Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure & Syllabus of

Master of Technology
(Computer Science and Engineering)

With Effect from Academic Year 2023-24

In-line with National Education Policy-2020 Guidelines

Prepared by: - Board of Studies in Computer Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

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Vision of the Institution

"To be globally acclaimed Institute in Technical Education and Research for holistic Socio-economic development".

Mission of the Institution

•To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
•To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
•Promote Research Culture among Students and Faculty through Projects and Consultancy.
•To make students Socially Responsible Citizen.

Vision of the Department

"To be a leader in the world of computing education practising creativity and innovation".

Mission of the Department

•To ensure students' employability by developing aptitude, computing, soft, and entrepreneurial skills
•To enhance academic excellence through effective curriculum blended learning and comprehensive assessment with active participation of industry
•To cultivate research culture resulting in knowledge-base, quality publications, innovative products and patents
•To develop ethical consciousness among students for social and professional maturity to become responsible citizens

Program Educational Objectives (PEO)

PEO	PEO Focus	PEO Statements
PEO1	Core Competency	Apply relevant domain-specific emergent knowledge to innovatively craft scientific solution addressing complex computing problems with selection of technological and infrastructural resources rationally.
PEO2	Critical Thinking	Assess the heterogeneous problem scenarios and map compartmentalized problems to formulate well-designed optimal and sustainable solutions by following systematic investigation process to reach out to meaningful conclusions.
PEO3	Research Skills	Contemplate multi-perspective broad problems having uncertainties in order to construct fit to purpose and use solutions or services by incorporating best practices and modern engineering tools.
PEO4	Learning Environment	Demonstrate good analytical, research, design and implementation skills to be recognized as ethical and responsible citizens and continue to pursue higher order goals.

Program Outcomes (PO)

Program Outcomes for PG Program (PO): NBA has defined the following three POs for a graduate of PG Engineering Program:

1. PO1: An ability to independently carry out research /investigation and development work to solve practical problems.
2. PO2: An ability to write and present a substantial technical report/document.
3. PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Program Specific Outcomes (PSO)

1. PSO1: Ability to conceive well-structured design and proficient implementation to provide solution to new ideas using latest theories and recent technologies in the specific domain.

1. PSO2: An ability to independently propose architecture and design for solution realization by carrying out research /investigation to solve real-life societal problems.

FF No. 653

Course Structure - Total Credits

Sr No	Course Name	Credits
1	FY SEM1	20
2	FY SEM 2	20
3	SY SEM 1	20
4	SY SEM2	20
	Total Credits	**80**

Nomenclature as per NEP

ESC- Engineering Science Course

PCC – Program Core Course

PEC- Program Elective Course

ELC – Experiential Learning Course

MDOE – Multi Disciplinary Open Elective

IKS-Indian Knowledge System

HSSM – Humanities Social Science and Management

FP – Field Project

INT – Internship

Course Structure (As per NEP-2020) FF No. 653

M.Tech FY Semester-I

Semester	Course	L	P	T	Credits	Total Credits
Sem-I	ESC-I	2	-	-	2	20
	PCC-I	3	2	-	4	
	PCC-II	3	2	-	4	
	ELC-I	2	-	-	2	
	PEC-I	3	2	-	4	
	ELC-II	-	8	-	4	
Sem-II	PCC-III	3	2	-	4	20
	PCC-IV	3	2	-	4	
	PEC-II	3	2	-	4	
	MD-OE	2	-	-	2	
	IKS-I	2	-	-	2	
	ELC-III	-	8	-	4	
Sem-III	HSSM-OE-I	2			2	20
	HSSM-OE-II	2			2	
	FP-I		32		16	
OR						
Sem-III	INT-I		40		20	
Sem-IV	HSSM-OE-III	2			2	20
	HSSM-OE-IV	2			2	
	FP-II		32		16	
OR						
Sem-IV	INT-II		40		20	

Course Structure **FF No. 653**

M.Tech FY Semester-I

Subject	Subject Code	Subject Name	Credits	Contact Hours	
				Theory (Hrs/ Week)	Lab (Hrs/ Week)
S1	ESC-I:CS5283	Probability and Queuing Theory	2	2	-
S2	PCC-I: CS5101	Computer Vision	4	3	2
S3	PCC-II: CS5208	Cloud Computing	4	3	2
S4	ELC-I: CS5284	Research Methodology	2	2	-
S5	PEC: CS5282	Deep Learning	4	3	2
S6	ELC-II: CS5107	Software Development Project- I	4	-	8
		Total Credits	**20**	13	14

M.Tech FY Semester-II

Subject	Subject Code	Subject Name	Credits	Contact Hours	
				Theory (Hrs/ Week)	Lab (Hrs/ Week)
S1	PCC-III :CS5280	Internet of Things	4	3	2
S2	PCC-IV: CS5281	Natural Language Processing	4	3	2
S3	PEC-II: CS5277	Cyber Security	4	3	2
S4	MD-OE: CS5271	Algorithms and Complexity	2	2	-
S5	IKS-I: CS5282		2	2	-
S6	ELC-III: CS5278	Software Development Project- II	4	-	8
		Total Credits	**20**	13	14

M.Tech SY Semester-III and IV

Semester	Subject Code	Subject Name	Credit
III	HSSM-OE-I		2
	HSSM-OE-II		2
III	FP-I: CS6007	Dissertation by Research	16
OR			
III	INT-I: CS6001	Dissertation by Internship	40
IV	HSSM-OE-III		2
IV	HSSM-OE-IV		2
IV	CS6008	Dissertation by Research	16
OR			
IV	INT-II: CS6002	Dissertation by Internship	20
		Total Credits	**40**

Course Content

Syllabus Template **FF No. : 654**

ES5001:: Linear Algebra And Applied Statistics

Credits: 3 **Teaching Scheme: Theory: 2 Hours / Week**

SECTION-1: Topics/Contents

Matrices: Matrix algebra, The Inverse of matrix, the LU factorization, Rank, Solving simultaneous equations using matrices: Gaussian Elimination.

Vector spaces: Vector spaces and subspaces, spanning set and Linear independence, Basis and dimension, The Four fundamental subspaces.

Linear Transformation: The kernel and range of linear transformation, Change of Basis, The Matrix of the linear transformation.

Applications: Markov chains, linear economic model, Population Growth,

Orthogonality: Inner Product, Orthogonality, Gram-Schmidt Orthogonalization and QR factorization, Least square approximations, The Singular value decomposition.

Eigen values and Eigen vectors: A Dynamical system on graphs, Introduction to eigen values, eigenvectors, Similarity and diagonalization.

Applications: Markov chains, Population Growth, Linear recurrence relations, System of linear differential equations, Discrete linear dynamical systems.

SECTION-2: Topics/Contents

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Probability and Statistics: Sample points and Sample spaces: Events, algebra of events, partitions, Bayes theorem, probability axioms, joint and conditional probability.

Random Variables : Introduction to random variables and random vectors, Discrete and continuous random variables, random vectors, some standard distributions, Central limit theorem, Simulation.

Statistics: Introduction, Random sampling, confidence interval, Testing of Hypothesis, correlation and simple linear regression.

Text Books:

1. Gilbert Strang, 'Linear Algebra and Its Applications', Fourth Edition- Cengage Learning, 2006
2. William Navidi, 'Statistics for Engineers and Scientists', Third Edition-McGraw Hill Education, 2013

Reference Books:

1. Kishore S Trivedi, 'Probability and Statistics with Reliability, Queuing, and Computer Science Applications' - PHI.
2. Kenneth Hoffman and Ray Kunze, 'Linear Algebra' 2nd edition, Prentice Hall India, 2013.
3. Cheney and Kincaid, 'Linear Algebra' 2nd edition, Jones and Bartlett learning, 2014.
4. David Poole , 'Linear Algebra a modern Introduction', 4th Edition- Cengage Learning-2018.
5. Seymour Lipschutz and John Schiller , 'Introduction to Probability and Statistics',Schaum's Outlines-Tata Mcgraw-Hill Edition-2005.

Course Outcomes :

The student will be able to –

1. Identify and comprehend linear algebraic structures that appear in various areas of Computer science
2. Use linear algebraic methods to perform computational tasks.
3. Apply properties of eigenvalues and orthogonality to analyze computational problems.
4. Identify and apply various concepts of probability theory.
5. Comprehend and use the statistics in real world situations.
6. Identify and set up relevant random experiments to apply tail inequalities.

Syllabus Template **FF No. : 654**

CS5101:: Computer Vision

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites: Knowledge of Linear Algebra & Different types of Signals, Image Processing

Course Objectives:

1. Learn fundamentals of and techniques used in image processing and computer vision
2. To acquaint with Image filtering and shape representation.
3. Understand Segment the image to identify the region of interest.
4. Identify various algorithms for Motion Estimation & Pattern recognition
5. To learn pattern recognition.
6. Develop an algorithm to recognize the specified objects in the given image.

Course Relevance: Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do.

SECTION-1: Topics/Contents

Image Formation Models :
Introduction, Elements of image processing system, Scenes and Images, Vector Algebra, color vision color model: RGB, HVS, YUV, CMYK, YCbCr and some basic relationships between pixels, Fundamentals of Image Formation, Human Vision System, Computer Vision System(6 hrs)

Image Processing and Feature Extraction:
Thresholding, Spatial domain techniques, Image Negative, Contrast stretching, gray level slicing, bit plane slicing, histogram and histogram equalization, local enhancement technique, image subtraction and image average, Image Smoothening: low-pass spatial filters, median filtering, Image Sharpening: high-pass spatial filter, derivative filters(8 hrs.)

Shape Representation and Segmentation :
Classification of image segmentation techniques: Edge-based Segmentation, Region based techniques, Types of Edge detector Feature Extraction- Boundary representation(Chain code), Boundary detection based techniques, Edges – Canny,, Convolutional Neural Network**(**6 hrs.)

SECTION-2: Topics/Contents

Motion Estimation & Pattern recognition: Regularization theory ,Epipolar Geometry, Optical computation , Stereo Vision: Distortion, Rectification, , Motion estimation , Structure from motion. Pattern recognition models: hidden Markov modes (6 hrs.)

Feature detection and description: Feature matching and model fitting, Dimension reduction and sparse representation, Shape correspondence and shape matching, Principal component analysis, Singular Value Decomposition Shape priors for recognition (6 hrs.)

Object Recognition:

Need, Automated object recognition system, pattern and pattern class, relationship between image processing and object recognition, approaches to object recognition.

Global Methods; Active Contours; Split and Merge; Mean Shift and Mode Finding, Change Detection. Principal component analysis, Singular Value Decomposition Shape priors for recognition, Face Recognition (8 hrs.)

List of Tutorials: (Any Three)

1. Introduction to OpenCV and Setting up Python Programming Environment for Computer Vision
2. Essentials of Linear Algebra Part-I (Matrix Theory) for Computer Vision
3. Essentials of Linear Algebra Part-II (Vector Spaces) for Computer Vision
4. Comparison of various edge detection techniques
5. Configuration of Raspberry Pi-4B for Computer Vision
6. Mathematics of Support Vector Machine
7. Mathematics of K-Means Classification.
8. Barcode detection Methods
9. Face Detection Methods

List of Practical's: (Any Six)

1. Image Manipulations and Geometrical Transformations
2. Implementation of Image Filtering Techniques
3. Implementation of Image Enhancements Techniques
4. Detection of Lines, Edges and Corners
5. Object Detection Model
6. Face Recognition Model
7. Image and Video Editing
8. Develop an algorithm for segmentation of an input image
9. Develop an algorithm for recognition of an object from input image.
10. Develop an algorithm for motion estimation from given video sequence.
11. Design an algorithm for SVM classifier
12. Design an algorithm for adaboost classifier
13. Line detection using Hough transforms 10. To design and develop optical flow algorithm for motion estimation

List of projects:

Select any one project from the list below and execute it.

1. Develop an application for vision-based security system during day/night time. The system should trigger an audio- visual alarm upon unauthorized entry.
2. Develop motion estimation/ tracking system to recognize object of interest related to one
3. of the following applications. (Automobile tracking/ face tracking/ human tracking)
4. Develop motion estimation/ tracking system to recognize object of interest related to one
5. of the following applications. (Space vehicle tracking/ solar energy tracking/ crowd pattern
6. tracking)
7. Human Detection using HOG or SIFT.
8. Line detection in video
9. Motion Estimation in video
10. Face Recognition
11. Digital Object Insertion

12. Video Stabilization
13. Barcode Detection
14. Detection of Dents on a Car
15. Detection of Stray Animals on the Road

List of Course Seminar Topics:

1. 1. Bioinspired Stereo Vision Calibration for Dynamic Vision Sensors
2. 2. Low-Power Computer Vision: Status, Challenges, and Opportunities
3. 3. Subpixel Computer Vision Detection based on Wavelet Transform
4. 4. Automatic Counting and Individual Size and Mass Estimation of Olive-Fruits Through
5. Computer Vision Techniques
6. 5. Person Recognition in Personal Photo Collection
7. 6. Measuring Gait Variables Using Computer Vision to Access Mobility and Fall Risk in
8. Wearable Vision Assistance System based on Binocular Sensors for Visually Impaired
9. Users
10. Edge Detection Algorithm for Musca-Domestica Inspired Vision System
11. Automated Vision Based High Intraocular Pressure Detection using Frontal Eye Images
12. Detection of Possible Illicit Messages using Natural Language Processing and Computer
13. Vision on Twitter and LinkedIn Websites

List of Course Group Discussion Topics:

1. Human Visual System vs Computer Vision System
2. Spatial Domain Filtering and Frequency Domain Filtering
3. Features from Accelerated Segment Test Features from Accelerated Segment Test and
4. Oriented Fast and Rotated Brief
5. Local Binary Pattern and Local Directional Pattern
6. K-Nearest Neighbors and K-Means
7. Monocular Vision and Stereo Vision
8. Image Enhancement and Image Restoration
9. Raspberry Pi-4B and Jetson Nano
10. Essential Matrix and Fundamental Matrix
11. Camera Calibration.

List of Home Assignments:

Design:

1. Depth Calculation based on Monocular Vision
2. Depth Calculation based on Stereo Vision
3. Automatic Attendance monitoring system
4. Detection of Traffic Signals
5. Pose Estimation

Case Study:

1. Detection of Roadside Infrastructure (Lampposts, Pavement Blocks, Seating Arrangements,
2. Roadside Line Markers, Manholes, Barricades, etc.
3. Vehicle License Plate Recognition at Security Checkpoints
4. Detection of Dents on a Car
5. Detection of Type of Roads (Tar, Cement, and Mud)
6. Hand-Gesture Recognition

Blog

Computer Vision for:

1. Mobility of Visually Impaired People
2. Avoiding Accidents
3. Obstacle Detection and Avoidance
4. Patient Monitoring
5. Fall detection
6. Surveys
7. Computer Vision for Differently Abled People
8. Computer Vision for Kids Care
9. Computer Vision Electric Vehicles
10. Computer Vision for Women Safety
11. 5. Computer Vision for Teaching-Learning Process at Academic Institutes

Suggest an assessment Scheme:

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

1. HA - 10 Marks
2. Seminar 15 Marks
3. Viva 20 Marks
4. Online MCQ-MSE Test 10 Marks
5. CP 10 Marks
6. LAB 10 Marks
7. Online MCQ-ESE Test 10 Marks

Text Books: ***(As per IEEE format)***

1. Gonzalez, Woods, "Digital Image Processing", Prentice Hall India, 2nd edition.
2. Pratt W.K., "Image Processing", John Wiley, 2001
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Publication.
4. Forsyth and Ponce, "Computer Vision-A Modern Approach", 2nd Edition, Pearson Education.
5. R. O. Duda, P.E.Hart, and D.G.Stork,", Pattern Classification", 2nd edition, Springer, 2007.
6. Theodoridis and Koutrombas," Pattern Recognition", 4th edition, Academic Press, 2009.

Reference Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", Thomson Learning.
2. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
3. Ludmila I.Kuncheva,"Combining pattern classifiers", John Wiley and sons Publication.
4. EthemAlpaydin," Introduction to Machine Learning", The MIT press.

Moocs Links and additional reading material:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs58/
2. https://www.coursera.org/lecture/introduction-tensorflow/an-introduction-to-computer-vision-rGn1n
3. https://www.coursera.org/lecture/convolutional-neural-networks/edge-detection-example-4Trod
4. https://www.coursera.org/learn/computer-vision-basics
5. https://www.coursera.org/projects/computer-vision-object-detection
6. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs58/

Course Outcomes:

The student will be able –

1) To formulate computational problems in abstract and mathematically precise manner
2) To design efficient algorithms for computational problems using appropriate algorithmic paradigm
3) To analyze asymptotic complexity of the algorithm for a complex computational problem using suitable mathematical techniques.
4) To establish NP-completeness of some decision problems, grasp the significance of the notion of NP-completeness and its relationship with intractability of the decision problems.
5) To understand significance of randomness, approximability in computation and design randomized algorithms for simple computational problems and design efficient approximation algorithms for standard NP-optimization problems.
6) To incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solutions for complex computing problems.

Future Courses Mapping:

1. Pattern Recognition
2. 2. Deep Learning

Job Mapping:

1. *Computer Vision Specialist*
2. *Data Engineer*
3. *Machine Learning Engineer*
4. *Data Scientist*
5. *Engineer-Autonomous Vehicle*
6. *Research Engineer*

Syllabus Template **FF No. : 654**

CS5277: Cyber Security

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites:

Data Communication, Computer Networks, Programming

Course Objectives:

- To learn foundations of Cyber Security and Ethical Hacking analysis
- To provide with a practical and theoretical knowledge of cryptography and network security
- To understand the concepts of Cyber Security, Ethical Hacking
- To Explore the threat landscape
- To understand the policies and mechanisms for securing the systems

Course Relevance: This course introduces the concept of cyber security, its interdisciplinary nature and its relation to nation, businesses, society and people. Students would gain knowledge of various cyber security terminologies, technologies, protocols, threat analysis, security principles, security mechanisms, policies and practices to secure systems.

SECTION-1: Topics/Contents

Introduction to Cyber Space: History of Internet, Cyber Crime, Information Security, Computer Ethics and Security Policies, Securing web browser, Antivirus.

Security Issues: E mail security, secure password and wi-fi security, social media and basic Windows security, Smartphone security guidelines.

Online Services and issues: Online Banking, Credit Card and UPI Security, Micro ATM, e-wallet and POS Security.

SECTION-1: Topics/Contents

Social Engineering: Types of Social Engineering, How Cyber Criminal Works, How to prevent for being a victim of Cyber Crime.

Cyber Security Threat Landscape and Techniques: Cyber Security Threat Landscape, Emerging Cyber Security Threats, Cyber Security Techniques, Firewall

IT Security Act, Information Destroying and Recovery Tools: IT Act, Hackers-Attacker-Countermeasures, Web Application Security.

List of Tutorials:

1. Implement Substitution and Transposition Cipher Algorithm
2. Implement RSA Algorithm

3. Study of different wireless network components and features of any one of the Mobile Security Apps.
4. Study of the features of firewall in providing network security and to set Firewall Security in windows.
5. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
6. Study of different types of vulnerabilities for hacking a websites / Web Applications.
7. Analysis the security vulnerabilities of E-Mail Application

List of Practicals: (Any Six)

1. Install VM Workstation in Ubuntu and set up windows and kali.
2. Set up and provide password credentials with Secure Socket Layer.
3. Write a program to sniff packet sent over the local network.
4. To perform attack using any method on computers in a LAN Environment.
5. Implement system hacking using tools.
6. Create virus with python script and implement attack and analyse the
7. effect of various viruses.
8. Sniffing Website Credentials using Social Engineering Toolkit.

List of Course Projects:

Analysis and comparison of key performing parameters to compare various cyber security tools.

List of Course Seminar Topics:

1. Data Breaches
2. Cloud Security
3. Social Engg
4. Internet security

List of Course Group Discussion Topics:

1. Wireless and wired communication security issues
2. Passwords
3. Social Media Handles
4. Internet Banking

List of Home Assignments:

Case Study
Surveys
Design
Blog

Text Books: ***(As per IEEE format)***

1. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., Enterprise Cybersecurity, -How to Build a Successful Cyberdefense Program Against Advanced Threats, A-press.

2. Nina Godbole, Sumit Belapure, Cyber Security, Willey

Reference Books: ***(As per IEEE format)***

1. Hacking the Hacker, Roger Grimes, Wiley

2. Cyber Law by Bare Act, Govt of India, It Act 2000.

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:

The students will be able to

- Define and classify cyber-crime, information security and types of malware.
- Apply different cyber security techniques.
- Understand issues, challenges and guidelines for safe internet browsing , smart phone security, social media security and Wi-Fi security.
- Relate Social engineering and cyber-criminal.
- Identify and apply various I.T security acts.
- Use Information destroying and recovery tools.

Job Mapping:

Job opportunities that one can get after learning this course

- Network Security Specialist
- Cyber Security Architect/Administrator
- IT Security Advisor / Manager
- Security Consultant, Forensics Investigator
- Security Auditor/Investigating Officer
- Ethical Hacker
- Entrepreneur

Syllabus Template **FF No. : 654**

CS5280 :: Internet of Things

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Section 1: [IC5207_CO1, IC5207_CO2, IC5207_CO3]

Introduction to Internet of Things – Definition & Characteristics, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates

Domain specific IOTs – Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle

IoT and M2M, IoT System Management with NETCONF-YANG,

IOT Platform Design Methodology – Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information model Specification, Service specification, IOT level Specifications, Functional View Specifications, Operational View Specification, device and component integration, application development, case study on IOT system for weather monitoring

Embedded suite for IoT

Physical device – Arduino / Raspberry Pi Interfaces, Hardware requirement of Arduino / Pi, Connecting remotely to the Arduino /Raspberry Pi , GPIO Basics, Controlling GPIO Outputs Using a Web Interface,– Programming , APIs / Packages, Arduino Interfaces, Integration of Sensors and Actuators with Arduino, Introduction to Python programming – Python data types & data structure, Control flow (if, for, while, range, break/continue, pass), Functions, Modules, packages, file handling, date/time operations, classes, Python packages of interest for IOT

Section 2 : [IC5207_CO4, IC5207_CO5, IC5207_CO6]

Connectivity Technologies and Communication Protocols in IOT

RFID: Introduction, Principle of RFID, Components of an RFID system, Wireless Sensor Networks: WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications,

Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4, Zig-bee, 6LoWPAN, Bluetooth, WirelessHART

IOT Physical Server and Cloud Offerings

cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, Fog Computing, SDN

Cloud Storage Models & Communication APIs, Web Application Messaging Protocol (WAMP), Python web application framework – Django, Developing Application with Django, Developing REST web services, SkyNet IoT Messaging Platform

Case Studies Illustrating IOT Design – Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer

List of Practicals

1. Python programming : data type
2. Python Programming : data structure
3. Python Programming : Control statements
4. Python Programming : functions
5. Python Programming : modules
6. Python Programming : File handling
7. Arduino / Raspberry Pi interface Sensor
8. Arduino / Raspberry Pi interface to to GSM module

9. Arduino / Raspberry Pi interface to Wi-fi module
10. Arduino / Raspberry Pi interface Bluetooth module
11. Cloud interfacing and programming like Thingspeak
12. Sensor data acquisition on Mobile / Developing Application with Django

List of Project areas

1. IoT Based Humidity and Temperature Monitoring Using Arduino Uno
2. IoT System for agriculture
3. IoT system for smart lighting
4. IoT Based Intelligent Traffic Management System
5. IoT based Smart Irrigation system
6. IoT based Smart parking system

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

Reference Books

1. Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, CRC Press Taylor & Francis Group, International Standard Book Number-13: 978-1-4987-6128-4
2. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things – Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9
3. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
5. Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things",. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.
6. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
7. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
8. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Course Outcomes

The student will be able to –

1. IC5207_CO1: Learn and demonstrate concepts of Internet of Things [1] (PO 1, 2, 3, 4, 12) (PSO 2, 3)
2. IC5207_CO2: Develop and demonstrate embedded tools usage for IOT. [2] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
3. IC5207_CO3: Demonstrate Python programming skills for IOT [3] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
4. IC5207_CO4: Understand, develop and demonstrate the connectivity technologies and protocols in IOT, Demonstrate Cloud technology concepts [3] (PO 1, 2, 3, 4, 12) (PSO 2, 3)
5. IC5207_CO5: Develop Web Application framework using Django [5] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
6. IC5207_CO6: Illustrate IOT design for application of Home automation, Smart Parking, Environment, Agriculture, Productivity applications etc [4] (PO 1, 2, 3, 4, 12) (PSO 2, 3)

Syllabus Template **FF No. : 654**

CS5201:: Algorithms and Complexity

Credits: 02 **Teaching Scheme:- Theory 2 Hrs/week**

Course Prerequisites: Basic courses on programming, data structures, Discrete structures, theory of computing.

Course Objectives:

1. Students will gain understanding of asymptotic notations and will be able to apply suitable mathematical techniques to find asymptotic time and space complexities of algorithms.
2. Students will develop ability to formulate computational problems in abstract and mathematically precise manner.
3. Student will gain understanding of different algorithm design paradigms such as divide and conquer, dynamic programming, greedy, backtracking and will apply suitable paradigm for designing algorithms for computational problems
4. Students will develop understanding of notions of NP-hardness and NP-completeness and their relationship with the intractability of decision problems.
5. Students will design randomized, approximation algorithms for some computational problems.

Course Relevance: This is a foundational course for Computer science and Engineering. This course develops algorithmic thinking capability of students. Designing algorithms using suitable paradigm and analyzing the algorithms for computational problems has a high relevance in all domains where computer science plays a crucial role (equally in Industry as well as research). This course is also an essential pre-requisite for advanced domain specific algorithmic courses such as Algorithmic Graph Theory, Algorithmic Number Theory, Computational Geometry, Motion planning and Robotics, etc, to give a few examples.

Once the student gains expertise in Algorithm design and in general gains ability of Algorithmic thinking, it facilitates in systematic study of any other domain (in computer science or otherwise) which demands logical thinking.

This course is also relevant for students who want to pursue research career in theory of computing, computational complexity theory, advanced algorithmic research.

SECTION-1: Topics/Contents

Basic introduction and time and space complexity analysis:
Asymptotic notations (Big Oh, small oh, Big Omega, Theta notations). Best case, average case, and worst-case time and space complexity of algorithms. Overview of searching, sorting algorithms. Revisiting simple algorithmic questions on basic data structures (linked lists, stacks, queues, trees). Using Recurrence relations and Mathematical Induction to get asymptotic bounds on time complexity. Master's theorem and applications. Proving correctness of algorithms.

Divide and Conquer: General strategy**,** Binary search and applications, Analyzing Quick sort, Merge sort, Counting Inversions, Finding a majority element, Order statistics (randomized and deterministic algorithms), Josephus problem using recurrence, Efficient algorithms for Integer arithmetic (Euclid's

algorithm, Karatsuba's algorithm for integer multiplication, fast exponentiation), basic idea of Fast Fourier transform.

Dynamic Programming: General strategy, simple dynamic programming-based algorithms to compute Fibonacci numbers, binomial coefficients, Matrix Chain multiplication, Optimal binary search tree (OBST) construction, Coin change problem, 0-1 Knapsack, Traveling Salesperson Problem, All pair shortest path algorithm, Longest increasing subsequence problem

SECTION-2: Topics/Contents

Greedy and Backtracking strategy:

Greedy: General strategy, Analysis and correctness proof of minimum spanning tree and shortest path algorithms, fractional knapsack problem, Huffman coding, conflict free scheduling.

Backtracking: General strategy, n-queen problem, backtracking strategy for some NP-complete problems (e.g. graph coloring, subset sum problem, SUDOKU)

Introduction to complexity classes and NP-completeness:

Complexity classes P, NP, coNP, and their interrelation, Notion of polynomial time many one reductions reduction, Notion of NP-hardness and NP-completeness, Cook-Levin theorem and implication to P versus NP question, NP-Complete problems (some selected examples).

Introduction to Randomized and Approximation algorithms:

Introduction to randomness in computation, Las-Vegas and Monte-Carlo algorithms, Abundance of witnesses/solutions and application of randomization, solving SAT for formulas with "many" satisfying assignments, randomized quick sort, Las-Vegas and Monte-Carlo algorithms for majority search, Karger's Min-cut algorithm, birthday paradox, coupon collector problem, Schwartz-Zippel Lemma and application, randomized data structures (randomized BST, skip lists)

Introduction to Approximation algorithms for NP-optimization problems, Approximation algorithm for Vertex Cover, metric Traveling-Sales-Person Problem(metric-TSP), Hardness of approximation for TSP.

List of Tutorials: (Any Three)

1) Problem solving based on asymptotic notations, solution of recurrences
2) Problem solving based on Divide and Conquer strategy
3) Advanced problem solving based on Divide and Conquer strategy
4) Problem solving based on Dynamic Programming strategy
5) Advanced problem solving based on Dynamic Programming strategy
6) Problem solving based on Greedy strategy
7) Problem solving based on Backtracking strategy
8) Proving correctness of algorithms: some techniques
9) Adversary lower bound technique
10) Problem solving based on complexity classes, NP-completeness.
11) Randomized Algorithms
12) Approximation Algorithms

List of Practicals: (Any Six)

1) Assignment based on some simple coding problems on numbers, graphs, matrices
2) Assignment based on analysis of quick sort (deterministic and randomized variant)

3) Assignment based on Divide and Conquer strategy (e.g. majority element search, finding kth rank element in an array)
4) Assignment based on Divide and Conquer strategy (e.g. efficient algorithm for Josephus problem using recurrence relations, fast modular exponentiation)
5) Assignment based on Dynamic Programming strategy (e.g. Matrix chain multiplication, Longest increasing subsequence)
6) Assignment based on Dynamic Programming strategy (e,g, All pair shortest path, Traveling Sales Person problem)
7) Assignment based on Greedy strategy (e.g. Huffman encoding)
8) Assignment based on Backtracking (e.g. graph coloring, n-queen problem)
9) Assignment based on Las-Vegas and Monte-Carlo algorithm for majority element search
10) Assignment based on factor-2 approximation algorithm for metric-TSP

List of projects:

1. Applications of A* algorithm in gaming
2. Pac-Man game
3. File compression techniques
4. Solution of Maze (comparing the backtracking based solution and Dijkstra's algorithm)
5. Different exact and approximation algorithms for Travelling-Sales-Person Problem
6. Creation of Maze using backtracking
7. Knight tour algorithms
8. Network flow optimization and maximum matching
9. AI for different games such as minesweeper, shooting games, Hex, connect-4, sokoban, etc
10. SUDOKU solver
11. Graph theoretic algorithms
12. Computational Geometry Algorithms
13. AKS primality testing
14. Algorithms for factoring large integers
15. Randomized algorithms for primality testing (Miller-Rabin, Solovay-Strassen)
16. Slider puzzle game

List of Course Seminar Topics:

1. Divide and Conquer Vs Dynamic Programming
2. Greedy strategy
3. NP-hardness
4. Backtracking strategy
5. Dynamic Programming Vs Greedy
6. Computational Complexity
7. Philosophical relevance of P Vs NP question
8. Complexity classes
9. Space complexity
10. Compression Techniques
11. Real world applications of Graph theoretic algorithms
12. Approximation algorithms
13. Hardness of approximation
14. Pseudorandom number generators

List of Course Group Discussion Topics:

14. Greedy Algorithms
15. Dynamic Programming strategy
16. Dynamic Programming Vs Greedy
17. NP-completeness

18. P Vs NP question
19. Algorithm design paradigms
20. Different Searching techniques
21. Backtracking strategy
22. Relevance of Cook-Levin theorem
23. Randomness in computation
24. Approximation Algorithms
25. Application of Recursion

List of Home Assignments:

Design:

1. Problem solving based on Divide and Conquer strategy
2. Problem solving based on Dynamic Programming strategy
3. Problem solving based on Greedy strategy
4. Problem solving based on Backtracking strategy
5. Problems on Randomized Algorithms
6. Problems on Approximation Algorithms
7. Problems on NP completeness

Case Study:

1. AKS primality test
2. Quadratic sieve factoring algorithm
3. Huffman Encoding, LZW encoding
4. Network flow optimization algorithms
5. Approximation algorithms for TSP
6. Cook-Levin theorem and its relationship with intractability of computational problems
7. Sorting techniques

Blog:

1. Approximation Algorithms
2. Randomized Algorithms
3. Computational Geometry Algorithms
4. Number Theoretic Algorithms
5. Graph Theoretic Algorithms
6. P Vs NP Problem
7. Complexity classes
8. Greedy Algorithms
9. Divide and Conquer Vs Dynamic Programming

Surveys:

1. Primality Testing Algorithms
2. Integer Factoring Algorithms
3. NP-complete problems
4. Compression Techniques
5. Shortest Path Algorithms
6. Algorithms for finding Minimum Weight Spanning Tree
7. SAT solvers

Suggest an assessment Scheme:

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

Text Books: ***(As per IEEE format)***

1. *Cormen, Leiserson, Rivest and Stein "Introduction to Algorithms" ,PHI 3nd edition, 2009. ISBN 81-203-2141-3*

2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson, 1st edition, 2005. ISBN 978-81-317-0310-6

- *3. Dasgupta, Papadimitriu, Vazirani "Algorithms" McGraw-Hill Education; 1 edition (September 13, 2006), ISBN-10: 9780073523408, ISBN-13: 978-0073523408*

Reference Books:

- *1. Motwani, Raghavan "Randomized Algorithms", Cambridge University Press; 1 edition (August 25, 1995), ISBN-10: 0521474655, ISBN-13: 978-0521474658*
  - *2. Vazirani, "Approximation Algorithms", Springer (December 8, 2010), ISBN-10: 3642084699, ISBN-13: 978-3642084690*

Moocs Links and additional reading material:www.nptelvideos.in,

Course Outcomes:

The student will be able –

7) To formulate computational problems in abstract and mathematically precise manner
8) To design efficient algorithms for computational problems using appropriate algorithmic paradigm
9) To analyze asymptotic complexity of the algorithm for a complex computational problem using suitable mathematical techniques.
10) To establish NP-completeness of some decision problems, grasp the significance of the notion of NP-completeness and its relationship with intractability of the decision problems.
11) To understand significance of randomness, approximability in computation and designrandomized algorithms for simple computational problems and design efficient approximation algorithms for standard NP-optimization problems.
12) To incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solutions for complex computing problems.

Future Courses Mapping:

Following courses can be learned after successful completion of this course:
Advanced Algorithms, Computational Complexity, Computational Geometry, Algorithmic Number Theory, Algorithmic Graph Theory

Job Mapping:

Algorithm design lie at heart of any Computer Science/Engineering application. Once the student gains expertise in Algorithm design and in general gains ability of Algorithmic thinking, it facilitates in systematic studying any other domain (in computer science or otherwise) which demands logical thinking. Algorithm design is an essential component of any job based on programming. AllIndustries in computer Engineering always look for a strong knowledge in Algorithm design and Data structures. If student wants to pursue higher education/ research in Computer Science, this course is must.

Syllabus Template **FF No. : 654**

CS5272:: Advances in Machine Learning

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites: Mathematics, Data Structures

Course Objectives:

1 To introduce the concepts, techniques and building blocks of Machine Learning.
2 To evaluate the supervised Learning Techniques and its implementation
3 To Analyze Unsupervised Learning techniques and its applications in developing solutions to real world problems.
4 To apply Reinforcement Learning to a given situation
5 To generate an ability to design, analyze and perform experiments on real life problems using various ML Techniques.
6 To build Machine Learning models and implement in real life scenario for different applications.

Course Relevance: Machine Learning (ML) is currently one of the hottest buzzwords in tech and with good reason. The last few years have seen several techniques that have previously been in the realm of science fiction slowly transformed into reality. The importance of ML has been increasing as a growing number of companies are using these technologies to improve their products and services, evaluate their business models, and enhance their decision-making process.

SECTION-1: Topics/Contents

Artificial Neural Networks: activation functions, Learning Rules, Mc-Culloch-pitts Neuron model, Heb net, single layer and multilayer perceptron, Back propagation algorithm

SVM: Kernel functions, Linear SVM, Nonlinear SVM. Genetic algorithm, Regression analysis, k-means algorithm, k-nearest neighbor learning, Introduction to Machine Learning, Types of Learning: Supervised, Unsupervised, Reinforcement. Learning System: Well posed learning problem, Designing a learning system, Issues in machine learning. Decision Trees: Decision Tree Learning: representation, Basic decision tree learning algorithm, Issues in decision tree learning. Regression analysis, Multivariable regression. Directed graphical models: overview, representation of probability distribution and conditional independence statements. Common undirected graphical models: Factor models, Ising and Potts model, Gibbs distribution, log-linear models.

SECTION-2: Topics/Contents

Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Evaluating hypothesis accuracy, Sampling theory, Central limit theorem, hypothesis testing, comparing learning algorithms. Validation: Cross validation, Confusion matrix. Bayesian Learning: Bayes theorem, Maximum likelihood hypothesis, minimum description length principle, Gibbs algorithm, Bayesian belief networks, Expectation maximization algorithm Hidden Markov model, Recurrent Networks: weighted majority algorithm, Principal component Analysis (PCA), Ensemble, Collaborative Filtering, Applications and future scope. Gaussian Process Time series forecasting: encoder-decoder approach as in Deep AR, Correlated time series: High-dimensional multivariate forecasting with low-rank Gaussian Copula Processes, Uncertainty Estimation and out of distribution detection.

List of Tutorials: (Any Three)

1.To study the basic ML algorithm like Mc_Culloch_Pitts model / Heb Net / Backpropagation algorithm.
2.To study Support vector Machine
3.To study Genetic Algorithm
4.To study Regression analysis
5.To study K means algorithm
6.To study Decision tree Learning algorithm
7.Bayesian Learning, Bayes theorem and Naïve Bayes Theorem.
8.Hidden Markov model,
9.Principal component Analysis (PCA)
10.Recommender systems

List of Practical's: (Any Six)

1 To implement the basic ML algorithm like Mc_Culloch_Pitts model / Heb Net / Back propagation algorithm.
2 To Implement Support vector Machine for detection and classification
3 To Implement Genetic Algorithm for optimization and searching
4 To Implement Regression analysis
5 To Implement K means algorithm
6 To Implement Decision tree Learning algorithm
7 To Implement Bayesian Learning, Bayes theorem and Naïve Bayes Theorem.
8 To Implement Hidden Markov model,
9 To Implement Principal component Analysis (PCA)
10 To Design and Implement Recommender systems for various applications.

List of Projects:

1 Inventory management E Commerce
2 stock market price prediction
3 Identification / detection
4 Product Delivery Drones 5
5 Smart city water / light management system
6 Human Tracking system
7 Automatic Interview Conduction system
8 Student Information Chatbot Project.
9 Product Review Analysis For Genuine Rating.
10 Customer Targeted E-Commerce

List of Course Seminar Topics:

1. Applications of Machine Learning
2. Future of ML
3. Back propagation algorithm.
4. Support vector Machine
5. Genetic Algorithm
6. Regression analysis
7. K means algorithm
8. Decision tree Learning algorithm
9. Bayesian Learning, Bayes theorem and Naïve Bayes Theorem.
10. Hidden Markov model,
11. Principal component Analysis (PCA)

12. Recommender systems

List of Course Group Discussion Topics:

1 Machine Learning and Artificial Intelligence
2 Machine Learning and Data science
3 Machine Learning applications
4 Machine Learning future
5 Machine Learning after 10 years / 2030
6 Supervised Learning Techniques and Unsupervised Learning Techniques
7 Reinforcement Learning
8 Recommender systems
9 Will Automation and ML Reduce or Increase Jobs.
10 Cashless Economy using ML
11 ML in covid-19 situations

List of Home Assignments:

Design:

1. Detection
2. Classification
3. Clustering
4. Optimization
5. Recommender systems

Case Study:

1. How Auto industry Is Preparing For The 4th Industrial Revolution using ML
2. How Indian Retail Giant Is Using ML to Prepare For The 4th Industrial Revolution
3. Rolls-Royce And Google Partner To Create Smarter, Autonomous Ships Based On ML
4. The Amazing Ways Tesla Is Using Machine Learning And Big Data
5. The Incredible Ways John Deere Is Using Machine Learning To Transform Farming

Blog

1. ML Trends
2. ML Research
3. Machine Learning Recommender systems
4. Chatbot Magazine
5. ML in Medical
6. ML in Agriculture

Surveys

1. Adaption of Machine Learning ML AI in 2020
2. Machine Learning in Industry
3. Machine Learning in Digital Marketing
4. Machine Learning in Military
5. ML after Covid-19

Suggest an assessment Scheme:

HA, PPT,GD,MSE,ESE,LAB,CVV

Text Books: (As per IEEE format)

1. T. Mitchell, " Machine Learning", McGraw-Hill, 1997.
2. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.

Reference Books: (As per IEEE format)

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT press, 2004.
2. Jacek M. Zurada, “Introduction to Artificial neural System”, JAICO publishing house,2002,.

Moocs Links and additional reading material:

www.nptelvideos.in
www.eduplus.in

Course Outcomes:

Upon completion of the course, post graduates will be able to –

1.Demonstrate knowledge of learning algorithms and concept learning through implementation for sustainable solutions of applications. -(1)
2. Evaluate decision tree learning algorithms. -(3)
3. Analyze research based problems using Machine learning techniques. -(3)
4. Apply different clustering algorithms used in machine learning to generic datasets and specific multidisciplinary domains. -(4)
5. Formulate a given problem within the Bayesian learning framework with focus on building lifelong learning ability. -(5)
6. Evaluation of different algorithms on well formulated problems along with stating valid conclusions that the evaluation supports. -(5)

Future Courses Mapping:

Soft Computing, Deep Learning,

Job Mapping:

ML Scientist, ML Designer, ML Architectural Design, ML Developer, ML Data Analyst, ML AI Developer,

Syllabus Template **FF No. : 654**

CS5208:: Cloud Computing

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites:

Operating Systems

Fundamentals of Computer Networks

Course Objectives:

1. To become familiar with Cloud Computing and its ecosystem
2. To learn basics of virtualization and its importance
3. To evaluate in-depth analysis of Cloud Computing capabilities
4. To give a technical overview of Cloud Programming and Services.
5. To understand security issues in cloud computing

Course Relevance: Cloud computing to enable transformation, business development and agility in an organization.

SECTION-1: Topics/Contents

Topics and Contents

Introduction to Cloud Computing: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Evolution of cloud computing

Cloud Computing Architecture: Cloud versus traditional architecture, Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), , Public cloud, Private cloud, Hybrid cloud, Community cloud, Google Cloud architecture, The GCP Console, Understanding projects, Billing in GCP, Install and configure Cloud SDK, Use Cloud Shell, GCP APIs

Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Compute options in the cloud, Exploring IaaS with Compute Engine, Configuring elastic apps with autoscaling, Storage options in the cloud, Structured and unstructured storage in the cloud, unstructured storage using Cloud Storage, SQL managed services, Exploring Cloud SQL, Cloud Spanner as a managed service, NoSQL managed service options, Cloud Datastore, a NoSQL document store, Cloud Bigtable as a NoSQL option

SECTION-2: Topics/Contents

Platform as a Service (PaaS): Introduction to PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management, Exploring PaaS with App Engine, Event driven programs with Cloud Functions, Containerizing and orchestrating apps with Google Kubernetes Engine

Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS,

Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing and accounting, Billing in GCP

Cloud Security: Introduction to security in the cloud, the shared security model, Encryption options, Authentication and authorization with Cloud IAM, Identify Best Practices for Authorization using Cloud IAM.

Cloud Network : Introduction to networking in the cloud, Defining a Virtual Private Cloud, Public and private IP address basics, Google's network architecture, Routes and firewall rules in the cloud, Multiple VPC networks, Building hybrid clouds using VPNs, interconnecting, and direct peering, Different options for load balancing.

List of Tutorials: (Any Three)

1) GCP Infrastructure as a Service(IaaS)
2) GCP Platform as a Service(PaaS)
3) GCP Software as a Service(SaaS)
4) GCP storage
5) AWS S3
6) IBM cloud IAM
7) Azure storage
8) IBM cloud ML
9) Azure VM
10) AWS VM

List of Practicals: (Any Six)

1. Deployment and Configuration options in Amazon (AWS)
2. Deployment and Configuration options in Microsoft Azure
3. Deployment and Configuration options in Google Cloud
4. Getting Started with Cloud Shell and gcloud
5. App Engine: Qwik Start – Python
6. Cloud Functions: Qwik Start - Command Line
7. Cloud Storage: Qwik Start - CLI/SDK
8. Loading Data into Cloud SQL
9. App Dev: Storing Application Data in Cloud Datastore – Python
10. Cloud Endpoints: Qwik Start
11. Cloud Pub/Sub: Qwik Start – Python
12. Deploying the 'HelloWorld' app for the cloud
13. Building a 'HelloWorld' app for the cloud

List of Projects:

1. RPA using AWS cloud
2. Serverless Web App to order taxi rides using AWS lambda.
3. Deploying App on Kubernetes
4. Serverless web Application (GCP Cloud Functions)
5. Demonstration of EBS, Snapshot, Volumes
6. Single Node Cluster Implementation (Hadoop)
7. University Campus Online Automation Using Cloud Computing
8. Cloud Based Student Information Chatbot Project
9. Online Bookstore System On Cloud Infrastructure
10. Android Offloading Computation Over Cloud

11. Cryptography Secure File Storage On Cloud Using Hybrid

List of Course Seminar Topics:
1. Storage Cost Optimization On Cloud
2. Cloud Security And Cryptography
3. Infrastructure As A Code (IAC)
4. Cloud Computing In Healthcare
5. Serverless Architecture
6. Deployment Of Microservices In Kubernetes Engine
7. RPA Using AWS Cloud
8. Cloud Trends In Supporting Ubiquitous Computing
9. Mobile Cloud Computing
10. Modern Data Center Architecture

List of Course Group Discussion Topics:
1. Data Storage Security in Cloud
2. Cloud Services for SMB's
3. Monitoring Services Provided by GCP and AWS
4. Docker and Kubernetes
5. SaaS vs FaaS (Function as a service)
6. Hybrid Cloud
7. GCP Vs AWS Web Service Architecture
8. Cloud based security issues and threats
9. Authentication and identity
10. Future of Cloud-Based Smart Devices

List of Home Assignments:

Design:
1. Serverless Web App to order taxi rides using AWS lambda.
2. Deploying App on Kubernetes
3. Serverless web Application (GCP Cloud Functions)
4. Demonstration of EBS, Snapshot, Volumes
5. Single Node Cluster Implementation (Hadoop)

Case Study:
1. PayU Migration to AWS
2. Cloud object storage
3. Deployment and Configuration options in AWS
4. Deployment and Configuration options in Microsoft Azure
5. Deployment and Configuration options in GCP

Blog
1. Comparing design of various cloud computing platforms
2. AWS EKS and Google Cloud Functions
3. App Engine
4. Cloud Endpoints
5. Cloud Pub/Sub

Surveys
1. Disaster Recovery in Cloud Computing
2. Cloud Economics
3. Data archiving solutions
4. Salesforce
5. Dropbox

Suggest an assessment Scheme:

MSE, ESE, GD, Seminar, HA

Text Books: ***(As per IEEE format)***

1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley India.
2. Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India
3. *Gautam Shroff. "Enterprise Cloud Computing", Cambridge*

Reference Books: ***(As per IEEE format)***

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India
2. Antohy T Velte, et.al, "Cloud Computing : A Practical Approach", McGraw Hill.
3. *Michael Miller*, "Cloud Computing", Que Publishing.
4. *Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", SPD,O'REILLY*
5. Scott Granneman, "Google Apps", Pearson

Moocs Links and additional reading material: www.nptelvideos.in
https://nptel.ac.in/courses/106/105/106105167/
https://swayam.gov.in/nd1_noc20_cs55/preview
https://www.coursera.org/specializations/cloud-computing
https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/
https://aws.amazon.com/what-is-cloud-computing/
https://www.ibm.com/in-en/cloud/learn/cloud-computing

Course Outcomes:

1) Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

2) Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

3) Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

4) Choose the appropriate technologies, algorithms, and approaches for the related issues.
5) Display new ideas and innovations in cloud computing.
6) Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing.

Future Courses Mapping:

After completing this course different certifications courses in cloud be taken such as AWS, Azure, Google cloud certifications. One can go for higher studies in specialization of cloud computing and allied subjects.

Job Mapping:

Cloud Architect
Cloud Engineer
Cloud Administrator
Solutions Architect - Cloud Computing - AWS / Kubernetes
Cloud Computing Technical Consultant
Associate Cloud Computing Engineer
Cloud Computing Trainer

Syllabus Template **FF No. : 654**

CS5206:: Mobile Computing

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites: Data Communication and Networks

Course Objectives:

1. Study mobile generations to maintain legacy standards and networking components required to set-up mobile wireless networks.
2. Learn to set mobile network performance parameters depending on requirement of users.
3. Carryout calculations for system capacity for given city, state or country in accordance with the requirements.
4. Understand design of mobile network with appropriate technologies available in the market.
5. Use mobile network for smart city applications of future generations

Course Relevance: Mobile computing refers to technology to support voice and/or data network connectivity using wireless radio transmission. The most familiar application of mobile networking is the mobile phone. Recently both voice and data are being transmitted over both circuit-switched and packet-switched networks. Nowadays each network application is extended to mobile phone in the form of mobile app. Extension of each and every application of IT as well as non-IT industries makes it essential to lean this subject.

SECTION-1: Topics/Contents

Topics and Contents

Introduction to Cellular Networks: Personal Communication System (PCS), PCS Architecture, Cell phone generation-1G to 5G Mobile Station (UE), SIM, Base Station (enodeB), Base Station Controller, Mobile Switching Center, MSC Gateways, HLR and VLR, AuC/EIR/OSS, Radio Spectrum, Free Space Path Loss, S/N Ratio, Line of sight transmission, Length of Antenna, Fading in Mobile Environment. Cellular Network Design: Performance Criterion, Frequency Reuse, Co-channel Interference and System Capacity, Channel Planning, Cell Splitting, Mobility Management in GSM and CDMA. Medium Access Control: Specialized MAC, SDMA, FDMA, TDMA, CDMA, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), GMSK Modulation, 8PSK, 64 QAM, 128 QAM, OFDM and Multicarrier Modulation.

SECTION-2: Topics/Contents

Topics and Contents

Overview of GSM and CDMA as legacy standards : D-AMPS, GSM – Architecture, GSM Identifiers, Spectrum allocation, Physical and Logical Traffic and Control channels, GSM Bursts, GSM Frame, GSM Speech Encoding and decoding, Location Update, Incoming and Outgoing Call setup GPRS, EDGE, cdmaOne (IS-95: CDMA95), 3G and 4G Technologies for GSM and CDMA:, W-CDMA, UMTS, HSPA (High Speed Packet Access), HSDPA, HSUPA, HSPA+, TD-SCDMA, LTE (E-UTRA) 3GPP2 family CDMA2000 1x, 1xRTT, EV-DO (Evolution-Data Optimized), Long Term Evolution (LTE) in 4G. Architecture of 5G. Role of 5G in IoT.

List of Tutorials: (Any Three)

1) Air Propagation Model
2) Examples on different types of mobile antennas
3) Transmitted and Received power in mobile wireless transmission
4) Calculating system capacity for city
5) Examples on co-channel interference
6) Modulation Techniques in 3G
7) Examples on CDMA
8) Modulation Techniques in 4G
9) DTR Calculations for 3G and 4G
10) Duplexing Techniques in FDD and TDD

List of Practical's: (Any Six)

1) Installation of Android and sample Application for "Hello World"
2) Design an android Application for Phone Call
3) Design an android application for audio media player
4) Design an android application for video media player
5) Design an android Application for Simple Calculator
6) Design an android Application using Google Map To Trace Location of Device
7) Design an android Application for Frame Animation
8) Design an android Application for Day Time server
9) Design an android Application for File Transfer
10) Design an android Application for web mail

List of Projects:

1. Design mobile app to perform the task of creating the splash screen for the application using timer, camera options and integrate google map api on the first page of the application. Make sure map has following features:

i) Zoom & View change
ii) Navigation to specific locations
iii) Marker & getting location with touch
iv) Monitoring of location

2. Create an app to add of a product to SQLite database and make sure to add following features

i) SMS messaging and email provision
ii) Bluetooth options
iii) Accessing Web services
iv) Asynchronous remote method call
v) Use Alert box for user notification

3. Create an application for Bank using spinner, intent

a) Form 1: Create a new account for customer
b) Form 2: Deposit money in customer account.
c) Link both forms, after completing of first form the user should be directed to the second form
d) Provide different menu options

4. Create the module for payment of fees for College by demonstrating the following methods.

i) FeesMethod()- for calculation of fees
ii) Use customized Toast for successful payment of fees

iii) Implement an alarm in case someone misses out on the fee submission deadline
iv) Demonstrate the online payment gateway

5. Create the module for collecting cellular mobile network performance parameters using telephony API Manager
i) Nearest Base Station
ii) Signal Strengths
iii) SIM Module Details
iv) Mobility Management Information

6. Design an android Application for grocery
7. Design an android Application for people corner
8. Design an android Application for medical assistance
9. Design an android Application for Indian Penal Code knowledge
10. Design an android Application for detection friends in 1 km area
11. Design an android Application for group tally sheet
12. Design an android Application for key lock pattern detection

List of Course Seminar Topics:

1. Modulation Techniques in 3G
2. Modulation Techniques in 4G
3. Higher Data Rates in 5G
4. Reduced Latency in 5G
5. Energy Saving in 5G
6. W-CDMA-UMTS 3gpp
7. HSPA and HSPA+ (High Speed Packet Access)
8. TD-SCDMA,
9. 3GPP2 family CDMA2000 1x,
10. 3GPP2 family CDMA2000 1xRTT
11. 3GPP2 family CDMA2000 EV-DO
12. 4G LTE and LTE Advanced

List of Course Group Discussion Topics:

1. Comparison between 2G and 3G Architecture
2. Comparison between 3G and 4G Architecture
3 Comparison between 4G and 5G Architecture
4. Advances in Antenna Techniques in Mobile Networks
5. Utilization of Carrier Aggregation in Mobile Networks
6. Evolution of Multiple Access Schemes in Mobile Networks
7. Improved Spectral Efficiency in Mobile Networks
8. Role of Mobile networks in Smart City
9. Role of Mobile networks in IoT
10. Mobile Databases

List of Home Assignments:

Design:

1. Design a mobile app system for sending live locations of working women to their parents while travelling using UML and develop the mobile app for the same to validate it.
2. Caring Old Age People: Design a mobile app system for creating alarms for walking, eating, medicine etc for old age people using UML and develop the mobile app for the same to validate it.
3. Design of online app using RESTAPI
4. Design of offline app for saint literature
5. Design of mobile app for SUDOKU game

Case Study:
1. Prepare a case study on TRAI Acts 1997, 2012 and 2014, Telecom Regulatory Authority of India, Government of India, GOI
2. Prepare a case study on 3gpp 3G architecture, it functions and interactions including authentication, security, session management etc with the help of white papers and presentations.
3. Prepare a case study on 3gpp2 3G architecture, it functions and interactions including authentication, security, session management etc with the help of white papers and presentations.

4. Prepare a case study on 4G architecture, it functions and interactions including authentication, security, session management etc with the help of white papers and presentations.

5. Prepare a case study on 3gpp 5G architecture, it functions and interactions including authentication, security, session management etc with the help of white papers and presentations.

Blog
1. Create and write a blog for Mobile Application Development
2. Create and write a blog for Mobile Advertising.
3. Create and write a blog for gradual increments in Mobile Technologies.
4. Create and write a blog for access schemes in Mobile Networks.
5. Create and write a blog for routing in Mobile Networks.

Surveys
1. Carry out the survey on 3G technologies and their usage at international level
2. Carry out the survey on 4G technologies and their usage at international level.
3. Carry out the survey on 5G technologies and their usage at international level.
4. Carry out the survey on wired networks and their usage at international level.
5. Carry out the survey on wireless networks and their usage at international level.

Suggest an assessment Scheme:
Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

Higher levels of bloom taxonomy- apply, analyze, create and evaluate

Text Books: ***(As per IEEE format)***
1. Jochen Schiller, "Mobile Communications ",Pearson Education,Second Edition, 2004, ISBN: 13: 978-8131724262
2. Smith Collins, "3G Wireless Networks" McGraw Hill Communications, Second Edition , Indian Print, 2016, ISBN-13 978-0-07-063692-7
3. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together", 2012, ISBN-13: 978-1118341483

Reference Books: ***(As per IEEE format)***
1. Wireless Communications – Principles and Practice by Theodore S Rappaport, Pearson Education.
2. Wireless Communication and Networks by William Stallings, Second Edition, Prentice Hall

Moocs Links and additional reading material:
www.nptelvideos.in
https://developer.android.com

Course Outcomes:
The student will be able to –

1) Select components and radio spectrum for PCS based on bandwidth requirement.
2) Justify the Mobile Network performance parameters and design decisions.
3) Choose the modulation technique for setting up mobile network.
4) Formulate GSM/CDMA mobile network layout considering futuristic requirements which conforms to the technology.
5) Deploy the 3G/4G technology based network with bandwidth capacity planning.
6) Adapt to the requirements of next generation mobile network and mobile applications.

Future Courses Mapping:

Mention other courses that can be taken after completion of this course

IoT, Unmanned Ariel Vehicles, Drone Control Systems

Job Mapping:
What are the Job opportunities that one can get after learning this course

Mobile Application Developer, Telecom Engineer, IT Engineer

Syllabus Template **FF No. : 654**

CS5206:: Natural Language Computing

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites: Data Structures and Algorithms

Course Objectives:

1. To understand morphology for given natural language
2. To design lexical analyzer for given natural language
3. To evaluate and devise Syntactic Analyzer design for given natural language
4. To design type dependency parser using pragmatic approach for given natural language
5. To develop machine transliteration and machine translation for given natural language using statistical approach

Course Relevance: Although Natural Language Processing (NLP) has been with us for quite some time, it has only recently gained industry-wide attention, thanks to Deep Learning. Today, NLP is a core competence area in Data Science and IT, with applications spanning across sectors that rely on harnessing language data's potential. Essentially, NLP applications are designed to extract relevant and meaningful information from natural human language data and impart machines with the ability to interact with humans.

SECTION-1: Topics/Contents

Topics and Contents – Natural Language Processing
Origins of NLP, Challenges of NLP, Language and Knowledge, Processing Indian Languages, Formal Language Theory: Basic Notions, Regular Expressions and Automata:, Basic Regular Expression Patterns, Disjunction, Grouping and Precedence, Advanced Operators, Substitution, Finite State Automata, NFSA, Words and Transducers: Morphology, Inflectional Morphology, Derivational Morphology, Finite State Morphological Parsing, Construction of Finite State Lexicon, Finite State Transducers, FST for Morphological Parsing, Language Modelling: Grammar-based language models, lexical functional Grammar(LFG), Government and Binding (GB), Lexical functional Grammar Model, Generative grammars, Theory of parsing / Syntactic Analysis: Context Free Grammar, parsing, Top-down Parsing, Bottom-up parsing, Probabilistic parsing, Indian Languages parsing Semantic Analysis: Meaning Representation, Lexical Semantic, Ambiguity, Word Sense Disambiguation

SECTION-2: Topics/Contents

Computational Linguistics
Mathematical Foundations for Machine Learning: Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Linear and Logistic Regression, K-Nearest Neighbor, K-Means
Statistical Language modeling: N-gram model, Machine Transliteration: Rule-based, Phonology and Stress Analysis based and Statistical based, Support vector machine, Memory Entropy Model, Conditional Random Fields
Machine Translation: Rule-Based, Statistical-Based using MT Tools - GIZA++, SRTLM and Moses

List of Tutorials:

1) Manual Word Analysis on plain paper
2) Manual Word Generation on plain paper
3) Manual Morphology on plain paper
4) Manual N-Grams on plain paper
5) Manual N-Grams Smoothing on plain paper
6) Manual POS Tagging: Hidden Markov Model
7) Manual POS Tagging: Viterbi Decoding on plain paper
8) Manual Building POS Tagger on plain paper
9) Manual Chunking on plain paper
10) Manual Building Chunker on plain paper

List of Practical's: (Any Six)

1) Word Analysis
2) Word Generation
3) Morphology
4) N-Grams
5) N-Grams Smoothing
6) POS Tagging: Hidden Markov Model
7) POS Tagging: Viterbi Decoding
8) Building POS Tagger
9) Chunking
10) Building Chunker

List of Projects:

1. Project 1 :
   POS Taggers For Indian Languages
2. Project 02:
   Rule based Machine Translation for phrases/form labels
3. Project 03:
   Machine Translation/Transliteration using Statistical Machine Translation

List of Course Seminar Topics:

1) Child Language Acquisition
2) Comparable Corpora
3) Discourse Analysis
4) Hyperlex
5) Lie Detector
6) Shallow Parsing
7) Pragmatics
8) Text Retrieval Conference
9) Semantic Similarity in Taxonomy
10) NLP and Entropy
11) Named Entity Recognition

List of Course Group Discussion Topics:

1) N-gram model
2) Machine Transliteration: Rule-based

3) Phonology
4) Word Stress Analysis

List of Home Assignments:

Design:

1) Feature Extraction using seven moment variants
2) Feature Extraction using Zernike Moments
3) Tool for stress analysis
4) N-gram model

Case Study:

1) Support vector machine
2) Memory Entropy Model
3) Conditional Random Fields
4) Hidden Markov Model

Blog:

1) **Machine Translation:** Rule-Based
2) **Machine Translation:** Statistical-Based
3) MT Tools - GIZA++, SRTLM and Moses
4) GIZA++, SRTLM and Moses

Surveys:

1) Language Models
2) Top-down Parsing
3) Bottom-up parsing
4) Probabilistic parsing
5) Indian Languages parsing

Suggest an assessment Scheme:

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.

Higher levels of bloom taxonomy- apply, analyze, create and evaluate

Text Books: ***(As per IEEE format)***

1. Tanveer Siddiqui and U S Tiwary, "Natural Language Processing and Information Retrieval" Fourth Impression, Oxford, ISBN-13:978-019-569232-7.
2. Daniel Jurafsky and James H Martin., "Speech and Language Processing", 2nd edition, Pearson, Second Impression-2014,ISBN: 978-93-325-1841-4

Reference Books: ***(As per IEEE format)***

1. Alexander Clark, Chris Fox and Shalom Lappin "The Handbook of Computational Linguistics and Natural Language Processing",Wiley-Blackwell-2013, ISBN-978-1-118-34718-8
4. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
5. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
7. Radford, Andrew et. al., Linguistics, An Introduction, Cambridge University Press, 1999.
8. Journals : Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence

9. Conferences : Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics (COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT).

Moocs Links and additional reading material:

1) www.nptelvideos.in
2) *www.nfnlp.com*
3) *https://nlp-iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Computer%20Science*
4) *https://www.cse.iitb.ac.in/~cs626-460-2012/*

1. Analyze Morphology for given natural language
2. Apply different approaches to design Lexical Analyzer for given natural language
3. Evaluate and devise Syntactic Analyzer design for given natural language
4. Design Type Dependency Parser using pragmatic approach for given natural language
5. Develop machine transliteration for given natural language using statistical approach
6. Develop machine translation for given natural language using statistical approach

Future Courses Mapping:

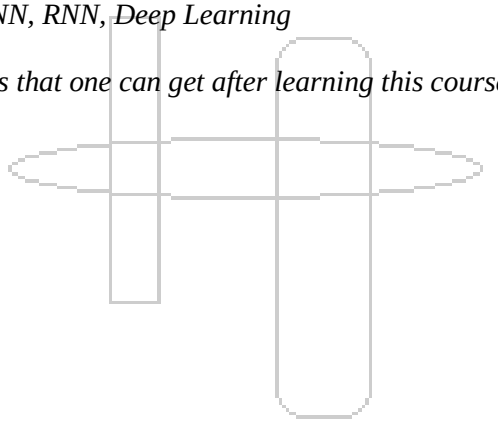
Mention other courses that can be taken after completion of this course

Computational Linguistics, ANN, RNN, Deep Learning

Job Mapping:

What are the Job opportunities that one can get after learning this course

IT Engineer



Syllabus Template **FF No. : 654**

CS5273::High Performance Networks

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites: Computer Networks

Course Objectives:

1. To associate mapping of human communication systems to engineering systems.
2. To merge digital communication framework with service framework to form internetwork.
3. To comprehend various channel encoding schemes for copper, optic fiber and wireless mediums.
4. To study physical layer and medium access IEEE 802.3 standards for copper and optic fiber.
5. To extend wireless local area network connectivity using IEEE 802.11 standards.
6. To setup the high speed network using IEEE 802.3 and 802.11 standards.

Course Relevance: The key technology of the information age is global communication. High Performance Networks is a truly global area of study as it enables global communication with the help of communication frameworks and service frameworks.

Communication frameworks are the backbone of all IT infrastructures and their applications in the world.

These technologies and applications often emerge in communication within countries of countries and spread rapidly around the world.

The main objective of the course is present the basic high speed backbone for LAN and WAN technology concepts that are required for developing internetworks.

SECTION-1: Topics/Contents

Physical Systems to Engineering Systems: Systems of Human Communications: Verbal, Non-Verbal and Visual, Dimensions of Physical Systems: Space, Density, Frequency, Time, Distance, Speed and Bandwidth, Global Internetworking Architecture: Communication Frameworks and Service Frameworks, Network Architectures: Network Devices and Network Services, Client-Server; Peer To Peer; Ad-hoc Network, Distributed and SDN

Reference Models: Design issues for Layers, OSI Model, TCP/IP Model, N-ISDN Model , ATM Model, B-ISDN Model, SONET, FDDI, Frame Relay Model, SNA Model, DNA Model. Is ATM still used? Is ISDN dying? Is Frame Relay outdated? Is SNA still present in the Market? Is PPP still used?

Line Coding, Modulations and Channel Coding in High Speed Networks: Coaxial Cable, TP, UTP, STP, OFC-SMF and MMF, Radio: Air, Line coding, Channel Encoding and modulations Techniques used in IEEE 802.3 standard and its extensions, IEEE 802.11 standards and its extensions for 100 Mbps, 1 GbE, 1 Gbps, 2.5 Gbps, 5 Gbps, 10 Gbps, 25Gbps, 40 Gbps, 100 Gbps networks. Chanel Encodings in 3G, 4G and 5G Mobile Networks, Is DOCSIS used in 2022? Do we use DSL line in 2022? Do we use coaxial cable in 2022?

SECTION-2: Topics/Contents

PHY and MAC Layer IEEE 802.3 Standards For Copper: Overview of 10 Mbps Ethernet, Fast Ethernet, GbE -Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet,40 Gigabit Ethernet, 100 Gigabit Ethernet

PHY and MAC Layer IEEE 802.3 Standards For Optical Fiber: 100 Mbps Fast Ethernet, GbE - Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet,40 Gigabit Ethernet, 100 Gigabit Ethernet

PHY and MAC Layer IEEE 802.11 Wireless LAN Standards: IEEE 802.11, Wi-Fi 1/IEEE 802.11a, Wi-Fi 2/IEEE 802.11b, Wi-Fi 3/IEEE 802.11g, Wi-Fi 4/IEEE 802.11n, Wi-Fi 5/IEEE 802.11ac, IEEE 802.11ad (WiGig), IEEE 802.11ah (HaLow), Wi-Fi 6/IEEE 802.11ax, Wi-Fi 6/IEEE 802.11ay, Wi-Fi 6/IEEE 802.11by, Wi-Fi 7/IEEE 802.11be

Miscellaneous: PHY and MAC Layer in 3G, 4G and 5G for Mobile Networks

List of Tutorials: (Any Three)

1) Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding from high speed network perspectives.
2) Examples and analysis of Manchester Encoding, Differential Manchester Encoding from high speed network perspectives.
3) Examples and analysis on Modulation and demodulation: PCM, FSK, BFSK, MSK, GMSK, PSK,QAM from high speed network perspectives.
4) Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency from high speed network perspectives.
5) Examples and analysis of channel encoding used in wired networks from high speed network perspectives.
6) Examples and analysis of channel encoding used in wireless networks from high speed network perspectives.
7) Examples on physical layer of IEEE 802.3, IEEE 802.11 and PMLN
8) Examples on medium access layer of IEEE 802.3, IEEE 802.11 and PMLN
9) Examples on queuing theory used for server performance
10) Examples on queuing theory used for internetwork routings
10) Examples on flow control performance used in internetworking

11) Examples on congestion control performance used in internetworking

List of Practical's: (Any Six)

1) To setup a small network of four machines with the backbone support of LAN in your institute and extends it by using wireless LAN 802.11 access point. Access the network through your mobile device.

2 and 3) Design the two client server for file transfer using TCP and UDP and analyze the behaviour of UDP in terms of buffer management with TCP protocol. Justify your analysis in terms of Wireshark Screen Shots. Does UDP protocol behaves in the same way as you studied from book. Analyze the behaviour of TCP and UDP from throughput and latency point of view.

4 and 5) Write the two programs using TCP and UDP sockets for wired network to implement the multiuser chat. Demonstrate the packets captured traces using Wireshark Packet Analyzer Does UDP protocol behaves in the same way as you studied from book. Analyze the behaviour of TCP and UDP from throughput and latency point of view.

6) Write a program to simulate line coding techniques used in high speed networks.

7) To improve the performance of YouTube, Blogger, Hangouts – they're all QUIC-based when we use chrome browser. QUIC has also been adopted by businesses that rely on a stable, fast connection for their service to be viable. Uber, for example, uses QUIC for their mobile apps. They rely on short bursts of latency-reliant data transfers – something that QUIC can help with. Carry to the experimentation and create the evidences to prove Quic latency feature.

8) Use network simulator NS3 to implement any one MAC Layer IEEE 802.3 Standards

9) Use network simulator NS3 to implement any one MAC Layer IEEE 802.11 Standards

10) Use network simulator NS3 to implement any one MAC Layer of Mobile Wireless Network

List of Course Projects:

1. Simulation of modulation and demodulation for digital telephone lines
2. Simulation of modulation and demodulation for 100 Mbps Ethernet Network
3. Simulation of modulation and demodulation for Gigabit Ethernet Network
4. Simulation of modulation and demodulation for 10Gigabit Ethernet Networks
5. Simulation of modulation and demodulation for 3G for mobile networks
6. Simulation of modulation and demodulation for 4G mobile networks
7. Simulation of modulation and demodulation for 5G mobile networks
8. Develop a tool box for line encoding methods
9. Develop a tool box for modulation and demodulation methods

List of Course Seminar Topics:

1. MIMO Technology For Wi-Fi
2. Underground and underwater data Communications
3. Transmission technologies for 4G mobile networks
4. Transmission technologies for 5G mobile networks
5. Autonomous systems in the Internet

List of Course Group Discussion Topics:

1. Energy-Efficient Architectures For Communication System
2. Data Communication in Software Defined Networks
3. Cognitive Radios for Future Communication Frameworks
4. Gigabit Ethernet (Encoding Framing, Modulation, Multiplexing, Diameter etc)
5. 10G Ethernet (Encoding Framing, Modulation, Multiplexing, Diameter etc)
6. IEEE 802.11 protocol based on HR-DSSS, ERP-OFDM, HT-OFDM, VHT-OFDM for wireless physical layer standard

List of Home Assignments:

Design:

1. Design a communication framework for irrigation system
2. Design a communication framework for automated car
3. Design a communication framework for smart city applications

4. Design a communication framework for physically challenged community

Case Study:
1. WiTricity technology for industrial applications
2. Multiple access schemes implemented in 4G mobile networks
3. QUIC
4. Priority based queuing systems for high speed networks

Blog
1.Journey of line encoding methods
2. Journey of modulation techniques
3. Journey of channel encoding techniques
4 Journey of access protocols techniques
5. Journey of IEEE 802.3 based standards
6. Journey of IEEE 802.11 based standards

Surveys
1. Survey on speed verses throughput for internet users in your city.
2. Survey on wifi access points being used by internet users in your city.
3. Survey on real time meeting video conferencing apps being used by internet users in your city.
4. Survey on offline vs. online education opinions of school to college students in your city.

Suggest an assessment Scheme:

Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Bloom's Taxonomy.

MSE: 10% + ESE: 10% + Seminar: 15% Group Discussion: 15% + Home Assignments: 10% + Course Project: 10% + Lab evaluation: 10% + CVV: 20%

Text Books: ***(As per IEEE format)***

1. *William Stallings, "High Speed Networks And Internet", Pearson Education, Second Edition, 2002.*
2. *High Performance Communication Networks, 2Nd Edition by Walrand Jean and Varaiya Pravin, Elsevier Science, 2014*
3. *Matthew S. Gast "802.11 Wireless Networks", O'Reilly publications; 2nd Edition.*

Reference Books: ***(As per IEEE format)***

1. *Gerd Keiser, MC Graw Hill International edition, optical fiber communication , third edition*
2. *John M Senior, PHI limited, optical fiber communication , third edition*
3. *Leon Gracia, Widjaja, " Communication Networks", Tata Mc Graw –Hill, New Delhi, 2000.*
4. *Behroz a. Forouzan, "Data communication and networking ", Tata MC Graw –Hill, New Delhi*
5. *Sumit Kasera, Pankaj Sethi, " ATM Networks", Tata Mc Graw- Hill, New Delhi , 2000*
6. *C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, 2004*

7. *Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, ISBN: 0-470-09510-5*

Moocs Links and additional reading material:
https://standards.ieee.org
https://portal.3gpp.org
https://www.etsi.org

Course Outcomes:
On the completion of course, student will able to
1. Correlate mapping of human communication systems to engineering systems.
2. Select appropriate communication framework and service framework to form internetwork.
3. Choose appropriate channel encoding schemes for copper, optic fiber and wireless mediums.
4. Build backbone of network using appropriate physical layer and medium access standards.
5. Expand wired local area network connectivity using IEEE 802.11 wireless LAN standards.
6. Design the high speed network using IEEE 802.3 and 802.11 standards for enterprise scalable application.

Future Courses Mapping:
Mention other courses that can be taken after completion of this course
5G *Wireless Mobile Networks, IoT Networks*

Job Mapping:
What are the Job opportunities that one can get after learning this course
Network Design Consultant, System Engineer, ISP Technology Consultant

Syllabus Template **FF No. : 654**

CS5279 : Genetic Algorithms

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

SECTION-1: Topics/Contents

A Gentle Introduction To Genetic Algorithms : What Are Genetic Algorithms? ,Robustness of Traditional Optimization and Search Methods. The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?

A Simple Genetic Algorithm. Genetic Algorithms at Work—a Simulation by hand. Grist for the Search Mill—Important Similarities 18 Similarity Templates (Schemata) 19 Learning the Lingo.

Genetic Algorithms Revisited: Mathematical Foundations: Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited. The Two-armed and й-armed Bandit Problem, How Many Schemata Are Processed Usefully. The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyper planes.

Computer Implementation Of A Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work?, Mapping Objective Functions to Fitness Form, Fitness Scaling, Coding, A Multiparameter, Mapped, Fixed-Point Coding, Discretization , Constraints.

SECTION-2: Topics/Contents

Some Applications Of Genetic Algorithms: The Rise of Genetic Algorithms , Genetic Algorithm Applications of Historical Interest , De Jong and Function Optimization, Improvements in Basic Technique , Current Applications of Genetic Algorithms.

Advanced Operators And Techniques In Genetic Search : Dominance, Diploidy, and Abeyance . Inversion and Other Reordering Operators .Other Micro-operators, Niche and Speciation, Multiobjective Optimization, Knowledge-Based Techniques, Genetic Algorithms and Parallel Processors .

Introduction To Genetics-Based Machine Learning : Genetics-Based Machine Learning: Whence It Came 218 What is a Classifier System? Rule and Message System. Apportionment of Credit: The Bucket Brigade , Genetic Algorithm . A Simple Classifier System in Pascal, Results Using the Simple Classifier System .

Applications Of Genetics-Based Machine Learning: The Rise of GBML, Development of CS-1, the First Classifier System , Smith's Poker Player , Other Early GBML Efforts , A Potpourri of Current Applications .

List of Practical's:

1. Implement Genetic Algorithm for following basic applications
   - Word Guess
   - Locating an Emergency Response Unit
2. Implement Genetic Algorithm for Combinatorial Optimization Problems:
   - Travelling Sales Person Problem,

- Bin Packing
- Set Covering

3. Implement Genetic Algorithm for Image Processing Problems:
   - Pattern recognition
   - Image Classification

4. Implement Genetic Algorithm for Business Problems:
   - Economic Forecasting
   - Evaluating credit risks
   - Detecting stolen credit cards before customer reports it is stolen

5. Implement Genetic Algorithm for Medical Problems:
   - Studying health risks for a population exposed to toxins
   - Feature Selection

Text Books:

1. Genetic Algorithms in Search, Optimization & Machine Learning, David E. Goldberg, Pearson Education.

Reference Books:

1. Handbook of Genetic Algorithms, Lawrence Davis, Editor, Van Nostrand Reinhold, 1991.
2. Genetic Programming, John R. Koza, MIT Press, 1992
3. Adaptation in Natural and Artificial Systems, John H. Holland, MIT Press, 1992

Course Outcomes:

Upon completion of the course, graduates will be able to –

1. Identify various problems which can be solved by Genetic Algorithms.
2. Model problems in the space of genetic algorithms.
3. Understand mathematical foundation of Genetic Algorithms.
4. Explore the concepts, operators and technology for Genetic Algorithms to solve various problems of different domains.
5. Apply Genetic Algorithm based Machine Learning approaches.
6. Analyze difference in performance of Machine Learning approaches and Genetic Algorithm based Machine Learning.

Syllabus Template **FF No. : 654**

CS5209 : Parallel Computing

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

SECTION-1: Topics/Contents

Fundamentals of Parallel computing and architectures

Parallel programming definition, motivation, Types and levels of parallelism, Different grains of parallelism, data dependence graph, data parallelism, functional parallelism, Flynn's classification of multi-processors, Definition of thread and process, programming parallel computers, Parallel computing architectures (multi-core CPUs, GPUs, traditional multi-processor system, Xeon-Phi, Jetson Kit, Kilocore processor), multiprocessor and multicomputer systems, interconnection networks, Modern GPU architecture (in brief), Performance comparison: Speedup, Gain time and scalability.

Introduction to CUDA

Introduction to CUDA programming model: threads, blocks, grid, Kernel, Kernel definition and kernel launch configuration, Use of GPU memories: global, shared, texture and constant memories, shared memory: organization, bank conflicts, global memory coalesced accesses, CUDA APIs: for memory allocation, synchronization, Execution of a CUDA kernel on GPU: concept of warp, warp divergence, CUDA example programs (Vector dot product, Vector-Matrix multiplication and etc). Atomic operations in CUDA and their use.

Introduction to GPU architecture and parallel algorithms

Introduction to Modern GPU Tesla architecture, Types of GPU memories: global, shared, texture memory and their properties and uses, Streaming processor (SP), Streaming multiprocessor (SM), Special Functional unit (SFU), SM instruction types, Fosters Parallel algorithm design, Designing GPU parallel algorithm for pattern clustering.

SECTION-2: Topics/Contents

CUDA code optimization and Performance improvement

CUDA code optimization: Memory optimization, Control flow optimization, Execution configuration optimization and Instruction optimization, Concept and application of page locked host memory, Single vss double precision computing on GPU: precision vss speed of computation, choosing correct precision for a real GPU application, memory leaks and associated problems, CUDA tools: cuda-memcheck and profiler.

Scientific Computing and problem solving on GPU-Part1

Parallel computation of binomial coefficients, Multi-variate 50olynomials in power form and their GPU parallel evaluation, Polynomials in Bernstein form and parallel computation of Bernstein coefficients: conventional method and using matrix method

Scientific Computing and problem solving on GPU-Part2

Parallel reduction on GPU and its applications. Compute intensive research oriented problems decided by instructor and their GPU parallelization. GPU Parallel implementation of nearest neighbor classifier for large data sets, OpenMP.

I. **List of Practicals**

1. Parallel GPU implementation of vector-vector operations
2. Parallel GPU implementation of vector-Matrix operations
3. Parallel computation of binomial coefficient matrix
4. Parallel GPU implementation of Matrix-Matrix operations
5. Assignment focusing on optimization of data transfer between CPU and GPU :using page locked host memory and to avoid the data transfer
    1. Assignment focusing on memory optimization: use of GPU shared, constant and

texture memory.
7. Parallel GPU implementation involving kernel looping.
8. Working of CUDA tools MemCheck and & Visual Profiler

II. List of indicative project areas

1. Pattern classification for large data sets
2. Clustering of patterns from large data set
3. Processing of large images like MRI images
4. GPU Parallel acceleration of RDBMS queries using GPU
5. GPU Parallel acceleration of scientific tasks
6. GPU parallel acceleration of simulation of large systems
7. GPU parallel acceleration of global optimization algorithms
8. GPU parallel computations in Computer networks like cryptography, intrusion detection
2. Any other area mutually decided by student and teacherintrusion detection

Text Books: (As per IEEE format)

1.David Kirk, Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-On Approach, 2 nd Edition, ELSEVIER Inc.
3. Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose

Reference Books: (As per IEEE format)

4. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP , Tata McGraw-Hill Edition
5. Kai Hwong, Advanced computer architecture, Tata McGraw-Hill Edition

Course Outcomes:

The student will be able to –

1. Recognize fundamentals of parallel computing and architectures available
2. Design parallel algorithms that better maps on GPU architecture
3. Write CUDA applications for execution on GPU
4. Apply parallel computing methods to scientific and engineering problems
5. Apply parallel computing methods to research problems
6. Optimize CUDA code using tools for performance improvements

Syllabus Template **FF No. : 654**

Cs5275: Data Analytics

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites:
Database Management Systems, Computational Statistics, Machine Learning

Course Objectives:

1. To understand the different phases of data analytics life cycle
2. To understand and practice analytical methods for solving real life problems.
3. To learn different types of data and its visualization
4. To study different data visualization techniques and tools

Course Relevance:
Data analytics is a part of data science that comprises the tools, technologies, techniques and processes by which an organization uses data to improve productivity and enhance business gain. Data scientists and researchers also rely on data analytics to prove or disprove scientific models, theories and hypotheses. Data analytics encompasses everything from fundamental business intelligence, reporting and online analytical processing to more advanced analytics. To make the right decisions for your business to succeed, you need the right data. So, it's important to have a data analytics strategy in place.

SECTION-1: Topics/Contents

Unit-I: Introduction
Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Opearationalize. Case Study: GINA

Unit-II : Basic Data Analytic Methods
Statistical Methods for Evaluation- Hypothesis testing, difference of means, wilcoxon rank–sum test, type 1 type 2 errors, power and sample size, ANNOVA. Advanced Analytical Theory and Methods: Clustering- Overview, K means- Use cases, Overview of methods, determining number of clusters, diagnostics, reasons to choose and cautions.

Unit-III : Association Rules and Regression
Advanced Analytical Theory and Methods: Association Rules- Overview, a-priori algorithm, evaluation of candidate rules, case study-transactions in grocery store, validation and testing, diagnostics. Regression- linear, logistics, reasons to choose and cautions, additional regression models.

SECTION-2: Topics/Contents

Unit-IV : Classification

Decision trees- Overview, general algorithm, decision tree algorithm, evaluating a decision tree. Naïve Bayes – Bayes Algorithm, Naïve Bayes Classifier, smoothing, diagnostics. Diagnostics of classifiers, additional classification methods (Perceptron, MLP, CNN, SVM)

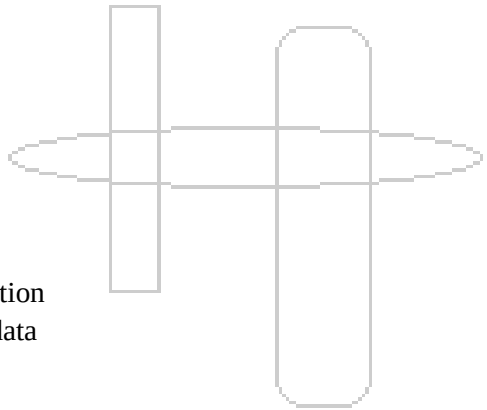
Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches, Semi-Supervised Classification, Active Learning, Transfer Learning

Unit-VI : Big Data Visualization

Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in Big data visualization.

Unit-V Title: Advanced Analytics-Technology and Tools

Analytics for unstructured data- Use cases, Map Reduce, Apache Hadoop. The Hadoop Ecosystem- Pig, HIVE, HBase, Mahout, NoSQL. An Analytics Project-Communicating, operationalizing, creating final deliverables.



List of Seminar Topics:

1. Hypothesis testing
2. Big Data Visualization
3. Hadoop Framwork
4. SQL vs NoSQL
5. Tools used in data visualization
6. Analytics for unstructured data
7. Genetic Algorithms
8. Transfer Learning
9. Data Analytic Methods
10. Tableau
11. Recent trends in Data Science

List of Course Group Discussion Topics:

1. Big Data and its characteristics
2. Big data Pros and Cons
3. Probability and Statistics
4. Hypothesis testing
5. Optimization Techniques
6. Machine Learning Techniques
7. Tools to visualize Big Data
8. Overfitting vs underfitting
9. Hadoop Framework

List of Design based Home Assignments:

Design:

1. *Explain different phases of Data Analytics life cycle*
2. Use the data and group them using k-means clustering algorithm. Show calculations of centroid

3. Height	4. Weight
5. 185	6.
7. 170	8. 72
9. 168	10. 56
11. 179	12. 68
13. 182	14. 72
15. 188	16. 77
17. 180	18. 71
19. 18	20. 70
21. 183	22. 84
23. 180	24. 88
25. 180	26. 67
27. 177	28. 76

3. Transactional data for an all electronics branch is as follows, find the frequent itemset and generate association rules with confidence values

4. Tid	5. List of Item_IDs
6. T100	7. I1,I2,I5
8. T200	9. I2,I4
10. T300	11. I2,I3
12. T400	13. I1,I2,I4
14. T500	15. I1,I3
16. T600	17. I2,I3
18. T700	19. I1,I3
20. T800	21. I1,I2,I3,I5
22. T900	23. I1,I2,I3

4. Explain following Decision Tree Algorithms with suitable examples
    - ID3 Algorithm
    - C4.5
    - CART
5. What is data visualization? Explain any four data visualization Techniques

Case Study:

1. Create academic performance dataset of students and perform data preprocessing using techniques of data cleaning and data transformation.
2. Global Innovation Social Network and Analysis (GINA).
3. For an employee dataset, create measure of central tendency and its measure of dispersion for statistical analysis of given data.
4. Use IRIS dataset from Scikit and apply data preprocessing methods
5. Use IRIS dataset from Scikit and apply K-means clustering methods

6. Use IRIS dataset from Scikit and plot 2D views of the dataset
7. Apply visualization methods on any big data

Blog

1. Pattern Recognition and classification
2. Data Science life cycle
3. Machine learning models
4. Machine Learning for Chatbot
5. Structured vs unstructured data
6. Data Visulization with Deep Learning
7. Data Analysis and analytics for Medical Field

Surveys:

1. Data Sceinec - survey
2. The essential role Big Data and analytics plays in start-ups
3. How Big Data is being used in the world of art and design
4. Donald Trump election campaign: Big Data in political campaigns
5. Paris Hospitals: Big Data in Healthcare

Assessment Scheme:

1. Seminar – 10 Marks
2. Group Discussion – 10 Marks
3. Home Assignment – 10 Marks
4. Course Viva – 20 Marks
5. MSE – 25 Marks
6. ESE –25Marks

Text Books:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X

2. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6

Reference Books:

1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication, ISBN: 978-1-118-16430-3
3. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
4. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. https://nptel.ac.in/courses/106107220
3. https://onlinecourses.nptel.ac.in/noc21_cs45
4. https://www.coursera.org/learn/introduction-to-data-analytics

Course Outcomes:

The student will be able to –

1:Interpret Data Analytics Life cycle for Big data.

2:Apply statistical methods for evaluation.

3:Apply clustering, association rule, regression and classification techniques to solve real life problem.

4:Selecting appropriate data visualizations to clearly communicate analytic insights.

5:Identify analytics for unstructured data.

CO Attainment levels:

Co1 - Level 2
Co2 - Level 3
Co3 - Level 5
Co4 - Level 3
Co5 - Level 4

Future Course Mapping:

Advanced course on Deep Analytics including big data analytics, data science

Job Mapping:

Deep learning engineer, Data Scientist, Data Analytics, Data Scientist
Data Analyst, Business Analyst, Data Engineer, Product Manager, Lead Data Scientist

Syllabus Template **FF No. : 654**

CS5282: DEEP LEARNING

Credits: 04 **Teaching Scheme:- Theory 3 Hrs/week Lab: 2 Hrs/week**

Course Prerequisites:
Linear algebra, probability theory and statistics, Digital signal processing, Computer vision

Course Objectives:

1. To understand the basic neural network architectures and learning algorithms
2. To understand the Forward and backward propagation NN and techniques to improve network performance
3. To understand the importance of deep learning and is variants
4. To understand the basics of sequential models of NN
5. To build deep nets with applications to solve real world problem

Course Relevance:
Deep learning is revolutionizing the technology and business world today. It is a subfield of machine learning concerned with algorithms to train computers to perform tasks by exposing neural networks to large amounts of data, its analysis and prediction. It is an incredibly powerful field with capacity to execute feature engineering on its own, uses multiple neural network layers to extract patterns from the data. Top applications of Deep learning involve, self-driving cars, natural language processing, robotics, finance, and healthcare

Section 1: Topics/Contents

Unit-I: Introduction [5 Hours]
Foundations of neural networks and deep learning, Logistic regression as a neural network, Single Layer Neural Network, different activation function, logistic regression cost function logistic regression gradient descent, vectorizing logistic regression

Unit-II : Neural Network [5 Hours]
Forward and backward propagation, Techniques to improve neural networks: regularization Optimizations, hyperparameter tuning batch normalization, data augmentation
Unit-III Title: Deep Neural Network [4 Hours]
Deep learning vs Machine Learning, Deep learning frameworks, Types of Deep Learning, Applications, Deep Learning architectures, Implementation of neural network for a case study

Section 2: Topics/Contents

Unit-IV : Convolutional Neural Networks [5 Hours]

Convolutional Neural Networks, padding, strided convolution, pooling layers, convolutional implementation of sliding windows Parameter tuning, Deep Learning Architectures: LeNet, AlexNet, VGG, GoogleNet ResNet, inception networks, case study: Real time applications

Unit-V : Sequencing Modeling [5 Hours]

Sequence modelling: recurrent nets RNN architecture, bidirectional RNNs, Vanishing and exploding gradient problem, Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Autoencoders, Regularized Autoencoders, Applications & use cases.

Unit-VI Title: Applications & Trends of Deep Learning [4 Hours]

Applications: object classification, object detection, face verification, Sentiment Analysis. Trends in Deep Learning: Self-Supervised Learning, Transformers and Attention Mechanisms, GPT and BERT Models, Capsule Networks, Reinforcement Learning, Generative Adversarial Networks, Explainable AI , Federated Learning

List of Laboratory Assignments

1 Implement logic gates using single layer perceptron
2 Implement a two class neural network with a hidden layer on any standard dataset.
3 Using CNN and MNIST dataset, perform digit classification
4 Develop an Autoencoder for handwritten digits dataset MNIST.
5 Using IMDB review dataset, perform sentiment classification using LSTM and BiLSTM and compare result
6 Using IMDB review dataset, perform sentiment classification using RNN.

List of Seminar Topics:

1. Deep learning for Stock Market Clustering
2. Application of Deep Networks in health care
3. Credit card fraud detection
4. Classification of skin cancer with deep neural networks
5. ALEXNET
6. VCGNET
7. Accelerating Deep Network Training by Reducing Internal Covariate Shift
8. Deep learning applications for predicting pharmacological properties of drugs
9. GAN (Generalised Adversial network)
10. Auto encoders
11. LSTM

List of Course Group Discussion Topics:

1. Recurrent or Recursive Networks for sequential Modelling?
2. Initializing network weights vs performance
3. Difficulty of training deep feedforward neural networks
4. Hyperparameter tuning: Is there a rule of thumb?

5. Problem of overfitting: How to handle?
6 Which cost function: Least squared error or binary cross entropy?
7. How to tackle with loss of corner information in CNN
8. Need of hundred classifiers to solve real world classification problem
9. Which optimization: Batch gradient descent of stochastic gradient descent
10. Activation functions: Comparison of trends
11. Remedy of problem of vanishing gradient and exploding gradient in RNN

List of Design based Home Assignments:

Design:

1. Deep learning for library shelf books identification
2. Development of control system for fruit classification based on convolutional neural networks
3. Classifying movie review using deep learning
4. Sentiment analysis of the demonetization of economy India
5. Predicting Students Performance in Final Examination
6. Identify and Apply deep learning algorithm to solve real life problems

Case Study:

1. Deep learning for security
2. Bag of tricks for efficient text classification
3. Convolutional Neural Networks for Visual Recognition
4. Deep Learning for Natural Language Processing
5. Scalable object detection using deep neural networks

Blog

1. Brain tumor segmentation with deep neural networks
2. Region-based convolutional networks for accurate object detection and segmentation
3. Human pose estimation via deep neural networks
4. Content Based Image Retrieval
5. Visual Perception with Deep Learning
6. Music genre classification system

Surveys:

1. Machine translation using deep learning - survey
2. Shaping future of radiology using deep learning
3. Training Recurrent Neural Networks
4. Text generation with LSTM
5. Deep learning applications in Biomedicine

Assessment Scheme:

1. Seminar – 10 Marks
2. Group Discussion – 10 Marks
3. Home Assignment – 10 Marks
4. Course Viva – 20 Marks

5. MSE – 25 Marks
6. ESE –25Marks

Text Books:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deeep Learning, MIT Press, 2016.
2. C., M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

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

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs11
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs50

Course Outcomes:

The student will be able to –

1) Demonstrate understanding of a logistic regression model, structured as a shallow Neural network
2) Build and train a deep Neural Network, Multilayer Perceptron
3) Apply techniques/variations in architectures to improve neural network performance
4) Demonstrate understanding of functionality of all layers in a convolutional neural network
5) Demonstrate Understanding of Recurrent Neural Network, Unsupervised Deep Learning algorithms and their applications
6) Implement Deep Learning algorithms for image recognition/classification tasks

CO Attainment levels:

Co1 - Level 3
Co2 - Level 3
Co3 - Level 5
Co4 - Level 4
Co5 - Level 5
Co6 - Level 4

Future Course Mapping:

Advanced course on Deep learning including Autoencoders and Boltzmann machines, Reinforcement Learning etc

Job Mapping:

Deep learning engineer, Data Scientist and Algorithm Architect with industries in domains Healthcare, Industrials & Energy, Automobiles, Finance & Insurance, Human Resources, Agriculture, Cybersecurity, Ad & Marketing, Media and Entertainment, Government, Defence, Data Analytics

Syllabus Template **FF No. : 654**

CS5283: Probability and Queuing Theory

Credits: 02 **Teaching Scheme:-Theory 2 Hrs/Week**

Section I

Discrete and Continuous Random Variables: Discrete and continuous Random Variables, Random Variables and Their Event Spaces, The Probability Mass and density Function, Distribution Functions, The Probability Generating Function, expectations, Discrete Random Vectors, Independent Random Variables .

Standard probability distributions: Some Important Distributions namely uniform, Poisson, geometric, Hypergeometric, The Exponential Distribution, The Reliability and Failure Rate, joint Distributed Random Variables, Order Statistics. Distribution of Sums , Functions of Normal Random Variables. Mixture Distributions, Conditional Expectation, Imperfect Fault Coverage and Reliability, Random Sums. Stochastic Processes: Classification of Stochastic Processes, The Bernoulli Process, The Poisson Process, Renewal Processes, Availability Analysis, Random Incidence, Renewal Model of Program Behavior.

Section II

Multiplexing of Traffic on a Communication Link, Queuing Models- Little's Theorem, Little's Theorem, Probabilistic Form of Little's Theorem, Application of Little's Theorem, The M/M/1 Queuing System, Arrival Statistics, Service Statistics, Markov Chain Formulation, Deviation of the Stationary Distribution, Occupancy Distribution upon Arrival, Occupancy Distribution upon Departure, The M/M/m, M/M/µ, M/M/m/m, AND Other Markov Systems, The M/M/m: The m-Server Case, M/M/µ: The Infinite-Server Case, M/M/m/m: The m-Server Loss System, Multidimensional Markov Chains- Applications in Circuit Switching, The M/G/1 System, M/G/1 Queues with Vacations, Reservations and Polling, Priority Queuing, The D/D/1 Queue. M/M/1 queue - Time-dependent behavior , Limiting behavior , Direct approach Recursion , Generating function approach , Global balance principle, Mean performance measures , Distribution of the sojourn time and the waiting time , Priorities, Preemptive-resume priority , Non-preemptive priority, Busy period ,Mean busy period, Distribution of the busy period.

TEXT BOOKS:

1. Kishor S.Trivedi, 'Probability and Statistics with reliability, Queuing, and Computer Science Applications', Prentice Hall India New Delhi, India reprints, (2005).
2. Bertsekas D. and Gallager R., "Data Networks," 2nd Ed., Prentice-Hall, Englewood Cliffs, N.J., 1992.
3. Jean-Yves Le Boudec, Patrick Thiran, "Network Calculus- Theory of Deterministic Queuing Systems for the Internet", Springer Verlag 2004

REFERENCE BOOKS:

1. Albert Leon-Gracia, 'Probability and Random Processes for electrical engineering', University of Toronto Pearson Education, 2nd Edition, 2004.
2. S. M. Ross, 'Introduction to probability & statistics for engineers & scientists', Academic Press, 3rd edition 2005.
3. Allen, A.O., 'Probability, Statistics and Queuing theory', Academic Press, 2nd Ed, 2005
4. Sheldon M. Ross, 'Introduction to probability models', Academic Press, seventh Edition, 2001.
5. William Feller, 'An introduction to probability theory and its application', Vol.-I, John Wiley & Sons, 3rd edition, 1950.
6. Keshav S., "An Engineering Approach to Computer Networking," Addison-Wesley,1997.

7. Stallings W., "High Speed Networks and Internet : Performance and Quality of Service", Prentice-Hall.

Course outcomes: By the end of the module students will be able to

1. Demonstrate Knowledge of random variables and probability distributions to solve computational problems.
2. Apply the Knowledge of Random variables, and probability distributions to solve computational problems.
3. Apply knowledge of mathematics, probability, and statistics to model and analyze some network design problems.
4. Understand Collection of random variables known as random processes and the Markov process, the Poisson process and the knowledge of other processes.
5. Illustrate the use of queuing theory to solve network queuing problems and systems software waiting for resources.

Syllabus Template **FF No. : 654**

CS5284: Research Methodology

Credits: 02 **Lab: 2 Hrs/week**

Unit1: Formulating Research Problem and Literature Review

Overview: RE-Search, Definition, Research characteristics, Difference between methods and methodology, Research categories, Overview of research process. How to get new research ideas: Creating thinking, Preparations for improving thinking Defining research problem statement: Need, What is a research problem, Sources of research problem, research problem components Literature Survey Overview: What is literature survey, Types of literature survey, Sources of information, Types of technical papers, Publication and patent databases, How to read a scientific paper, How to write scientific paper, writing technical papers in English – Grammar, Punctuation, Tips for writing correct English, How to write a research proposal, How research is funded, How to give a good research talk, Presentation tools Research Ethics and Legal Issues: Intellectual Property rights, Patents, Copyrights, Plagiarism.

Unit 2: Research Design and Data Collection

Research Design: What is research design, Research Design Parts, Research Design for exploratory and Descriptive Research, Principals of Research design. Sampling Design: Steps in sampling Design, Different Types of Sample Design.

Unit 3: Data Collection and Analysis

Methods of data collection: Data types, Data Collection Types: Observation, Interview, Questionnaire, Schedules, Collection of Secondary Data

Analysis and Processing of Data: Processing operations, Types of Analysis, statistics in Research, Measures of central Tendency, Measures of Dispersion, Measures of Asymmetry, Measures of Relationship, simple regression Analysis, Multiple correlation and regression, association in case of attributes

Unit 4: Hypothesis testing

Defining Hypothesis: What is hypothesis, Characteristics of hypothesis, Hypothesis Vs Problem Statement

Hypothesis Testing: Null hypothesis, Alternative Hypothesis, Level of significance, Type I and Type II Errors, One tailed and two tailed hypothesis, Power of hypothesis tests

Parametric Tests: z-test, t-test, chi-square test, F-test, ANOVA

Total Contact Hours: 28

Text Books:

1. 'Research Methodology: Methods and Trends', , by Dr. C. R. Kothari, 2nd revised edition, New Age International Limited Publishers, ISBN: 978-81-224-1522-3
2. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, 2nd Edition, Juta and Co. Ltd, ISBN: 0-70215660-4

Reference Books

1. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition, APH Publishing Corporation

2. 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
3. 'Research Methodology' by Dr. Jayant Tatke, 2009, Symbiosis Centre for Distance Learning
4. 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & Co
5. Online material / papers provided by the faculty

Course Outcomes: The student will be able

1. To learn Literature survey and sources of information.
2. To prepare and publish technical papers in reputed international journals.
3. To prepare and apply for research grants / patents.
4. To understand data collection and preprocessing.
5. To design and implement different systems / methods / models.
6. To evaluate the systems / methods / models.

Syllabus Template **FF No. : 654**

CS5107 and CS 5208: Software Development Project-I and II

Credits: 04 **Lab: 8 Hrs/week**

Course Prerequisites: Programming concepts, Programming Languages

Course Objectives:

1. To develop problem solving ability using programming skills by exploring and proposing solutions to realistic/social problems.
2. To Evaluate alternative approaches, and justify the use of selected tools and methods,
3. To emphasize learning activities those are long-term, inter-disciplinary and student-centric.
4. To engage students in rich and authentic learning experiences.
5. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
6. To develop an ecosystem to promote entrepreneurship and research culture among the students

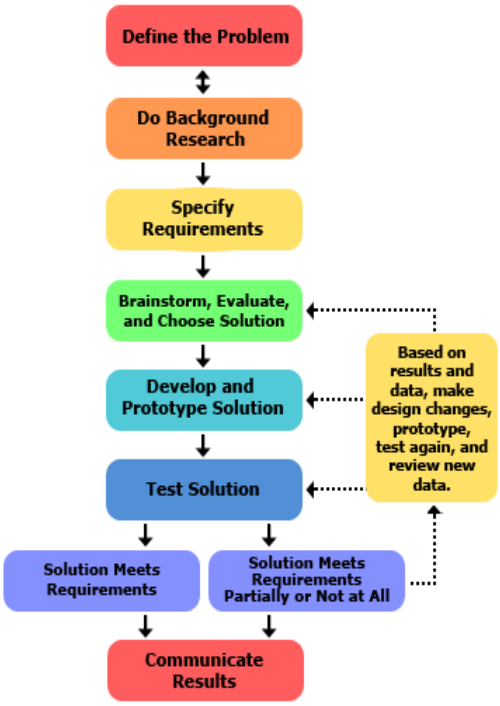
Focus is on coding skills

Software development project is the process of conceiving, specifying, designing, programming, documenting, testing, and bug fixing involved in creating and maintaining applications, frameworks, or other software components. Software development is a process of writing and maintaining the source code, but in a broader sense, it includes all that is involved between the conception of the desired software through to the final manifestation of the software, sometimes in a planned and structured process.[1] Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

The software can be developed for a variety of purposes, the three most common being to meet specific needs of a specific client/business (the case with custom software), to meet a perceived need of some set of potential users (the case with commercial and open source software), or for personal use (e.g. a scientist may write software to automate a mundane task). Embedded software development, that is, the development of embedded software, such as used for controlling consumer products, requires the development process to be integrated with the development of the controlled physical product. System software underlies applications and the programming process itself, and is often developed separately.

The need for better quality control of the software development process has given rise to the discipline of software engineering, which aims to apply the systematic approach exemplified in the engineering paradigm to the process of software development.

There are many approaches to software project management, known as software development life cycle models, methodologies, processes, or models. The waterfall model is a traditional version, contrasted with the more recent innovation of agile software development.



This diagram shows the steps of the engineering design process, and the table below describes each step in more detail:

Engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called iteration, and it is likely that your process will do the same!

1. **Define the Problem**

The engineering design process starts when you ask the following questions about problems that you observe:

- What is the problem or need?
- Who has the problem or need?
- Why is it important to solve?

[Who] need(s) [what] because [why].

Select research area and application area then title of the project

2. Do Background Research

Learn from the experiences of others — this can help you find out about existing solutions to similar problems, and avoid mistakes that were made in the past. So, for an engineering design project, do background research in two major areas:

- Users or customers

- Existing solutions

  Literature review can be done with the help of following table after searching science direct / IEEE / Springer / ACM etc papers in chosen title.

Sr No	Name of the Author	Title of the paper	Publisher,Year, volume, number	Research findings	Limitations
1					
2					
3					
…..					

From this table you can list the Limitations and then try to overcome these limitations that becomes your Research Methodology.

3. Specify Requirements

Design requirements state the important characteristics that your solution must meet to succeed. One of the best ways to identify the design requirements for your solution is to analyze the concrete example of a similar, existing product, noting each of its key features.

For detailed help with this step, use these resources:

- Specify Requirements
- Design Requirement Examples
- How to Analyze a Physical Product
- How to Analyze a Software Product or Website
- How to Analyze an Environment
- How to Analyze an Experience
- How Many Design Requirements?

4. Brainstorm Solutions

There are always many good possibilities for solving design problems. If you focus on just one before looking at the alternatives, it is almost certain that you are overlooking a better solution. Good designers try to generate as many possible solutions as they can.

For detailed help with this step, use these resources:

- Brainstorm Multiple Solutions

5. Choose the Best Solution

Look at whether each possible solution meets your design requirements. Some solutions probably meet more requirements than others. Reject solutions that do not meet the requirements.

For detailed help with this step, use these resources:

- **Choose the Best Solution**

6. Develop the Solution

Development involves the refinement and improvement of a solution, and it continues throughout the design process, often even after a product ships to customers.

For detailed help with this step, use these resources:

- Development Work
- Drawing
- Storyboards

7. Build a Prototype

A prototype is an operating version of a solution. Often it is made with different materials than the final version, and generally it is not as polished. Prototypes are a key step in the development of a final solution, allowing the designer to test how the solution will work.

For detailed help with this step, use these resources:

- Prototyping

8. Test and Redesign

The design process involves multiple iterations and redesigns of your final solution. You will likely test your solution, find new problems, make changes, and test new solutions before settling on a final design.

For detailed help with this step, use these resources:

- Test and Redesign

9. Communicate Results

To complete your project, communicate your results to others in a final report and/or a display board. Professional engineers always do the same, thoroughly documenting their solutions so that they can be manufactured and supported.

For detailed help with this step, use these resources:

- Final Report
- Paper presentation in conferences / Paper publication in the reputed international journals

On completion of the course, learner will be able to–

CO1: Identify the real life problem from societal need point of view
CO2: Choose and compare alternative approaches to select most feasible one
CO3: Analyze and synthesize the identified problem from technological perspective
CO4: Design the reliable and scalable solution to meet challenges using C++/JAVA

CO5: Evaluate the solution based on the criteria specified
CO6: Inculcate long life learning attitude towards the societal problems

Syllabus Template **FF No. : 654**

CS6001 and CS 6002: Dissertation by Internship

Credits:.20..... **Teaching Scheme Theory: …40... Hours/Week**

Guidelines:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales. Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations. Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training.

The following guidelines are proposed to give academic credits for the internship undergone as a part of the M.Tech Engineering curriculum.

Duration:

Industry Internship will be started at the beginning of the semester 3 or semester 4 or yearlong for the duration 6 months or 12 months.

Identification of Internship work:

Student may choose to undergo Internship at Industry/Govt./NGO/MSME/ Innovation/IPR/Entrepreneurship. Contacting various companies for Internship and Internship work identification process should be initiated at the end of 6th semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Students can take internship work in the form of online/onsite work from any of the following but not limited to:

- Working for consultancy/ research project
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ start-ups cells of institute
- Industry / Government Organization Internship,
- Internship through Internshala
- In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship
- Research internship under professors, IISC, IIT's, Research organizations

Internship Documents Submission:

Students must submit internship offer letter, internship completion letter, FF 1029 (Students feedback form), FF 1030 (Industry feedback about interns).

Students must present their internship progress time to time to faculty mentors. Faculty mentors and industry mentors both can evaluate the progress of the intern combiningly.

Internship Work Evaluation:

In-semester and end semester internship evaluation and assessment will be done by internal (Faculty mentor) and external examiners - a supervisor from industry.

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the internship/training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report.

If the student remains absent without prior intimation to the department/institute/concern authority/T & P Cell, his entire training can be cancelled and he will fail.

Course Outcomes: Industry Internship

On the completion of course, students will able to-

1	Analyze quantitative data, statistical data or human social situations and evaluate programs, services or performance of individuals	1
2	Compile statistical data, facts or information in order to create new systems or processes	2
3	Make decisions or alternatives within a certain situation by investigating the underlying causes of a problem	3
4	Learn the techniques of operating new equipment, new procedures at the organization and perform research by extracting information form libraries, archives	4
5	Utilize training and experiential learning opportunities for the development of skills in assessment, crisis intervention, consultation, outreach, and provision of supervision.	5
6	Work in an open and supportive environment conducive to the development of multicultural competence and sensitivity to individual differences in order to integrate knowledge base with diversity.	3

Syllabus Template **FF No. : 654**

CS6007 and CS6008:: Dissertation By Research

Credits: 16 **Lab: 32 Hours/week**

Course Outcomes:

1. State the research problem along with hypothesis.
2. Critically evaluate contextual literature information based on empiricism
3. Perform technical analysis by making use of relevant methodology
4. Propose architecture and design for solution realization by incorporating best practices and technology alternatives
5. Discuss the virtuous dimensions of their research
6. Present the outcomes and lessons learned of the research

In the first semester students are expected to complete the following sub-components of Thesis and present it to panel of examiners. Hard copy of the semester I report should include the following.

1. Motivation behind the Research
2. Need of the Research
3. Information Gathering Survey Report
4. Scope of the Thesis
5. Problem specification with System Requirement Specification (SRS).
6. System Analysis and Feasibility study Report covering feasibility in terms of implementation, usability.

In the second semester students are expected to complete the following sub-components of Thesis and present it to panel of examiners.

1. System Design
2. Implementation
3. Testing

It is mandatory to publish the at least one Journal/Conference paper before the submission of Thesis.

Guidelines for M. Tech. Dissertation Organization

Common To All	1. Outer Cover Page, Inside Cover Page same as Outer Cover Page (as per the format provided) If you were an intern then use "A **Report on Dissertation by Internship**" otherwise use "**A Report on Dissertation by Research**" on report covers as well on the first page. 2. Certificate (as per the format given) 3. **Certificate of Originality** (as per the format provided) 4. **Internship offer as well as Completion** letter from the Sponsoring Industry (if applicable) 5. Acknowledgement (Must be signed by the student) 6. Table of Contents (Index) 7. List of Tables 8. List of Figures 9. List of Acronyms	**Dissertation Report Formatting Instructions:** 1. Paper Size A4 2. Margins: L:1.25 inch or 3.2 cm, R : T : B : 1.0 inch or 2.5 cm", Header and Footer 0.5 inch or 1.27 cm 3. Font : Times New Roman or Arial Chapter Title : 14 (bold) , Subtitle :12(bold),Text : 11 4. Top page should have logo of VIT 5. Hard bound copy - 03
Chapter	**Topic**	**Description**
1	**Introduction** • Research Context /Motivation • Research Rationale • Problem statement and Limitations/constraints • Structure/ Organization of the thesis **Focus of Introduction:** What is the topic and why is it important? State the problem(s) as simply as you can.Try to step back mentally and take a broader view of the problem. How does it fit into the broader world of your discipline?	1. State the research problem, which is often referred to as the purpose of the study. 2. Provide the context and set the stage for your research question in such a way as to show its necessity and importance. 3. Present the rationale of your proposed study and clearly indicate why it is worth doing. 4. Briefly describe the major issues and sub-problems to be addressed by your research. 5. Identify the key independent and dependent variables of your experiment. Alternatively, specify the phenomenon you want to study. 6. State your hypothesis or theory, if any. For exploratory or phenomenological research, you may not have any hypotheses. (Please do not confuse the hypothesis with the statistical null hypothesis.) 7. Set the delimitation or boundaries of your proposed research in order to provide a clear focus. 8. Provide definitions of key concepts. (This is

		optional.)
2	**Background** • Aim/Objectives of the Literature survey • Existing Methods/Approaches/ Techniques • Comparison of the Methods/Approaches/Techniques • Key areas / parameters identification **Focus of Literature Survey:** • establish a theoretical framework for your topic / subject area • define key terms, definitions and terminology • identify studies, models, case studies etc supporting your topic • define / establish your area of study, ie your research topic.	Where did the problem come from? What is already known about this problem? What other methods have been tried to solve it? 1. Ensures that you are not "reinventing the wheel". 2. Gives credits to those who have laid the groundwork for your research. 3. Demonstrates your knowledge of the research problem. 4. Demonstrates your understanding of the theoretical and research issues related to your research question. 5. Shows your ability to critically evaluate relevant literature information. 6. Indicates your ability to integrate and synthesize the existing literature. 7. Provides new theoretical insights or develops a new model as the conceptual framework for your research. 8. Convinces your reader that your proposed research will make a significant and substantial contribution to the literature (i.e., resolving an important theoretical issue or filling a major gap in the literature)
3	**Problem Analysis** • Approach Used : Algorithmic/ UML/ Mathematical Model • Details of the Problem Analysis • Properties and characteristics discovery • Application of Domain Knowledge to discover feature set • Behavioral aspects and traceability of problem tree	What are the important cases? How many partitions the problem has? Which method has been adopted? A surprising number of problems go unnoticed or are only recognized when the situation becomes serious. Opportunities are also missed. There are specific techniques you can use to help you recognize problems and opportunities. The process of definition differs for closed and open-ended problems. With closed problems you need to define all the circumstances surrounding the deviation from the norm. Defining open-ended problems involves identifying and defining your objectives and any obstacles which could prevent you reaching them. The problem definition provides the basis for finding solutions.
4	**Solution Realization/ Methodology/System Design**	Finding solutions involves analyzing the problem to ensure that you fully understand it

	• Design of the proposed solution • Design Constraints • Implementation details **Key Issues:** • identifying all the features of an ideal solution, including the constraints it has to meet • eliminating solutions which do not meet the constraints • evaluating the remaining solutions against the outcome required • making the decision to implement solution • How components. Modules are specified? Whether the details are sufficient and complete? Is there any match between Problem and Solution?	and then constructing courses of action which will achieve your objective. Analyzing the problem involves identifying and collecting the relevant information and representing it in a meaningful way. Analyzing closed problems helps you to identify all the possible causes and confirm the real cause, or obstacle, before looking for a solution. With open ended problems you are looking for information which will help to suggest a range of possible ways to solve the problem. Analysis also helps you to decide what the ideal solution would be, which helps to guide your search for solutions. 1. Design -Is it a questionnaire study or a laboratory experiment? What kind of design do you choose? 2. Subjects or participants - Who will take part in your study? What kind of sampling procedure do you use? 3. Instruments - What kind of measuring instruments or questionnaires do you use? Why do you choose them? Are they valid and reliable? 4. Procedure - How do you plan to carry out your study? What activities are involved? How long does it take?
5	**Results and Discussion** • Experimentaion as a Case Study • Test Cases • Validation Approach • Representation and interpretation of results	Make sure that you have described the conditions which obtained for each set of results. What was held constant? What were the other relevant parameters? Make sure too that you have used appropriate statistical analyses. Where applicable, show measurement errors and standard errors on the graphs. Use appropriate statistical tests. You need to demonstrate your knowledge of alternative methods and make the case that your approach is the most appropriate and most valid way to address your research question
6	**Conclusion**	Your abstract should include your conclusions in very brief form, because it must also include some other material. A summary of conclusions is usually longer than the final section of the abstract, and you have the space to be more explicit and more careful with qualifications.

		You might find it helpful to put your conclusions in point form
7	**Future Scope**	It is often the case with scientific investigations that more questions than answers are produced. Are there ways in which your work could be improved by future workers? Does your work suggest any interesting further avenues? What are the practical implications of your work?
	Bibliography **(In IEEE format only)**	List of consistent and correct references should be made available in this section. The references must have break ups as per the sections indicated earlier.
	Appendix-I **Appendix-II**	If there is material that should be in the thesis but which would break up the flow or bore the reader unbearably, include it as an appendix. Some things which are typically included in appendices are: important and original computer programs, data files that are too large to be represented simply in the results chapters, pictures or diagrams of results which are not important enough to keep in the main text.
	Annex-I/II: Publications **1. Paper Title:** **2. Name of the conference/journal where paper presented/published** **3. Review comments by reviewer** 4. Certificate if provided **5.** Complete Paper if Open Source otherwise Paper Abstract only	Paper should be published in the IEEE/ACM/Springer/Elsevier Conferences/Journals having Citation Index in Thomson Reuters' /SCOPUS/Google Scholar.

Guidelines for Writing Content of Dissertation Report

Read all the following items before writing dissertation report:

1. Follow the generic outline provided by coordinator in consultation with guide.
2. Do not cut-and-paste figures from other sources. (If required, you must cite the Figure number, etc of the source with permission).
3. Do NOT use your guide as a “proof-reader”.
4. Prepare a report with absolutely no spelling mistakes, no obvious errors e.g. due to wrong cut and pastes, no Figure/Table reference errors, no reference list formatting errors.
5. Pay attention to the format of references. Study how books, journal articles, conference articles, web sites, etc. are cited in a published article. Use IEEE format
6. IMPORTANT: Every sentence must follow from a previous sentence. Tell a story. Don't jump from one idea to another in consecutive sentences or consecutive paragraphs.
7. Please do not use the word "works" – as in "related works" or "other works" or "prior works" when referring to existing literature. Correct usage: "related work" or "other work" or "prior work." Make sure whether to use an "s" or not. "Notation" not "Notations”, “Software”, not “Softwares”.
8. Check your usage of singular and plural nouns. Should it be "file transfers on circuit-switched networks" or "file transfer on circuit-switched network”. It depends on the context. Pay attention. Even more important, check if the verb in the sentence corresponds to the noun with respect to it this singular vs. plural aspect.
9. Pay attention to the usage of the article "the".
10. Always cross-reference citations to references, figures, tables, section numbers, etc.
11. Always be consistent. For example if you refer to a node in a figure as "Node 1" in the text description of the figure, then consistently use capital "N" even when the words "Node 1" occur in the middle of a sentence. Same thing applies to names of messages, parameters, etc.
12. Do not reference "forward." This means in Section 2, don't say this is explained in Section 4. Only exception is in the introduction section where you describe the whole outline of the paper. Or in a section introduction where you say what each sub-section does.
13. Use a comma before the last phrase if there are many phrases separated by commas in 1 sentence. Use "and" before the last phrase. Place the comma before the "and".
14. Quotes inside punctuation mark, could be a comma or a period, e.g., "Switch Mapping Table."
15. Always have exactly one space between the end of a sentence and the start of the next.
16. There should be a space after a comma also.
17. Always have a comma before "which" - use "that" instead of "which" in cases where a comma "feels" inappropriate.
18. If two words form an adjective, then use hyphen except if the first word ends with "ly." (e.g. “erroneously transmitted data” vs. “Fast-retransmit mechanism of TCP”).
19. A paragraph needs a minimum of two sentences, i.e., no one-sentence forms a paragraphs.
20. Do not use words like "don't", "doesn’t," "can't" in technical writing. It should be "do not," "does not", and "cannot" respectively.
21. Do not start a sentence with "Because" or "And."
22. Draw a distinction between “connection setup procedure" where "setup" is a noun versus "to set up a connection," where "set" is a verb.

23. Use present tense in the abstract, introduction and in the whole paper, except the conclusions and/or summary section. In the conclusions/summary section, use past tense.
24. When saying something like "as shown in Equation (14)" in your text, you should omit the word "Equation." Just say (14).
25. Summary/Conclusions" should also contain insights in brief and also you *must* try to come up with some concrete improvements that can be done in this dissertation. There should also be one paragraph that truly qualifies as a "conclusion" from your Literature survey.
26. Always read your write-up at least THREE times in PRINTED FORM after you think you have finished it before submitting it. PRINT IT ON PAPER AND READ IT.