12.</b>	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
<b>b</b>	<b>Module Name:</b> Introduction to MongoDB Queries
	Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505 shared?collectionId=lex_auth_013177169294712832113 shared&amp;collectionType=Course</a>

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

**Software configuration and installation:**

1. Angular  
Setup details: Angular Application Setup - Internal - Viewer Page | Infosys Springboard (onwingspan.com)
2. MongoDB  
TOC - MongoDB Essentials - A Complete MongoDB Guide | Infosys Springboard (onwingspan.com)

**Web Links:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_20858515543254600000 shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview) (Angular JS)
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113 shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview) (MongoDB)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

<b>IV Year – I Semester</b>	<b>Minor Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>SOFTWARE ENGINEERING</b>					

**Course Objectives:**

This course is designed to acquire the generic software development skill through various stages of software life cycle and also to ensure the quality of software through software development with various protocol based environment

**Course Outcomes:**

Students taking this subject will gain software engineering skills in the following areas:

- Ability to transform an Object-Oriented Design into high quality, executable code
- Skills to design, implement, and execute test cases at the Unit and Integration level
- Compare conventional and agile software methods
- Prepare SRS document, design document, test cases and software configuration management and risk management related document.
- Develop function oriented and object oriented software design using tools like rational rose.
- Use modern engineering tools necessary for software project management, estimations, time management and software reuse
- Generate test cases for software testing

**UNIT I**

The Nature of Software, Software Engineering, The Software Process, Software Engineering Practice, Software Myths. A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology.

**UNIT II**

Agility, Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, A Tool Set for the Agile Process, Software Engineering Knowledge, Core Principles, Principles That Guide Each Framework Activity, Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

**UNIT III**

Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling, Requirements Modeling Strategies, Flow-Oriented Modeling, Creating a Behavioral Model, Patterns for Requirements Modelling,.

**UNIT IV**

Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model, Software Architecture, Architectural Genres, Architectural Styles, Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow, Components, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for WebApps, Designing Traditional Components, Component- Based Development.

**UNIT V**

The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation, Elements of Software Quality Assurance, SQA Tasks, Goals & Metrics, Statistical SQA, Software Reliability, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies



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for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System Testing, The Art of Debugging, Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing.

**List of Experiments:**

- 1) Perform the following, for the following experiments:
  - i. Do the Requirement Analysis and Prepare SRS
  - ii. Draw E-R diagrams, DFD, CFD and structured charts for the project.
- 1) Course Registration System
- 2) Students Marks Analyzing System
- 3) Online Ticket Reservation System
- 4) Stock Maintenance
- 5) Draw the UML Diagrams for the problem 1,2, 3, 4.
- 6) Design the test cases for e-Commerce application (Flipcart, Amazon)
- 7) Design and Implement ATM system through UML Diagrams.

**Text Books:**

- 1) Software Engineering a practitioner's approach, Roger S. Pressman, Seventh Edition, McGraw Hill Higher Education.
- 2) Software Engineering, Ian Sommerville, Ninth Edition, Pearson.

**Reference Books:**

- 1) Software Engineering, A Precise Approach, PankajJalote, Wiley India, 2010.
- 2) Software Engineering, Ugrasen Suman, Cengage.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105182/>



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## **MINOR COURSES**

**PART –B**



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>COMPUTATIONAL THINKING</b>					

**Course Objective:**

- The subject is aimed at students with little or no programming experience.
- It aims to provide students with an understanding of the role computation can play in solving problems.
- It also aims to help students, regardless of their major, to feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals.

**Course Outcomes:**

After studying this course, Student should be able to:

1. Describe the skills that are involved in computational thinking
2. Demonstrate the concepts of Boolean Logic and Software Development.
3. Analyze the concepts of algorithmic thinking as modeling and abstraction as encapsulation.
4. Illustrate the distinctive nature of data organization, White box and Black box testing.
5. Student will be aware of a range of applications of computational thinking in different disciplines, Authentication and authorization.

**UNIT I:**

**Introduction:** Computers, Computational Thinking, Abacus to Machine, The First Software, The First Modern Computer, Moore's Law, **Real-World Information Becomes Computable Data**, Information and Data, Converting Information into Data, Data Capacity, Data Compression

**UNIT II:**

**Logic:** Boolean Logic, Applications of Propositional Logic, **Solving Problems**, Logical Reasoning, Decomposition: Software Design, Decomposition: Other Uses, Abstraction: Class Diagrams, Abstraction: Use Case Diagrams

**UNIT III:**

**Algorithmic Thinking:** Algorithms, Software and Programming, Languages, Actions, **Modeling Solutions:** Activity Diagrams, Selection in Activity Diagrams, Repetition in Activity Diagrams, Control Abstraction in Activity Diagrams, States and State Diagrams, Behavior in State Diagrams,

**UNIT IV:**

**Data Organization:** Names, Lists, Graphs, Hierarchies, **Algorithmic Thinking:** Von Neumann Architecture, Spreadsheets, Text Processing, Patterns, Computer Errors, Software Correctness, Verification, Software Testing, White Box Testing, Black Box Testing with Equivalence Partitioning, Boundary Value Analysis

**UNIT V:**

**Concurrent Activity:** Parallelism or Concurrency, Scheduling, Sorting Networks, **Information Security:** Security, Foundations, Common Forms of Cybercrime, Secure- Step 1: Authenticate, Secure- Step 2: Authorization, All a Matter of Risk



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**Text Book:**

1. David Riley, Kenny A. Hunt, Computational Thinking for the Modern Problem Solver, 2014.
2. G Venkatesh, Madhavan Mukund, Computational Thinking: A Primer for Programmers and Data Scientists, 2021.

**Reference Books:**

1. Paolo Ferragina, Fabrizio Luccio, Computational Thinking: First Algorithms, then coding, Springer, 2018.
2. Karl Beecher, computational thinking: A beginner's guide to problem-solving and programming, 2017.

**NPTEL Link:** Physics through Computational Thinking:  
[https://onlinecourses.nptel.ac.in/noc22\\_ph12/preview](https://onlinecourses.nptel.ac.in/noc22_ph12/preview)



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<b>OBJECT ORIENTED PROGRAMMING THROUGH JAVA</b>					

**Course Objectives:**

The learning objectives of this course are:

- To identify Java language components and how they work together in applications
- To learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- To learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Practice programming in the Java
- Gain knowledge of object-oriented paradigm in the Java programming language

**Course Outcomes:**

By the end of the course, the student will be

- Evaluate default value of all primitive data type, Operations, Expressions, Control- flow, Strings
- Determine Class, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrating simple inheritance, multi-level inheritance, Exception handling mechanism
- Construct Threads, Event Handling, implement packages, developing applets

**UNIT I**

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement ( - - ) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?., Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

**UNIT II**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**UNIT III**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-





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dimensional Arrays, Arrays of Varying Lengths, Three- dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**UNIT IV**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Random Class, Time Package, Formatting for Date/Time in Java,

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions, try-with-resources, Catching Subclass Exception, Custom Exceptions, Nested try and catch Blocks, Rethrowing Exception, Throws Clause.

**UNIT V**

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Methods for Comparison of Strings, Methods for Modifying Strings, Methods for Searching Strings, Data Conversion and Miscellaneous Methods, Class String Buffer, Class String Builder.

**List of Experiments:**

**Exercise - 1 (Basics)**

- a) Write a JAVA program to display default value of all primitive data type of JAVA
- b) Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.

**Exercise - 2 (Operations, Expressions, Control-flow, Strings)**

- a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
- b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
- c) Write a JAVA program using StringBuffer to delete, remove character.

**Exercise - 3 (Class, Objects)**

- a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- b) Write a JAVA program to implement constructor.

**Exercise - 4 (Methods)**

- a) Write a JAVA program to implement constructor overloading.
- b) Write a JAVA program implement method overloading.

**Exercise - 5 (Inheritance)**

- a) Write a JAVA program to implement Single Inheritance
- b) Write a JAVA program to implement multi level Inheritance



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**Exercise - 6** (Inheritance - Continued)

- a) Write a JAVA program give example for “super” keyword.
- b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

**Exercise - 7** (Exception)

- a) Write a JAVA program that describes exception handling mechanism
- b) Write a JAVA program Illustrating Multiple catch clauses

**Exercise – 8** (Runtime Polymorphism)

Write a JAVA program that implements Runtime polymorphism

**Exercise – 9** (User defined Exception)

- a) Write a JAVA program for creation of Illustrating throw
- b) Write a JAVA program for creation of Illustrating finally

**Text Books:**

- 1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
- 2) The complete Reference Java, 8th edition, Herbert Schildt, TMH.

**References Books:**

- 1) Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
- 2) Murach's Java Programming, Joel Murach

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105191/>
- 2) [https://www.w3schools.com/java/java\\_data\\_types.asp](https://www.w3schools.com/java/java_data_types.asp)



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<b>DATA ANALYTICS USING PYTHON</b>					

**Course Objective:**

- To provide a comprehensive knowledge of data science using Python.

**Course Outcomes:**

By completing the course the students will be able to:

- Understand various file formats in loading and storage of data.
- Understand NumPy and Pandas

**UNIT I:**

**NumPy Basics:** The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays, Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transporting Arrays and Swapping Axes.

**UNIT II:**

**Universal Functions:** Fast Element-wise Array Functions, **Data Processing using Arrays:** Expressing Conditional Logic as Array Operations, Mathematical and Statistical Methods, Methods for Boolean Arrays, Sorting, File Input and Output with Arrays: Saving and Loading Text Files.

**UNIT III:**

**Getting started with pandas:** Introduction to pandas: Series, DataFrame, Index Objects, Essential Functionality: Reindexing, Dropping entries from an axis, Indexing, selection, and filtering, Sorting and ranking, Axis Indexes with Duplicate Values, Summarizing and Computing Descriptive Statistics: Unique Values, Value Counts

**UNIT IV:**

**Handling Missing Data:** filtering out missing data, Filling in Missing data, Hierarchical Indexing: Recording and Sorting Levels, Summary Statistics by Level, Using a DataFrame's Columns, **Data Loading, Storage, and File Formats :** Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format

**UNIT V:**

**Data Wrangling:** Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values. **Plotting and Visualization:** Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.

**List of Experiments:**

1	Creating a NumPy Array a. Basic ndarray b. Array of zeros c. Array of ones d. Random numbers in ndarray e. An array of your choice f. Imatrix in NumPy g. Evenly spaced ndarray
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2	<p>The Shape and Reshaping of NumPy Array</p> <ol style="list-style-type: none"> <li>Dimensions of NumPy array</li> <li>Shape of NumPy array</li> <li>Size of NumPy array</li> <li>Reshaping a NumPy array</li> <li>Flattening a NumPy array</li> <li>Transpose of a NumPy array</li> </ol>
3	<p>Expanding and Squeezing a NumPy Array</p> <ol style="list-style-type: none"> <li>Expanding a NumPy array</li> <li>Squeezing a NumPy array</li> <li>Sorting in NumPy Arrays</li> </ol>
4	<p>Indexing and Slicing of NumPy Array</p> <ol style="list-style-type: none"> <li>Slicing 1-D NumPy arrays</li> <li>Slicing 2-D NumPy arrays</li> <li>Slicing 3-D NumPy arrays</li> <li>Negative slicing of NumPy arrays</li> </ol>
5	<p>Stacking and Concatenating Numpy Arrays</p> <ol style="list-style-type: none"> <li>Stacking ndarrays</li> <li>Concatenating ndarrays</li> <li>Broadcasting in Numpy Arrays</li> </ol>
6	<p>Perform following operations using pandas</p> <ol style="list-style-type: none"> <li>Creating dataframe</li> <li>concat()</li> <li>Setting conditions</li> <li>Adding a new column</li> </ol>
7	<p>Perform following operations using pandas</p> <ol style="list-style-type: none"> <li>Filling NaN with string</li> <li>Sorting based on column values</li> <li>groupby()</li> </ol>
8	<p>Read the following file formats using pandas</p> <ol style="list-style-type: none"> <li>Text files</li> <li>CSV files</li> <li>Excel files</li> <li>JSON files</li> </ol>
9	<p>Read the following file formats</p> <ol style="list-style-type: none"> <li>Pickle files</li> <li>Image files using PIL</li> <li>Multiple files using Glob</li> <li>Importing data from database</li> </ol>
10	<p>Demonstrate web scraping using python</p>
11	<p>Perform following preprocessing techniques on loan prediction dataset</p> <ol style="list-style-type: none"> <li>Feature Scaling</li> <li>Feature Standardization</li> <li>Label Encoding</li> <li>One Hot Encoding</li> </ol>
12	<p>Perform following visualizations using matplotlib</p> <ol style="list-style-type: none"> <li>Bar Graph</li> <li>Pie Chart</li> <li>Box Plot</li> <li>Histogram</li> </ol>



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	e. Line Chart and Subplots f. Scatter Plot
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**Text Books:**

1. Wes McKinney, “Python for Data Analysis”, O’REILLY, ISBN:978-1-449-31979-3, 1st edition

**Reference Books:**

1. Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly

**Web References:**

<https://www.coursera.org/learn/data-analysis-with-python>



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>ARTIFICIAL INTELLIGENCE</b>					

**Course Objectives:** The student will be able to

- Know the methodology of Problem solving
- Implement basic AI algorithms
- Design and carry out an empirical evolution of different algorithms on a problem formalization

**Course Outcomes (COs):** At the end of the course, student will be able to

- Understand the fundamental concepts in Artificial Intelligence
- Analyze the applications of search strategies and problem reductions
- Apply the mathematical logic concepts.
- Develop the Knowledge representations in Artificial Intelligence.
- Explain the Fuzzy logic systems.

**UNIT I:**

**Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.

**UNIT II:**

**Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem

**Search Strategies:** exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction

**UNIT III:**

**Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, predicate logic

**UNIT IV:**

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR

**Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure.

**UNIT V:**

**Expert system and applications:** Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools.

**Text Books:**

1. Artificial Intelligence, Saroj Kaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2<sup>nd</sup> ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence, Rich, Kevin Knight, Shiv Shankar B Nair, 3<sup>rd</sup> ed, TMH
4. Introduction to Artificial Intelligence, Patterson, PHI



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**Reference Books:**

1. Artificial intelligence, structures and Strategies for Complex problem solving, -George F Luger, 5<sup>th</sup> ed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier



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		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>UNIX AND SHELL PROGRAMMING</b>					

**Course Objectives:**

Understating the shell commands, shell programming, system calls of files and processes, signals, inter-process communication concepts and programming, TCP and UDP.

**Course Outcomes:** After finishing this course student will be able to:

- Gain good knowledge on Unix commands and awareness of shell programming
- Know about different system calls for files and directories
- Ability to know the working of processes and signals
- Application of client server program for IPC
- Knowledge about socket programming

**UNIT-I:**

Introduction, Architecture of unix, Responsibilities of shell, unix file system, vi editor. **Unix commands:** Some Basic Commands, file utilities, process utilities, text processing utilities, network utilities, disk utilities, backup utilities , Security by file permissions.

**UNIT-II:**

**Shell Programming:** shell variables, The Export command, The Profile File a Script Run During starting, The First Shell Script, The read command, Positional Parameters, The \$? Variable , Knowing the exit Status- More about the Set Command, The Exit command, Branching Control Structures, Loop Control Structures, The Continue and Break Statement- The Expr Command, Performing Integer Arithmetic- Real Arithmetic in Shell Programs- The here Document(<<), The Sleep Command, Debugging Scripts, The Script command, The Eval command, The Exec Command, Sample programs.

**UNIT-III:**

**Files** - Introduction, file descriptors, open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, links-soft and hard links-symlink, link, unlink.

**UNIT IV:**

**Directories**-Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT V:**

**Process Control:** process identifiers, fork function, vfork function, exit function, wait and waitpid functions, exec functions, user identification. **Signals:** signal handling using signal function, kill and raise, alarm, pause, abort and sleep functions.

**List of Experiments:**

- 1)a) Study of Unix/Linux general purpose utility command list: man,who,cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.
- b) Study of vi editor
- c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system
- d) Study of Unix/Linux file system (tree structure)





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e) Study of .bashrc, /etc/bashrc and Environment variables.

- 2) Write a C program that makes a copy of a file using standard I/O, and system calls
- 3) Write a C program to emulate the UNIX `ls -l` command.
- 4) Write a C program that illustrates how to execute two commands concurrently with a command pipe. Ex: `- ls -l | sort`
- 5) Implementation of `fork ()`, `wait ()`, `exec()` and `dexit ()`, System calls

**Text Books:**

4. Unix the ultimate guide, 3<sup>rd</sup> edition, Sumitabha Das, TMH.
5. Advanced programming in the Unix environment by W. Richard Stevens.
6. Unix network programming by W. Richard Stevens.

**Reference Books:**

1. Introduction to Unix and shell programming, Venkateshmurthy
2. Unix and shell programming by B.M. Harwani, OXFORD university press.



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<b>PART B</b>	<b>Minor Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>CLOUD COMPUTING</b>					

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

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

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNIT I:**

**Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNIT II:**

**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNIT III:**

**Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV:**

**Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNIT V:**

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

3. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
4. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.



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**Reference Books:**

4. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madiseti, University Press
5. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
6. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH



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**Suggested Courses for Honors Program**



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MATHEMATICS FOR MACHINE LEARNING (AI &amp; ML)</b>					

**Course Objectives:**

The main objectives of this course is to make student understand and apply the basic mathematical concepts that are essential for machine learning algorithms

**Course Outcomes:**

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

- understand the basic notions of machine learning and of the related basic mathematical tools;
- comprehend the basic concepts and techniques of convex optimization
- have a good knowledge of the statistical and computational properties of some well known machine learning algorithms;
- implement machine learning algorithms on synthetic and real data sets using mathematical concepts like linear algebra, probability and calculus

**UNIT-I**

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces

**UNIT-II**

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

**UNIT-III**

Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny

**UNIT-IV**

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

**UNIT-V**

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform  
 Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

**Text Books:**

1. “Mathematics for Machine Learning”, Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2<sup>nd</sup> Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.



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**Reference Books:**

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>TEXT MINING AND TIME SERIES ANALYSIS</b>					
<b>(AI &amp; ML)</b>					

**Course Objectives:** This course will cover the major techniques for mining and analyzing text data to discover interesting patterns, extract useful knowledge, and support decision making, with an emphasis on statistical approaches that can be generally applied to arbitrary text data in any natural language with no or minimum human effort. Develop the skills needed to do empirical research in fields operating with time series data sets. The course aims to provide students with techniques and receipts for estimation and assessment of quality of economic models with time series data.

**Course Outcomes:**

After completing the course Student will be able to:

- Student will be aware of fundamental concepts of text mining, unsupervised information extraction.
- Student will be aware of text clustering algorithms like feature selection, distance-based clustering and latent semantic indexing.
- Student will be aware of Text classification algorithm and text mining techniques.
- Student should aware of all the characteristics of time series and measures of dependencies.
- Student will be able to understand the ARIMA Models.

**UNIT I:**

**Introduction to Text Mining:** Introduction, Algorithms for Text Mining, Information Extraction from Text: Introduction, Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction. Text Summarization Techniques: Extractive Summarization, Topic Representation Approaches, Influence of Context, Indicator Representation and Machine Learning for Summarization.

**UNIT II:**

**Text Clustering Algorithms:** Introduction, Feature Selection and Transformation Methods for Text Clustering, Distance-Based Clustering Algorithms, Word and Phrase-based Clustering, Probabilistic Document Clustering and Topic Modelling. Dimensionality Reduction and Topic Modelling: Latent Semantic Indexing, Topic Models and Dimension Reduction.

**UNIT III:**

**Text Classification Algorithms:** Introduction, Feature Selection for Text Classification, Decision Tree Classifiers, Rule-based Classifier, Probabilistic and Naïve Bayes Classifiers, Linear Classifier, Proximity-based Classifier, Meta-Algorithms for Text Classification, Probabilistic Models for Text Mining: Mixture models, Stochastic Processes in Bayesian Nonparametric Models, Graphical Models.

**UNIT IV:**

**Characteristics of Time Series:** Introduction, Nature of Time Series Data, Time Series Statistical Models, Measures of Dependence: Autocorrelation and Cross-Correlation, Stationary Time Series, Time Series Regression and Exploratory Data Analysis: Classical Regression, Exploratory Data Analysis, Smoothing.



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**UNIT V:**

**ARIMA Models:** Introduction, Autoregressive Moving Average Models, Difference Equations, Autocorrelation and Partial Autocorrelation, Building ARIMA Models, Multiplicative Seasonal ARIMA Models, Spectral Analysis and Filtering: Cyclical Behaviour and Periodicity, Spectral Density, Periodogram and Discrete Fourier Transform, Nonparametric and Parametric Spectral Estimation, Linear Filters, Dynamic Fourier Analysis and Wavelets.

**Text Books:**

1. Charu C. Aggarwal, Chengxing Zhai, “Mining Text Data”, Kluwer Academic Publishers, Springer, 2012.
2. Robert H. Shumway and David S. Stoffer, “Time Series Analysis and Its Applications with R Examples”, Springer, 2016.

**Reference Books:**

1. James D. Hamilton, Time Series Analysis, Princeton University Press, 2004.
2. Avishek Pal and PKS Prakash, Practical Time Series Analysis, Birmingham - Mumbai, 2017.
3. Box, G.E.P., G.M. Jenkins and G.C. Reinsel. n Time Series Analysis, Forecasting, and Control, 3rd ed. Englewood Cliffs, NJ: Prentice Hall, 1994.
4. Chan, N.H. Time Series: Applications to Finance. 2002, New York: Wiley.
5. Fuller, W.A. Introduction to Statistical Time Series, 2<sup>nd</sup> ed. New York: Wiley, 1996.





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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>NATURAL LANGUAGE PROCESSING</b>					
<b>(AI &amp; ML)</b>					

**Course Objectives:**

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

**Course Outcomes:** After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

**UNIT I:**

**Introduction :**Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

**UNIT II:**

**Word Level Analysis:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and Maximum Entropy models.

**UNIT III:**

**Syntactic Analysis :** Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures

**UNIT IV:**

**Semantics And Pragmatics:** Requirements for representation, First-Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selectional restrictions, Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods, Word Similarity using Thesaurus and Distributional methods.

**UNIT V:**

**Discourse Analysis And Lexical Resources :** Discourse segmentation, Coherence, Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm, Coreference Resolution, Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).



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**Text Books:**

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, OReilly Media, 2009.

**Reference Books:**

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkha and Fred J. Damerau, Handbook of Natural Language Processing, Second, Chapman and Hall/CRC Press, 2010. Edition
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>REINFORCEMENT LEARNING (AI &amp; ML)</b>					

**Course Objectives:**

By the end of the class students should be able to:

- Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
- Given an application problem (e.g. from computer vision, robotics, etc), decide if it should be formulated as a RL problem; if yes be able to define it formally (in terms of the state space, action space, dynamics and reward model), state what algorithm (from class) is best suited for addressing it and justify your answer.

**Course Outcomes:**

By the end of this course, students should be able to do the following:

1. Learn how to define RL problems like Tic-Tac-Toe, Multi-arm.
2. Student will be able to understand the finite markov decision processes.
3. Student will be to Understand Monte Carlo Methods and how it is work with tabular methods to solve classical control problems
4. Student should aware of Eligibility Traces and Understand how to find with approximate solutions.
5. Explore imitation learning tasks and solutions
6. Recognize current advanced techniques and applications in RL

**UNIT I:**

**Reinforcement Learning Problem:** Introduction, Elements of Reinforcement Learning, Limitations and Scope, Tic-Tac-Toe, Multi-arm Bandits:  $n$ -Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit, Associative Search.

**UNIT II:**

**Finite Markov Decision Processes:** Agent-Environment Interface, Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation, Dynamic Programming: Policy- Evaluation, Improvement, Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming.

**UNIT III:**

**Monte Carlo Methods:** Monte Carlo- Prediction, Estimation of Action Values, Control, Control without Exploring Start, Temporal- Difference learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning, Games, Afterstates.

**UNIT IV:**

**Eligibility Traces:**  $n$ -Step TD Prediction, Forward and Backward View of TD( $\lambda$ ), Equivalences of Forward and Backward Views,  $sar(\lambda)$ , Watkin's Q( $\lambda$ ), Off-policy Eligibility Traces using Important Sampling, Variable  $\lambda$ .

**UNIT V:**

**Planning and Learning with Tabular Methods:** Models and Planning, Integrating Planning, Acting and Learning, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.



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**Text Book:**

1. Rich S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2015.
2. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, Reinforcement Learning Algorithms: Analysis and Applications, 1<sup>st</sup> Edition, Springer, 2021.

**Reference Books:**

1. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agent, 1<sup>st</sup> Edition, O'Reilly, 2020.
2. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever, Handbook of Reinforcement Learning and Control, 1<sup>st</sup> Edition, Springer, 2021.

**NPTEL Link:** Reinforcement Learning: [https://onlinecourses.nptel.ac.in/noc22\\_cs34/preview](https://onlinecourses.nptel.ac.in/noc22_cs34/preview)



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>INTERNET OF THINGS (Systems Engineering)</b>					

**Course Objectives:**

The main objectives of this course are

- Vision and Introduction to Internet of Things (IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

**Course Outcomes (COs):**

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

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

**UNIT I:**

**The Internet of Things:** An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

**UNIT II:**

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

**UNIT III:**

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

**UNIT IV:**

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

**UNIT V:**

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.



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**Text Books:**

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

**Reference Books:**

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things, CunoPfister , Oreilly



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>DATA COMMUNICATIONS AND INFORMATION CODING THEORY</b> <b>(Systems Engineering)</b>					

**Course Objective:**

The objective of this course is to introduce the basic concepts of information theory and coding, including information, source coding, channel model, channel capacity, channel coding and so on.

**Course Outcomes:**

The students at the end of the course will be able to:

- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.
- Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.
- Implement the encoder and decoder of one block code or convolutional code using any program language

**UNIT I:**

Overview; Basic Concepts - Entropy and Mutual information; Lossless Source Coding – Source entropy rate; Kraft inequality; Huffman code; Asymptotic equipartition property; Universal coding; Noisy Channel Coding - Channel capacity

**UNIT II:**

Random channel codes; Noisy channel coding theorem for discrete memory-less channels; Typical sequences; Error exponents; Feedback; Continuous and Gaussian channels; Lossy Source Coding - Rate-Distortion functions; Random source codes; Joint source-channel coding and the separation theorem.

**UNIT III:**

Source coding- Text, Audio and Speech: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

**UNIT IV:**

Source coding- Image and Video: Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

**UNIT V:**

Error control coding- Block codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC Error control coding

**Text books:**

1. Mark Kelbert(Author), Yuri Suhov, Information Theory and Coding by Example, Cambridge University Press,2013

**Reference books:**

1. Simon Haykin and Michael Moher, Communication Systems, 5th Edition, Wiley, 2010
2. T.M. & Thomas, J.A. (2006). Elements of information theory. New York: Wiley.
3. Ad´amek, Foundations of coding, Wiley Interscience, 1991.
4. T. M. Cover and J. A. Thomas, Elements of information theory, Wiley, 1991.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>SERVICE ORIENTED ARCHITECTURES</b> <b>(Systems Engineering)</b>					

**Course Objectives:**

- To gain understanding of the basic principles of service orientation
- To learn service oriented analysis techniques
- To learn technology underlying the service design
- To learn the concepts such as SOAP, Registering and Discovering Services.

**Course Outcomes:** At the end of this course, students are expected to gain the following learning:

1. Get the foundations and concepts of service based computing
2. Advocate the importance and means of technology alignment with business
3. Understanding the basic operational model of web services,
4. Gain the knowledge of key technologies in the service oriented computing arena
5. Apply and practice the learning through a real or illustrative project/case study.

**UNIT I**

**Software Architecture:** Need for Software Architecture, Objectives of Software Architecture, Types of Information Technology (IT) Architecture, Architectural Patterns and Styles

**Architecting Process for Software Applications:** Architectural Considerations, Architecting Process for Software Applications, Level 0: High-Level Architecture, Level 1: Solution Architecture Detailed Design

**UNIT II**

**SOA and MSA Basics:** Service Orientation in Daily Life, Evolution of SOA and MSA Service-oriented Architecture and Microservices architecture –Drivers for SOA, Dimensions of SOA, Conceptual Model of SOA, Standards And Guidelines for SOA, Emergence of MSA

**Service-Oriented Architecture:** Considerations for Enterprise-wide SOA, Strawman Architecture for Enterprise-wide SOA, Enterprise SOA Reference Architecture, Object-oriented Analysis and Design (OOAD) Process, Service-oriented Analysis and Design (SOAD) Process

**UNIT III**

**Service-Oriented Applications:** Considerations for Service-oriented Applications, Patterns for SOA, Pattern-based Architecture for Service-oriented Applications, Composite Applications, Composite Application Programming Model

**Service-Oriented Analysis and Design:** Need for Models, Principles of Service Design Non-functional Properties for Services, Design of Activity Services (or Business Services) Design of Data Services, Design of Client Services, Design of Business Process Services

**UNIT IV**

**Microservices Architecture:**

**Trend in SOA – Microservices Architecture (MSA):** Services Model for Cloud and Mobile Solutions, API Adoption on the Rise, Challenges and Takeways from SOA Implementations Architecture Trend – Microservices Architecture, Microservices Architecture in Action

**Cloud and MSA:** Cloud Services, Hybrid Cloud Services, Considerations for Hybrid Cloud Services, Cloud Services and MSA, MSA for SMAC Solutions

**UNIT V**

**Mobile and MSA:** Mobile Technologies, Types of Mobile Applications, MSA for mobile solutions Case Study: SOA – Loan Management System (LMS) PoC, MSA – APIary PoC





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**Text Book:**

1. Shankar Kambhampaty, Service - Oriented Architecture & Microservices Architecture, 3ed: For Enterprise, Cloud, Big Data and Mobile , ISBN: 9788126564064,Wiley.
2. Mark Richards, Microservices vs Service-Oriented Architecture, O'Reilly Media, Inc., 2016.

**Reference Books:**

1. Thomas Erl, Services-Oriented Architecture: Concepts, Technology and Design, Prentice Hall, 2005.
2. Guido Schmutz, Peter Welkenbach, Daniel Liebhart, Service-Oriented Architecture: An Integration Blueprint, Packt Publisher, 2010.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>DESIGN OF SECURE PROTOCOLS</b> <b>(Systems Engineering)</b>					

**Course Objectives:**

The main objective of this course is that to explore various protocols and design of various protocols with deeper security.

**Course Outcomes:**

By the end of the course Student will

- Get the exposure to various protocols.
- Gain knowledge on various secure mechanisms through set of protocols.
- Efficiently design new set of protocols.
- Learn Security issues and overcome means with protocols.

**UNIT – I:**

OSI:ISO Layer Protocols: Application Layer Protocols, TCP/IP, HTTP, SHTTP, LDAP, MIME, POP & POP3, RMON, SNMP. Presentation Layer Protocols, Light Weight Presentation Protocol Session layer protocols.

**UNIT – II:**

RPC protocols, transport layer protocols, ITOT, RDP, RUDP, TALI, TCP/UDP, compressed TCP. Network layer Protocols, routing protocols, border gateway protocol-exterior gateway protocol, internet protocol IPv4, IPv6, Internet Message Control Protocol, IRDP Transport Layer Security, TSL, SSL, DTLS

**UNIT – III :**

Data Link layer Protocol, ARP, In ARP, IPCP, IPv6CP, RARP, SLIP .Wide Area and Network Protocols, ATM protocols, Broadband Protocols, Point to Point Protocols, Other WAN Protocols, security issues.

**UNIT – IV:**

Local Area Network and LAN Protocols, ETHERNET Protocols, VLAN protocols, Wireless LAN Protocols, Metropolitan Area Network Protocol, Storage Area Network and SAN

**UNIT – V :**

Protocols, FDMA, WIFI and WIMAX Protocols, security issues. Mobile IP, Mobile Support Protocol for IPv4 and IPv6, Resource Reservation Protocol. Multicasting Protocol, VGMP, IGMP, MSDP .Network Security and Technologies and Protocols, AAA Protocols, Tunneling Protocols, Secured Routing Protocols, GRE- Generic Routing Encapsulation, IPSEC– Security.

**Text Books:**

1. Jawin: “Networks Protocols Handbook”, 3rd Edition, Jawin Technologies Inc., 2005.
2. Bruce Potter and Bob Fleck : “802.11 Security”, 1st Edition, O’Reilly Publications, 2002.

**Reference Books:**

1. Ralph Oppliger : “SSL and TSL: Theory and Practice”, 1st Edition, Arttech House, 2009.
2. Lawrence Harte: “Introduction to CDMA- Network services Technologies and Operations”, 1st Edition, Althos Publishing, 2004.
3. Lawrence Harte: “Introduction to WIMAX”, 1st Edition, Althos Publishing, 2005



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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>NETWORK CODING (Systems Engineering)</b>					

**Course Objectives:**

- Students will gain the understanding of core network programming by using sockets and transport layer protocols like TCP and UDP
- Students will gain the understanding of inter process communication and implementation of different forms of IPC in client-server environment
- Students will get an exposure to various application layer protocols which are designed using sockets and transport layer protocols

**Course Outcomes:**

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

- Explain the client-server paradigm and socket structures.
- Describe the basic concepts of TCP sockets and TCP echo client-server programs.
- Discuss the UDP sockets and UDP echo client-server programs.
- Explain Socket options and ability to understand IPC
- Apply the applications of sockets and demonstrate skill to design simple applications like FTP, TELNET etc.

**UNIT-I:**

Introduction to Network Programming: OSI model, transport layer protocols: TCP, UDP and SCTP, network architecture: client-server and peer-to-peer systems, Sockets-socket Address structures: IPv4, IPv6 and Generic-value result arguments, Byte ordering functions, Byte manipulation functions, Address conversion functions

**UNIT-II:**

TCP: introduction to TCP, TCP connection establishment and termination TIME\_WAIT State. Elementary TCP sockets, Socket, connect, bind, listen, accept, fork, exec function, concurrent servers, Close function, read and write functions

**UNIT-III:**

TCP echo client server program, getsockname and getpeername functions I/O multiplexing: I/O models, Select function, TCP echo server using select function, shutdown function, Poll function

**UNIT-IV:**

UDP: Introduction to UDP, difference between TCP and UDP, recvfrom( ) and sendto( ) functions, UDP echo client server program, UDP echo client server using select function. Socket Options: IPv4 socket options, IPv6 socket options

**UNIT-V:**

Socket Options: Generic socket options, TCP socket options. IPC: Introduction to IPC, forms of IPC, UNIX kernel support for pipes, FIFO, message queues, semaphores and shared memory Network programming concepts Implementation: FTP, ping, arp, SMTP, TELNET



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**Text Books:**

1. Unix Network programming, the socket networking API, W.Richard Stevens, bill fenner, Andrew m.rudoff ,PHI.

**References Books:**

1. Advanced programming in the UNIX environment, W.Richard Stevens, pearson education



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II Year - II Semester	Honors Course	L	T	P	C
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>PRINCIPLES OF CYBER SECURITY (Information Security)</b>					

**Course Objectives:**

- To learn threats and risks within context of the cyber security architecture.
- Student should learn and Identify security tools and hardening techniques.
- To learn types of incidents including categories, responses and timelines for response.

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

- Apply cyber security architecture principles.
- Demonstrate the risk management processes and practices.
- Appraise cyber security incidents to apply appropriate response
- Distinguish system and application security threats and vulnerabilities.
- Identify security tools and hardening techniques

**UNIT-I:**

**Introduction to Cyber Security**-Cyber security objectives, roles, differences between information security and cyber security, Cyber security principles-confidentiality, integrity, availability, authentication and non repudiation

**UNIT-II:**

**Information Security within Lifecycle Management**-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, **Risks & Vulnerabilities**-Basics of risk management, Operational threat environments, Classes of attacks

**UNIT-III:**

**Incident Response**-Incident categories, Incident response, Incident recovery, **Operational security protection**-Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management

**UNIT-IV:**

**Threat Detection and Evaluation Monitoring**-Vulnerability management, Security logs and alerts, Monitoring tools and appliances, **Analysis**-Network traffic analysis, packet capture and analysis

**UNIT-V:**

**Introduction to backdoor System and security**-Introduction to metasploit, backdoor, demilitarized zone (DMZ), Digital signature, Brief study on Harding of operating system.

**Text Books:**

1. NASSCOM: Security Analyst Student Hand Book, Dec 2015
2. Information Security Management Principles, Updated Edition, [David Alexander](#), [Amanda Finch](#), [David Sutton](#), BCS publishers, June 2013

**Reference Books:**

1. Cyber Security Fundamentals-Cyber Security, Network Security and Data Governance Security, 2<sup>nd</sup> Edition, ISACA Publishers, 2019



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>COMPUTATIONAL NUMBER THEORY (Information Security)</b>					

**Course Objectives:** This course will focus on designing efficient algorithms (and providing complexity analysis) for the most important problems from number theory, with major applications in coding theory and cryptography.

**Course Outcomes:**

Upon completing the course the student will be able to

- understand with basics of number theory and its applications.
- demonstrate the arithmetic of finite fields, polynomials.
- analyze the elliptic curves, testing and factorization.
- Student will be able to solve the discrete logarithms and large sparse linear systems.
- Student will be able to apply the skills for writing programs of cryptography algorithms.

**UNIT I:**

**Arithmetic of Integers:** Basic Arithmetic Operations, GCD, Congruences and Modular Arithmetic, Linear Congruences, Polynomial Congruences, Quadratic Congruences, Multiplicative Orders, Continued Fractions, Prime Number Theorem and Riemann Hypothesis, Running Times of Arithmetic Algorithms.

**UNIT II:**

**Arithmetic of Finite Fields:** Existence and Uniqueness of Finite Fields, Representation of Finite Fields, Implementation of Finite Field Arithmetic, Arithmetic of Polynomials: polynomials over Finite Fields, Finding Roots of Polynomials over Finite Fields, Factoring Polynomials over Finite Fields, Properties of Polynomials with Integer Coefficients, Factoring Polynomials with Integer Coefficients.

**UNIT III:**

**Arithmetic of Elliptic Curves:** Elliptic Curve, Elliptic-Curve Group, Elliptic Curve over Finite Fields, Pairing on Elliptic Curves, Elliptic-Curve Point Counting, Primality Testing: Introduction, Probabilistic Primality Testing, Deterministic Primality Testing, Primality Testing for Number of Special Forms.

**UNIT IV:**

**Integer Factorization:** Trial Division, Pollard's Rho Method, Pollard's  $p-1$  Method, Dixon's Method, CFRAC Method, Quadratic Sieve Method, Cubic Sieve Method, Elliptic Curve Method, Number-Field Sieve Method, Discrete Logarithms: Square-Root Methods, Algorithms: Prime Fields, Fields of Characteristic Two, General Extension Fields, Elliptic Curves(ECDLP).

**UNIT V:**

**Large Sparse Linear Systems:** Structured Gaussian Elimination, Lanczos Method, Wiedemann Method, Block Methods

**Text Books:**

1. Abhijit Das, Computational Number Theory, CRC Hall, 1<sup>st</sup> Edition, 2013.
2. T. H. Cormen, C. E. Leiserson, R. Rivest and C. Stein, Introduction to Algorithms, Prentice Hall India, 2nd Edition, 2002.



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**Reference Books:**

1. Victor Shoup, A Computational Introduction to Number Theory and Algebra, 2<sup>nd</sup> Edition, Cambridge University Press, 2008.
2. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press, 2021.
3. M. Mignotte, Mathematics for computer algebra, Springer-Verlag, 1992.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>CRYPTANALYSIS (Information Security)</b>					

**Course Objective:**

- Learns various applied cryptanalytic attacks

**Course Outcomes:**

By completing the course the students will be able to:

- Understand the cryptanalysis of classic ciphers, stream ciphers and block ciphers
- Understand the cryptanalysis of public key attacks

**UNIT-I:**

Classic Ciphers: Transposition Ciphers, Substitution Ciphers, One-Time Pad, Codebook Ciphers, Enigma: Enigma Cipher Machine, Enigma Keyspace, Rotors, Enigma Attack, Purple: Purple Cipher Machine, Purple Keyspace, Purple Diagnosis, Decrypting Purple, Purple versus Enigma

**UNIT-II:**

Stream Ciphers: Introduction, Shift Registers: Berlekamp-Massey Algorithm, Cryptographically Strong Sequences, Shift Register-Based Stream Ciphers, ORYX: ORYX Cipher, ORYX Attack, RC4: RC4 Algorithm, RC4 Attack, PKZIP: PKZIP Cipher, PKZIP Attack

**UNIT-III:**

Block Ciphers: Introduction, Block Cipher Modes, Hellman's Time-Memory Trade-Off: Cryptanalytic TMTO, Bad Chains, Distributed TMTO, CMEA: CMEA Cipher, SCMEA Cipher, Akelarre: Akelarre Cipher, Akelarre Attack, FEAL: FEAL-4 Cipher, FEAL-4 Differential Cipher

**UNIT-IV:**

Lattice-based cryptanalysis: Direct attacks using lattice reduction: Dependence relations with small coefficients, some applications of short dependence relations, Coppersmith's small roots attacks: Univariate modular polynomials, Bivariate polynomials, Extension to rational roots, Security of RSA with small decryption exponent

**UNIT-V:**

Public Key Attacks: Introduction, Factoring Algorithms: Trial Division, Dixon's Algorithm, Quadratic Sieve, Factoring Conclusions, Discrete Log Algorithms: Trial Multiplication, Baby-Step Giant-Step, Index Calculus, Discrete Log Conclusions, RSA Implementation Attacks: Timing Attacks, Glitching Attack

**Text Books:**

2. Mark Stamp, Richard M. Low, "Applied Cryptanalysis Breaking Ciphers In The Real World," Wiley-Interscience A John Wiley & Sons, Inc., Publication
3. Antoine Joux, "Algorithmic Cryptanalysis," CRC Press

**Reference Books:**

2. VanOorschot, P. C., Menezes, A. J., Vanstone, S. A., "Handbook of Applied Cryptography," CRC Press.

**Web References:**

<https://www.udemy.com/course/introduction-to-cryptography-online-course-rahsoft-crypto-certificate/>





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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>ELLIPTIC CURVE CRYPTOGRAPHY</b> <b>(Information Security)</b>					

**Course Objective:**

Learns the deployment of elliptic curve cryptography to secure applications

**Course Outcomes:**

By completing the course the students will be able to:

- Understands Finite Field Arithmetic and Elliptic Curve Arithmetic
- Survey the attacks and validates the domain parameters and keypairs.

**UNIT-I:**

Introduction: Cryptography basics, Public-key Cryptography: RSA systems, Discrete Logarithm Systems, Elliptic Curve Systems, need for Elliptic Curve Cryptography

Finite Field Arithmetic: Introduction to Finite Fields, Prime Field Arithmetic: Addition and Subtraction, Integer Multiplication, Integer Squaring, Reduction, Inversion

**UNIT-II:**

Binary Field Arithmetic: Addition, Multiplication, Polynomial multiplication, Polynomial squaring, Reduction, Inversion and Division

Optimal Extension Field Arithmetic: Addition and Subtraction, Multiplication and Reduction, Inversion

**UNIT-III:**

Elliptic Curve Arithmetic: Introduction to Elliptic Curves: Simplified Weierstrass equations, Group Law, Group Order, Group Structure, Isomorphism Classes

Presentation and the group Law: Projective Coordinates, The elliptic curve  $y^2=x^3+ax+b$ , The elliptic curve  $y^2+xy=x^3+ax^2+b$ , Point Multiplication: Unknown point, Fixed point, Multiple point multiplication, Koblitz Curves

**UNIT-IV:**

Cryptographic Protocols: The elliptic curve discrete logarithm problem: Pohlig-Hellman attack, Pollard's rho attack, Index-Calculus attacks, Isomorphism attacks, Domain Parameters: Domain Parameter generation and validation, Generating Elliptic Curves verifiably at random, determining the number of points on an elliptic curve

**UNIT-V:**

Key pairs, Signature Schemes: ECDSA, EC-KCDSA, Public-key encryption: ECIES, PSEC, Key Establishment: Station-to-Station, ECMQV, Secure Implementation Issues: Error Message Analysis, Fault Analysis Attacks, Timing Attacks

**Text Books:**

4. Darrel Hankerson, Alfred Menezes, Scott Vanstone, "Guide to Elliptic Curve Cryptography," Springer.

**Reference Books:**

1. Henri Cohen, Gerhard Frey, Roberto Avanzi, Christophe Doche, Tanja Lange, Kim Nguyen, and Frederik Vercauteren, "Handbook of Elliptic and Hyperelliptic Curve Cryptography," Chapman & Hall/CRC, Taylor & Francis Group.

**Web References:**

<https://www.udemy.com/course/elliptic-curve-cryptography-masterclass/>



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>INTRODUCTION TO QUANTUM COMPUTING AND QUANTUM CRYPTOGRAPHY (Information Security)</b>					

**Course Objective:**

- Understands Quantum Computing and Quantum Algorithms

**Course Outcomes:**

By completing the course the students will be able to:

- Analyze complex vector space for quantum computing
- Understand QKD algorithms

**UNIT-I:**

Elements of Quantum Information Theory: Dirac Notation and Linear Algebra, Density Operator Formalism: POVMs and Projective Measurements, Qubits and Pauli Operators, Composite Systems and Entanglement: The Schmidt Decomposition and Purifications

**UNIT-II:**

Quantum Operations: Depolarizing Channel, Shannon and Von Neumann Entropy: Operational Meaning, Min and Max Entropy: Operational Meaning, Smooth Min and Max Entropy, Data Compression and Error Correction, Privacy Amplification

**UNIT-III:**

Algorithms: Deutsch's Algorithm, The Deutsch–Jozsa Algorithm, Simon's Periodicity Algorithm, Grover's Search Algorithm

Programming Languages: Quantum Assembly Programming, Toward Higher-Level Quantum Programming, Quantum Computation before Quantum Computers

**UNIT-IV:**

Introduction to Quantum Key Distribution: The BB84 Protocol: Secret Key Rate, Finite-Key Security: General QKD Protocol, Reduction to Asymptotic Key Rate, The B92 Protocol, The EPR Protocol, Quantum Teleportation

**UNIT-V:**

Quantum Conference Key Agreement: Extending QKD to Multiple Parties: Multipartite BB84 Protocol, Security of CKA: General CKA Protocol, Classical and Quantum Data Compression, Error-Correcting Codes

**Text Books:**

1. Grasselli Federico, "Quantum Cryptography: From Key Distribution to Conference Key Agreement," Springer International Publishing.
2. Noson S. Yanofsky, Mirco A. Mannucci, "Quantum Computing For Computer Scientists," Cambridge University Press

**Reference Books:**

3. Kollmitzer C., Pivk M. (Eds.), "Applied Quantum Cryptography," Lect. Notes Phys. 797(Springer, Berlin Heidelberg 2010), DOI 10.1007/978-3-642-04831-9

**Web References:**

<https://www.edx.org/course/quantum-computing>



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>PUBLIC KEY INFRASTRUCTURE AND TRUST MANAGEMENT</b> <b>(Information Security)</b>					

**Course objectives:**

The course is designed to train the graduates in depth understanding of Public Key Cryptography, Public key Infrastructure, security credentials and design new or modify existing cryptographic techniques.

**Course Outcomes:**

Graduates after completing the course shall gain:

- In depth understanding of Public key cryptography and Infrastructure.
- Ability to design and analyze Public Key cryptographic techniques.
- Ability to solve network security issues in real time applications.
- Ability to take up doctoral level research work in security.

**UNIT I:**

**Public key infrastructure:** components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates.

**UNIT II:**

**PKI Services:** Authentication, Integrity and Confidentiality, Mechanisms, Secure Communication, Secure Time Stamping, Non-Repudiation, Privilege Management, Certificate policies, Certificate Authority, Registration Authority.

**UNIT III:**

**Key and Certificate Management:** Key/Certificate Life Cycle Management, Certificate Revocation: Periodic Public Mechanisms, performance, Scalability and Timeliness, Multiple Key pairs, Key Pair Uses, Real-World Difficulties, Independent Certificate Management.

**UNIT IV:**

**Trust Models:** Strict Hierarchy of Certification Authorities, Distributed Trust Architecture, Web Model, User-Centric Trust, Cross-Certification, Entity Naming, Certificate Path processing, PKI Information Dissemination: Repositories and Techniques, private Dissemination, Public and Repositories, In-Band Protocol Exchange.

**UNIT V:**

**PKI Standards:** Introduction, Major Standards Activities, X.509, PKIX, X.500, LDAP, ISO TC68, ANSI X9f, S/MIME, IPsec, TLS, SPKI, OpenPGP, EDIFACT.

**Text Books:**

1. Carlisle Adams, Steve Lloyd, Understanding Public-Key Infrastructure: Concepts, Standards, and Deployment Considerations, Sams, 1999.
2. [John R. Vacca](#), Public Key Infrastructure, Building Trusted Applications and Web Services, Auerbach Publications, 2004.



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**Reference Books:**

1. Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education, Prentice Hall, 2011.
2. Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>INFORMATION SECURITY ANALYSIS AND AUDIT</b> <b>(Information Security)</b>					

**Course Objectives:**

- Understanding and knowledge of Security Auditing, and introduce the Threats and defense in the systems.
- Acquiring the knowledge on Evidence collection and evaluation techniques.

**Course Outcomes:**

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

- Illustrate the fundamental concepts of information security and systems auditing
- Analyze the latest trend of computer security threats and defense
- Identify security weaknesses in information systems, and rectify them with appropriate security mechanisms
- Explain the security controls in the aspects of physical, logical and operational security control and case studies
- Evaluate the security of information systems

**UNIT-I:**

**Overview of Information System Auditing-** Effect of Computers on Internal Controls, Effects of Computers on Auditing, Foundations of information Systems Auditing, Conducting an Information Systems Audit.

**UNIT-II:**

**The management Control Framework-I-** Introduction, Evaluating the planning Function, Leading Function, Controlling Function, Systems Development Management Controls, Approaches to Auditing Systems Development, Normative Models of the Systems Development Process, Evaluating the Major phases in the Systems Development Process, Programming Management Controls, Data Resource Management Controls.

**UNIT-III:**

**The Management Control Framework-II-** Security Management Controls, Operations management Controls Quality assurance Management Controls, Case Studies.

**UNIT-IV:**

**Evidence Collection-** Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires, and Control Flowcharts. Performance Management tools- Case Studies.

**UNIT-V:**

**Evidence Evaluation-** Evaluating Asset Safeguarding and Data Integrity, Evaluating System, Effectiveness, Evaluating System Efficiency, Information Systems Audit and Management: Managing the Information Systems Audit Function.

**Text Book:**

1. Information Systems Control and Audit, 1<sup>st</sup> Edition, Ron Weber, Pearson Education, 2013

**Reference Book:**

1. Information System Audit and Assurance, D P Dube, TMH, New Delhi, 2008



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>CLOUD AND IOT SECURITY (Information Security)</b>					

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

- Discuss about Security Requirements in IoT Architecture
- Explain Random number generation
- Demonstrate Authorization with Publish / Subscribe schemes
- Identify Lightweight and robust schemes for Privacy protection
- Explain about IoT cloud security architecture

**UNIT I:**

**Introduction: Securing Internet of Things:** Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications. Security Architecture in the Internet of Things, Security Requirements in IoT, Insufficient Authentication /Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability, Attacks Specific to IoT. Vulnerabilities, Secrecy and Secret-Key Capacity, Authentication/Authorization for Smart Devices, Transport Encryption, Attack, Fault trees

**UNIT II:**

**Cryptographic Fundamentals for IoT:** Cryptographic primitives and its role in IoT, Encryption and Decryption, Hashes, Digital Signatures, Random number generation, Cipher suites, key management fundamentals, cryptographic controls built into IoT messaging and communication protocols.

**UNIT III:**

**Identity & Access Management Solutions for IoT:** Identity lifecycle, authentication credentials, IoT IAM infrastructure, Authorization with Publish / Subscribe schemes and access control

**UNIT IV:**

**Privacy Preservation and Trust Models for IoT:** Concerns in data dissemination, Lightweight and robust schemes for Privacy protection, Trust and Trust models for IoT, self-organizing Things, Preventing unauthorized access.

**UNIT V:**

**Cloud Security for IoT:** Cloud services and IoT, offerings related to IoT from cloud service providers, Cloud IoT security controls, enterprise IoT cloud security architecture, New directions in cloud enabled IoT computing

**Text Books:**

1. Practical Internet of Things Security (Kindle Edition) by Bria Russell, Drew VanDuren

**References Books:**

1. Securing the Internet of Things, Elsevier
2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>WEB SECURITY (Information Security)</b>					

**Course Objectives:**

- Underlying security principles of the web
- Overview of concrete threats against web applications
- Insights into common attacks and countermeasures
- Current best practices for secure web applications

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

- Demonstrate security concepts, security professional roles, and security resources in the context of systems and security development life cycle
- Justify applicable laws, legal issues and ethical issues regarding computer crime
- Explain the business need for security, threats, attacks, top ten security vulnerabilities, and secure software development
- Apply information security policies, standards and practices, the information security blueprint
- Analyze and describe security requirements for typical web application scenario

**UNIT-I:**

**Introduction-**A web security forensic lesson, Web languages, Introduction to different web attacks, Overview of N-tier web applications, Web Servers-Apache, IIS.

**UNIT-II:**

**Securing the Communication Channel-** Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS, and dealing with the impact on your application, Insights into the latest evolutions for HTTPS deployments.

**UNIT-III:**

**Web Hacking Basics-** HTTP & HTTPS URL, Web under the Cover Overview of Java security Reading the HTML source, Applet Security Servlets Security Symmetric and Asymmetric Encryptions, Network security Basics, Firewalls & IDS.

**UNIT-IV:**

**Securely Handling Untrusted Data-**Investigation of injection attacks over time, Understanding the cause behind both server-side and client-side injection attacks, Execution of common injection attacks, and implementation of various defenses.

**UNIT-V:**

**Preventing Unauthorized Access-**Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process prevent authorization bypasses and harden session management mechanisms, Securing Large Applications, Cyber Graffiti.

**Text Books:**

1. Web Hacking: Attacks and Defense, Latest Edition , McClure, Stuart, Saumil Shah, and Shreeraj Shah, Addison Wesley, 2003
2. Professional Java Security, 1.3 Edition, Garms, Jess and Daniel Somerfield, Wrox, 2001



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>BLOCK CHAIN ARCHITECTURE DESIGN AND USE CASES (Information Security)</b>					

**Course Objectives:**

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

- Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

**Course Outcomes:**

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

- Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- Identify the risks involved in building Block chain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Blockchain implementations and Understand Crypto currency markets
- Examine how to profit from trading crypto currencies.

**UNIT I**

Introduction, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain.

Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution, Consortia, Forks, Public Blockchain Environments, Type of Players in Blockchain Ecosystem, Players in Market.

**UNIT II**

Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on blockchain, data storage on blockchain, wallets, coding on blockchain: smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.

**UNIT III**

Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, Types of Blockchain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Blockchain Solutions, Architecture Considerations, Architecture with Blockchain Platforms, Approach for Designing Blockchain Applications.

**UNIT IV**

Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts





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**UNIT V**

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application.

Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Blockchain with IoT and AI/ML Quantum Computing and Blockchain, Initial Coin Offering, Blockchain Cloud Offerings, Blockchain and its Future Potential.

**Text Books:**

- 1) Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
- 2) Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain”, O’Reilly

**Reference Books:**

- 1) Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
- 2) Blockchain: Blueprint for a New Economy, Melanie Swan, O’Reilly

**e-Resources:**

- 1) <https://github.com/blockchainedindia/resources>



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II Year - II Semester	Honors Course	L	T	P	C
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>DATA VISUALIZATION (Data Science)</b>					

**Course Objectives:**

The main objective of this course is to make it easier to identify patterns, trends and outliers in large data sets

**Course Outcomes:**

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

- Identify and recognize visual perception and representation of data.
- Illustrate about projections of different views of objects.
- Apply various Interaction and visualization techniques.
- Analyze various groups for visualization.
- Evaluate visualizations

**UNIT-I:**

**Introduction to Data Visualizations and Perception:** Introduction of visual perception, visual representation of data, Gestalt principles, Information overload.

**UNIT-II :**

**Visual Representations:** Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

**UNIT-III :**

**Classification of Visualization Systems:** Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

**UNIT-IV :**

**Visualization of Groups:** Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

**UNIT-V :**

**Visualization of Volumetric Data And Evaluation of Visualizations:** Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

**Text Books:**

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2<sup>nd</sup> edition, A K Peters, Ltd 2015.

**Reference Books:**

1. Tamara Munzner, Visualization Analysis & Design ,1<sup>st</sup> edition, AK Peters Visualization Series 2014
2. Scott Murray, Interactive Data Visualization for the Web ,2<sup>nd</sup> Edition, 2017



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>STATISTICAL FOUNDATIONS FOR DATA SCIENCE</b>					
<b>(Data Science)</b>					

**Course Objectives:**

The course will introduce the fundamental concepts of probability and statistics required for a program in data science

**Course outcomes:**

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

- Use the statistical concepts in the field of data science.
- Employ the techniques and methods related to the area of data science in variety of applications.
- Apply logical thinking to understand and solve the problem in context.
- Explore statistical learning methods and their application to modern problems in science, industry, and society.
- Build analytics pipelines for regression problems and classification problems

**UNIT I:**

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

**UNIT II:**

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Expectations and moments; Covariance and correlation; Statistics and sampling distributions; Hypothesis testing of means, proportions, variances and correlations; Confidence (statistical) intervals; Correlation functions; White-noise process

**UNIT III:**

Probabilistic formulations of prediction problems: Plug-in estimators, empirical risk minimization, Linear threshold functions, perceptron algorithm, Risk bounds, Concentration inequalities, Uniform convergence, Rademacher averages; combinatorial dimensions, Convex surrogate losses for classification, Linear regression, Regularization and linear model selection, Feature Selection Methods, Cross Validation methods.

**UNIT IV:**

Game-theoretic formulations of prediction problems, High Dimensional methods, Lasso, Ridge Regression, Dimensionality Reduction, Minimax strategies for log loss, linear loss, and quadratic loss, Universal portfolios, Online convex optimization.

**UNIT V:**

Neural networks: Stochastic gradient methods, Combinatorial dimensions and Rademacher averages, Hardness results for learning, Efficient learning algorithms.

**Text Books:**

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



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3. James, G., Witten, D., Hastie, T., Tibshirani, R. An Introduction to Statistical Learning with Applications in R, Springer, 2013.

**Reference Books:**

1. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer, 2009.



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MINING MASSIVE DATA SETS (Data Science)</b>					

**Course Objective:** The course will discuss data mining and machine learning algorithms for analyzing very large amounts of data. The emphasis will be on MapReduce and [Spark](#) as tools for creating parallel algorithms that can process very large amounts of data.

**Course Outcomes:**

Upon completion of this course, the student will be able to:

1. Discuss research directions in Mining Massive Datasets, such as similarity search, streaming data, clustering, and graph mining.
2. Analyze policy, focusing on methods for mining massive datasets and potential policy and management applications, by synthesizing and summarizing the current state of the art, and facilitating discussion by posing questions, preliminary conclusions, and ideas to explore.
3. Develop a research project relevant to Mining Massive Datasets and produce a report describing the project's background, methods, results, and conclusions.
4. Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program.
5. Good knowledge of Java and Python will be extremely helpful since most assignments will require the use of Spark

**UNIT I:**

**Data Mining:** Data Mining, Statistical Limits on Data Mining, MapReduce: Distributed File Systems, MapReduce, Algorithms Using MapReduce, Extensions to MapReduce.

**UNIT II:**

**Finding Similar Items:** Applications of Near-Neighbor Search, Shingling of Documents, Distance Measures, Theory of Locality-Sensitive Functions, Applications of LSH Hashing.

**UNIT III:**

**Mining Data Streams:** Stream Data Model, Sampling Data in Streams, Filtering Streams, Link Analysis: PageRank, Efficient Computational of PageRank, Link Spam, Hubs and Authorities.

**UNIT IV:**

**Frequent Itemsets:** Market-Based Model, Market Based and A-Priori Algorithm, Limited-Pass Algorithms, Clustering: Introduction, Hierarchical Clustering and K-means Algorithm, CURE Algorithm.

**UNIT V:**

**Dimensionality Reduction:** Eigenvalues and Eigenvectors, Principal-Component Analysis, CUR Decomposition, Large-Scale Machine Learning: Machine Learning Model, Perceptrons, SVM's, Nearest Neighbors.

**Text Books:**

1. Jure Leskovec, Anand Rajaraman, Jeffery D. ULLman, Mining of Massive Datasets, Cambridge University Press, 2014.
2. Pattern Recognition and Machine Learning. Christopher Bishop. Springer-Verlag New York. 2006.



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**Reference Books:**

1. Machine Learning: A Probabilistic Perspective. Kevin Murphy. MIT Press. 2012
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Trevor Hastie, Robert Tibshirani, Jerome Friedman. Springer. 2013



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MEDICAL IMAGE DATA PROCESSING</b>					
<b>(Data Science)</b>					

**Course Objectives:**

The course will provide the participants with an up-to-date background in current state-of-the-art in medical imaging and medical image analysis. The aim of the course is to show how to extract, model, and analyze information from medical data and applications in order to help diagnosis, treatment and monitoring of diseases through computer science.

**Course Outcomes:** At the End of the Course:

1. Student will be able to explain the basic concepts of Medical Imaging Technologies, Systems and Formation Principles.
2. Student will be able to analyze the Medical Image Storage and Processing.
3. Student will be able to visualize the MRI, NMR and Artifacts.
4. Student should expertise the Segmentation and Classification techniques on Medical Image Data.
5. Student will be able to analyze the Nuclear Imaging like PET, SPECT and 3D Images.

**UNIT I:**

**Introduction:** Introduction to Medical Imaging Technology, Systems, and Modalities. Brief History, Importance, Applications, Trends, Challenges. Medical Image Formation Principles: X-Ray physics, X-Ray generation, Attenuation, Scattering, Dose Basic Principles of CT, Reconstruction Methods, Artifacts, CT hardware.

**UNIT II:**

**Storage and Processing:** Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding, contrast enhancement, SNR characteristics; filtering; histogram modeling.

**UNIT III:**

**Visualization:** Medical Image Visualization Fundamentals of Visualization, Surface and Volume Rendering/Visualization, Animation, Interaction. Magnetic Resonance Imaging (MRI) Mathematics of MR, Spin Physics, NMR Spectroscopy, Imaging Principles and Hardware, Image Artifacts.

**UNIT IV:**

**Segmentation And Classification:** Medical Image Segmentation, Histogram-Based Methods, Region Growing and Watersheds, Markov Random Field Models, Active Contours, Model-Based Segmentation. Multi-Scale Segmentation, Semi-Automated Methods, Clustering-Based Methods, Classification-Based Methods, Atlas-Guided Approaches, Multi-Model Segmentation. Medical Image Registration Intensity-Based Methods, Cost Functions, Optimization Techniques.

**UNIT V:**

**Nuclear Imaging:** PET and SPECT Ultrasound Imaging Methods, Mathematical Principles, Resolution, Noise Effect, 3D Imaging, Positron Emission Tomography, Single Photon Emission Tomography, Ultrasound Imaging, Applications. Medical Image Search and Retrieval Current Technology in Medical Image Search, Content-Based Image Retrieval, New Trends: Ontologies, Applications, Other Applications Of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.



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**Text Books:**

1. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
2. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.

**Reference Books:**

1. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
2. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
3. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition 1, Prentice Hall, 2005.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.