DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Scheme (Final Year)

Seventh Semester

S. No.	Subject Code	Course Title	Subject Name	L	T	P	Credits
1	CS107101CS	Program Core	Distributed Systems	3	1	0	**4**
2	CS1072XXCS	Program Elective	Elective - III	3	0	0	**3**
3	CS1072XXCS	Program Elective	Elective - IV	3	0	0	**3**
4	CS1073XXCS	Open Elective	Open Elective - III	3	0	0	**3**
5	CS107401CS	Laboratory	Distributed Systems Lab	0	0	2	**1**
6	CS107501CS	Project Work		0	0	8	**4**
7	CS107701CS	Summer Internship II					**2**
		Total Credits					**20**

Program Elective –III & IV		**Open Elective-III**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
CS107201CS	Deep Learning	CS107301CS	Mobile Application Development
CS107202CS	Wireless Sensor Network	CS107302CS	Internet of Things
CS107203CS	Advanced Computer Vision	CS107303CS	Software Testing
CS107204CS	Block Chain Technology	CS107304CS	Software Metrics and Quality Management
CS107205CS	Big Data Analytics	CS107305CS	Advanced Machine Learning

Distributed Systems

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Distributed Systems	3-1-0, (4)	EPR	CS107101CS

[Pre-requisites: Operating System]

Course Objectives

1. To understand fundamentals of Distributed Systems.
2. To explore the issues in communications in distributed systems.
3. To understand the various issues in process and thread management.
4. To discuss the issues in designing the distributed file system.
5. To understand security issues in Distributed System.

Course Content

Unit-1 Introduction:

Parallel and Distributed Systems - multiprocessor versus multi computer systems - Message - passing systems versus shared memory systems - Primitives for distributed communication - Synchronous versus asynchronous executions - Design issues and challenges - Distributed Computing paradigms.

Unit-2 Rpc And Synchronization:

Remote Procedure Calls: RPC Model, Transparency of RPC, Implementation of RPC Mechanism, RPC Messages, Marshalling, Server Management (Stateful and Stateless Server), Parameter-Passing Semantics (Call-by-Value, Call-by Reference), Call- Semantics, Communication Protocols for RPCs, Client-Server Binding, Special Types of RPCs. Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

Unit-3 Resource & Process Management, DFS:

Resource Management: Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach. Process Management: Process Migration, Threads. Distributed File Systems: File Models, File Accessing Models, File Sharing Semantics, File-Caching Schemes, and File Replication.

Unit-4 Transaction And Security:

Distributed transaction - Consistency models - Replication - Fault tolerance - Distributed commit and failure recovery - Distributed file systems (NFS - AFS & coda) . Security in distributed systems - Security: authentication - Distributed middleware: CORBA - Case studies : DCOM and JINI.

Course Materials

Required Text: Text books

1. P K Sinha,“ Distributed Operating System”,PHI, IEEEPress.

Optional Materials: Reference Books

1. Tanenbaum, “Distributed Systems: Principles and Paradigms”, Pearson Education.
2. Kshemkalyani, Ajay D., Mukesh Singhal,“ Distributed Computing: Principles, Algorithms, and Systems”, Cambridge University Press.
3. Coulouris, Dollimore, Kindberg,“ Distributed Systems-Concepts and Design”, Pearson Education Asia.

Deep Learning

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Deep Learning	3-0-0, (3)	EPR	CS107201CS

[Pre-requisites: Soft Computing]

Course Objectives

1. To present the mathematical, statistical and computational challenges of building neural networks
2. To study the concepts of deep learning To introduce dimensionality reduction techniques
3. To enable the students to know deep learning techniques to support real-time applications
4. To examine the case studies of deep learning techniques

Course Content

Unit-1 Introduction Of Neural Network:

Introduction to ANN, Models of a Neuron, Activation functions, Learning and Training: Hebbian, Memory based, Competitive, Supervised and Unsupervised learning, Memory models, Recall and Adaptation, Network Architectures, Single-layered Feed-forward Networks, Multi-layered Feedforward Networks, gradient descent and contemporary variants, back-propagation algorithm, regularization, batch normalization, loss functions, Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Regularization, Dropout, Recurrent Networks, Topologies.

Unit-2 Convolutional Neural Networks:

Convolutional Networks- Fundamentals, architectures, pooling, visualization, popular convnet architectures - AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet-v1, Inception, Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.Recurrent Neural Networks LSTM, GRU, Encoder Decoder architectures.

Unit-3 Deep Unsupervised Networks:

Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM.

Unit-4 Deep Learning Tools And Applications:

Deep Learning Tools: TensorFlow Caffe, Theano, Torch, etc. Case study and applications in Image Processing, Natural Language Processing, Speech Recognition, Video Analytic etc. using different deep neural networks.

Course Materials

Required Text: Text books

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.

Optional Materials: Reference Books

1. Michael Nielsen, Neural Networks and Deep Learning, Determination Press.
2. Neural Network: A Comprehensive Foundation, Haykin, Pearson Education
3. Neuro-Fuzzy and Soft-Computing – A computational approach to learning and machine intelligence; Jang, Sun and Mizutani; Prentice Hall of India.
4. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers.
5. Neural Network & Fuzzy System by Bart Kosko, PHI
6. Principles of Soft Computing by S.N. Sivanandam and S.N. Deepa, Wiley India.

Wireless Sensor Networks

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Wireless Sensor Networks	3-0-0, (3)	EPR	CS107202CS

[Pre-requisites: Computer Network]

Course Objectives

1. To understand the basic principles behind a Wireless Sensor Network.
2. To understand a broad coverage of challenges and latest issues related to the design and management of WSN and aspects like hardware and radio architecture, protocols and their applications.

Course Content

Unit-1 Overview of Wireless Sensor Networks:

Background of Sensor Network Technology, Applications of Wireless Sensor Networks, Protocol Stack of WSNs, Data Retrieval in Sensor Networks, Classification of WSNs, Sensor Deployment Mechanisms, WSNs-ZigBee technology, Bluetooth technology, Issues in design of Sensor Network, Wireless Sensor Network Architecture.

Unit-2 MAC Protocols:

MAC Layer, Medium Access Control Protocols for Wireless Sensor Networks, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs: Schedule-Based Protocols, Random Access-Based Protocols, Coordination, Schedule Synchronization, Adaptive Listening, Access Control and Data Exchanges, IEEE 802.15.4 LR-WPANs Standard.

Unit-3 Routing Protocols:

Routing Protocols for Wireless Sensor Networks, Data Dissemination and Gathering, RoutingChallenges and Design Issues, Network Scale and Time-Varying Characteristics, ResourceConstraints, Sensor Applications Data Models, Routing Strategies: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information Systems, Geographical Routing Directed Diffusion.

Unit-4 Qos And Energy Management:

QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, Network Layer Solutions, QoS Frameworks, Need for Energy Management, Battery, Transmission Power, System Power Management Schemes.

Course Materials

Required Text: Text books

1. Holger Karl and Andreas Wiling" Protocols and Architectures for Wireless Sensor Networks"- John Wiley & Sons.
2. Akyildiz, Ian F., and Mehmet Can Vuran. *Wireless sensor networks*. Vol. 4. John Wiley & Sons.

Optional Materials: Reference Books

1. Roberto Verdone, Davide Dardari, Gianluca Mazzini and Andrea Conti," Wireless Sensors Actuators and Networks", Academic Press, 1 st Edition.
2. Sohraby, Kazem, Daniel Minoli, and Taieb Znati. *Wireless sensor networks: technology, protocols, and applications*. John wiley & sons.

Advanced Computer Vision

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Advanced Computer Vision	3-0-0, (3)	EPR	CS107203CS

[Pre-requisites: Computer Vision]

Course Objectives

1. Student will gain knowledge about Salience
2. Student will learn Image Segmentation.
3. Student will understand the model Interpretability.

Course Content

Unit-1 Introduction and Deep Learning Review:

Background requirements and issues, human vision, geometry and photometry, Visual features and representations: Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc. Visual Matching: Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow. Review of Deep Learning, introduction and evolution of CNNs, Visualization and Understanding CNNs: Visualization of Kernels, backprop-to-image/deconvolution methods, deep dream, hallucination, neural style transfer; CAM, Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, SmoothGrad)

Unit-2 Image Classification and Object Detection:

Overview of image classification, classification techniques, CNNs for image classification: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets etc.

Overview and background of object detection, R-CNN, Fast R-CNN, Faster R-CNN, R-FCN, SPP-net, YOLO and its variants, SSD, RetinaNet.

Unit-3 Image Recognition and Segmentation:

Image recognition and verification overview, Challenges, Algorithms: SIFT, SURF, PCA, LDA, Popular CNNs: Siamese network, triplet network, Loss used in recognition (ranking loss, contrastive loss, triplet loss etc.), Application areas of image recognition.

Image Segmentation overview, Semantic, Instance and panoptic Segmentation, Encoder and decoder based architectures, Segmentation based on FCN, Based on dialatation/atrous convolution: DialatedNet, DeepLab, Based on top-down/bottom-up approach: Deconvnet, U-net and its variants, SegNet, FC-DenseNet, Based on global context: ParseNet, GCN , EncNet, Based on receptive field enlargement and multi-scale context incorporation: DeepLabV2 and DeepLabV3, PSPNet, Gated-SCNN

Unit-4 Recent Trends:

Attention Models: Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks.

Deep Generative Models: Review of (Popular) Deep Generative Models: GANs, VAEs; Other Generative Models: PixelRNNs, NADE, Normalizing Flows, etc.

Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning; Reinforcement Learning in Vision;

Course Materials

Required Text: Text books

Optional Materials: Reference Books

Block Chain Technology

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Block Chain Technology	3-0-0, (3)	EPR	CS107204CS

[Pre-requisites: Programming]

Course Objectives

1. The students are expected to understand the architectural components of a blockchain system
2. The students are expected to understand smart contracts, their technical capabilities, practical applications, limitations and security constraints they operate within
3. The students are expected to understand forking and the way the Bitcoin network evolves

Course Content

Unit-1 Introduction to Blockchain:

Basic Cryptographic primitives used in Blockchain , Understand the differences between centralised, decentralised and distributed peer to peer networks, Consensus algorithms and their scalability problems, Definition of Blockchain, History of blockchain, Blockchain 2.0, Types of Blockchain, Public Ledgers, Blockchain as public ledgers, Blockchain Architecture, Markle Root Tree, working of blockchain, , Permissioned Model of Blockchain.

Unit-2 Cryptocurrency and Consensus:

Bitcoin, Bitcoin Transactions, The Chain and the Longest Chain, Cryptocurrency to Blockchain 2.0. Creation of coins, Payments and double spending, Fork, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Distributed Consensus Importance, Distributed consensus in open environments, Consensus in Bitcoin- Bitcoin Consensus, Proof of Work (PoW), Hashcash PoW, Bitcoin PoW, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool. Byzantine fault tolerant system, Hybrid Consensus, blockchain and future world of Web 3.0.

Unit-3 Platforms and Smart Contracts:

Different Blockchain Platforms: Ethereum, Hyperledger, EOS, IBM Blockchain, CORDA, Ethereum basics: Ethereum Virtual Machine (EVM), Wallets for Ethereum, Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, Writing smart contracts using Solidity , Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain. Chaincode, Design a Distributed Application (DAPP)

Unit-4 Security and Applications:

Attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks, Attacks on different consensus, Attacks on Smart Contracts. Applications of blockchain in cyber security, integrity information, Applications of blockchain in Healthcare, Financial system, Supply chain management, E-governance, Property records, Micropayments, Notary, Sidechains, Agriculture, Domain Name Service and future of Blockchain,

Course Materials

Course Materials

Required Text: Text books

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Blockchain Technology: Cryptocurrency and Applications S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan
3. Oxford University Press 2019
4. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Antonopoulos

Optional Materials: Reference Books

1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017. 3. Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing.

2. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing.
3. Blockchain: Step-By-Step Guide to Understand by Paul Laurence
4. Hands-On Blockchain for Python Developers: Gain blockchain programming skills to build decentralized applications using Python Paperback
5. Building Blockchain Projects (English, Paperback, Prusty Narayan), Packt Publishing

Big Data Analytics

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Big Data Analytics	3-0-0, (3)	EPR	CS107205CS

[Pre-requisites:

1. Programming Language (Java preferably)
2. Practice of SQL (queries and subqueries)
3. Exposure to Linux Environment.]

Course Objectives

1. To understand the Big Data Platform and its Use cases
2. To provide an overview of Apache Hadoop
3. To provide HDFS Concepts and Interfacing with HDFS
4. To understand Map Reduce Jobs
5. To provide hands on Hadoop EcoSystem
6. To apply analytics on Structured, Unstructured Data.
7. To exposure to Data Analytics with R

Course Content

Unit-1 Introduction To Big Data And Hadoop:

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Unit-2 HDFS(Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Unit-3 Map Reduce:

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit-4 Hadoop Ecosystem:

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase versus RDBMS. Big SQL: Introduction, Big Data Analytics with R, Visual data analysis techniques- interaction techniques - Systems and applications.

Course Materials

Required Text: Text books

1. Tom White “Hadoop: The Definitive Guide” Third Edition, O’reily Media.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics, Wiley.

Optional Materials: Reference Books

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer.
2. Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press.
3. Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media, Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, “Mining of Massive Datasets”, Cambridge University Press.
5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons.
6. Glen J. Myat, “Making Sense of Data”, John Wiley & Sons.
7. Pete Warden, “Big Data Glossary”, O’Reily.
8. Michael Mineli, Michele Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses, Wiley Publications.
9. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, MC Press.
10. Paul Zikopoulos , Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications.

Mobile Application Development

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Mobile Application Development	3-0-0, (3)	EPR	CS107301CS

[Pre-requisites: JAVA Programming]

Course Objectives

4. To facilitate students to understand android SDK.
5. To gain basic understanding of Android application development.
6. To gain knowledge of Android Studio development tools.

Course Content

Unit-1 Introduction To Android:

The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

Unit-2 Android Application Design Essentials:

Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

Unit-3 Android User Interface Design Essentials:

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

Unit-4 Using Common Android APIs:

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World, Android Graphics : Graphics API,2D Graphics, Android Google Map with GSI, Android Map V2 API, Adding Map, Customizing Map, GoogleMap class, Android Google Map Application.

Course Materials

Required Text: Text books

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed..

Optional Materials: Reference Books

1. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd
2. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Internet of Things

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Internet of Things	3-0-0, (3)	EPR	CS107302CS

[Pre-requisites:

1. Computer Networks,
2. Computer Architecture,
3. OS]

Course Objectives

1. To learn the basic concepts of Smart Objects, IoT Architectures, and various various IoT-related protocols
2. To understand the relevance of IoT infrastructure for IoT applications development
3. To apply data analytics and use cloud in the context of IoT
4. To understand the fundamentals of security and privacy in the context of IoT.

Course Content

Unit-1 Fundamentals of IoT:

Evolution of Internet of Things - Enabling Technologies - IoT Architectures: oneM2M - IoT World Forum (IoTWF) and Alternative IoT models - Simplified IoT Architecture and Core IoT Functional Stack - Fog - Edge and Cloud in IoT - Functional blocks of an IoT ecosystem - Sensors - Actuators - Smart Objects and Connecting Smart Objects.

Unit-2 IoT Protocols IoT Access Technologies:

Physical and MAC layers - topology and Security of IEEE 802.15.4 - 802.15.4g - 802.15.4e - 1901.2a - 802.11ah and LoRaWAN - Network Layer: IP versions - Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo - Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT.

Unit-3 Data Acquiring, Data Collection, Storage, Computing and Prototyping

Data acquiring and Storage, Organising Data, transaction, Business process, Enterprise, Integration and Analysis, Cloud Computing Paradigm for Data collection, Storage. Things Connected to the Cloud/Internet, Prototyping Embedded device Software, Internet, Web/cloud Service and Software Development fundamentals.

Unit-4 IOT Privacy, Security, Vulnerabilities Solutions, Business Models and Processes using IOT and Case Studies.

Vulnerabilities, Security requirements, Threat analysis, Use cases, Misuse cases, IOT security tomography, Layered attack model, Identify management, Establishment, Access control, Security models, Profiles protocols for IOT. **Case studies:** Design Layers, Design Complexity, Designing using Cloud PAAS, IOT/IIOT Applications in the Premises Supply Chain, Customer Monitoring, Agriculture, Smart homes, Cities, Street Lights Control and Monitoring.

Course Materials

Required Text: Text books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017.
2. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill Education, private limited, 2017.
3. Shriram K Vasudevan, Abhishek K Nagarajan, Internet of Things, 2/E, Wiley India Pvt Ltd.

Optional Materials: Reference Books

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach, Universities Press
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key Applications and Protocols”, Wiley.
3. Jan Holler et al., “From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence”, Elsevier.

Software Testing

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Software Testing	3-0-0, (3)	EPR	CS107303CS

[Pre-requisites: Software Engineering]

Course Objectives

1. To learn the criteria for test cases.
2. To learn the design of test cases.
3. To understand test management and test automation techniques.
4. To apply test metrics and measurements.

Course Content

Unit-1 Introduction:

Testing as an Engineering Activity, Testing as a Process, Testing Maturity Model, Testing axioms – Basic definitions, Software Testing Principles, The Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Defect Examples-Developer/Tester Support of Developing a Defect Repository.

Unit-2 Test Case Design Strategies:

Introduction to Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, State based testing, Cause-effect graphing, Compatibility testing, user documentation testing , domain testing , Random Testing , Requirements based testing . Using White Box Approach to Test design, Test Adequacy Criteria, static testing vs. structural testing , code functional testing, Coverage and Control Flow Graphs , Covering Code Logic ,Paths, code complexity testing, Additional White box testing approaches, Evaluating Test Adequacy Criteria.

Unit-3 Levels Of Testing:

The need for Levels of Testing , Unit Test – Unit Test Planning , Designing the Unit Tests, The Test Harness, Running the Unit tests and Recording results, Integration tests – Designing Integration Tests, Integration Test Planning, Scenario testing, Defect bash elimination System Testing, Acceptance testing, Performance testing, Regression Testing, Internationalization testing, Ad-hoc testing – Alpha, Beta Tests, Testing OO systems, Usability and Accessibility testing, Configuration testing, Compatibility testing, Testing the documentation, Website testing.

Unit-4 Test Management and Automation:

People and organizational issues in testing , Organization structures for testing teams , testing services , Test Planning – Test Plan Components, Test Plan Attachments, Locating Test Items, test management, test process , Reporting Test Results, Introducing the test specialist, Skills needed by a test specialist, Building a Testing Group, The Structure of Testing Group, Software test automation , skills needed for automation, scope of automation, design and architecture for automation, requirements for a test tool, challenges in automation , Test metrics and measurements , project, progress and productivity metrics, **Automated Tools for Testing:** Load Runner, configuring a scenario & host, Managing scenarios using test director, Runtime and transaction online monitors, Win Runner, Exploring the WinRunner Window, spying on GUI map mode, Rapid test script wizard.

Course Materials

Required Text: Text books

1. Srinivasan Desikan and Gopalaswamy Ramesh, –Software Testing – Principles and Practices, Pearson Education.
2. Ron Patton, –Software Testing, Second Edition, Sams Publishing, Pearson Education. AU Library.com

Optional Materials: Reference Books

1. Ilene Burnstein, –Practical Software Testing‖, Springer International Edition.
2. Edward Kit Software Testing in the Real World – Improving the Process, Pearson Education.
3. Boris Beizer, Software Testing Techniques – 2nd Edition, Van Nostrand Reinhold, New York.
4. Aditya P. Mathur, –Foundations of Software Testing _ Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.

Software Metrics and Quality Management

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Software Metrics and Quality Management	3-0-0, (3)	EPR	CS107304CS

[Pre-requisites: Software Engineering]

Course Objectives

1. To gain basic knowledge about metrics, measurement theory and related terminologies
2. To learn measure the quality level of internal and external attributes of the software product
3. To introduce the basics of software reliability and to illustrate how to perform planning, executing and testing for software reliability
4. To explore various metrics and models of software reliability
5. To compare various models of software reliability based on its application

Course Content

Unit-1 Introduction to Software Quality:

Quality: Popular Views, Quality Professional Views, Software Quality, Total Quality Management, Fundamentals Of Measurement Theory: Definition, Operational Definition, And Measurement, Level Of Measurement, Some Basic Measures, Reliability And Validity, Measurement Errors, Software Quality Metrics Overview: Product Quality Metrics, In Process Quality Metrics, Metrics for Software Maintenance, Examples for Metrics Programs, Collecting software Engineering Data.

Unit-2 Overview of Software Metrics:

Software metrics, Software measurement, Metrology, Property-oriented measurement, Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurement, Subject-domain-oriented measurement, Software measure classification, Goal-based paradigms: Goal-Question-Metrics (GQM) and Goal-Question-Indicator-Metrics (GQIM), Applications of GQM and GQIM, Software engineering investigation, Investigation principles, Investigation techniques.

Unit-3 Complexity Metrics & Availability Metrics:

Halsted's Software Science, Cyclomatic complexity, Syntactic Metrics, Structure Metrics, Metric for Object Oriented projects: OO concepts and constructs, Design & complexity metrics, Productivity Metrics, Quality Management Metrics. Definition and Measurement of System Availability, Reliability Availability and Defect Rate, Collecting Customer Outage Data For Quality Improvement, In Process Metrics For Outage And Availability. Software Project Assessment, Software Process Maturity Assessment.

Unit-4 Software Process Improvement:

Measuring Process Maturity, Measuring Process Capability, Staged Versus Continuous Debating Religion, Measuring Levels, Establishing The Alignment Principle, Measuring The Value Of Process Improvement, Measuring Process Compliance. Using Function Point Metrics to Measure Software Process Improvement: Software Process Improvement Sequences, Process Improvement Economies, Measuring Process Improvement at Activity Levels.

Course Materials

Required Text: Text books

1. Norman E-Fenton and Shari Lawrence Pflieger."Software Metrics". International Thomson Computer Press.
2. Stephen H Khan: Metrics and Models in Software Quality Engineering, Pearson 2nd edition.

Optional Materials: Reference Books

1. S.A. Kelkar, "Software quality and Testing, PHI Learning, Pvt., Ltd., New Delhi.
2. Watts S Humphrey, "Managing the Software Process", Pearson Education Inc.
3. Mary Beth Chrissis, Mike Konrad and Sandy Shrum, "CMMI", Pearson Education (Singapore) Pvt. Ltd.
4. Philip B Crosby, " Quality is Free: The Art of Making Quality Certain ", Mass Market.
5. Robert B. Grady, Deborah L. Caswell, Software Metrics: Establishing a Company-wide Program, Prentice-Hall
6. Alan C. Gillies, Software quality: Theory and management, Chapman & Hall, London, U.K.

Advanced Machine Learning

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Advanced Machine Learning	3-0-0, (3)	EPR	CS107305CS

[Pre-requisites: Machine Learning]

Course Objectives

1. Students will be able to describe modern formulations of unsupervised, semi-supervised and self-supervised learning.
2. Students will be able to formulate learning problems with limited supervision, implement them using existing libraries and evaluate them using standard evaluation metrics.
3. The students should be able to design experiments for evaluation and analyze the results to test the effectiveness of individual components of an algorithm.

Course Content

Unit-1 Introduction

Introduction to ML & DL; Review of CNNs and Autoencoders, Semi-supervised Learning (theory + traditional ML settings), Semi-supervised Learning (DL setting; Mixup and variants),

Unit-2 Metric Learning

Distance Metric Learning (linear and kernelized methods), Distance Metric Learning (DL setting).

Unit-3 Adaptation Theory

Domain Adaptation (theory + linear methods), Domain Adaptation (DL setting), Active Learning (theory + traditional ML setting), Active Learning (DL setting).

Unit-4 Self Supervised Learning

Self-supervised Learning (DL settings), Self-supervised Learning (DL settings), and Clustering with deep neural networks (k-means, spectral clustering, hierarchical, etc.), Overflow, Shot Learning and its types: Zero shot learning, One shot learning, N-shot learning, Applications of shot learning, Comparison on Zero & One shot Learning.

Course Materials

Required Text: Text books

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press.
3. T. M. Mitchell, Machine Learning (1 ed.), McGraw Hill, 2017. ISBN 978-1259096952.
4. E. Alpaydin, Introduction to Machine Learning (3 ed.), PHI, 2015. ISBN 978-8120350786.

Optional Materials: Reference Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning. MIT Press.

Distributed Systems Lab

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Distributed Systems Lab	0-0-2, (1)	EPR	CS107401CS

[Pre-requisites: Operating System Lab]

Course Objectives

1. To understand and implement the fundamentals of Distributed Systems
2. To explore the issues in communications in distributed systems
3. To understand the various issues in process and thread management
4. To discuss the issues in design the distributed file system
5. Know security issues in Distributed System

Course Content

1. Implement concurrent echo client-server application in JAVA
2. Implement a Distributed Chat Server using TCP Sockets in JAVA.
3. Implement concurrent day-time client-server application in JAVA
4. Configure following options on server socket and tests them: SO_KEEPALIVE, SO_LINGER, SO_SNDBUF, SO_RCVBUF, TCP_NODELAY
5. Write a program to Incrementing a counter in shared memory in JAVA
6. Write a program to Simulate the Distributed Mutual Exclusion in JAVA
7. Write a program to Implement Java RMI" mechanism for accessing methods of remote systems.
8. Write a program to Create CORBA based server-client application

Course Materials

Required Text: Text books

1. P K Sinha, "Distributed Operating System", PHI, IEEE Press.

Optional Materials: Reference Books

1. Tanenbaum, "Distributed Systems: Principles and Paradigms", Pearson Education.
2. Coulouris, Dollimore, Kindberg, "Distributed Systems - Concepts and Design", Pearson Education Asia