

M. Tech. 3rd SEMESTER COMPUTER SCIENCE & ENGINEERING: Scheme 2018 – 2020

Academic year: 2019 – 2020

Subject Code	Title of the Course	Remarks				Credits
		L	T	P	S	
UE18CS61X	Elective – V	2	0	0	0	2
UE18CS601	Project Work Phase – 1	0	0	32	0	16
Total						18

Elective – V								
Sl#	Course Code	Title of the Course	L	T	P	S	Credits	Course Type
1.	UE18CS611	Cloud Strategy Planning and Management	2	0	0	0	2	EC
2.	UE18CS612 [#]	Data Centre Networking	2	0	0	0	2	EC
3.	UE18CS613 ^{**}	Mobile Application Development in the Cloud	2	0	0	0	2	EC
4.	UE18CS614	Software Project Planning and Management	2	0	0	0	2	EC
5.	UE18CS615 ^{\$}	Safety and Security for Internet of Things	2	0	0	0	2	EC
6.	UE18CS616 ^{\$\$}	Design, Specification, and Analysis of Cyber-physical Systems	2	0	0	0	2	EC
7.	UE18CS617	Designing IoT Solutions	2	0	0	0	2	EC
8.	UE18CS618	Advanced Software Testing	2	0	0	0	2	EC
<p>Note: Prerequisite course – *UE18CS503,* UE18CS521, **UE18CS502,UE18CS503,UE18CS522 ^{\$}UE18CS502, ^{\$}UE18CS503, ^{\$}UE18CS522, ^{\$\$}UE18CS503, ^{\$\$}UE18CS522 [#]UE18CS503</p>								

ELECTIVES TO BE OPTED FOR SPECIALIZATION		
Sl. No.	SPECIALIZATION	ELECTIVE – V
1.	Cloud Computing	UE18CS611, UE18CS612, UE18CS613,UE18CS614, UE18CS618
2.	Cyber Security	UE18CS616, UE18CS617, UE18CS618
3.	Big Data & IoT	UE18CS614, UE18CS615, UE18CS616, UE18CS617, UE18CS618

M. Tech. 4th SEMESTER COMPUTER SCIENCE & ENGINEERING: Scheme 2018 – 2020
Academic year: 2019 – 2020

Subject Code	Title of the Course	Remarks				
		L	T	P	S	Credits
UE18CS62*	Elective – VI	2	0	0	0	2
UE18CS651	Project Work Phase - 2	0	0	32	0	16
Total					18	

Elective – VI								
Sl#	Course Code	Title of the Course	L	T	P	S	Credits	Course Type
1.	UE18CS621*	Cloud Security	2	0	0	0	2	EC
2.	UE18CS622**	Cloud Computing Future	2	0	0	0	2	EC
3.	UE18CS623 [§]	Speech and Natural Language Processing	2	0	0	0	2	EC
4.	UE18CS624 ^{§§}	Topics in Big Data and IoT	2	0	0	0	2	EC
5.	UE18CS625	Software Architectures	2	0	0	0	2	EC
6.	UE18CS626	Business Fundamentals	2	0	0	0	2	EC
<p>Note: Prerequisite course – *UE18CS503 **UE18CS521 §§UE18CS531, §§UE18CS522</p>								

ELECTIVES TO BE OPTED FOR SPECIALIZATION		
Sl. No.	SPECIALIZATION	ELECTIVE – VI
1.	Cloud Computing	UE18CS621, UE18CS622, UE18CS623, UE18CS626
2.	Cyber Security	UE18CS621, UE18CS626
3.	Big Data & IoT	UE18CS623, UE18CS624, UE18CS626

UE18CS611:

CLOUD STRATEGY PLANNING AND MANAGEMENT (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- Provide the students the skills and knowledge required to plan and manage a Cloud Computing strategy within an organization.
- This will enable students to evaluate the strategic value of Cloud Computing in its IT Strategy.
- Introduce IT Governance and Compliance models.
- Introduce tools used in IT governance and administration.
- Use cases and case studies on how cloud computing transforms IT and business.

Course Outcomes:

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

- Strategically assess how cloud computing enables IT Transformation and business value in an organization.
- Analyze the role that cloud computing can play in the business process.
- Critically appraise how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.
- Evaluate how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.
- Implement IT governance to manage business realization from cloud IT services.

Course Content:

- 1. Achieving Business Value from IT Transformation:** Moving to a cloud architecture and strategy to achieve business value. BPM, IS, Porter's Value chain model and BPR as a means of delivering business value, Investigate business strategy models to gain competitive advantage for organizations, SWOT/PEST, Economies of scale, Porter's 3 Strategies and 5 Competitive Forces. Also D'Aveni's hyper competition models.
- 2. Discuss Roles:** Roles of the strategic IS/IT leaders such as Chief Information Officer (CIO) and the Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.
- 3. IT Strategy:** Develop an IT strategy to deliver on strategic business objectives in the business strategy. IT Project planning in the areas of ITaaS, SaaS, PaaS and IaaS. Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud. Services, Databases and Applications on demand.
- 4. The Effect on Enterprise Architecture:** The effect on Enterprise Architecture and its traditional frameworks such as Zachman and The Open Group Architecture Framework (TOGAF). Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services (IaaS, PaaS, PRaaS, SaaS), Gartner's 5 pillars of benefit realization.
- 5. IT Governance:** IT governance as a service in measuring the delivery of IT Strategy from Cloud IT Services using Sarbannes Oxley (CobiT) and other commonly-used approaches.

Reference Books:

1. "Easiest Ever Guide to Strategic IT Planning", Arnold J Cummins, E-Book, <https://ebookey.org/dl/Arnold-J-Cummins-Easiest-Ever-Guide-to-Strategic-IT-Planning/>
2. "Enterprise Cloud Computing - A Strategy Guide for Business and Technology Leaders", Andy Mulholland, Jon Pyke, Peter Fingar, Meghan Kiffer Press, 2010.
3. "Management Strategies for the Cloud Revolution", Charles Babcock, McGraw Hill, 1st Edition, 2010.
4. "A Quick Start Guide to Cloud Computing: Moving Your Business into the Cloud", Mark I. Williams, Kogan Page Limited, 2010.

**UE18CS612:
DATA CENTRE NETWORKING (2-0-0-0-2)**

Course Objectives:

- The objective of the course is to give an overview of Networking basics and then given an in-depth understanding of Cloud Networking.
- Students will also learn the design considerations and the technologies that are used. They will also get an understanding of the recent trend towards Software Defined Networking.

Course Outcomes:

At the end of the course student will be able to

- Identify the characteristics of a cloud network
- Implement the different technologies and topologies used in cloud and data center

Course Contents:

1. **Cloud networking overview:** Networking basics, cloud data center and networking introduction, characteristics of cloud networking, evolution from mainframes to cloud.
2. **Technology:** Switch fabric technology – fabric architecture overview, fabric topologies, congestion management. Cloud and data center topologies: traditional multitiered, data center network switch types, flat data center networks, rack scale architectures.
3. **Networking** standards, virtualization and networking: ethernet data rate standards, virtual LANs, data center bridging, improving network bandwidth, remote DMA, virtual switching. Network virtualization: Multi-tenant networks, traditional network tunneling protocols, VXLAN, NVGRE, Tunnel Locations. defined networking.
4. **Data center** software background, OpenFlow, Network Function virtualization, SDN Deployment.
5. **High Performance Computing Networks:** HPC System architectures, Multisocket CPU boards, HPC Networking standards.

Reference Books:

1. "Cloud Networking: Understanding Cloud Based Data Center Networks", Greg Lee, Morgan Kaufmann, 2015.
2. "Software Defined Networking: Design and Deployment", Patricia Morreale and James Anderson, CRC Press, 2014

UE18CS613:

MOBILE APPLICATION DEVELOPMENT IN THE CLOUD (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- Provide an overview of various mobile development platforms.
- Discuss on how mobile applications interact with the cloud.
- Design mobile applications that use the cloud for both storage and computation.
- Introduction to tools required for mobile application development.
- Introduction of security and synchronization challenges in cloud environments.

Course Outcomes:

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

- Demonstrate various mobile development technologies and platforms.
- Develop mobile applications that use the cloud.
- Demonstrate tool based development and debugging of cloud applications.
- Design security features into development of a cloud application.
- Design an end-to-end cloud application on the mobile.

Course Content:

1. **Overview:** Evolution of Mobile Computing, Mobile Cloud Ecosystem, Mobile Player – Pages, Apps and Widgets, Revisiting role of HTML5, Mobile Development Considerations, Getting Started: Web Kit Browser Engine, nginx Web Server to test Apps on Mobile Devices.
2. **Building a Touch Sensitive Drawing App:** How to Draw on Screen, Drawing in Response to Touch Events, DRY principle, Using Amazon Cloud, Using EC2, Deploying Mobile Web App, Building Mobile Web Apps: Installing mobile web apps on iPhone and Android home screens, Use of HTML5 and JQuery.
3. **Building Apps in the Cloud:** Node JavaScript Server and Node APIs, Developing Efficient Storage Algorithms, Designing multi-process architecture, Connecting nginx, Node, and MongoDB, developing web service interface for SimpleDB, Synchronizing local data with remote data.
4. **Working with Amazon S3 service:** Streaming Data efficiently, Understanding OAuth protocol, Designing a Large Scale System, Using memcached server, using consistent hashing algorithm.
5. **Understanding web:** hybrid and native apps, Streaming data onto Amazon S3, Understanding different kinds of cloud development services, publishing apps.

Reference Books:

1. “Beginning building mobile application development in the cloud”, Richard Rodger, Wiley, 2012.
2. “Cloud Computing”, Kris Jamsa, Jones & Bartlett Learning, 2012.

3. "Mobile Cloud Computing: Architectures, Algorithms and Applications", Debashis De, CRC Press, 2015.
4. "Advances in Mobile Cloud Computing Systems", F. Richard Yu, Victor C.M. Leung, CRC Press, 2015.

**UE18CS614:
SOFTWARE PROJECT PLANNING AND MANAGEMENT (2-0-0-0-2)**

Course Objectives:

- This course highlights importance of software project management and to formulate strategy in managing projects.
- The course covers cost estimation of a project and risk management with an exposure to the software management metrics.

Course outcomes:

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

- Incorporate the process of project management and its application, with practice of key stages of project management.
- Identify the factors that put a project at risk and quantify the likely effect of risk on project timescales.

Course Content:

1. **Metrics:** Introduction, The Metrics Roadmap, A Typical Metrics Strategy, Set Targets and track Them, Understanding and Trying to minimize variability. **Software configuration management:** Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management.
2. **Risk management:** Introduction, risk management and its importance, Risk management cycle, Risk identification: common tools and techniques. **Project planning and tracking:** Components of Project Planning and Tracking, The "What " Part of a Project Plan, The "What Cost " Part of a Project Plan.
3. **Software requirements gathering:** Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering. **Estimation:** Need for Estimation, The three phases of Estimation.
4. **Design and development phases:** Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint. **Project management in the testing phase:** Introduction, What is testing?, what are the activities that makeup testing?. **Project management in the maintenance phase:** Introduction, Activities during Maintenance Phase.
5. **Globalization issues in project management:** Evolution of globalization, challenges in building global teams. **Impact of the internet on project management:** Introduction, the effect of internet on project management. **People focused process models:** Growing emphasis on people centric models, people capability maturity model.

Reference Books:

1. "Managing Global Projects", Ramesh Gopaldaswamy, Tata McGraw Hill, 2013.
2. "Managing the Software Process", Watts Humphrey, Pearson

UE18CS615:

SAFETY AND SECURITY FOR INTERNET OF THINGS (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- Introduces security issues in the Internet of Things.
- Introduces techniques to examine threats and vulnerabilities in IoT
- Introduces cryptographic methods and security mechanisms for IoT systems and wearable.
- Introduces tools for assessing risk.
- Introduces techniques to perform identity management.

Course Outcomes:

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

- Analyze an IoT system for security challenges.
- Demonstrate capability to encrypt/decrypt data in IoT systems.
- Demonstrate usage of tools to assess risk.
- Design security for a wearable IoT system.
- Develop Identity management prototypes.

Course Content:

1. **IoT security challenges and requirements:** Vulnerabilities and Threats for IoT – Attack surface areas, Standards and practices for IoT security – MQTT security, OWASPIoT Security.
2. **Lightweight Cryptosystems for IoT:** block and stream ciphers (PRESENT/Spongent), Hash functions and MAC – (Quark/Marvin), Asymmetric cryptography (ECC), Digital signatures.
3. **Risk – Assessment and Analysis:** Adaptive Risk management for IOT.
4. **Identity Management:** Authentication and Anonymity.
5. **Security of wearable and implantable Devices:** Security of wearable and implantable body area networks, Distributed monitoring for adaptive security, Case Studies – electronic lock picking, attacking smart Televisions, exploiting wireless connectivity.

Reference Books:

1. “Abusing the Internet of Things – Blackouts, Freakouts and Stakeouts”, Nitesh Dhanjani, O’Reilly, 2015.
2. “Security of Things –An Implementers Guide to Cyber-Security for Internet of Things”, Ollie Lighthouse, NCC Group, 2014.“Adaptive Security for the Internet of Things”, H Abie, Elsevier, 2015

UE18CS616:

DESIGN, SPECIFICATION AND ANALYSIS OF CYBER-PHYSICAL SYSTEMS

(2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- This course introduces the fundamentals of cyber physical systems.
- The course will introduce the different layers of cyber physical systems and the challenges and technologies in each layer.
- Introduces scalable networking for CPS.
- Introduces management of networking devices for CPS.
- Introduces interoperability issues and solutions for CPS.

Course Outcomes:

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

- Evaluate the technologies of cyber physical systems.
- Design and implement modules of CPS.
- Demonstrate scalability of the networking infrastructure for CPS.
- Demonstrate management of the network devices.
- Demonstrate interoperability between CPS solutions.

Course Content:

1. **Introduction:** CPS Architecture – Cyber Physical System Design.
2. **CPS Interconnection & QoS:** Cyber Physical Internet – Network QoS in CPS – CPS Security.
3. **Interoperability and communication in CPS:** Heterogeneous networking in CPS.
4. **CPS and heterogeneous mobile computing:** Scalable architectures for heterogeneous environments.
5. **CPS Network Services:** Cyber physical control systems – Cyber physical systems management.

Reference Books:

1. "Challenges, Opportunities, and Dimensions of Cyber-Physical Systems", H. Sultana, V. Saritha, P. Krishna, IGI Global, 2014.

UE18CS617:

Designing IoT Solutions (2-0-0-0-2)

Course objective:

- Learn IoT concepts and principles of designing IoT solutions.
- Map out a process for an IoT solution and identify the sensors and other devices required.
- Evaluate different infrastructure components and network systems, and design the basic network for IoT solutions.
- Apply software solutions for different systems and Big Data to concept designs, and learn how data is managed in the network.
- Identify and analyse IoT security and privacy risks, and design secured hardware and software.

Course outcome:

- Prepare a viable IoT conceptual design that solves a problem and is ready to prototype and test.

Course content:

- 1. Introduction to the Internet of Things (IoT) :** Understand the building blocks of IoT solutions, Identify issues and design challenges in IoT solutions, Design principles of IoT solutions, life cycle of IoT solutions
- 2. IoT sensors and devices :** Identify sensors and other devices needed for different IoT solutions, Basic electronic design as applied to IoT sensors and embedded controllers
- 3. IoT networks and protocols:** Networking technologies, Network architecture, Common protocols
- 4. IoT programming and data management :** IoT platforms, Service oriented architecture, Data acquisition and preparation, Data analytics
- 5. Cyber security and privacy :** Identify and analyse IoT security and privacy risks, Design considerations to secure hardware and software
- 6. Capstone project :** Prepare and present technical design of an IoT solution

Reference books:

1. Internet of Things (A Hands-on-Approach) Arshdeep Bahga, Vijay Madisetti
2. Designing the Internet of Things - Adrian McEwen, HakinCassimally
3. Enterprise IoT by Dirk Slama, Frank Puhmann, Jim Morrish, Rishi M Bhatnagar
Publisher: O'Reilly Media, Inc.
Release Date: November 2015
ISBN: 9781491934258
4. Designing for the Internet of Things - A Curated Collection of Chapters from the O'Reilly Design Library

**UE18CS618:
ADVANCED SOFTWARE TESTING (2-0-0-0-2)**

Course Objectives:

- The purpose of this course to enable students to understand basics and goals of software testing & techniques
- The course will give an exposure to various tools used for automating the testing process and will have an idea of various methods and evaluation procedures for improving the quality models.

Course outcomes:

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

- Assess the specific software testing strategies and methodologies and analyze software measurement criteria.
- Identify, analyze and formulate criteria and specifications appropriate to a given problem
- Compare and contrast available automated support tools and their applications.

Course Content:

- 1. Basics of Software testing and examples-** Basic definitions of software testing – Test cases – Identifying test cases – Examples: Generalized pseudo code- The triangle problem. Decision table-based testing: Decision Tables, Test cases for the triangle problem, Test cases for the Next Date function.
- 2. Data Flow testing:** Definition of Use testing, Slice-based testing. **Levels of testing:** Traditional view of testing levels, **Integration Testing:** A closer look at the SATM system. **System testing:** Basic concepts of Threads, requirement specification, Finding threads, **Interaction Testing:** Context of interaction, A taxonomy of interactions.
- 3. Issues in object-oriented testing:** Units for object-oriented testing, Implications of composition and encapsulation, inheritance and polymorphism. **Object-oriented integration testing:** UML support for integration testing, MM-paths for object-oriented software.
- 4. GUI testing:** The currency conversion program, Unit testing. **Object-Oriented System Testing:** Currency converter UML description. **Exploratory testing:** The context-driven school, Exploring exploratory testing with familiar examples, Exploratory and context-driven testing observations.
- 5. Model-based testing:** Testing based on models, appropriate models, Use case-based testing, Commercial tool support for model-based testing. **Test-Driven Development:** Test-Driven code cycles

Pre-requisite Courses: None

Reference Books:

1. "Software Testing, A Craftsman's Approach", C Paul C. Jorgensen, Auerbach Publications, 3rd Edition, 2013.
2. "Foundations of Software Testing", Aditya P Mathur, Pearson, 2008.
3. "Software Testing and Analysis – Process, Principles and Techniques", Mauro Pezze, Michal Young, John Wiley & Sons, 2008.

UE18CS621:

CLLOUD SECURITY (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- The objective of this course is to introduce the security and privacy challenges in cloud computing.
- The course will study application of various cryptographic/security techniques in cloud computing.
- Will introduce risks and threats posed to cloud computing.
- Will introduce legal issues with respect cloud security.
- Introduce case studies with respect to cloud security.

Course Outcomes:

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

- Analyze factors that are critical to implementing security and privacy in the cloud.
- Demonstrate how to develop and test secure code for cloud computing platforms.
- Demonstrate the various threats faced by a cloud computing environment and ways to manage these threats.
- Analyze and demonstrate case-studies involving cloud security.
- Demonstrate cryptographic techniques used in cloud computing.

Course Content:

1. **Cloud Computing Software Security Fundamentals:** Objectives, Security Services – Authentication, Authorization, Auditing, Accountability. Security Design Principles, Cloud Software Requirements – Secure Development practices, software requirements engineering, security policy implementation.
2. **Secure Cloud Software Testing:** Cloud Computing and Business continuity. Secure remote access.
3. **Risk Issues:** privacy and compliance risks, threats to infrastructure, data and access control. Cloud service provider risks. Virtualization Security Management.
4. **Security Architecture:** Architectural considerations, Identity Management and Access controls, Autonomic Security. Encryption and Key Management, Data Deduplication, Retirement.
5. **Cryptography Fundamentals:** encryption, signatures, Remote data storage – data checking, secure Deduplication, searchable encryption, availability in the cloud. Privacy enhancing encryption.

Reference Books:

1. “Securing the cloud: Cloud Computing Security Techniques and Tactics”, Vic (J. R.) Winkler, Elsevier, 2011.
2. “Cloud Security and Privacy”, Tim Mather, Subra Kumara Swamy and Shahed Latif, O Reilly, 2009.
3. “Cloud Security A Comprehensive Guide to Secure Cloud Computing”, Ronald L Krutz, Russell Dean Vines, Wiley, 2010.
4. “Cryptography for Security and Privacy in Cloud Computing”, Stefan Raas and Daniel Siamanig, Artech house, 2013.

UE18CS622:
CLOUD COMPUTING FUTURE (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- The objective of this course is to analyze the future of cloud computing.
- The course will focus on efforts to develop new technology for cloud computing.
- The course will also highlight the challenges driving these efforts.
- Is to equip the students with ability to carry out research in cloud computing.
- Communicate in various cloud computing forums.

Course Outcomes:

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

- Demonstrate the limitations of present-day cloud computing technology.
- Demonstrate new technological developments to address these challenges.
- Contribute to one of these efforts.
- Summarize current state of the art in cloud-computing through case studies.
- Demonstrate capability to communicate in real-world forums..

Course Content:

1. **Big Data Management:** Big data management and data cloud, Big data analysis, Discovering and clustering from data mining Big Data applications, Big data privacy, Cloud Computing in Health Care
Introduction, Cloud Computing for Healthcare, Security and Interoperability, Case study
2. **Cloud in Science:** Introduction, Complexity of scientific applications, cloud technologies for science, science clouds, cloud projects for science, operation research as a service, Eservice, Green computing, Introduction, proposition, HiPC, Green Computing
3. **Cloud in Enterprises and Manufacturing:** Introduction, Emergence of cloud Industrialization, Industrial transformation to the cloud, Cloud Manufacturing, Economics and Business Facet of cloud computing
Introduction, Business Model, Economic benefits of moving into the cloud, Spot pricing mechanism, application migration considerations
4. **Standardization:** Introduction, Standards led by the Industry, Open grid forum, SNIA, IETF cloud reference framework Distributed management task force (DMTF), National Institute of Standards and Technology (NIST),The Open Group,The Cloud Standards Customer Council,Open Cloud Consortium,Enterprise and Networking Perspective
5. **Security in the Cloud:** Introduction, Deployment options security, service delivery models security. Security aspects of cloud anatomy, secure cloud computing architecture, cloud security alliance

Reference Books:

1. "Pervasive Cloud Computing Technologies: Future Outlooks and Interdisciplinary Perspectives", Lucio Grandinetti (University of Calabria, Italy), Ornella Pisacane (Polytechnic University of Marche, Italy) and Mehdi Sheikhalishahi (University of Calabria, Italy), October 2013, ISBN13: 9781466646834
2. Selected papers in Cloud Computing from latest conferences.

UE18CS623:

SPEECH AND NATURAL LANGUAGE PROCESSING (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- Introduce the student to advances in multimedia technologies relevant to Big Data
- Understand the business relevance of speech and natural language technologies
- Introduce the basic models used for processing speech and natural language
- Work with tools to perform speech/natural language processing
- Gain a practical insight into solving these problems

Course Outcomes:

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

- Demonstrate the use of speech/natural language processing in solving real-life problems
- Demonstrate the use of tools for performing speech/NLP
- Demonstrate capability to perform analysis and compare various models
- Work in a team to solve related problems
- Communicate the solution to the instructor using a report.

Course Content:

1. **Introduction** - Business relevance, Survey of English Morphology (inflectional and derivational morphology), Finite State Morphological parsing, Porter Stemmer, Word and Sentence Tokenization, Detection and Correction of Spelling Errors, Minimum Edit Distance
2. **Ngrams** – Word Counting in Corpora, Simple (unsmoothed) N-Grams, Training and Test Sets, Evaluating N-Grams. Part of Speech Tagging – English Word Classes, Tagsets for English, Part-of-Speech Tagging
3. **Hidden Markov and Maximum Entropy Models** – Markov Chains, Hidden Markov Model, Likelihood Computation, Decoding, HMM Training, Maximum Entropy Models. Phonetics – Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Phonological Categories and Pronunciation Variation, Acoustic Phonetics and Signals, Automatic Speech Recognition – Speech Recognition Architecture, HMM Applied to Speech, Feature Extraction: MFCC Vectors, Acoustic Likelihood Computation, Lexicon and Language Model, Search and Decoding, Embedded Training, Word Error Rate.

4. **Syntactic Parsing** – Parsing as Search, Ambiguity, Search in the Face of Ambiguity, Dynamic Programming Parsing Methods, Partial Parsing, Statistical Parsing – Probabilistic CFGs, Probabilistic CKY Parsing, Ways to Learn PCFG, Rule Probabilities, Problems with PCFGs, Improving PCFGs, Probabilistic Lexicalized CFGs, Evaluating Parsers.
5. **Lexical Semantics** – Word Senses, Relation between Senses, Wordnet: Database of Lexical Relations, Event Participants, Primitive Decomposition, Metaphor, Computational Lexical Semantics – Word Sense Disambiguation, Supervised Word Sense Disambiguation, WSD Evaluation, Minimally Supervised WSD, Word Similarity, Semantic: Role Labeling.

Reference Books:

1. “Speech and Language Processing: An Introduction to Natural Language Processing”, Daniel Jurafsky and James H. Martin, Prentice Hall, 2009.
2. “Computational Linguistics and Speech Recognition”, Dan Jurafsky, James H. Martin, Prentice Hall, 2nd Edition, 2008.
3. “Foundations of Statistical Natural Language Processing”, Christopher D. Manning and Hinrich Schütze, MIT Press, 1999.
4. “Natural Language Understanding”, James Allen, Benjamin/Cummings publishing Company, 2nd edition, 1995.
5. “Digital Processing of Speech Signals”, Lawrence R. Rabiner, Ronald W. Schafer, Prentice Hall, 1978.

UE18CS624:

TOPICS IN BIG DATA AND IoT (2-0-0-0-2)

Course Objectives:

The objective(s) of the course is to

- This course introduces topics of research in the areas of Big Data and IOT.
- The course covers study of papers relevant to current challenges/solutions in Big Data.
- In depth treatment of one specific topic related to Big Data/IOT.
- Aim of making the student perform independent research in Big Data/IOT.
- Demonstrate the ability to read and summarize relevant literature.

Course Outcomes:

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

- Define requirement for problem in Big Data/IOT.
- Demonstrate capability to survey the literature and propose a solution.
- Build a prototype to showcase a solution.
- Present the prototype to different audiences and get feedback on the research.
- Work independently on a problem.

Course Content:

- 1. Big Data Management:** The foundations and principles of on-going investigations, and presents an analysis of current challenges and advances related to Big Data management: Big Data Platforms for the Internet of Things, Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness Big Data Management Systems for the Exploitation of Pervasive Environments. FID False Authentications, Adaptive Pipelined Neural Network Structure in Self-Aware Internet of Things
- 2. Spatial Dimensions of Big Data:** Application of Geographical Concepts and Spatial Technology to the Internet of Things, Fog Computing.
- 3. IoT Models & Architectures:** Theoretical and state-of-the-art models, architectures, e-infrastructures, and algorithms that enable the inter-cooperative and inter-operable nature of the Internet of Things for the purpose of collective and computational intelligence, in the Big Data context
- 4. Metadata Management in Smart Grids:** Context-Aware Dynamic Discovery and Configuration of 'Things' in Smart Environments.
- 5. Cutting-edge Internet of Things related applications:** Social Networking Analysis, Architecture for Product Traceability in Logistic Applications.

Reference Books:

1. "Big Data and Internet of Things: a Roadmap for Smart Environments" , Bessis, Nik.. (Ed. Ciprian Dobre) , Springer International Publishing, 2014.
2. "Big Data and the Internet of Things: Enterprise Information Architecture for a New Age", Stackowiak, Robert, Art Licht, VenuMantha, and Louis Nagode, Apress, 2015.

UE18CS625:

SOFTWARE ARCHITECTURE (2-0-0-0-2)

Course Objectives:

- This course involves in architect of complex software systems expected in real life scenarios.
- To expose students to issues involved The scope emphasizes non-functional requirements/quality attributes that are typically not as well addressed as functional requirements.
- Also addresses architectural views at different stages of software evolution which may be relevant to range of stakeholders starting from sponsors, developers, all the way to production support people. Architecture Patterns/styles discussed to make appropriate choices during the software architecture process.

Course outcomes:

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

- Apply design patterns to programming problems to evolve efficient designs
- Design a software conforming to the various software architecture principles

Course Content:

- 1. Introduction:** The Architecture Business Cycle, Software processes and the architecture business cycle. **Software Architecture concepts:** Software Architecture, Architectural Elements. **Viewpoints and Views:** Architectural Views, Benefits of using viewpoints, viewpoint pitfalls, and viewpoints catalog. **Perspectives:** Quality Properties, Applying Perspectives to views.
- 2. Role of Software Architect:** Architecture Definition Process, Role of Architect. **Introduction:** What software architecture is and what it is not, other points of view,

Architectural patterns, reference models and reference Architectures, Importance of software architecture. **Architectural styles:** Pipes and filters, Data abstraction and Object-oriented organization.

3. Case Studies: Keyword in Context; Instrumentation software; Mobile robotics; Cruise control. Introduction: Architectural Patterns, Design Patterns and Idioms.

4. Interactive architecture patterns: Model-View-Controller, Presentation-Abstraction-Control. **Distributed pattern:** Broker Pattern. **Adaptive patterns:** Microkernel, Reflection. **Design Patterns:** Structural decomposition, Whole-Part Organization of work, Master-Slave, Access Control, and Proxy. **Reading assignment:** J2EE/.NET/SEDA architecture. **Quality attributes:** Functionality and architecture of quality attributes.

5. Architecture tactics: Achieving Quality: Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics; Security tactics. **Architectural definition:** Architecture Definition in SDLC designing the architecture. **Architectural documentation:** Views; choosing the relevant views; documenting a view, Documentation across views, Context Diagram, Principles and Traceability.

Reference Books:

1. "Software Architecture in Practice", Len Bass, Paul Clements, Rick Kazman, Pearson Education, 2nd Edition, 2003.
2. "Software Systems Architecture", Nick Rozanski and Eoin Woods, Pearson Education (Indian Edition), (reprint edition), 2009

**UE18CS626:
BUSINESS FUNDAMENTALS (2-0-0-2)**

Course Objectives:

The objective of this course is to

- Understand the different types of business ownership
- Understand how a modern business organization works
- Understand the importance of marketing and the activities involved in it
- Understand how a business organization is run and managed, and
- Understand the activities required to set up a start-up company

Course Outcomes:

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

- Describe the various legal forms of business ownership.
- Explain the functions and working of a business organization.
- Describe the processes involved in product/services strategy.
- Explain the role of management in a business organization.
- Explain the factors that can make a startup company successful.

Course Content:

1. Introduction and Legal forms of Business: Historical context of how businesses evolved into their present forms. Forms of ownership (proprietorship, partnerships, Nonprofit, corporations).

2. Start-Ups: Evolution of startups, Important factors in startups: Idea, Team, Business Model, Funding Options, Timing. Startup Culture, Startup ecosystems, Startup environment in India, Case Studies of successes and failures.

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3.Business Functions: Typical functions of any business organization: Production, Finance, Accounting, Human Resource Management. How the activities of a business are reported - Balance Sheets and Profit/Loss accounts.

4.Business Functions: Research and Development, and Marketing, Marketing: The activities, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large. Marketing is used to create the customer, to keep the customer and to satisfy the customer. How to tailor a product or service to a target market. Sales

5.Management: Setting the strategy of an organization and coordinating the efforts of its employees or volunteers to accomplish its objectives through the application of available resources, such as financial, natural, technological, and human resources.

Text Book (s)

T1. Introduction to Business, Student Edition (McGraw Hill)

Reference (s):

R1. The single biggest reason why startups succeed | Bill Gross (TED Talk)

R2. Entrepreneurship Simplified (From Idea to IPO) by Ashok Soota and SR Gopalan, Penguin Random House India, 2016