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

DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE STRUCTURE AND SYLLABUS

For UG – R20

B. TECH - INFORMATION TECHNOLOGY

(Applicable for batches admitted from 2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

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COURSE STRUCTURE

I Year – I SEMESTER						
S. No	**Course Code**	**Courses**	**L**	**T**	**P**	**Credits**
1	HS	Communicative English	3	0	0	3
2	BS	Mathematics - I (Calculus And Differential Equations)	3	0	0	3
3	BS	Applied Physics	3	0	0	3
4	ES	Programming for Problem Solving using C	3	0	0	3
5	ES	Computer Engineering Workshop	1	0	4	3
6	HS	English Communication Skills Laboratory	0	0	3	1.5
7	BS	Applied Physics Lab	0	0	3	1.5
8	ES	Programming for Problem Solving using C Lab	0	0	3	1.5
Total Credits			**19.5**			

I Year – II SEMESTER						
S. No	**Course Code**	**Courses**	**L**	**T**	**P**	**Credits**
1	BS	Mathematics – II (Linear Algebra And Numerical Methods)	3	0	0	3
2	BS	Applied Chemistry	3	0	0	3
3	ES	Computer Organization	3	0	0	3
4	ES	Python Programming	3	0	0	3
5	ES	Data Structures	3	0	0	3
6	BS	Applied Chemistry Lab	0	0	3	1.5
7	ES	Python Programming Lab	0	0	3	1.5
8	ES	Data Structures Lab	0	0	3	1.5
9	MC	Environment Science	2	0	0	0
Total Credits			**19.5**			

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II Year – I SEMESTER						
S.No	**Course Code**	**Courses**	**L**	**T**	**P**	**Credits**
1	BS	Mathematics III	3	0	0	3
2	IT	Object Oriented Programming through C++	3	0	0	3
3	IT	Operating Systems	3	0	0	3
4	IT	Database Management Systems	3	0	0	3
5	IT	Discrete Mathematics and Graph Theory	3	0	0	3
6	IT	Object Oriented Programming through C++ Lab	0	0	3	1.5
7	IT	Operating Systems Lab	0	0	3	1.5
8	IT	Database Management Systems Lab	0	0	3	1.5
9	SO	**Skill Oriented Course I** 1) Animations- 2D Animation 2) Distributed Technologies- NoSQL	0	0	4	2
10	MC	Constitution of India	2	0	0	0
Total Credits			**21.5**			

II Year – II SEMESTER						
S.No	**Course Code**	**Courses**	**L**	**T**	**P**	**Credits**
1	BS	Statistics with R	2	0	2	3
2	IT	Principles of Software Engineering	3	0	0	3
3	IT	Automata Theory and Compiler Design	3	0	0	3
4	ES	Java Programming	3	0	0	3
5	HS	Managerial Economics and Financial Accountancy	3	0	0	3
6	IT	UML Lab	0	1	2	2
7	IT	FOSS Lab	0	0	2	1
8	ES	Java Programming Lab	0	0	3	1.5
9	SO	**Skill Oriented Course II** 1) Animations- 3D Animation **OR** 2) Distributed Technologies- MongoDB	0	0	4	2
Total Credits			**21.5**			
10	Minor	Object Oriented Programming through C++[$]	3	0	2	3+1
11	Honors	Any course from the Pool, as per the opted track	4	0	0	4

$- Integrated Course

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III B. Tech – I Semester

S.No	Course Code	Courses	Hours per week			Credits
			L	T	P	C
1	PC	Computer Networks	**3**	**0**	**0**	**3**
2	PC	Design and Analysis of Algorithms	**3**	**0**	**0**	**3**
3	PC	Data Mining Techniques	**3**	**0**	**0**	**3**
4	Open Elective/Job Oriented	**Open Elective-I** Open Electives offered by other departments/ DevOps (Job Oriented course)	**3**	**0**	**0**	**3**
5	PE	**Professional Elective-I** 1. Artificial Intelligence 2. Agile Software Process 3. Distributed Systems 4. Advanced Unix Programming	**3**	**0**	**0**	**3**
6	PC	Data Mining Techniques with R Lab	**0**	**0**	**3**	**1.5**
7	PC	Computer Networks Lab	**0**	**0**	**3**	**1.5**
8	SO	**Skill Oriented Course - III** 1.Animation course: Animation Design **OR** 2. Continuous Integration and Continuous Delivery using DevOps	**0**	**0**	**4**	**2**
9	MC	Employability Skills-I	**2**	**0**	**0**	**0**
10	PR	**Summer Internship 2 Months(Mandatory) after second year(to be evaluated during V semester**	**0**	**0**	**0**	**1.5**
Total credits						**21.5**
11	Minor	Computer Networks[$]	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4

$- Integrated Course

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III B. Tech – II Semester						
S.No	**Course Code**	**Courses**	**Hours per week**			**Credits**
			L	**T**	**P**	**C**
1	PC	Machine Learning	**3**	**0**	**0**	**3**
2	PC	Big Data Analytics	**3**	**0**	**0**	**3**
3	PC	Cryptography and Network Security	**3**	**0**	**0**	**3**
4	PE	**Professional Elective-II** 1.Mobile Computing 2.MEAN Stack Development 3. Design Patterns 4.Scripting Languages	**3**	**0**	**0**	**3**
5	Open Elective/ Job Oriented	**Open Elective-II** Open Electives offered by other departments	**3**	**0**	**0**	**3**
6	PC	Big Data Analytics lab	**0**	**0**	**3**	**1.5**
7	PC	Machine Learning using Python Lab	**0**	**0**	**3**	**1.5**
8	PC	Cryptography and Network Security Lab	**0**	**0**	**3**	**1.5**
9	SO	**Skill Oriented Course - IV** 1.Data Science: Natural Language Processing **OR** 2.Video Analytics	**0**	**0**	**4**	**2**
10	MC3201	Employability skills-II	**2**	**0**	**0**	**0**
Total credits						**21.5**
Industrial/Research Internship(Mandatory) 2 Months during summer vacation						
11	Minor	Data Structures and Algorithms[$]	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4
Minor course through SWAYAM			**-**	**-**	**-**	**2**

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IV B. Tech –I Semester						
S.No	**Course Code**	**Course Title**	**Hours per week**			**Credits**
			L	**T**	**P**	**C**
1	PE	**Professional Elective-III** 1.Cloud Computing 2. Artificial Neural Networks 3. Internet of Things (IoT) 4.Cyber Security & Forensics	**3**	**0**	**0**	**3**
2	PE	**Professional Elective-IV** 1. Deep Learning Techniques 2. Social Networks Analysis 3. Advanced Databases 4.MOOCS-NPTEL/SWAYAM	**3**	**0**	**0**	**3**
3	PE	**Professional Elective-V** 1.Block-Chain Technologies 2.M-Commerce 3.Ethical Hacking 4.MOOCS-NPTEL/SWAYAM	**3**	**0**	**0**	**3**
4	Open Elective /Job Oriented	**Open Elective-III** Open Electives offered by other departments	**2**	**0**	**2**	**3**
5	Open Elective /Job Oriented	**Open Elective-IV** Open Electives offered by other departments	**2**	**0**	**2**	**3**
6	HS	Universal Human Values 2: Understanding Harmony	**3**	**0**	**0**	**3**
7	SO	PYTHON: Deep Learning **OR** Secure Coding Techniques **OR** APSSDC offered Courses	**0**	**0**	**4**	**2**
8	PR	**Industrial/Research Internship 2 months (Mandatory) after third year (to be evaluated during VII semester**	**0**	**0**	**0**	**3**
					Total credits	**23**
11	Minor	Software Engineering[$] / 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
		Minor course through SWAYAM	**-**	**-**	**-**	**2**

$- Integrated Course

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

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

POOL1- AI & ML 1. Mathematics for Machine Learning 2. Text Mining and Time Series Analysis 3. Natural Language Processing 4. Reinforcement Learning	**POOL2- Systems Engineering** 1. Internet of Things 2. Data Communications and Information Coding Theory 3. Service Oriented Architectures 4. Design of Secure Protocols 5. Network Coding
POOL3- Information Security 1. Principles of Cyber Security 2. Computational Number Theory 3. Cryptanalysis 4. Elliptic Curve Cryptography 5. Introduction to Quantum Computing and Quantum Cryptography 6. Public Key Infrastructure and Trust Management 7. Information Security Analysis and Audit 8. Cloud and IoT Security 9. Web Security 10. Block Chain Architecture Design and Use Cases	**POOL4 – Data Science** 1. Data Visualization 2. Statistical Foundations for Data Science 3. Mining Massive Data Sets 4. Medical Image Data Processing

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SUGGESTED COURSES FOR MINOR ENGINEERING IN IT

Note:

1. Any THREE courses *(Any FOUR courses in case of MOOCS)* need to be studied from PART-A.
2. Any ONE course (*If it is in Regular Mode*) need to be studied from PART-B.
3. TWO, NPTEL courses of EIGHT week duration covering a total of 4 credits (offered by the department of CSE/IT 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.
5. If sufficient numbers of students are not opted, as per the guidelines, dept can suggest students to pursue under MOOCS. In this case, department/students can select course such that there will not be any duplication.

Eligibility for Minor in IT:

PART A						
Regular Mode				**MOOCS***		
S.No	**Subject**	**L-T-P**	**Credits**	**Course available in NPTEL**	**NPTEL Link**	**Credits**
1	Operating Systems	3-0-2	4	Operating Systems	https://onlinecourses.swayam2.ac.in/cec21_cs20/preview	As recommended by the NPTEL (Dept need to verify the credits and suggest)
2	Data Structures and Algorithms	3-0-2	4	Data Structure and algorithms using Java	https://nptel.ac.in/courses/106105225	
3	Software Engineering	3-0-2	4	Software Engineering	https://onlinecourses.swayam2.ac.in/cec21_cs21/preview	
4	Computer Networks	3-0-2	4	Computer Networks	https://onlinecourses.swayam2.ac.in/cec22_cs05/preview	
5	Database Management Systems	3-0-2	4	Data Base Management System	https://onlinecourses.nptel.ac.in/noc22_cs51/preview	
* If sufficient number of students are not available to offer, can pursue under MOOCS						

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PART B						
S.No	**Subject**	**L-T-P**	**Credits**	**Course available in NPTEL**	**NPTEL Link**	**Credits**
1	Object Oriented Programming through C++	3-0-2	4	Programming in C++ (Two Credits)	https://onlinecourses.nptel.ac.in/noc21_cs02/preview	As recommended by the NPTEL (Dept need to verify the credits and suggest)
2	Data Analytics using Python	3-0-2	4	Data Analytics with Python	https://nptel.ac.in/courses/106107220	
3	Artificial Intelligence	4-0-0	4	Artificial Intelligence: Knowledge Representation And Reasoning	https://nptel.ac.in/courses/106106140	
				OR		
				An Introduction to Artificial Intelligence	https://onlinecourses.nptel.ac.in/noc22_cs56/preview	
4	Unix and Shell Programming	3-0-2	4			
5	Cloud Computing	4-0-0	4	Cloud computing	https://onlinecourses.nptel.ac.in/noc22_cs20/preview	
				OR		
				Cloud Computing and Distributed Systems (TWO Credits)	https://onlinecourses.nptel.ac.in/noc21_cs15/preview	
* If sufficient number of students are not available to offer, can pursue under MOOCS						

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IV Year – I Semester		L	T	P	C
		3	0	0	3
CLOUD COMPUTING (Professional Elective-III)					

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.

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Reference Books:

1. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, 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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IV Year – I Semester		L	T	P	C
		3	0	0	3
ARTIFICIAL NEURAL NETWORKS (Professional Elective-III)					

Course Objectives: The main objective of the course is to
- Introduce the foundations of Artificial Neural Networks.
- Acquire the knowledge on Soft Computing Concepts.
- learn various types of Genetic algorithms and its applications.
- 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 Interference, 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, Kohnen'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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IV Year – I Semester		L	T	P	C
		3	0	0	3
INTERNET OF THINGS (IoT) **(Professional Elective-III)**					

Course Objectives:
From the course the student will learn
- the application areas of IOT
- the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- building blocks of Internet of Things and characteristics

Course Outcomes:
By the end of the course, student will be able to
- Review Internet of Things (IoT).
- Demonstrate various business models relevant to IoT.
- Construct designs for web connectivity
- Organize sources of data acquisition related to IoT, integrate to enterprise systems.
- Describe IoT with Cloud technologies.

UNIT I:
The Internet of Things- An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, Examples OF IoTs, Design Principles For Connected Devices, Internet connectivity, **Application Layer Protocols-** HTTP, HTTPS, FTP

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.

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

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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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IV Year – I Semester		L	T	P	C
		3	0	0	3
CYBER SECURITY & FORENSICS (Professional Elective-III)					

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 andTesting 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. Nickolai 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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IV Year – I Semester		L	T	P	C
		3	0	0	3
DEEP LEARNING TECHNIQUES (Professional Elective-IV)					

Course Objectives: At the end of the course, the students will be expected to:

- 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 Learing, 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]**

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Text Books:

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courvile, 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
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

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DEPARTMENT OF INFORMATION TECHNOLOGY

IV Year – I Semester		L	T	P	C
		3	0	0	3
SOCIAL NETWORK ANALYSIS (Professional Elective-IV)					

Course Objectives:

- Formalize different types of entities and relationships as nodes and edges and represent thisinformation as relational data
- Plan and execute network analytical computations
- Use advanced network analysis software to generate visualizations and perform empirical investigations of network data
- Interpret and synthesize the meaning of the results with respect to a question, goal, or task
- Collect network data in different ways and from different sources while adhering to legal standards and ethics standards

Course Outcomes:

After completing the course student should:

- Know basic notation and terminology used in network science
- Be able to visualize, summarize and compare networks
- Illustrate basic principles behind network analysis algorithms
- Develop practical skills of network analysis in R programming language
- Be capable of analyzing real work networks

UNIT I:

Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.

UNIT II:

Random graph models**:** Random graphs and alternative models, Models of network growth, Navigation in social Networks, Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions.

UNIT III:

Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Navigation in Networks Revisited.

UNIT IV:

Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity, The Erdos Renyi Model, Clustering Models.

UNIT V:

Network structure -Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory, Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

Text Books:

1. S. Wasserman and K. Faust. “Social Network Analysis: Methods and Applications”, Cambridge University Press.
2. D. Easley and J. Kleinberg, “Networks, Crowds and Markets: Reasoning about a highly connected world” , Cambridge University Press, 1st edition,2010

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Reference Books:

1. Maarten van Steen. "Graph Theory and Complex Networks. An Introduction", 2010.
2. Reza Zafarani, Mohammed Ali Abbasi, Huan Liu. "Social Media Mining: An Introduction". Cambridge University Press 2014.
3. Maksim Tsvetovat and Alexander Kouznetsov. "Social Network Analysis for Startups". O'Reilly Media, 2011.

e-Resources:

1) https://www.classcentral.com/course/edx-social-network-analysis-sna-9134
2) https://www.coursera.org/learn/social-network-analysis

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DEPARTMENT OF INFORMATION TECHNOLOGY

IV Year – I Semester		L	T	P	C
		3	0	0	3
ADVANCED DATABASES (Professional Elective-IV)					

Course Objectives:

- This Subject deals with dealing data in the real world, maintaining data without any redundancy, several techniques involved in DBMS to recover the problems caused due to redundancy, storing data for quick insertion, manipulation and deletion operations in order to retrieve data from the database.
- This subject provides an introduction to multidisciplinary field of data mining, the general data features, techniques for data preprocessing, general implementation of data warehouses and OLAP, the relationship between data warehousing and other generalization methods
- The concepts of data clustering includes a different methods of clustering such as k-means, k-mediods, db scan algorithm, role of data mining in web mining.

Course Outcomes:

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

- Analyze on normalization techniques.
- Elaborate on concurrency control techniques and query optimization.
- Summarize the concepts of data mining, data warehousing and data preprocessing strategies.
- Apply data mining algorithms.
- Assess various classification & cluster techniques.

UNIT I:

Introduction: Concepts and Definitions, Relational models, Data Modeling and Query Languages, Database Objects. **Normalization Techniques:** Functional Dependency, 1NF, 2NF, 3NF, BCNF; Multi valued Dependency; Loss-less Join and Dependency Preservation.

UNIT II:

Transaction Processing: Consistency, Atomicity, Isolation and Durability, Serializable Schedule, Recoverable Schedule, Concurrency Control, Time-stamp based protocols, Isolation Levels, Online Analytical Processing, **Database performance Tuning and Query optimization:** Query Tree, Cost of Query, Join, Selection and Projection Implementation Algorithms and Optimization Database Security: Access Control, MAC, RBAC, Authorization, SQL Injection Attacks.

UNIT III:

Data Mining: stages and techniques, knowledge representation methods, data mining approaches (OLAP, DBMS, Statistics and ML). **Data warehousing:** data warehouse and DBMS, multidimensional data model, OLAP operations. **Data processing:** cleaning, transformation, reduction, filters and discretization with weka.

UNIT IV:

Knowledge representation: background knowledge, representing input data and output knowledge, visualization techniques and experiments with weka. **Data mining algorithms:** association rules, mining weather data, generating item sets and rules efficiently, correlation analysis.

UNIT V:

Classification & Clustering: 1R algorithm, decision trees, covering rules, task prediction, statistical classification, Bayesian network, instance based methods, linear models, Cluster/2, Cobweb, k-means, Hierarchical methods. **Mining real data:** preprocessing data from a real medical domain, data mining

techniques to create a comprehensive and accurate model of data. **Advanced topics:** text mining, text classification, web mining, data mining software.

Text Books:

1. Fundamentals of Database Systems, RamezElmasri, Shamkant B. Navathe, Addison-Wesley,6th edition-
2. Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 3rd edition-

Reference Books:

1. Principles of Distributed Database Systems, Prentice Hall, P. Valduriez, M. TamerOzsu 3rd edition-2000
2. Database systems: Design, implementation and Management, C.M. Coronel, S. Morris, P. Rob, Boston: Cengage Learning,9th edition-2011

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IV Year – I Semester		L	T	P	C
		3	0	0	3
BLOCK-CHAIN TECHNOLOGIES (Professional Elective-V)					

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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IV Year – I Semester		L	T	P	C
		3	0	0	3
M-COMMERCE (Professional Elective-V)					

Course Objectives:
The objective of the course is to provide the students with the Mobile Commerce concepts, environment and customer value and Business applications of Mobile Commerce.

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

- Define mobile commerce and its framework, growth benefits and limitations
- Determine the information distribution for mobile networks in multimedia content
- Describe the method how to publish mobile networks and mobile payment models in multimedia
- get acquaintance with wireless communications technology with reference to WWAN, Cellular systems 2G, 2.5G, 3G, 4G, 5G and WLAN, and WMAN technology
- learn M-COMMERCE applications in various areas like advertising, payment, ticketing, product location, entertainment and shopping

UNIT I:
Electronic Commerce: Traditional commerce and E-commerce, Internet and WWW, Role of WWW, Value Chains, Strategic Business and Industry Value Chains, Role of E-commerce. Packet Switched Networks, TCP/IP Protocol Script, Internet Utility Programmes – SGML, HTML and XML, Web Client and Servers, Web Client/Server Architecture, Intranet and Extranets, Web Based Tools for E-commerce, Security.

UNIT II:
Mobile Commerce: Introduction, Infrastructure of M–Commerce, Types Of Mobile Commerce Services, Technologies of Wireless Business, Benefits and Limitations, Support, Mobile Marketing & Advertisement, Non– Internet Applications in M–Commerce, Wireless/Wired Commerce Comparisons.

UNIT III:
Mobile Commerce Technology : A Framework For The Study Of Mobile Commerce, NTT Docomo's I-Mode, Wireless Devices For Mobile Commerce, Towards a Classification Framework for Mobile Location Based Services, Wireless Personal and Local Area Networks, The Impact of Technology Advances on Strategy Formulation in Mobile Communications Networks.

UNIT IV:
Mobile Commerce Theory and Applications : The Ecology of Mobile Commerce, The Wireless Application Protocol, Mobile Business Services, Mobile Portal, Factors Influencing the Adoption of Mobile Gaming Services, Mobile Data Technologies and Small Business Adoption and Diffusion, E–commerce in The Automotive Industry, Location– Based Services: Criteria For Adoption and Solution Deployment, The Role of Mobile Advertising in Building a Brand, M–commerce Business Models

UNIT V:
Business– To– Business Mobile E– Commerce : Enterprise Enablement, Email and Messaging, Field Force Automation (Insurance, Real Estate, Maintenance, Healthcare), Field Sales Support (Content Access, Inventory), Asset Tracking and Maintenance/Management, Remote IT Support, Customer Retention (B2C Services, Financial, Special Deals), Warehouse Automation, Security.

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Text Books:

1. E.Brian Mennecke, J.Troy Strader, "Mobile Commerce: Technology, Theory and Applications", Idea Group Inc., IRM press, 2003.
2. Ravi Kalakota, B.Andrew Whinston, "Frontiers of Electronic Commerce", Pearson Education, 2003.

Reference Books:

1. P. J. Louis, "M-Commerce Crash Course", McGraw- Hill Companies February 2001.
2. Paul May, "Mobile Commerce: Opportunities, Applications, and Technologies Of Wireless Business" Cambridge University Press March 2001.

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IV Year – I Semester		L	T	P	C
		3	0	0	3
ETHICAL HACKING (Professional Elective-V)					

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, stegnography 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 dns enum, 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, 1st Edition, Justin Clarke-Salt, Syngress Publication
3. Mastering Modern Web Penetration Testing, Prakhar Prasad, Packt Publishing, October 2016

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DEPARTMENT OF INFORMATION TECHNOLOGY

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

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 forwhich 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
2. Purpose and motivation for the course, recapitulation from Universal Human Values-I
3. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
4. Continuous Happiness and Prosperity- A look at basic Human Aspirations
5. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
6. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
7. 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 asarbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!
2. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
3. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
4. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
5. Understanding the characteristics and activities of 'I' and harmony in 'I'
6. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
7. Programs to ensureSanyam and Health.

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

8. 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
9. Understanding the meaning of Trust; Difference between intention and competence
10. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
11. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
12. 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 students 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

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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IV Year – I Semester		L	T	P	C
		0	0	4	2
PYTHON: DEEP LEARNING (Skill Oriented Course)					

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
- Data visualization using Python: Data visualization functions and plots https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012605191343693824145 5_shared/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
- Clustering using Python: Clustering, techniques, Assessment and evaluation https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013044179942342656119 0_shared/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
- Time series analysis : Patterns, decomposition models, smoothing time, forecasting data https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012605180474425344128 0_shared/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_01277649241666355225 9_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 hyper parameter tuning.
https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_01278569444316774491 0_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

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_01279205825881702427 2_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_01310292337329766487 3_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_01310791722668032018 4_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_01311184442254131298 4_shared?collectionId=lex_auth_01274814254931148859_shared&collectionType=Course

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Exercise 9:

Module name: Autoencoders Advanced
Exercise: Demonstration of Application of Autoencoders.
https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013116455128989696 2081_shared?collectionId=lex_auth_0127481425493114885 9_shared&collectionType=Course

Exercise 10 :

Module name: Advanced GANs
Exercise:Demonstration of GAN.
https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013115545666428928 1901_shared?collectionId=lex_auth_0127481425493114885 9_shared&collectionType=Course

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.
https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_0127481425493114885 9_shared&collectionType=Course

Exercise 12:

Module name : Capstone project
Exercise : Complete the requirements given in capstone project
https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_0127481425493114885 9_shared&collectionType=Course

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

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Web Links: [Courses mapped to Infosys Springboard platform]

1. 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 [Deep learning for Developers]

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IV Year – I Semester		L	T	P	C
		0	0	4	2
SECURE CODING TECHNIQUES (Skill Oriented Course)					

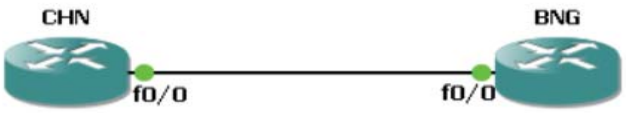
Course Outcomes:
At the end of the Course, Student will be able to:

- Implement Network Configuration
- Install Programming APIs and Implement OWASP design principles while designing a web application
- Write Python script to implement web request
- Understand the importance of security in all phases of SDLC
- Write secure coding using some of the practices in C/C++/Java and Python programming languages

List of Experiments:

EXPERIMENT-1:
1.1 Identification of classes of IPv4 addresses
1.2 Classification of IPv4 Address into public and private
1.3 Create a Sub net
1.4 To determine Network ID, Broadcast ID, Usable Host
Web link:
https://infyspringboard.onwingspan.com/web/en/viewer/pdf/lex_auth_01323957463569203224 0_shared?collectionId=lex_auth_012683751296065536354_shared&collectionType=Course

EXPERIMENT-2:
2.1 Configure the given topology deducing from the outputs following it



2.2 Troubleshoot the below topology with below operations

- Configure the below topology
- Protect the privileged mode by assigning it a password
- Display 'Welcome to BENGALURU' and 'Welcome to MYSURU' as message of the day, while entering the consoles of respective DC's

Web link:
https://infyspringboard.onwingspan.com/web/en/viewer/pdf/lex_auth_01323957463569203224 0_shared?collectionId=lex_auth_012683751296065536354_shared&collectionType=Course

EXPERIMENT-3:
3.1 Explore cryptography, input and output sanitization, error handling, input validation, logging and auditing, and session and exception management.
3.2 Install Programming interfaces (APIs), including those that offer different types of functionality, such

as Microsoft's Crypto API and Python's pycrypto, which both provide cryptographic functions.
3.3 Implement Concurrency, type safety, memory management, configuration parameter management, tokenizing, and sandboxing.
Web Link : https://springboard.percipio.com/courses/57a7fcde-9829-4f12-a9af-cb14eacf673e/videos/6135b4f6-29dc-4d44-98c5-60fcbfa859d0?tab=overview

EXPERIMENT-4:
4.1 Server-side and client-side code
4.2 scan a web app for vulnerabilities using OWASP ZAP and Burp Suite
4.3 explore secure coding using the OWASP ESAPI
Web Link : https://springboard.percipio.com/courses/79fb661e-26b5-4ae5-a008-2cf7d4e63e3c/videos/ccaa5e65-ab27-4bd4-8416-cc262569e96c

EXPERIMENT-5:
Defensive programming for C/C++ including inspections, testing, and input validation
Web Link: https://springboard.percipio.com/courses/f44c02f9-1bcc-11e7-b15b-0242c0a80b07/videos/f44ced50-1bcc-11e7-b15b-0242c0a80b07

EXPERIMENT-6:
6.1 Identify when to use Python, along with a working knowledge of how to write and run a Python script, are beneficial skills in secure coding
6.2 Create variables, containers including lists, dictionaries, and tuples, conditionals, loops, and functions in a Python script.
6.3 Imports and file reading and writing using a PowerShell script. Finally, you'll learn how to use a Python script to make a web request.
Web Link : https://springboard.percipio.com/courses/be99adad-1f65-47a8-a4b5-6b5346072b8e/videos/71397986-c553-419f-a525-105965ca3158

EXPERIMENT-7:
Consider the following code in C language:

```
int main() {
   mybufferOverflow();
}
void mybufferOverflow() {
char stringLine[10];
printf("Enter the text: ");
gets(stringLine);
 printf("You have entered: ", stringLine);
return 0;
}
```

What is a buffer overflow attack that can happen on this code? Rewrite the code prevent buffer overflow.

EXPERIMENT-8:
Create a login page with user name and password which will connect to a database which will store the name and password. You can use Java and HTML code and database as per convenience. Simulate an SQL injection attack. Write embedded SQL code to avoid SQL injection attack. Document how this is taken care in the later versions of Java.

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EXPERIMENT-9:
Create a login page with user name and password which will connect to a database which will store the name and password. You can use Python as a base and database as per convenience. Simulate an SQL injection attack. Write the revised code in Python that will sanitize the inputs and help prevent an SQL injection attack.

EXPERIMENT-10 :
Read and understand the Heartbleed vulnerability. Identify the code in C++ that can simulate this vulnerability and also code to fix it. Document the secure coding practices to take care of this vulnerability and the reasons for it to happen.

EXPERIMENT-11:
Go to OWASP.org. Read about the top 10 vulnerabilities mentioned. Document the following:
a. Name of the vulnerability
b. Causes
c. Mitigation

How will you prevent it in the programming language that you use, if applicable with example codes

EXPERIMENT-12:
Go to http://cwe.mitre.org/top25/archive/2021/2021_cwe_top25.html. Read about the top 10 vulnerabilities mentioned. Document the following:
a. Name of the programming error
b. Causes
c. Mitigation
d. How will you prevent it in the programming language that you use, if applicable with example codes

Web Link : http://cwe.mitre.org/top25/archive/2021/2021_cwe_top25.html

Web Links:
1. https://infyspringboard.onwingspan.com/web/en/viewer/pdf/lex_auth_01323957463569203224 0_shared?collectionId=lex_auth_012683751296065536354_shared&collectionType=Course
2. https://springboard.percipio.com/courses/57a7fcde-9829-4f12-a9af-cb14eacf673e/videos/6135b4f6-29dc-4d44-98c5-60fcbfa859d0?tab=overview
3. https://springboard.percipio.com/courses/79fb661e-26b5-4ae5-a008-2cf7d4e63e3c/videos/ccaa5e65-ab27-4bd4-8416-cc262569e96c
4. https://springboard.percipio.com/courses/f44c02f9-1bcc-11e7-b15b-0242c0a80b07/videos/f44ced50-1bcc-11e7-b15b-0242c0a80b07
5. https://springboard.percipio.com/courses/be99adad-1f65-47a8-a4b5-6b5346072b8e/videos/71397986-c553-419f-a525-105965ca3158
6. https://www.techtarget.com/searchsecurity/definition/buffer-overflow#:~:text=A%20buffer%20overflow%20occurs%20when,adjacent%20to%20the%20destination%20buffer
7. https://www.journaldev.com/34028/sql-injection-in-java
8. https://realpython.com/prevent-python-sql-injection/
9. https://www.securecoding.com/blog/finding-and-fixing-c-vulnerabilities/
10. https://owasp.org/www-project-top-ten/

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

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.

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UNIT V:
The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation, Elements of Software Qualtiy Assurance, SQA Tasks, Goals & Metrics, Statistical SQA, Software Reliability, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies 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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PART B	Minor Course	L	T	P	C
		3	0	2	4
OBJECT ORIENTED PROGRAMMING THROUGH C++					

Course Objectives:

- Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
- Understand dynamic memory management techniques using pointers, constructors, destructors
- Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
- Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
- Demonstrate the use of various OOPs concepts with the help of programs

Course Outcomes:

By the end of the course, the student

- Classify object oriented programming and procedural programming
- Apply C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling
- Build C++ classes using appropriate encapsulation and design principles
- Apply object oriented or non-object oriented techniques to solve bigger computing problems

UNIT I

Introduction to C++: Difference between C and C++, Evolution of C++, The Object Oriented Technology, Disadvantage of Conventional Programming, Key Concepts of Object Oriented Programming, Advantage of OOP, Object Oriented Language.

UNIT II

Classes and Objects &Constructors and Destructor: Classes in C++, Declaring Objects, Access Specifiers and their Scope, Defining Member Function, Overloading Member Function, Nested class, Constructors and Destructors, Introduction, Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments parameterized Constructor, Destructors, Anonymous Objects.

UNIT III

Operator Overloading and Type Conversion & Inheritance: The Keyword Operator, Overloading Unary Operator, Operator Return Type, Overloading Assignment Operator (=), Rules for Overloading Operators, Inheritance, Reusability, Types of Inheritance, Virtual Base Classes- Object as a Class Member, Abstract Classes, Advantages of Inheritance, Disadvantages of Inheritance.

UNIT IV

Pointers & Binding Polymorphisms and Virtual Functions: Pointer, Features of Pointers, Pointer Declaration, Pointer to Class, Pointer Object, The this Pointer, Pointer to Derived Classes and Base Class, Binding Polymorphisms and Virtual Functions, Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Virtual Destructor.

UNIT V

Generic Programming with Templates & Exception Handling: Definition of class Templates, Normal Function Templates, Over Loading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked Lists with Templates, Exception Handling, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements, Specifying Exceptions.

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Overview of Standard Template Library, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

List of Experiments:

Exercise -1 (Classes Objects)
Create a Distance class with:
- •feet and inches as data members
- •member function to input distance
- •member function to output distance
- •member function to add two distance objects

1. Write a main function to create objects of DISTANCE class. Input two distances and output the sum.
2. Write a C++ Program to illustrate the use of Constructors and Destructors (use the above program.)
3. Write a program for illustrating function overloading in adding the distance between objects (use the above problem)

Exercise – 2 (Access)
Write a program for illustrating Access Specifiers public, private, protected
1. Write a program implementing Friend Function
2. Write a program to illustrate this pointer
3. Write a Program to illustrate pointer to a class

Exercise -3 (Operator Overloading)
1. Write a program to Overload Unary, and Binary Operators as Member Function, and Non Member Function.
2. Write a c ++ program to implement overloading assignment = operator

Exercise -4 (Inheritance)
Write C++ Programs and incorporating various forms of Inheritance
- i) Single Inheritance
- ii) Hierarchical Inheritance
- iii) Multiple Inheritances
- iv) Multi-level inheritance
- v) Hybrid inheritance

Exercise -5(Templates, Exception Handling)
1. Write a C++ Program to illustrate template class
2. Write a Program for Exception Handling Divide by zero
3. Write a Program to rethrow an Exception

Exercise -6
1. Write a C++ program illustrating user defined string processing functions using pointers (string length, string copy, string concatenation)
2. Write a C++ program illustrating Virtual classes & virtual functions.
3. Write C++ program that implement Bubble sort, to sort a given list of integers in ascending order

Text Books:
1) A First Book of C++, Gary Bronson, Cengage Learning.
2) The Complete Reference C++, Herbert Schildt, TMH.

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Reference Books:

1) Object Oriented Programming C++, Joyce Farrell, Cengage.
2) C++ Programming: from problem analysis to program design, DS Malik, Cengage Learning
3) Programming in C++, Ashok N Kamthane, Pearson 2nd Edition

e- Resources:

1) https://nptel.ac.in/courses/106/105/106105151/
2) https://github.com/topics/object-oriented-programming

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DEPARTMENT OF INFORMATION TECHNOLOGY

PART B	Minor Course	L	T	P	C
		3	0	2	4

DATA ANALYTICS USING PYTHON

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DEPARTMENT OF INFORMATION TECHNOLOGY

PART B	Minor Course	L	T	P	C
		4	0	0	4
ARTIFICIAL INTELLIGENCE					

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, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional 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 , 2nd ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence, Rich, Kevin Knight, Shiv Shankar B Nair, 3rd 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 Lugar, 5th 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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PART B	Minor Course	L	T	P	C
		3	0	2	4
UNIX AND SHELL PROGRAMMING					

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)
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() andexit (), System calls

Text Books:

1. Unix the ultimate guide, 3rd edition, Sumitabha Das, TMH.
2. Advanced programming in the Unix environment by W. Richard Stevens.
3. Unix network programming by W. Richard Stevens.

Reference Books:

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

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PART B	Minor Course	L	T	P	C
		4	0	0	4
CLOUD COMPUTING					

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.

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Reference Books:

4. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, 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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DEPARTMENT OF INFORMATION TECHNOLOGY

II Year - II Semester	Honors Course	L	T	P	C
		4	0	0	4
MATHEMATICS FOR MACHINE LEARNING (AI & ML)					

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, 2nd 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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	Honors Course	L	T	P	C
		4	0	0	4
TEXT MINING AND TIME SERIES ANALYSIS (AI & ML)					

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.

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.

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Text Books:

1. Charu C. Aggarwal, Chengxing Zhai, "Mining Text Data", Kluver 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, 2nd ed. New York: Wiley, 1996.

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	Honors Course	L	T	P	C
		4	0	0	4
NATURAL LANGUAGE PROCESSING (AI & ML)					

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 Indurkhya 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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	Honors Course	L	T	P	C
		4	0	0	4
REINFORCEMENT LEARNING (AI & ML)					

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(λ), Equivalences of Forward and Backward Views, saras(λ), Watkin's Q(λ), Off-policy Eligibility Traces using Important Sampling, Variable λ.

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, 1st Edition, Springer, 2021.

Reference Books:

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

NPTEL Link: Reinforcement Learning:
https://onlinecourses.nptel.ac.in/noc22_cs34/preview

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II Year - II Semester	Honors Course	L	T	P	C
		4	0	0	4
INTERNET OF THINGS (Systems Engineering)					

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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	Honors Course	L	T	P	C
		4	0	0	4
DATA COMMUNICATIONS AND INFORMATION CODING THEORY (Systems Engineering)					

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

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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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	Honors Course	L	T	P	C
		4	0	0	4
SERVICE ORIENTED ARCHITECTURES (Systems Engineering)					

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

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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

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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	Honors Course	L	T	P	C
		4	0	0	4
DESIGN OF SECURE PROTOCOLS (Systems Engineering)					

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, SNTP, 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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	Honors Course	L	T	P	C
		4	0	0	4
NETWORK CODING (Systems Engineering)					

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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DEPARTMENT OF INFORMATION TECHNOLOGY

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

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, 2nd Edition, ISACA Publishers, 2019

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	Honors Course	L	T	P	C
		4	0	0	4
COMPUTATIONAL NUMBER THEORY (Information Security)					

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 Metods

Text Books:
1. Abhijit Das, Computational Number Theory, CRC Hall, 1st 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, 2nd Edition, Cambridge Iniversity 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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		L	T	P	C
	Honors Course	**4**	**0**	**0**	**4**
CRYPTANALYSIS (Information Security)					

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	Honors Course	L	T	P	C
		4	0	0	4

ELLIPTIC CURVE CRYPTOGRAPHY
(Information Security)

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		L	T	P	C
	Honors Course	4	0	0	4

INTRODUCTION TO QUANTUM COMPUTING AND QUANTUM CRYPTOGRAPHY
(Information Security)

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

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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	Honors Course	L	T	P	C
		4	0	0	4
INFORMATION SECURITY ANALYSIS AND AUDIT (Information Security)					

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.

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Text Book:
1. Information Systems Control and Audit, 1st 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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	Honors Course	L	T	P	C
		4	0	0	4
CLOUD AND IOT SECURITY (Information Security)					

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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	Honors Course	L	T	P	C
		4	0	0	4
WEB SECURITY (Information Security)					

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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	Honors Course	L	T	P	C
		4	0	0	4
BLOCK CHAIN ARCHITECTURE DESIGN AND USE CASES (Information Security)					

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 inpayment 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 currencymarkets
- 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. Antonpoulos, "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
		4	0	0	4
DATA VISUALIZATION (Data Science)					

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, 2nd edition,A K Peters, Ltd 2015.

Reference Books:

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

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

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.

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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.
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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	Honors Course	L	T	P	C
		4	0	0	4
MINING MASSIVE DATA SETS (Data Science)					

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:
- Discuss research directions in Mining Massive Datasets, such as similarity search, streaming data, clustering, and graph mining.
- 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.
- Develop a research project relevant to Mining Massive Datasets and produce a report describing the project's background, methods, results, and conclusions.
- Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program.
- 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-Senstive 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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	Honors Course	L	T	P	C
		4	0	0	4
MEDICAL IMAGE DATA PROCESSING (Data Science)					

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.