PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

COURSE STRUCTURE FOR B. TECH UNDER PVP19 REGULATIONS
(EFFECTIVE FROM ACADEMIC YEAR 2019-20)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

I B. Tech – I Semester

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1101	Communicative English I	2	0	0	2	30	70	100
19BS1101	Engineering Mathematics I (Calculus and Algebra)	3	0	0	3	30	70	100
19BS1103	Engineering Chemistry	3	0	0	3	30	70	100
19ES1102	Problem Solving and Programming	3	1	0	4	30	70	100
19HS1151	Communicative English I Lab	0	0	3	1.5	25	50	75
19BS1152	Engineering Chemistry Lab	0	0	3	1.5	25	50	75
19ES1152	Problem Solving and Programming Lab	0	0	3	1.5	25	50	75
19ES1153	Basic Workshop	0	0	3	1.5	25	50	75
19MC1151	NCC/NSS/NSO/YOGA	0	0	2	0	100		100
Total		**11**	**1**	**14**	**18**	**320**	**480**	**800**

I B.Tech – II Semester

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1201	Communicative English II	2	0	0	2	30	70	100
19BS1202	Engineering Mathematics II (Probability and Statistics)	3	0	0	3	30	70	100
19BS1205	Engineering Physics	3	0	0	3	30	70	100
19ES1201	Basic Electrical and Electronics Engineering	3	1	0	4	30	70	100
19ES1203	Engineering Graphics	1	0	3	2.5	30	70	100
19HS1251	Communicative English II Lab	0	0	3	1.5	25	50	75
19BS1253	Engineering Physics Lab	0	0	3	1.5	25	50	75
19ES1251	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5	25	50	75
19CS3251	Information Technology Workshop (IT)	0	0	2	0	100		100
19MC1151	NCC/NSS/NSO/YOGA	0	0	2	0	100		100
Total		**12**	**1**	**17**	**20.5**	**350**	**550**	**900**

II B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19BS1302	Engineering Mathematics III (Discrete Mathematical Structures)	3	0	0	3	30	70	100
19BS1303	Life Sciences for Engineers	2	0	0	2	30	70	100
19ES1302	Design Thinking & Product Innovation	2	0	0	2	30	70	100
19CS3301	Fundamentals of Digital Logic Design	3	0	0	3	30	70	100
19CS3302	Object Oriented Programming	2	0	0	2	30	70	100
19CS3303	Data Communications	2	0	0	2	30	70	100
19CS3304	Data Structures	3	1	0	4	30	70	100
19MC1301	Environmental Sciences	3	0	0	0	100	-	100
19BS1351	Life Sciences for Engineers Lab	0	0	2	1	25	50	75
19ES1352	Design Thinking & Product Innovation Lab	0	0	2	1	25	50	75
19CS3351	Object Oriented Programming Lab	0	0	2	1	25	50	75
19CS3352	Data Structures Lab	0	0	3	1.5	25	50	75
Total		20	1	9	22.5	410	690	1100

II B.TECH– II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19BS1403	Engineering Mathematics- IV (Number Theory and Cryptography)	3	0	0	3	30	70	100
19ES1401	AI Tools	2	0	0	2	30	70	100
19CS3401	Computer Organization and Architecture	3	0	0	3	30	70	100
19CS3402	Operating Systems	3	0	0	3	30	70	100
19CS3403	Computer Networks	3	0	0	3	30	70	100
19CS3404	Design and Analysis of Algorithms	3	0	0	3	30	70	100
19MC1402	Constitution of India	3	0	0	0	100		100
19ES1451	AI Tools Lab	0	0	2	1	25	50	75
19CS3451	Computer Networks Lab	0	0	2	1	25	50	75
19CS3452	Design and Analysis of Algorithms Lab	0	0	2	1	25	50	75
19CS3453	Python Programming	0	0	2	1	25	50	75
Total		20	0	8	21	380	620	1000

III B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19ES1501	InternetofThings	2	0	0	2	30	70	100
19CS3501	SoftwareEngineering	3	0	0	3	30	70	100
19CS4501	ProgramElective-I	3	0	0	3	30	70	100
19CS3502	Formal Languages andAutomataTheory	3	0	0	3	30	70	100
19CS3503	Database ManagementSystems	3	0	0	3	30	70	100
	InterdisciplinaryElectiveI	3	0	0	3	30	70	100
	OpenElectiveI	3	0	0	3	30	70	100
19ES1552	InternetofThings Lab	0	0	2	1	25	50	75
19CS3551	SoftwareEngineeringLab	0	0	2	1	25	50	75
19CS3552	Database ManagementSystemsLab	0	0	2	1	25	50	75
	Total	**20**	**0**	**6**	**23**	**285**	**640**	**925**

Program Elective-I

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Advanced Data Structures	PE	3	0	0	3
2	**Networks and Security**	Advanced Computer Networks	PE	3	0	0	3
3	**Software Engineering**	Software Requirements Management	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Distributed Systems	PE	3	0	0	3

INTERNET OF THINGS

Course Code	19ES1501	**Year**	III	**Semester**	I
Course Category	ES	**Branch**	All Branches	**Course Type**	Theory
Credits	2	**L-T-P**	2-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Summarize the genesis and impact of IoT applications, architectures in real world. (L2).
CO2	Illustrate diverse methods of deploying smart objects and connect them to network (L3).
CO3	Construct simple applications using Arduino. (L3).
CO4	Interpret different protocols and select which protocol can be used for a specific application (L2).
CO5	Identify and develop a solution for a given application using APIs (L3).

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
*** - Average value indicates course correlation strength with mapped PO**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2	2	2	3	3					2	3	3
CO2	2		2	2	2	3	3					2	3	3
CO3	2	3	2	2	3	3	3					2	3	3
CO4	3	3	3	3			2					2	3	3
CO5	3	3	3	3	3	3	2	2			3	3	3	3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	**CO1**
II	Smart Objects: The Things in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.	**CO2**
III	Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, Developing on the Arduino, Some	**CO3**

	Notes on the Hardware, Openness	
IV	Communication in the IoT: Internet Principles, Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, An Example: HTTP Ports, Other Common Ports, Application Layer Protocols HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.	**CO4**
V	Prototyping Online Components: Getting Started with an API, Mashing Up APIs, Scraping, Legalities, Writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Going Further, Real-Time Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.	**CO5**

Learning Resources

Text Books

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

Reference Books

1. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014
2. Srinivasa K G, Internet of Things,CENGAGE Leaning India, 2017

Software Engineering

Course Code	19CS3501	**Year**	III	**Semester**	I
Course Category	**Program Core**	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Object Oriented Programming
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of Software Engineering	**L2**
CO2	Apply various life cycle activities for a project and make an effective report	**L3**
CO3	Apply Risk and Quality management Strategies	**L3**
CO4	Analyze and choose appropriate process Model based on User requirements	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Software Engineering**: Software, Software Engineering, The changing nature of software, Software myths. **A Generic view of process:** Software engineering-A layered technology, a process framework, CMMI. **Process models:** The waterfall model, Incremental process models, Evolutionary process models, Unified Process Model.	**CO1,CO4**
II	**Requirements engineering:** Requirements engineering tasks, initiating the requirements engineering process, Eliciting requirements, Negotiating requirements, validating requirements. **Analysis model:** Requirements Analysis, Data modelling concepts, Scenario-Based Modelling, Flow-Oriented Modelling, Class-Based Modelling, Creating a behavioural model.	**CO1, CO2**
III	**Design Engineering**: Design process and Design quality, Design concepts, the design model.	**CO1, CO2**

	Creating an architectural design: Software architecture, Architectural styles and patterns. **Performing User interface design:** Golden rules.	
IV	**Testing Strategies:** A strategic approach to software testing, Test strategies for conventional software- Unit testing, Integration testing, Validation testing, System testing **Testing tactics:** Software testing fundamentals, White-Box testing – Basis path testing, Control structure testing, Black-Box testing – Methods	**CO1, CO2**
V	**Risk management:** Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan. **Quality Management:** Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews	**CO1, CO3**

Learning Resources
Text Book
1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, Seventh edition, 2009, McGraw Hill, International Edition.
References
1. Software Engineering, Ian Sommerville, Seventh edition, 2004, Pearson,India 2. Software Engineering, K.K. Agarwal &Yogesh Singh, 2007, New Age International Publishers. 3. Software Engineering Principles and Practice, Waman S Jawadekar, 2004, McGrawHill. 4. Fundamentals of Software Engineering, Rajib Mall, Fourth edition, 2009, PHI.
e-Resources and other Digital Material
1. https://onlinecourses.nptel.ac.in/noc20_cs68

PROGRAM ELECTIVE-1

Advanced Data Structures

Course Code	19CS4501A	**Year**	III	**Semester**	I
Course Category	Program Elective-1	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data Structures, Problem Solving and Programming
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the usage of various data structures such as queues, trees, Dictionaries, Graphs, Tries and their representations.	**L2**
CO2	Apply various tree operations for Balancing Trees.	**L3**
CO3	Apply the concept of Priority Queues for solving problems and make an effective report.	**L3**
CO4	Apply various data structures for text processing applications.	**L3**
CO5	Analyze the given scenario and choose appropriate Algorithm for solving Graph problems.	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Dictionaries:** Sets, Dictionaries, Hash Tables, Open Hashing, Closed Hashing (Rehashing Methods), Hashing Functions (Division Method, Multiplication Method, Universal Hashing), Hash Table Restructuring, Skip Lists, Analysis of Skip Lists. (Reference 1)	**CO1**
II	**Balanced Trees:**AVL Trees: Maximum Height of an AVL Tree, Insertions and Deletions. **2-3 Trees:**Insertion, Deletion.	**CO1,CO2**
III	**Priority Queues :** **Binary Heaps:** Implementation of Insert and Delete min, Creating Heap. **Binomial Queues:** Binomial Queue Operations: Insertion and Deletion.	**CO1,CO3**

IV	**Graph algorithms :** Minimum-Cost Spanning Trees- Prim's Algorithm, Kruskal's Algorithm **Shortest Path Algorithms:** Dijkstra's Algorithm **All Pairs Shortest Paths Problem:** Floyd's Algorithm,Warshall's Algorithm	**CO1,CO5**
V	**Pattern matching and Tries:** **Pattern matching algorithms-** the Boyer –Moore algorithm, the Knuth Morris-Pratt algorithm,Anagram Pattern Search **Tries:** Definitions and concepts of digital search tree, Binary trie, Patricia, Multi-way trie.	**CO1,CO4**

Learning Resources
Text Books
1. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Second edition , Pearson. 2. Data Structures and Algorithms Made Easy by NarasimhaKarumanchi, 2020, Career Monk Publications.
References
1. Fundamentals of DATA STRUCTURES in C, Horowitz, Sahani, Anderson-freed, Second edition, Universities Press. 2. Data Structures A Pseudocode Approach, Richard F Gilberg, Behrouz A Forouzan, Cengage.
e-Resources and other Digital Material
1. http://lcm.csa.iisc.ernet.in/dsa/dsa.html 2. http://utubersity.com/?page_id=878 3. http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures 4. http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

Advanced Computer Networks

Course Code	19CS4503B	**Year**	III	**Semester**	I
Course Category	Program Elective - I	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the Fundamentals of Computer Networks, performance Issues, and Technologies.	**L2**
CO2	Apply appropriate multicast routing protocol for a given context and make an effective report	**L3**
CO3	Apply suitable Congestion control/Congestion Avoidance mechanism for improving QoS.	**L3**
CO4	Apply resource Allocation for a given multimedia application/overlay networks.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Foundation:** Applications, Requirements, Network Architecture, Implementing Network Software, Performance	**CO1**
II	**Wired and Wireless Networks:** Ethernet andMultiple access networks – Physical properties, Access Protocol**,** Experience with Ethernet**. Wireless** - Wi-Fi (802.11), Bluetooth (802.15.1), Cell Phone Technologies.	**CO1**
III	**Inter-networking (Part - I): Implementation and Performance** - Switch Basics, Ports, Fabrics, Router Implementation. **The Global Internet** – Routing Areas, Inter-domain Routing (BGP), IP Version 6 (IPv6).**Multicast** – Multicast Addresses, Multicast Routing(DVMRP, PIM,MSDP),**Multiprotocol Label Switching -** Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels.	**CO1,CO2**

IV	**Inter-networking (Part - II)**: **End-to-End Protocols** - Transport for Real-Time Applications (RTP) – Requirements, RTP Design, Control Protocol. **Congestion Control and Resource Allocation** - Issues in Resource Allocation, Queuing Disciplines, TCP Congestion Control, Congestion- Avoidance Mechanisms , Quality of Service.	**CO1,CO3**
V	**Applications: Multimedia Applications** - Session Control and Call Control (SDP, SIP, H.323), Resource Allocation for Multimedia Applications, **Overlay Networks** - Routing Overlays, Peer-to-Peer Networks, Content Distribution Networks.	**CO1,CO4**

Learning Resources

Text Books

1. Computer Networks, A Systems Approach, Larry L .Peterson, Bruce S. Davie, Fifth edition, 2012, Morgan Kaufmann publishers.

References

1. Computer Networks, Andrew S Tanenbaum and David J Wetherall, Fifth Edition, Pearson,2012, Education.

e-Resources & Other Digital Material

1. https://cseweb.ucsd.edu/classes/wi19/cse124-a/courseoverview/compnetworks.pdf
2. https://fdocuments.in/document/solution-manual-for-computer-networks-by-larry-l-peterson-bruce-s-davie.html

Software Requirement Management

Course Code	19CS4501C	**Year**	III	**Semester**	I
Course Category	Program Elective-I	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Object Oriented Programming
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the Fundamentals of Requirement Engineering Process and estimation models	**L2**
CO2	Apply the Requirement elicitation Process in Software Development	**L3**
CO3	Apply the Requirement description and management techniques to software Development and make an effective report.	**L3**
CO4	Analyze various Software Estimation process models and identify the appropriate model for given software project	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction,** requirements, requirement engineering, requirements document, best way to write requirements, detailed requirements ,difference between functional and nonfunctional requirements, system stakeholders, requirements engineering process, recognizing requirements engineering process problems, suggesting a good requirements engineering process	**CO1**
II	**Requirements Elicitation:** Assess system feasibility, identify and consult system stakeholders, record requirement sources, system's operating environment, using business concerns to drive requirements elicitation, domain constraints, collect requirements from multiple viewpoints, use scenarios to elicit requirements, operational process.	**CO1,CO2**
III	**Describing Requirements**: Standard templates use language, use diagrams, and supplement natural language requirements, specifying requirements quantitatively. **Requirements Management:** Uniquely identify each requirement, policies for requirements management, traceability policies, maintaining a traceability manual, change management policies, identify global	**CO1,CO3**

	system requirements, identify volatile requirements, record rejected requirements.	
IV	**Software Size Estimation**: Software estimation, size based estimation, two views of sizing, function point analysis, Mark-II FPA, full function points, LoC estimation, and conversion between size measures.	**CO1,CO4**
V	**Effort, Schedule & Cost Estimation**: estimation factors, approaches for effort and schedule estimation, COCOMO II, Putnam estimation model, algorithmic models, **Cost estimation tools:** Desirable features of requirements management tools, some requirements management tools available,	**CO1,CO4**

Learning Resources
Text Books
1. Requirements Engineering: A good practice guide,Ian Sommerville and Pete Sawyer, Seventh edition, 2005, John Wiley. 2. Software Requirements and Estimation, Rajesh Naik, Swapna Kishore, TMH, 2001.
References
1. Managing Software Requirements, A Use Case Approach, Don, Second edition, 2003, Dean, AddisionWesley. 2. Requirements Engineering and Rapid Development, Ian Graham, 1998,Addision Wesley. 3. Mastering the Requirements Process, S.Robertson, J.Robertson, Second edition, 2006, Pearson. 4. Cryptography: Theory and Practice, Stinson. D, Third Edition, 2012, Chapman & Hall/CRC.
e-Resources and other Digital Material
1. https://onlinecourses.nptel.ac.in/noc20_cs68 2.https://thedigitalprojectmanager.com

Distributed Systems

Course Code	19CS4501D	**Year**	III	**Semester**	I
Course Category	Program Elective-I	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Operating Systems
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand of the principles and foundations on which the Internet and other distributed systems are based.	**L2**
CO2	Apply different approaches for supporting distributed applications.	**L3**
CO3	Analyze the role of middleware technologies in designing Distributed systems	**L4**
CO4	Analyze the sharing of data in distributed environment using various distributed algorithms.	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Characterization Of Distributed Systems:** Introduction, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges **System Models**: Introduction, Physical models, Architectural models, Fundamental models.	**CO1,CO2**
II	**Inter process Communication**: Introduction, The API for the Internet protocols, External data representation and marshalling, Multicast communication, Network virtualization: Overlay networks. **Remote Invocation**: Introduction, Request-reply protocols, Remote procedure call, Remote method invocation. **Indirect Communication**: Introduction, Group communication, Publish-subscribe systems, Message queues, Shared memory approaches.	**CO1,CO2**

III	**Operating System Support**: Introduction, The operating system layer, Protection, Processes and threads, Communication and invocation, Operating system architecture, Virtualization at the operating system level. **Distributed Objects and Components**: Introduction, Distributed objects, Case study: CORBA, From objects to components.	**CO1,CO3**
IV	**Time And Global States**: Introduction, Clocks, events and process states,Synchronizing physical clocks,Logical time and logical clocks,Global states,Distributed debugging **Coordination And Agreement:** Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication,Consensus and related problems	**CO1,CO4**
V	**Distributed Transactions:** Introduction, Flat and nested distributed transactions,Atomic commit protocols,Concurrency control in distributed transactions,Distributed deadlocks,Transaction recovery **Replication:** Introduction, System model and the role of group communication,Fault-tolerant services	**CO1,CO4**

Learning Resources
Text Book
1. Distributed System: Concepts and Design, Coulouris, Dollimore, Kindberg, 2006, Pearson Education.
References
1. Distributed Operating System, TanenbaumS, 2005, Pearson Education. 2. Distributed System: Concepts and Design, P K Sinha, 2004, PHI. 3. Advanced Concepts in Operating Systems, MukeshSinghal&Niranjan G Shivaratri, 2001, Tata McGraw Hill.
e-Resources and other Digital Material
1. https://www.cdk5.net/wp/ 2. www.distributedsystemscourse.com 3. https://ocw.mit.edu/

Formal Languages and Automata Theory

Course Code	19CS3502	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Discrete Mathematics
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Formal Languages and Automata.	**L2**
CO2	Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving various problems.	**L3**
CO3	Analyze automata and their computational power to recognize languages.	**L4**
CO4	Analyze different Turing machines techniques to solve problems	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Fundamentals:** Strings, Alphabet, Language, Operations, Chomsky hierarchy of languages **Finite Automata:** Definitions, finite automation model, Deterministic Finite Automata, Non-Deterministic Finite Automata, Finite Automata with Epsilon Transitions, and Finite Automata with Output.	**CO1,CO3**
II	**Regular Expressions and Languages**: Regular Expressions, identity Rules, Finite Automata and Regular Expressions, Applications of Regular Expressions, Closure Properties of Regular Sets, Pumping Lemma for Regular Languages, Equivalence and Minimization of Finite Automata .	**CO1,CO2**
III	**Grammars:** Context–free grammars; Parse trees; Applications; Ambiguity in grammars and Languages, Simplification of Context Free Grammars, Normal Forms, Pumping Lemma For Context Free Languages	**CO1,CO2**

IV	**Pushdown Automata:** Definition of the Pushdown Automaton, The Language of Push Down Automaton, Equivalence between Acceptance by Empty Store and Acceptance by Final State, Equivalence of CFG and PDA, Deterministic Pushdown Automaton, Closure Properties of Context Free Languages.	**CO1,CO2, CO3**
V	**Turing Machines:** Turing Machine as Acceptor, Turing Machine as a Computing Device, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine, Universal Turing Machines (UTM), Halting Problem, Post Correspondence Problem	**CO1,CO3, CO4**

Learning Resources

Text Books

1. Introduction to Automata Theory, Languages and Computations,H.E.Hopcroft, R.Motwani and J.D Ullman, Second Edition, Pearson Education.
2. Introduction of the Theory and Computation, Michael Sipser, 1997, Thomson Brokecole.

References

1. Theory of Computer Science, Automata languages and computation, Mishra,Chandra Shekaran, Second edition, PHI
2. Elements of The theory of Computation, H.R.Lewis and C.H.Papadimitriou, Second Edition, 2003, Pearson Education/PHI.
3. Formal Languages and Automata Theory, Basavarj S. Anami,Karibasappa K.G, WILEY-INDIA.
4. Introduction to Languages and the Theory of Computation,J.C.Martin, Third Edition, TMH, 2003.

Database Management Systems

Course Code	19CS3502	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Mathematics -1, Data Structures
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of database management systems	**L2**
CO2	Apply SQL as well as Relational Algebra to find solutions to a broad range of queries	**L3**
CO3	Apply various data models for database design	**L3**
CO4	Apply normalization techniques to improve database design	**L3**
CO5	Analyze a given database application scenario to use ER model for conceptual design of the database and make an effective report	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Databases:** Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications. Overview of Database Languages and Architectures: Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-Server Architecture for DBMSs.	**CO1**
II	**Relational Model:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. SQL: Data Definition, Constraints, and Basic Queries and Updates, SQL: Advanced Queries, Assertions, Triggers, and Views Formal Relational Languages: Relational Algebra: Unary Relational	**CO1,CO2, CO3**

	Operations: Select and Project, Relational Algebra Operations from Set Theory, Binary Relational Operations: Join and Division, Examples of Queries in Relational Algebra.	
III	**Conceptual Data Modeling:** High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship Types of Degree Higher Than Two.Relational Database Design Using ER-to-Relational Mapping.	**CO1,CO3, CO5**
IV	**Database Design Theory:** Functional Dependencies, Normal forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multi valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.	**CO1,CO4**
V	**Transaction Processing:** Introduction, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability &Serializability, Transaction Support in SQL. Introduction to Concurrency Control: Two-Phase Locking Techniques: Types of Locks and System Lock Tables, Guaranteeing Serializability by Two-Phase Locking. Introduction to Recovery Protocols: Recovery Concepts, No-UNDO/REDO Recovery Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging.	**CO1**

Learning Resources
Text Books
1. Database Systems Models, Languages, Design and Application Programming, RamezElmasri,ShamkantB. Navathe, Sixth edition, Pearson.
References
1. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S. Sudarshan, Fifth Edition, McGraw Hill. 2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, Third Edition, TMH. 3. Introduction to Database Systems, C.J.Date, Eigth Edition , Pearson
e-Resources and other Digital Material:
1. https://nptel.ac.in/courses/106/105/106105175/ 2. https://onlinecourses.nptel.ac.in/noc21_cs04/ 3. https://nptel.ac.in/courses/106/106/106106093/

Internet of Things Lab

Course Code	19ES1552	**Year**	III	**Semester**	I
Course Category	ES	**Branch**	All	**Course Type**	Practical
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Problem Solving and Programming Lab
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Develop various sensor interfacing using Visual Programming Language	**L6**
CO2	Analyze various Physical Computing Techniques	**L4**
CO3	Evaluate Wireless Control of Remote Devices	**L5**
CO4	Design and develop Mobile Application which can interact with Sensors and Actuators	**L6**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	3	2	3	3	2	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	3	3	3	3	2	2
CO3	3	3	3	3	2	3	3	2	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	3	3	3	3	2	2

Syllabus		
EXP No.	**Contents**	**Mapped CO**
1	Digital I/O Interface - Multicolour Led, IR Sensor, PIR, Slot Sensor.	**CO1**
2	Analog Read and Write - Potentiometer, Temperature Sensor, Led Brightness Control.	**CO1**
3	Dc Motor Control - Dc Motor Speed and Direction Control.	**CO2**
4	Read data from sensor and send it to a requesting client. (using socket communication) Note: The client and server should be connected to same local area network.	**CO2**
5	Fabrication and direction control of wheeled robot using Arduino	**CO2**
6	Serial Communication - Device Control.	**CO2**
7	Wireless Module Interface - Bluetooth and Wifi.	**CO3**
8	Wireless Control of wheeled Robot using Bluetooth/Wifi.	**CO3**
9	Basic Android App Development using MIT App Inventor.	**CO4**
10	Smart Home Android App Development using App Inventor and Arduino.	**CO4**
Learning Resources		
Text Books		
1. Sylvia Libow Martinez, Gary S Stager, "Invent To Learn: Making, Tinkering, and Engineering in the Classroom", Constructing Modern Knowledge Press, 2016.		
References		
1. Michael Margolis, "Arduino Cookbook", Oreilly, 2011.		

Software Engineering Lab

Course Code	19CS3551	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	CSE	**Course Type**	Practical
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Object Oriented Programming
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply analysis, design and visual modelling concepts for analysing concern case studies	L3
CO2	Implement visual model experimentation as an individual, or team member by using modelling tools.	--
CO3	Develop an effective report based on various case studies analysed	--
CO4	Apply analytical knowledge for a given case study and express with an effective oral communication.	L3
CO5	Analyze outputs generated through modelling tools	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3											2		
CO2					3				3					
CO3										3				
CO4	3									3				
CO5		3												

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	Develop UML behavioral and structural diagrams for a given scenario	**CO1,CO2,CO3, CO4,CO5**
2	**Prepare a SRS document in line with the IEEE recommended standards for the below case study** An automated teller machine (ATM) or the automatic banking machine (ABM) is banking subsystem that provides bank customers with access to financial transactions in a public space without the need for a cashier, clerk or bank teller. Customer uses bank ATM to check balances of his/ her bank accounts, deposit funds, withdraw cash and/or transfer funds. ATM technician provides maintenance and repairs	**CO1,CO2,CO3, CO4,CO5**
3	**A Point-of-Sale (POS) System** A retail POS system typically includes a computer, monitor, keyboard, barcode scanners, weight scale, receipt printer, credit card processing system, etc. and POS terminal software. It interfaces to various service applications, such as a third-party tax calculator and inventory control. These systems must be relatively fault tolerant; that is, even if remote services are temporarily unavailable they must still be of capturing sales and handling at least cash payments. A POS system must support multiple and varied client-side terminals and interfaces such as browser, PDAs, touch-screens	**CO1,CO2,CO3, CO4,CO5**
4	**Credit Card Processing System** Credit card processing system (Credit card payment gateway) is a system under consideration. Main part of the system is the Merchant's Credit Card Processing System. The merchant submits a credit card transaction request to the credit card payment gateway on behalf of a customer. Bank which issued customer's credit card which could approve or reject the transaction. If transaction is approved, funds will be transferred to merchant's bank account.	**CO1,CO2,CO3, CO4,CO5**
5	**Hospital Management System** Hospital management system is a large system including several subsystems or modules providing variety of functions. Hospital subsystem or module supports some of the many job duties of hospital receptionist. Receptionist schedules patient's appointments and admission to the hospital, collects information from patient upon patient's arrival and/or by phone. For the patient that will stay in the hospital ("inpatient") she or he should have a bed allotted in a ward. Receptionists might also receive patient's payments, record them in a database and provide receipts, file insurance claims and medical reports.	**CO1,CO2,CO3, CO4,CO5**

6	Apply software development life cycle activities on student interested case study and prepare an effective report.	**CO1,CO2,CO3, CO4,CO5**

Learning Resources
Text Book
1. Software Engineering: A Practitioner's Approach,Roger S. Pressman, Seventh edition, 2009, McGraw Hill, International Edition.
References
1. Software Engineering, K.K. Agarwal &Yogesh Singh, 2007, New Age International Publishers. 2.Software Engineering, Ian Sommerville, Seventh edition, 2004, Pearson,India. 3. Software Engineering Principles and Practice, Waman S Jawadekar, McGrawHill, 2004. 4. Fundamentals of Software Engineering, Rajib Mall, Fourth edition, 2009, PHI.
e-Resources and other Digital Material
1. https://onlinecourses.nptel.ac.in/noc20_cs68

Database Management Systems Lab

Course Code	19CS3552	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	CSE	**Course Type**	Practical
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Problem Solving and Programming Lab
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply database management techniques to solve problems	**L3**
CO2	Implement experiments by using modern tools like MYSQL, Oracle	
CO3	Develop an effective report based on various constructs implemented.	
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs of queries for a given problem	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3											2		
CO2					3				3					
CO3										3				
CO4	3									3				
CO5		3												

Syllabus		
EXPNo.	**Contents**	**Mapped CO**
1	Introduction to MySQL Workbench. How to use MySql Workbench to run SQL Statements.	**CO1,CO2,CO3,CO4,CO5**
2	Examples on i)DDL Commands: CREATE , ALTER, DROP and TRUNCATE a Table ii) Implementation of Constraints PRIMARY KEY, FOREIGN KEY, CHECK,NOT NULL, UNIQUE.	**CO1,CO2,CO3,CO4,CO5**
3	Examples on i) DML Commands. INSERT, UPDATE and DELETE ii) DCL Commands: COMMIT , ROLLBACK and SAVEPOINT.	**CO1,CO2,CO3,CO4,CO5**
4	Examples on retrieving data from a single table using i)SELECT statement ii) SELECT statement with where clause(Comparison Operators, AND, OR, NOT, IN, BETWEEN,LIKE) iii) ORDER BY clause(sort by column name) iv) LIMIT clause	**CO1,CO2,CO3,CO4,CO5**
5	Examples on Functions in MySQL: String, Numeric,Date, Time and Other Functions.	**CO1,CO2,CO3,CO4,CO5**
6	Examples on Summary Queries: Queries using Aggregate functions,GROUP By and Having Clauses, ROLLUP Operator.	**CO1,CO2,CO3,CO4,CO5**
7	Examples on Inner join, outer join using USING, NATURAL Keywords	**CO1,CO2,CO3,CO4,CO5**
8	Examples on SUB/SUMMARY Queries Using IN, ANY, SOME, ALL , EXISTS and NOT EXISTS functions	**CO1,CO2,CO3,CO4,CO5**
9	Examples on i)Creating INDEXES and VIEWS ii) INSERT,DELETE and DROP on VIEWS	**CO1,CO2,CO3,CO4,CO5**
10	Examples on i) Create and Call STORED PROCEDURE (IN,OUT,INOUT Parameters) , Drop a STORED PROCEDURE. ii) Create,call and Drop a FUNCTION. iii) Create and Drop a TRIGGER	**CO1,CO2,CO3,CO4,CO5**
11	Case Study using real world database applications	**CO1,CO2,CO3,CO4,CO5**
Learning Resources		
Text Books		
2. Murach's MySQL, JOEL MURACH, 2012, Shroff Publishers & Distributors Pvt.Ltd.		
References		

1.The Complete Reference MYSQL, VikramVaswani, 2017, McGrawHill Education.
2. DATABASE SYSTEMS Models, Languages, Design and Application Programming, RamezElmasri, ShamkantB. Navathe, Sixth Edition, Pearson.
3. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S. Sudarshan, Fifth Edition, McGraw Hill.

III B. TECH – II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1601	EngineeringEconomicsandManagement	3	0	0	3	30	70	100
19CS3601	CompilerDesign	3	0	0	3	30	70	100
19CS4601	ProgramElective-II	3	0	0	3	30	70	100
19CS3602	MachineLearning	3	0	0	3	30	70	100
19CS4602	ProgramElective-III	3	0	0	3	30	70	100
19CS3603	WebApplicationDevelopment	2	0	0	2	30	70	100
19MC1601	EngineeringEthics	3	0	0	0	100		100
	OpenElectiveII	3	0	0	3	30	70	100
19CS3651	CompilerDesignLab	0	0	2	1	25	50	75
19CS3652	WebApplicationDevelopmentLab	0	0	2	1	25	50	75
	Total	**23**	**0**	**4**	**22**	**360**	**590**	**950**

Program Elective-II

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Soft Computing	PE	3	0	0	3
2	**Networks and Security**	Cryptography and Information Security	PE	3	0	0	3
3	**Software Engineering**	Design Patterns	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Unix Operating Systems	PE	3	0	0	3

Program Elective-III

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Neural Networks	PE	3	0	0	3
2	**Networks and Security**	Cyber Security	PE	3	0	0	3
3	**Software Engineering**	Software Metrics	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Cloud Computing	PE	3	0	0	3

Engineering Economics and Management

Course Category:	HSS								**Credits:**				3		
Course Type:	Theory								**Lecture-Tutorial- Practical:**				3-0-0		
Prerequisites :	-								**Continuous Evaluation:**				30		
									Semester End Evaluation:				70		
									Total Marks:				100		
Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO 1	To understanding of the fundamental concepts of Managerial economics and demand.													
	CO 2	The ability to apply knowledge to evaluate future demand and theory of production.													
	CO 3	To understanding of the foundational concepts of cost, market structure and role of pricing methods in business.													
	CO 4	To understanding about the principles of management and human resource management function in an organization.													
	CO 5	To understand the broad scope of marketing, societal, ethical and other diverse aspects ofmarketing and production.													

Contribution of Course Outcomes towards achievement of Program Outcomes		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
	CO1	3	3		2								3	3	
	CO2	3	3		2								3	3	
	CO3	3	3		2								3	3	
	CO4	3	3		2								3	3	
	CO5	3	3		2								3	3	
	1- Low						**2-Medium**					**3-High**			

Course Content

UNIT-1	**Introduction to Managerial Economics & Demand Analysis:** Definition of Managerial Economics, Nature and Scope – Managerial Economics and its relation with other subjects. Demand Analysis: Meaning - Demand determinants- Law of Demand and its exceptions.	**CO1**
UNIT-2	**Elasticity of Demand, Demand Forecasting & Theory of Production:** Definition -Types of Elasticity of demand - Measurement of price elasticity of demand. Demand Forecasting: Meaning - Factors governing demand forecasting - Methods of demand forecasting. Production: Production Function- Law of variable proportions- Isoquants, Law of returns to scale.	**CO2**
UNIT-3	**Cost Analysis, Market Structures & Pricing:** Cost concepts - Break-Even Point - Managerial Significance and limitations of BEP - (simple problems). Market: meaning characteristics of market and Types of market competition – Pricing strategies	**CO3**
UNIT-4	**Introduction to Management & Human Resource Management: Meaning,** nature, importance and Functions of Management, Henri Fayol principles. HRM: objective and function, manpower planning, sources of recruitment.	**CO4**
UNIT-5	**Introduction to Marketing Management & Production management:** Meaning,	**CO5**

	Concepts of Marketing, Marketing Mix, Marketing Segmentation. Production management: objectives, Types of Plant Layout , location – Factors effecting it	

References:

1. Managerial Economics and Financial Analysis, J.V.Prabhakar Rao, Maruthi Publications, 2011
2. Managerial Economics and Financial Analysis, N. Appa Rao. & P. Vijaya Kumar, Cengage Publications, New Delhi, 2011.
3. Managerial Economics and Financial Analysis, A R Aryasri, TMH, 2011.
4. Management Science, Aryasri, TMH, 2004.
5. Management Science, Rajesh C. Jampala, P. Adi Lakshmi, Duvuri Publications, Machilipatnam, 2010.

Compiler Design

Course Code	19CS3601	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Formal Languages and Automata Theory
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts in Compiler Design	**L2**
CO2	Apply scanning of tokens to perform the Lexical Analysis and Semantic analysis using attribute grammar	**L3**
CO3	Apply the various parsing techniques to generate the parse trees with an effective report.	**L3**
CO4	Analyze various code optimization techniques for intermediate code forms and Code Generation.	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Language Processors:** Overview of language processing system: – preprocessors – compiler – assembler – Linkers & loaders, difference between compiler and interpreter- structure of a compiler:–phases of a compiler. **Lexical Analysis: -** Role of Lexical Analysis – Input Buffering – Specification of Tokens – Recognition of Token – The Lexical Analyzer Generator (LEX).	**CO1,CO2**
II	**Syntax Analysis: –**Introduction: - Role of a parser – Context Free Grammar – Writing Grammar. **Top Down Parsing: –** Recursive Descent Parsing-FIRST and FOLLOW-LL(1) Grammar – Non recursive Predictive Parsing- Error Recovery in Predictive Parsing.	**CO1,CO3**

III	**Bottom up Parsing: –** Reductions – Handle Pruning - Shift Reduce Parsing – Conflicts During Shift–Reduce Parsing. **Introduction to simple LR Parsing: –** Why LR Parsers – Model of an LR Parsers — Construction of SLR Tables. **More powerful LR parsers:** -Canonical LR(1) items ,Construction of CLR (1) parsing table – Construction of LALR Parsing tables.	**CO1,CO3**
IV	**Syntax Directed Translation:** Syntax Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes for Postfix Translation Schemes –Parser Stack Implementation of Postfix SDT's. **Runtime Environment: -** Storage organization - Stack allocation – Static allocation - Heap management-Introduction to Garbage Collection. **Intermediate code: -** Variants of Syntax Trees - Three address code – Quadruples - Triples - Indirect Triples.	**CO1,CO2**
V	**Optimization of Basic Blocks: –** DAG representation of basic block. Machine independent code optimization - Common sub expression elimination - Constant folding - Copy propagation -Dead code elimination - Strength reduction - Loop optimization. **Machine dependent code optimization: -** Peephole optimization – Register allocation - Instruction scheduling - Inter Procedural Optimization - Garbage collection via reference counting.	**CO1,CO4**

Learning Resources
Text Books
1. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Second Edition, Pearson Education.
References
1.Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University. 2. Principles of compiler design, V. Raghavan, Second edition, 2011, TMH. 3. Compiler Design, Muneeswaran K. First Edition, 2012, Oxford University Press.
e-Resources and other Digital Material
1.http://www.nptel.iitm.ac.in/downloads/106108052/ 2.http://www.vssut.ac.in/lecture_notes/lecture1422914957.pdf

Program Elective-II

Soft Computing

Course Code	19CS4601A	**Year**	III	**Semester**	II
Course Category	Program Elective-II	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Mathematics, Probability and Statistics
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of soft computing techniques and their applications	**L2**
CO2	Apply fuzzy logic to handle uncertainty and solve problems with an effective report.	**L3**
CO3	Apply genetic algorithms to solve engineering problems	**L3**
CO4	Apply Nature Optimization algorithms for real-time problems.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Soft Computing:** Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing , **Applications of Soft computing techniques:** Handwritten Script Recognition, Image Processing and Data Compression, Automotive Systems and Manufacturing, Soft computing based Architecture, Decision Support System.	**CO1**
II	**Fuzzy Set Theory:** Fuzzy Versus Crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations. Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based Systems, Defuzzification Methods and Applications.	**CO1,CO2**
III	**Fundamentals of Genetic Algorithms:** Genetic Algorithms: History, Basic Concepts, Creation of Offsprings, Working Principle, Encoding,	**CO1,CO3**

	Fitness Function, Reproduction. **Genetic Modelling:** Inheritance Operators, Cross Over, Inversion, And Deletion, Mutation Operator, Bit-Wise Operators, Bit-Wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithms, Hybrid Systems.	
IV	**Nature-Inspired Optimization Algorithms:** Differential Evolution, Ant and Bee Algorithms, Particle Swam Optimization.	**CO1,CO4**
V	**Nature-Inspired Optimization Algorithms:** The Firefly Algorithm, Cuckoo Search, The Bat Algorithm, The Flower Algorithm, Parameter Tuning and Parameter Control.	**CO1,CO4**

Learning Resources
Text Books
1. Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications, S. Rajasekaran, G. A. VijayalakshmiPai, 2017, PHI Learning. 2. Nature – Inspired Optimization Algorithms, XIN- SHE YANG, Second Edition, 2020, Elsevier.
Reference Books
1. Principles of Soft Computing, S.N.Sivanandam, S.N.Deepa, Wiley India Pvt. Ltd., 2018, Paperback. 2. Genetic Algorithms: Search and Optimization. E. Goldberg. 3. Fuzzy Sets and Fuzzy Logic-Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall, 2015, Paperback. 4. First course on Fuzzy Theory and Applications, Kwang H. Lee, 2005, Springer. 5. Neuro Fuzzy and Soft Computing, S. R. Jang, C.T. Sun and E. Mizutani, 2004, PHI / Pearson Education. 6. Neural Networks Algorithms, Applications, and Programming Techniques, James A. Freeman and David M. Skapura, 2003, Addison Wesley.
e-Resources & Other Digital Material
1. https://nptel.ac.in/courses/106/105/106105173/ 2. https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html#resources

Cryptography and Information Security

Course Code	19CS4601B	**Year**	III	**Semester**	II
Course Category	Program Elective - II	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Number Theory and Cryptography
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the need of security over the network	L2
CO2	Apply various cryptographic techniques for providing authentication.	L3
CO3	Apply various Key Management Techniques for secure key sharing and make an effective report.	L3
CO4	Apply various security protocols for real-time applications.	L3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Security Concepts:** Introduction, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security **Symmetric Key Ciphers:** Block Cipher Principles, Blow fish, IDEA, Stream Ciphers, RC4	**CO1,CO2**
II	**Cryptographic Hash Functions:** Message Authentication, Secure Hash Algorithm(SHA-512) Message Authentication Codes: Message Authentication Requirements, MAC's Based on Block Ciphers: DAA and CMAC **Digital Signatures:** Digital Signatures, Schnorr Digital Signature, NIST Digital Signature Algorithm	**CO1,CO2**
III	**Key Management and Distribution:** Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509	**CO1,CO3**

	Certificates. Public-Key Infrastructure.	
IV	**Transport-Level Security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell(SSH)	**CO1,CO4**
V	**Email Security:** Pretty Good Privacy, S/MIME **IP Security**: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange	**CO1,CO4**

Learning Resources
Text Books
1. William Stallings. Cryptography and Network Security – Principles and Practice, Seventh edition, 2017, Pearson Education.
References
1. Cryptography and Network Security, AtulKahate, Third edition, 2013, Mc Graw Hill. 2. Cryptography and Network Security, C K Shyamala, N Harini, Dr T R Padmanabhan. First edition, 2011, Wiley India. 3. Cryptography and Network Security, Forouzan and Mukhopadhyay, Third edition, 2015, Mc Graw Hill. 4. Information Security, Principles, and Practice, Mark Stamp, 2011, Wiley India. 5. Principles of Computer Security, WM. Arthur Conklin and Greg White, 2016, TMH. 6. Introduction to Network Security, Neal Krawetz, 2007, CENGAGE Learning.
e-Resources & Other Digital Material
1. http://nptel.ac.in/courses/106105031/lecture, Dr. DebdeepMukhopadhyay, IIT Kharagpur 2. https://www.coursera.org/learn/information-security-data 3. https://www.coursera.org/learn/number-theory-cryptography

Design Patterns

Course Code	19CS4601C	**Year**	III	**Semester**	II
Course Category	Program Elective-II	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Databases and Object oriented design and programming.
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the concept of Design patterns for problems and solutions.	**L2**
CO2	Apply creational patterns in software design for class instantiation.	**L3**
CO3	Apply structural and behavioral patterns to develop design solutions.	**L3**
CO4	Analyze design solutions by using structural patterns for given case studies.	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.	**CO1**
II	**Creational Patterns:** Abstract Factory, Builder, Factory Method, Prototype, Singleton.	**CO1, CO2**
III	**Structural Patterns:** Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.	**CO1, CO3,CO4**
IV	**Behavioral Patterns:** Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor. Conclusion: What to Expect from Design Patterns, The Pattern Community.	**CO1,CO3**

V	**A Case Study:** Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation.	**CO1, CO2,CO3**

Learning Resources
Text Book
1. Design Patterns Elements of Reusable Object-Oriented Software, Erich Gamma, First edition, 1995, Pearson Education.
References
1 Head First Design Patterns, by Eric Freeman, Elisabeth Robson,First Edition, 2004, O'Reilly Media, Inc. 2. Peeling Design Patterns, by Prof.MedaSreenivasa Rao, NarasimhaKarumanchi, First Edition, 2017, CareerMonk Publications. 3. JAVA Enterprise Design Patterns Vol-III, Mark Grand , 2001, Wiley Dream Tech.
e-Resources and other Digital Material
1. https://www.coursera.org/learn/design-patterns. 2. https://www.coursera.org/learn/uml. 3. https://www.coursera.org/learn/object-oriented-design. 4.https://sourcemaking.com/design-patterns-ebook.

Unix Operating Systems

Course Code	19CS4601D	**Year**	III	**Semester**	II
Course Category	Program Elective-II	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Operating Systems
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of UNIX systems.	**L2**
CO2	Apply the concepts of process subsystem in uniprocessor and multiprocessor systems	**L3**
CO3	Apply the concepts of file systems in Unix kernels	**L3**
CO4	Analyze various schedulers for different types of processes to create useful report	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to UNIX**: The process and the kernel, Mode, space and context, Process abstraction, Executing in kernel mode, synchronization, and process scheduling.	**CO1,CO2**
II	**Introduction to Threads**: Fundamental abstractions, Lightweight process design, Issues to consider, User level thread libraries, scheduler activations	**CO1,CO2**
III	**Process Scheduling**: Clock interrupts handling, Scheduler Goals, Traditional UNIX scheduling, Solaris 2.x Scheduling Enhancements.	**CO1,CO2,CO4**
IV	**Synchronization and Multiprocessing**: Introduction, Synchronization in Traditional UNIX Kernels, Multiprocessor Systems, Multiprocessor synchronization issues, Semaphores, spin locks, condition variables, Read-write locks, Reference counts.	**CO1,CO2,CO3**
V	**File system interface and framework** : The user interface to files, File systems, Special files, File system framework, The Vnode/Vfs architecture, Implementation Overview, File System dependent objects, Mounting a file system, Operations on files. **File System Implementations** : System V file system (s5fs) implementation, Berkeley FFS, FFS functionality enhancements and analysis, Temporary file systems, Buffer cache and other special-purpose file systems.	**CO1,CO3**

Learning Resources
Text Books
1. UNIX Internals, UreshVahalia, 2005, Pearson Education.
References
1.Uresh Vahalia, UNIX Internals, Pearson Education, 1997 2. Advanced Programming in the UNIX Environment, Richard Stevens, Stephen A. Rago, Second edition, 2005, Pearson Education.
e-Resources and other Digital Material
1. https://www.tutorialspoint.com/unix/index.html 2. https://www.cse.iitb.ac.in/~mythili/teaching/cs347_autumn2016/notes/09-filesystem-io.pdf

Machine Learning

Course Code	19CS3602	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Statistics and Probability
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of machine learning.	**L2**
CO2	Apply learning techniques on appropriate problems.	**L3**
CO3	Apply Evaluation, hypothesis tests and compare learning techniques for various problems.	**L3**
CO4	Apply Reinforcement learning to address the real time problems in different areas.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction**: What is Machine learning, Designing a Learning System, Perspectives and Issues in Machine Learning, Applications of Machine learning.	**CO1**
II	**Supervised Learning**: Decision Trees, Bayes Theorem, Naive Bayes Classifier, Measuring Classifier Accuracy, Estimating Hypothesis Accuracy.	**CO1,CO2 ,CO3**
III	**Instance Based Learning** – Support vector machine, Ensemble Methods, k-Nearest Neighbor Learning, Expectation Maximization Algorithm, Case Based Reasoning.	**CO1,CO2 ,CO3**

IV	**Un Supervised Learning:** Partition methods of Clustering, Hierarchical methods, Density based clustering, Scalable Clustering Algorithms, Cluster Evaluation measures. **Association analysis**: Apriori algorithm, efficiently finding frequent itemsets with FP-growth.	**CO1,CO2 ,CO3**
V	**Reinforcement learning**: The learning Task, Elements of Reinforcement learning, Q-Learning, Model based Learning, Temporal Difference learning.	**CO1,CO4**

Text Book
1. Introduction to Machine Learning, EthemAlpaydin, Second Edition, 2010, Prentice Hall of India. 2. Machine Learning,AnuradhaSrinivasaraghavan,and Vincy Joseph,Kindle Edition,2020, WILEY.
References
1. Machine Learning by Tom M. Mitchell, International Edition 1997, McGraw Hill Education. 2."Deep Learning", Ian Goodfellow, YoshuaBengio, Aaron Courville, 2016, MIT Press. 3. Machine Learning a Probabilistic Perspective, Kevin P Murphy & Francis Bach, First Edition, 2012,MIT Press. 4. Introduction to Data Mining, Tan,Vipin Kumar,Michael Steinbach, Nineth Edition, 2013, Pearson
e-Resources and other Digital Material
1.https://www.coursera.org/learn/machine-learning 2.https://nptel.ac.in/courses/106/106/106106139/

Program Elective-III

Neural Networks

Course Code	19CS4602A	**Year**	III	**Semester**	II
Course Category	Program Elective-III	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Statistics and Probability
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the fundamentals and types of neural networks, Fuzzy logic principles.	**L2**
CO2	Apply Back propagation networks for various problems	**L3**
CO3	Apply Associative memory and Adoptive resonance theory for real world problemsand prepare an effective report.	**L3**
CO4	Apply ANN techniques for solving various problems	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
UNIT-1	**Introduction to Artificial Intelligence System:** Neural Network, Fuzzy logic, GeneticAlgorithm. **Fundamentals of Neural Networks: Basic Concepts of** Neural Network, Human Brain, Model of Artificial Neuron **Neural Network Architecture:** Single layer Feed-forward networks, Multilayer Feed-forward networks, Recurrent Networks, Characteristics of Neural networks, Learning methods,Early Neural Network Architectures-Rosenblatt's perceptron, Adaline Network, MADALINE Network.	**CO1**
UNIT-2	**Back propagation Networks:** Back Propagation networks, Architecture of Back-propagation(BP) Networks, Back-propagation Learning, Effect of Tuning parameters of the Back propagation Neural Network, Selection of various parameters in BPN.	**CO1, CO2**

UNIT-3	**Associative Memory:** Auto correlators, Heterocorrelators, Wang et al's Multiple Training Encoding Strategy, Exponential BAM, and Associative Memory for Real coded pattern pairs, Applications.	**CO1,CO2, CO3**
UNIT-4	**Adaptive Resonance Theory**: Introduction-Cluster structure, vector quantization, Classical ART networks, Simplified ART architectures, ART1-Architectre, Special features of ART1 models, ART1 algorithm, Illustration, ART2-Architecture of ART2,ART2 algorithm, Illustration, Applications-Character recognition using ART1.	**CO1, CO2, CO4**
UNIT-5	**Applications of ANN:** Introduction, Direct applications-Pattern Classification, Associative memories, Optimization. Application areas-Applications in speech, applications in image processing	**CO1,CO2, CO4**

Learning Resources
Text Books
1. Neural Networks,Fuzzy Logic and Genetic Algorithms, S.Rajasekaran and G.A. VijayalakshmiPai, second edition, 2017, PHI Publications. 2. Artificial neural network, B. Yegnanarayana, PHIPublication.
Reference Books
1. Neural Networks for Pattern Recognition, Bishop, C. M., 1995, Oxford University Press. 2. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee,PHI. 3. Build Neural Network with MS Excel sample by Joechoong.
e-Resources & Other Digital Material
1.https://www.coursera.org/learn/neural-networks-deep-learning 2. https://www.coursera.org/learn/machine-learning

Cyber Security

Course Code	19CS4602B	**Year**	III	**Semester**	II
Course Category	Program Elective - III	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Number Theory and Cryptography
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basics of cybercrime and offences	L2
CO2	Apply various security measures on mobile devices for a given scenario and make an effective report	L3
CO3	Apply various methods and tools used in Cyber Crime.	L3

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Cybercrime:** Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of **Cybercrimes, And Cybercrime:** The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.	CO1
II	**Cyber Offenses:** How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, **Cyber cafe and Cybercrimes, Botnets**: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.	CO1
III	**Cybercrime:** Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.	CO1,CO2
IV	**Tools and Methods Used in Cybercrime:** Introduction, Proxy	CO1,CO3

	Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.	
V	**Cyber Security:** Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.	CO1,CO3

Text Books
1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Prespectives, Nina Godbole and Sunil Belapure, First edition, 2011, Wiley INDIA.
References
1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, First edition, 2011, CRC Press. 2. Chwan-Hwa(John) Wu,J.David Irwin, Introduction to Cyber Security, First edition, 2013, CRC Press T&F Group.
e-Resources & Other Digital Material
1. http://nptel.ac.in/courses/106105031/lecture by Dr. DebdeepMukhopadhyay, IIT Kharagpur

Software Metrics

Course Code	19CS4602C	**Year**	III	**Semester**	II
Course Category	Professional Elective-III	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand various fundamentals of measurement and software metrics	**L2**
CO2	Apply frame work and analysis techniques for software measurement and write an effective report.	**L3**
CO3	Apply internal and external attributes of software product for effort estimation.	**L3**
CO4	Apply reliability models for predicting software quality	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Fundamentals of Measurement:** Measurement: what is it and why do it?: Measurement in Software Engineering, Scope of Software Metrics, **The Basics of measurement**: The representational theory of measurement, Measurement and models, Measurement scales and scale types, meaningfulness in measurement	**CO1**
II	**A Goal-Based Framework For Software Measurement:** Classifying software measures, Determining what to Measure, Applying the framework, Software measurement validation, Performing Software Measurement validation **Empirical investigation**: Principles of Empirical Studies, Planning Experiments, Planning case studies as quasi-experiments ,Relevant and Meaningful Studies	**CO1,CO2**
III	**Software Metrics Data Collection:** Defining good data ,Data collection for incident reports, How to collect data, Reliability of data collection Procedures **Analyzing software measurement data:** Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques	**CO2**
IV	**Measuring internal product attributes: Size** Properties of Software Size, Code size, Design size, Requirements analysis and Specification size, Functional size measures and estimators, Applications of size measures **Measuring internal product attributes: Structure:** Aspects of Structural Measures, Control flow structure of program units, Design-level Attributes, Object-oriented Structural attributes and measures	**CO3**
V	**Measuring External Product Attributes:** Modelling software quality, Measuring aspects of quality, Usability Measures, Maintainability measures, Security Measures **Software Reliability: Measurement and Prediction:** Basics of reliability theory, The software reliability problem, Parametric reliability growth models, Predictive accuracy	**CO3,CO4**

Learning Resources
Text Books
1. Software Metrics A Rigorous and Practical Approach,Norman Fenton, James Bieman , Third Edition, 2014
References
1. Software metrics,Norman E, Fenton and Shari Lawrence Pfleeger, International Thomson

Computer Press, 1997
2. Metric and models in software quality engineering,Stephen H.Kan, Second edition, 2002, Addison- Wesley Professional.
3. Measuring the Software Process, William A. Florac and Areitor D. Carletow, 1995, Addison – Wesley.
4. Practical Software Metrics for Project Management and Process Improvement, Robert B.Grady, 1992, Prentice Hall.

Cloud Computing

Course Code	19CS4602D	**Year**	III	**Semester**	II
Course Category	Program Elective-III	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks, Operating Systems
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Understand the basic concepts of Cloud Computing.	**L2**
CO2	Apply cloud computing services to commercial systems for deploying cloud	**L3**
CO3	Apply cloud computing concepts in various business sectors.	**L3**
CO4	Analyze different platforms in industry for building and training in cloud computing-related IT areas	**L4**

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction to Cloud:** Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. **Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.	**CO1**
II	**Cloud Computing Architecture :** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.	**CO1**
III	**Aneka:** Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction	**CO1,CO2**

	Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.	
IV	**Cloud Applications:** Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	**CO1,CO3**
V	**Cloud Platforms in Industry:** Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.	**CO1,CO4**

Learning Resources
Text Books
1. Mastering Cloud Computing, RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi, 2013, TMH.
References
1. RajkumarBuyya,JamesBroberg, AndrzejGoscinski, Cloud Computing Principles and Paradigms, Wiley Publishing inc. 2. George Reese, "Cloud Application Architectures", First Edition, O"Reilly, Media 2009. 3. Micheal Miller, "Cloud Computing – web based Applications that change the way you work and collaborate Online", .Pearson Education.
E-Resources and other Digital Material
1.http://www.slideshare.net/himanshuawasthi2109/cloud-computing-ppt-16240131 2. http://nptel.ac.in/courses/106105033/41 3. https://www.youtube.com/watch?v=r8Lu_BjxlZc 4.http://video.mit.edu/watch/mitef-nyc-cloud-computing-8347/

Web Application Development

Course Code	19CS3603	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	JAVA
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of web application development.	**L2**
CO2	Apply HTML, CSS and Java Script to create static and dynamic web pages.	**L3**
CO3	Apply JDBC API to interact with database and make an effective report.	**L3**
CO4	Apply the concepts of server side technologies for dynamic web applications.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**HTML:**Understanding 3-tier Web Architecture, Overview of HTTP, Introducing HTML document structure, Creating Headings on a web page, Working with links, Creating a Paragraph, Working with images, Working with tables, working with frames, Introduction to Forms and HTML controls. **Cascading Style Sheets:** Inline, Internal and External Style Sheets, Style class, Multiple styles.	**CO1, CO2**
II	**JavaScript:**Introducing DHTML, Introducing JavaScript, Client Side benefits of using JavaScript, Embedding JavaScript in an HTML page, Using Variables, Using Operators, Working with Control Flow statements, Working with functions, Handling Events, Using Arrays, Creating objects in JavaScript. **XML**: Introduction to XML: Syntax of XML, document structure, and document type definition.	**CO1, CO2**
III	**JDBC:**Java Database Connectivity: JDBC Connectivity, Types of JDBC drivers, Steps to write a JDBC application, JDBC Statements, Manipulations on the database.	**CO1, CO3**
IV	**Servlets:** Introduction to Servlets: Lifecycle of a servlet, the servlet api, the javax.servlet package, the javax.servlet.http package, handling http request & responses, Servlets with database connectivity. Introduction to Model View Controller (MVC): Architecture.	**CO1, CO4**
V	**JSP:**Introduction to JSP: The problem with servlet, the anatomy of a JSP page, JSP processing, JSP applications, JSP components, comments, expressions, scriptlets, JSP database connectivity	**CO1, CO4**

Learning Resources
Text Books
1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press. 2. Jason Hunter, William Crawford, Java Servlet Programming, Second edition, 2003, O'Reilly, 2003 3. Robert W.Sebesta, Programming the World Wide Web, Fourth edition, 2007, Pearson.
References
1. Internet and World Wide Web - How to program, Dietel and Nieto, 2006, PHI/Pearson Education. 2. JAVA The Complete References, Herbert Schildt, Eighth edition, 2014, McGraw Hill. 3. Web Technologies, UttamK.Roy, 2004, Oxford Higher Education publication. 4. Web Warrior Guide to Web Programming, Bai Ekedaw, 2012, Thompson Publications.

e-Resources and other Digital Material
1. www.w3schools.com 2. Prof. I. Sengupta. (14th, May, 2017), Department of Computer Science & Engineering, I.I.T.,Kharagpur, “Internet Technologies", NPTEL videos.

Engineering Ethics

Course Code	19CS3651	**Year**	III	**Semester**	II
Course Category	Mandatory Course	**Branch**	CSE	**Course Type**	Theory
Credits	1.5	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation :	100	**Semester End Evaluation:**	-	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the core values that shape the ethical behaviour of an engineer and Exposed awareness on professional ethics and human values.	**L2**
CO2	Understand the basic perception of profession, professional ethics, various moral issues&uses of ethical theories.	**L2**
CO3	Understand various social issues, Industrial standards, code of ethics and role of professional ethics in engineering field.	**L2**
CO4	Demonstrate responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.	**L3**
CO5	Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**HUMAN VALUES** Morals, values and Ethics –Integrity –Work ethic – Service learning –Civic virtue –Respect for others –Living peacefully – Caring –Sharing –Honesty –Courage –Valuing time –Cooperation – Commitment –Empathy –Self-confidence –Character –Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	**CO1**
II	**ENGINEERINGETHICS** Senses of "Engineering Ethics" –Variety of moral issues –Types of inquiry –Moral dilemmas –Moral Autonomy – Kohlberg‟s theory –Gilligan‟s theory –Consensus and Controversy – Models of professional roles –Theories about right action –Self-interest – Customs and Religion –Uses of Ethical Theories.	**CO2**
III	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as Experimentation –Engineers as responsible Experimenters –Codes of Ethics – A Balanced Outlook on Law.	**CO3**
IV	**SAFETY, RESPONSIBILITIESAND RIGHTS** Safety and Risk – Assessment of Safety and Risk –Risk Benefit Analysis and Reducing Risk – Respect for Authority –Collective Bargaining –Confidentiality –Conflicts of Interest – Occupational Crime –Professional Rights –Employee Rights – Intellectual Property Rights (IPR) –Discrimination.	**CO4**
V	**GLOBAL ISSUES** MultinationalCorporations–BusinessEthics-EnvironmentalEthics–ComputerEthics-Role in Technological Development–Weapons Development–Engineers as Managers–Consulting Engineers–Engineers as Expert Witnesses and Advisors–Honesty –Moral Leadership–Sample Code of Conduct.	**CO5**

Learning Resources
Text Books
1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003. 2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004. 2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –Concepts and Cases", Cengage Learning, 2009
e- Resources & other digital material

www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Compiler Design Lab

Course Code	19CS3651	**Year**	III	**Semester**	II
Course Category	Program Core	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-2	**Prerequisites**	
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply C, LEX and YACC programming to write a solution for the phases of compiler problems.	**L3**
CO2	Implement programs as an individual on different IDEs.	**-**
CO3	Develop an effective report based on various programs implemented.	**-**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs generated by executing C, LEX and YACC programs for different test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3											2		
CO2					3				3			3		
CO3										3				
CO4	3									3				
CO5		3												

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Design aLexicalanalyzerforthegivenlanguage. The lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value.	**CO1,CO2,CO3,CO4,CO5**
2	(a) Implement the lexical analyzer using LEX program for the regular expression RE's: a(a+b)* (b) Implement the LEX program to implement RE's: (a+b)*abb(a+b)*	**CO1,CO2,CO3,CO4,CO5**
3	(a) Implement the lexical analyzer using JLEX, FLEX or LEX or other lexical analyzer generating stools. (b) Implement the lexical analyzer Program to count no of +ve and –ve integers using LEX	**CO1,CO2,CO3,CO4,CO5**
4	(a) Implement the lexical analyzer Program to count the number of vowels and consonants in a given string. (b) Implement the lexical analyzer Program to count the number of characters, words, spaces, end of lines in a given input file.	**CO1,CO2,CO3,CO4,CO5**
5	Implement a 'C' program to calculate First and Follow sets of given grammar	**CO1,CO2,CO3,CO4,CO5**
6	Design Predictive parser for the given language.	**CO1,CO2,CO3,CO4,CO5**
7	Implementation of Shift Reduce Parsing Algorithm.	**CO1,CO2,CO3,CO4,CO5**
8	Design LALR bottom up parser for the given language. (Implementation of calculator using YACC)	**CO1,CO2,CO3,CO4,CO5**
9	Convert the BNF rules into YACC form and write code to generate abstract syntax tree.	**CO1,CO2,CO3,CO4,CO5**
10	Generation of Code for a given Intermediate Code.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ulman, Second Edition, Pearson Education.
2. Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.

References
1. lex&yacc – John R. Levine, Tony Mason, Doug Brown, O‟reilly 2. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wileydreamtech. 3. Engineering a Compiler-Cooper & Linda, Elsevier. 4. Compiler Construction, Louden, Thomson. 5. Principles of compiler design, V. Raghavan, Second edition,TMH,2011.
e-Resources and other Digital Material
1. http://www.nptel.iitm.ac.in/downloads/106108052/

Web Application Development Lab

Course Code	19CS3652	**Year**	III	**Semester**	II
Course Category	Program Core Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1	**L-T-P**	3-0-0	**Prerequisites**	JAVA
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply web technologies to develop applications.	**L3**
CO2	Implement various applications as an individual or team member	**-**
CO3	Develop an effective report based on various programs implemented	**-**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs of web based applications	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3											2		
CO2					3				3					
CO3										3				
CO4	3									3				
CO5		3												

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Design static web sites with html tags by taking different examples.	**CO1, CO2, CO3, CO4, CO5**
2	Design web pages using different types of CSS.	**CO1, CO2, CO3, CO4, CO5**
3	Apply Client side validations using JavaScript	**CO1, CO2, CO3, CO4, CO5**
4	Create an XML file for student/employee/book data and validate against DTD	**CO1, CO2, CO3, CO4, CO5**
5	Develop different JDBC applications to interact with database.	**CO1, CO2, CO3, CO4, CO5**
6	Create different web applications using servlets	**CO1, CO2, CO3, CO4, CO5**
7	Develop different web applications using JSP	**CO1, CO2, CO3, CO4, CO5**
8	Build web applications (case studies) based on the **choice of student/faculty**	**CO1, CO2, CO3, CO4, CO5**

Learning Resources
Text Books
1.Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press, 2009 2. JavaServer Pages,Hans Bergsten, Thirrd Edition, 2017, O'Reilly Media
Reference Books:
1. The Complete reference to J2EE, Jim Keogh, 2017, Tata McGrawHill. 2. Advanced Java 2 Platform How to Programl, H. M. Deitel, P.J. Deitel, S.E. Santry, Third Edition, 2016, Prentice Hall Publications. 3. Java Servlet Programming, Jason Hunter, William Crawford, Second edition, 2003 O'Reilly.
e- Resources & other digital material
1. www.w3schools.com 2. Prof. I. Sengupta. (14th , May, 2017), Department of Computer Science & Engineering, I.I.T.,Kharagpur, "Internet Technologies", NPTEL videos.

IV B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1701	OrganizationBehavior	3	0	0	3	30	70	100
19CS3701	Mobile ApplicationDevelopment	3	0	0	3	30	70	100
19CS4701	ProgramElective-IV	3	0	0	3	30	70	100
19CS4702	ProgramElective-V	3	0	0	3	30	70	100
	InterdisciplinaryElectiveII	3	0	0	3	30	70	100
19CS3751	Mobile ApplicationDevelopment Lab	0	0	2	1	25	50	75
19CS3761	ProjectPhase-I	0	0	4	2	100		100
19CS3771	IndustrialTraining/Internship/ResearchProjects in NationalLaboratories/AcademicInstitutions	0	0	0	2	75		75
Total		**15**	**0**	**6**	**20**	**350**	**400**	**750**

Program Elective-IV

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Deep Learning	PE	3	0	0	3
2	**Networks and Security**	Adhoc and Sensor Networks	PE	3	0	0	3
3	**Software Engineering**	Agile Software Development	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Parallel Computing	PE	3	0	0	3

Program Elective-V

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Big Data	PE	3	0	0	3
2	**Networks and Security**	Cyber Forensics	PE	3	0	0	3
3	**Software Engineering**	Software Testing Methodologies	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Fundamentals of Block Chain Technology	PE	3	0	0	3

Organization Behaviour

Course Category:	HS	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practical:**	3-0-0
Prerequisites:	Nil	**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to:	
CO1	Demonstrate the applicability of the concept of organizational behaviour to understand the behaviour and culture of people in the organization.
CO2	Demonstrate the applicability of analyzing the complexities associated with management of individual behaviour in the organization.
CO3	Analyze the complexities associated with management of the group behaviours (Group Dynamics) in the organization and role of leadership.
CO4	Demonstrate how the organizational behaviour can integrate in understanding the motivation for creating positive work culture.
CO5	Demonstrate how the organizational behaviour can influence in understanding the importance of learning and leadership for an organization to create positive impact.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1								3	3		2			3
CO 2								3	3		2			3
CO 3								3	3		2			3
CO 4								3	3		2			3
CO 5								3	3		2			3

Course Content		
UNIT-1	**Introduction to Organizational Behaviour and Culture:** Definition-Nature-Scope-Roles of Manager- Challenges-Opportunities- Creating and Maintaining Organizational Culture	**CO1**
UNIT-2	**Foundations of Individual Behaviour:** Perception: Definition-Factors- The Perception Process- Motivation: Definition- Factors-Theories of Motivation: Maslow's Hierarchy Theory of Needs-Herzberg's Theory-Expectancy Theory	**CO2**
UNIT-3	**Foundations of Group Behaviour:** Group-Definition- Types of Groups- Stages of Group Development- Group Decision Making- techniques-Johari Window-Transactional Analysis	**CO3**
UNIT-4	**Managing Group Behaviour**- Team- Definition- Types of Teams- Team Building- Conflict – Intra-Personal and Inter Personal Conflict	**CO4**
UNIT-5	**Leadership**- Definition- Types- Theories of Leadership: Trait theories-Contingency theories-**Learning**- Definition- Theories of Learning	**CO5**

Learning Resources
Text Books
1. Aswathappa K., "Organizational Behavior-Text, Cases and Games", Himalaya Publishing House, New Delhi, 2008. 2. Stephen B. Robbins, "Organizational Behavior", PHI, New Delhi, 2008
Reference Books
1. PareekUdai: "Understanding Organizational Behavior", Oxford University Press, New Delhi, 2007. 2. Sharma V.S., Veluri: "Organizational Behavior", JAICO Publishing House, New Delhi, 2009. 3. Mary Ann Von Glinow, Radha R. Sharma, Steven L. McShane, "Organizational Behavior", Tata McGraw Hill Education, New Delhi, 2008.

Mobile ApplicationDevelopment

Course Code	19CS3701	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Java, Database Management Systems, Advanced Java and Web Technologies
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basic concepts of android studio development environment	**L2**
CO2	Apply UI components to develop applications and make an effective report.	**L3**
CO3	Apply Database APIs to develop applications	**L3**

Syllabus		
Unit No.	**Course Content**	**Mapped CO**
UNIT-1	**Beginning Android and Java:** Introduction to Android Platform, Android vs. other mobile platforms, Android Stack, Android Versions, Why Java in Android?, How Java and Android work together, The structure of Android's Java code, Android emulator, Sample programs on emulator	**CO1**
UNIT-2	**Java, XML, and the UI Designer:** Examining the logcat output, Exploring the project Java and the main layout XML, Working with common widgets, Writing our first Java code, Activity life cycle demo app	**CO1, CO2**

UNIT-3	**Getting Started with Layouts:** Introducing layouts, Building a precise UI with Constraint Layout, Laying out data with TableLayout, Android Dialog Windows: Dialog windows, Coding the Fragment classes and their layouts	**CO3**
UNIT-4	**Data Persistence and Sharing:** Android intents, Switching Activity, Passing data between activities, Persisting data with Shared Preferences, Reloading data with Shared Preferences, What is JSON?	**CO4**
UNIT-5	**Android Databases:** What is a database? What is SQLite? SQL syntax primer, Android SQLite API, Coding the database class	**CO1,CO4**

Learning Resources

Text Books

1. Android Programming for Beginners: Build in-depth, full-featured Android apps starting from zero programming experience, John Horton, 3rd Edition, 2021, PACKT Publishers.

Reference Books

1. Head First Android Development: A Brain-Friendly Guide, Dawn Griffiths, David Griffiths,2015, O′Reilly
2. Android 9 Development Cookbook, Rick Boyer, 3rd Edition, 2018, Packt Publishers
3. Android Programming: Pushing the Limits Paperback – Illustrated, Erik Hellman, 2013, Wiley
4. Professional Android, Reto Meier, Ian Lake, 4th Edition, 2018, Wrox

ProgramElective-IV

Deep Learning

CourseCode	19CS4701A	**Year**	IV	**Semester**	I
CourseCategory	Program Elective - IV	**Branch**	CSE	**CourseType**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning, Neural Networks
ContinuousInternalEvaluation:	30	**Semester EndEvaluation:**	70	**TotalMarks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental techniques and principles of deep learning.	**L2**
CO2	Apply concepts and major architectures of deep networks to build solutions for variety of problems.	**L3**
CO3	Apply Deep learning techniques to build applications in various domains.	**L3**
CO4	Analyze CNN techniques to classify images and detect objects and prepare an effective report.	**L4**

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**A Review of Machine Learning –** The Learning Machines, How Can Machines Learn? Biological Inspiration, What Is Deep Learning?,**Fundamentals of Deep Networks** – Defining Deep Learning, What Is Deep Learning? Common Architectural Principles of Deep Networks: Parameters, Layers, Activation Functions, Loss Functions, Hyperparameters.	**CO1, CO2**
II	**Building Blocks of Deep Networks –** RBMs, Autoencoders, Variational Autoencoders. **Major Architectures of Deep Networks:** Unsupervised pretrained networks, Deep Belief Networks, Generative Adversarial Networks.	**CO1, CO2**

III	**Convolutional Neural Networks (CNNs) –** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Applications.	**CO1, CO4**
IV	**Sequence Modeling – Recurrent and Recursive Nets** – Unfolding Computational Graphs, Recurrent Neural Networks, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs, Applications.	**CO1, CO3**
V	**Deep Learning applications –** Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.	**CO1, CO3**

Learning Resources

Text books

1. Deep learning: A practitioner's approach,Josh Patterson and Adam Gibson, First Edition, 2017, O'Reilly Media.
2. Deep Learning,Ian Goodfellow, YoshuaBengio, Aaron Courville, 2016, MIT Press.

References

1. Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O'Reilly,
2. Deep learning Cook Book, Practical recipes to get started Quickly, DouweOsinga, O'Reilly, 2019,Shroff Publishers.

e-Resources and other Digital Material

1. https://www.deeplearningbook.org/
2. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3. https://www.udemy.com/share/101X6W/ (or) https://www.udemy.com/course/deep-learning-advanced-nlp/
4. https://www.youtube.com/watch?v=5tvmMX8r_OM&list=PLtBw6njQRU-rwp5__7C0oIVt26ZgjG9NI

Adhoc Sensor Networks

Course Code	19CS4701B	**Year**	IV	**Semester**	I
Course Category	Program Elective - IV	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the Basic Concepts of Adhoc Sensor Networks	**L2**
CO2	Apply appropriate MAC Protocols for a given scenario	**L3**
CO3	Apply suitable Routing/Transport Protocols for a given scenario and write an effective report	**L3**
CO4	Apply Data Dissemination/Localization aspects in the context of WSN	**L3**
CO5	Apply suitable QoS Framework/models to enhance quality of Service in WSN	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Adhoc Wireless Networks** – Introduction, Issues In Ad Hoc Wireless Networks, Ad Hoc Wireless Internet **Mac Protocols For Ad Hoc Wireless Networks** – Design Goals Of A Mac Protocol For Ad Hoc Wireless Networks, Classifications Of MAC protocols, Contention-Based Protocols, Contention-Based Protocols With Reservation Mechanisms, Contention-Based MAC protocols With Scheduling Mechanisms, Other MAC protocols.	**CO1**
II	**Routing Protocols For Ad Hoc Wireless Networks -** Issues In Designing A Routing Protocol For Ad Hoc Wireless Networks, Classifications Of Routing Protocols, Table-Driven Routing Protocols, On-Demand Routing Protocols, Hybrid	**CO1,CO2**

	Routing Protocols, **Multicast Routing In Ad Hoc Wireless Networks** – Tree-Based Multicast Routing Protocols, Mesh-Based Multicast Routing Protocols, Energy-Efficient Multicasting	
III	**Transport Layer And Security Protocols For Ad Hoc Wireless Networks** – Issues In Designing A Transport Layer Protocol For Ad Hoc Wireless Networks, Design Goals Of A Transport Layer Protocol For Ad Hoc Wireless Networks, Classification Of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Security In Ad Hoc Wireless Networks.	**CO1,CO3**
IV	**WirelessSensorNetworksAndMacProtocols**- WSNNetworkarchitecture, data dissemination, MAC Protocols For Sensor Networks: self-organizing, Hybrid TDMA/FDMAand CSMA based MAC, Location Discovery	**CO1,CO4**
V	**Quality Of Service In Ad Hoc Wireless Networks**– QoS Frameworks For Ad Hoc Wireless Networks:QoS Models. **Quality Of A Sensor Network**, Other Issues - EnergyEfficientDesign-Synchronization-TransportLayer issues.	**CO1,CO5**

Learning Resources

Text Books

1. Ad Hoc Wireless Networks – Architectures and Protocols, C. Siva Ram Murthy and B.S. Manoj, 2004, Pearson Education.

References

1. Wireless Sensor Networks – An Information Processing Approach, Feng Zhao and Leonidas Guibas, 2004, Elsevier Publications.
2. Protocols and Architectures for Wireless SensorNetworks, Holger Karl and Andreas Willig, 2009, John Wiley and Sons.

e-Resources & Other Digital Material

1. https://nptel.ac.in/courses/106/105/106105160/
2. https://www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf

Agile Software Development

Course Code	19CS4701C	**Year**	IV	**Semester**	I
Course Category	Program Elective - IV	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering, Software Metrics, Software project management
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of agile methods in various development environments	L2
CO2	Apply the concepts of Xtreme programming in projects and make an effective report.	L3
CO3	Apply the Techniques of Feature-Driven Development to deliver tangible software results.	L3
CO4	Analyzethe given scenario and chose appropriate Agile methods/ tools for software Development.	L4

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** The Agile manifesto, Agile methods, XP: Extreme Programming, DSDM, SCRUM, feature- Driven Development, modeling misconceptions, agile modeling, tools of misconceptions, updating agile models.	**CO1**
II	**Extreme Programming:** Introduction, core XP values, the twelve XP practices, about extreme programming, planning XP projects, test first coding, making pair programming work.	**CO1,CO2**
III	**Agile Modeling and XP**: Introduction, the fit, common practices, modeling specific practices, XP objections to agile modeling, agile modeling and planning XP projects, XP implementation phase	**CO1,CO2**
IV	**Feature-Driven Development:** Introduction, incremental software development, Regaining Control, The motivation behind FDD, planning an iterative project, architecture centric, FDD and XP	**CO1,CO3**
V	**Agile Methods with RUP and PRINCE2 and Tools and Obstacles**: Agile modeling and RUP, FDD and RUP, agile methods and prince2, tools to help with agile development, Eclipse, An agile IDE, obstacles to agile software development, management intransigence, the failed project syndrome, contractual difficulties, familiarity with agility.	**CO1,CO4**

Learning Resources
Text Books
1. Agile and Iterative Development: a manager's guide, Craig Larman, First edition, 2004, Addison Wesley.
References
1. The Art of Agile Development,Pearson, Robert C. Martin,Juli, James Shore, Chromatic, First edition, 2013, O'Reilly Media. 2. Software Project Management, Rajibmal, Sixth edition, 2017, McGraw Hill Education. 3. Agile software construction,John hunt, First edition, 2005, springer.
e-Resources and other Digital Material
1. https://agilesoftwaredevelopment.com

Parallel Computing

Course Code	19CS4701D	**Year**	IV	**Semester**	I
Course Category	Program Elective - IV	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Operating Systems, Computer Organization
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the concepts of Parallel computing/programming	**L2**
CO2	Apply various Distributed programming Algorithms for a given Program.	**L3**
CO3	Apply various Shared Memory Programming methods with Pthreads/OpenMP on a given matrix/program.	**L3**
CO4	Apply parallelism and searching for a given tree structure.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Parallel Computing**: Need of Performance, Building Parallel Systems, Why to Write Parallel Programs? How to Write Parallel Programs? Approach : Concurrent, Parallel, Distributed **Parallel Hardware and Parallel Software :**Background, Modifications to the von Neumann Model, Parallel Hardware, Parallel Software, Input and Output, Performance, Parallel Program Design and Writing and Running Parallel Programs	**CO1**
II	**Distributed Memory Programming with MPI:** Getting Started, The Trapezoidal Rule in MPI, Dealing with I/O, Collective Communication, MPI Derived Data types, A Parallel Sorting Algorithm**.**	**CO1,CO2**

III	**Shared Memory Programming with Pthreads** : Processes, Threads and Pthreads, Hello, World program ,Matrix-Vector Multiplication, Critical Sections Busy-Waiting, Mutexes, Producer-Consumer Synchronization and Semaphores, Barriers and Condition Variables, Read-Write Locks, Caches, Cache-Coherence, and False Sharing and Thread-Safety	**CO1,CO3**
IV	**Shared Memory Programming with OpenMP :** Introduction to Open MP, The Trapezoidal Rule, Scope of Variables, The ReductionClause, The Parallel For Directive, More About Loops in OpenMP: Sorting, SchedulingLoops, Producers and Consumers, Caches, Cache-Coherence, and False Sharing andThread-Safety	**CO1,CO3**
V	**Parallel Program Development and Parallel Algorithms :** Two N-Body Solvers, Tree Search and Case Studies	**CO1,CO4**

Learning Resources

Text Books

1. An Introduction to Parallel Programming, Peter S Pacheco, 2011, Elsevier India.

References

1. Parallel Programming for Multicore and Cluster Systems, Thomas Rauber, GudulaRünger, Second Ed., Springer, 2015
2. Introduction to Parallel Computing(From Algorithms to Programming on State-of-the-Art Platforms), Roman Trobec, BoštjanSlivnik, Patricio Bulić, BorutRobič, 2018, Springer Nature Switzerland.
3. Introduction to Parallel Computing,AnanthGrama, Anshul Gupta, George Karypis&Vipin Kumar, Second edition, 2004, Pearson Education

e-Resources & Other Digital Material

1. www. https://www.udemy.com/
2. https://www.coursera.org/

ProgramElective-V

Big Data

Course Code	19CS4701A	**Year**	IV	**Semester**	I
Course Category	Program Elective-V	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of big data	**L2**
CO2	Apply the concept of HDFS, Map reduce,Spark for storing and processing of Big data	**L3**
CO3	Apply Hive for working with Big data and formulate an efficient report	**L3**
CO4	Apply various analytics mechanisms to design a recommender system.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Meet Hadoop:** Data, Data Storage and Analysis, Querying All Your data, Beyond Batch, Comparison with Other Systems: Relational database Management Systems, Grid Computing, Volunteer Computing, A Brief History of Apache Hadoop. **Map Reduce:** A Weather Dataset: Data Format, Analyzing the data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java Map Reduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed Map Reduce Job.	**CO1,CO2**
II	**The Hadoop Distributed Filesystem:** The Design of HDFS, HDFS Concepts, The Command Line Interface, Hadoop File systems, The Java Interface, Data Flow, Parallel Copying with distcp.	**CO1,CO2**

III	**Hive:** Hive Shell, An Example, Running Hive: Configuring Hive, Hive Services, The Metastore, Comparison with Traditional Databases: Schema on Read Versus Schema on write, Updates, transactions, and Indexes, SQL-on Hadoop Alternatives, **HiveQL:** Data Types, Operators and Functions and Tables: managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables and Dropping Tables.	**CO1,CO3**
IV	**Spark:** Installing Spark, An Example: Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables: Broadcast Variables, Accumulators, Anatomy of a Spark Job: Run: Job Submission, DAG Construction, Task Scheduling, Task Execution	**CO1,CO2**
V	**Use case Study:** Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative Filtering System and Content Based Recommendations.	**CO1,CO4**

Text Book

1. Hadoop: The Definitive Guide, Tom White, Fourth Edition, 2015, O'Reilly.
2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley

References

1. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers
2. Big Data and Analytics, Seema Acharya, SubhashiniChellappan, First Edition, 2015, Wiley.
3. Big data analytics with R and Hadoop, VigneshPrajapati, First Edition, 2013, SPD.
4. Spark: The Definitive Guide :Big Data Processing Made simple, Bill Chambers and MateiZaharia, First Edition, 2018, O'Reilly

e-Resources and other Digital Material

1. https://nptel.ac.in/courses/106/104/106104189/
2.https://www.coursera.org/specializations/big-data
3..https://www.edx.org/course/big-data-fundamentals

Cyber Forensics

Course Code	19CS4801B	**Year**	IV	**Semester**	II
Course Category	Program Elective - V	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand Fundamentals of Cyber Forensics, Tools and Techniques	**L2**
CO2	Apply digital techniques for processing of crime evidence and incident scenes for a given scenario	**L3**
CO3	Apply various Disk management techniques/File Structures for Examining and investigating a given case and make an effective report	**L3**
CO4	Apply various digital forensics tools and methods on various platforms for a given scenario	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Understanding the Digital Forensics Profession and Investigations:** An Overview of Digital Forensics, Preparing for Digital Investigations, Maintaining Professional Conduct, Preparing a Digital Forensics Investigation, Conducting an Investigation. **Data Acquisition:** Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools.	**CO1**
II	**Processing Crime and Incident Scenes**: Identifying Digital Evidence, Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes, Preparing for a Search, Securing a Digital Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash	**CO1,CO2**

III	**Working with Windows and CLI Systems:** Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding Virtual Machines	**CO1,CO3**
IV	**Current Digital Forensics Tools:** Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software **Digital Forensics Analysis and Validation:** Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques. **Network Forensics:** Network Forensics Overview: The Need for Established Procedures, Securing a Network, Developing Procedures for Network Forensics, Investigating Virtual Networks, Examining the Honeynet Project.	**CO1,CO4**
V	**E-mail and Social Media Investigations**: Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Applying Digital Forensics Methods to Social Media Communications. **Mobile Device Forensics and the Internet of Anything:** Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices, Understanding Forensics in the Internet of Anything. **Cloud Forensics:** Basic Concepts of Cloud Forensics, Conducting a Cloud Investigation, Tools for Cloud Forensics	**CO1,CO4**

Learning Resources
Text Books
1. Guide to Computer Forensics and Investigations, Bill Nelson, Amelia Phillips, Christopher Steuart, Sixth edition, 2020, Cengage Learning India Pvt. Ltd.
References
1 Investigating the Cyber Breach: The Digital Forensics Guide for the Network Engineer, Lakhani Joseph,Muniz,Aamir, First edition, 2018, PearsonEducation. 2 Digital Forensics Basics: A Practical Guide Using Windows OS,Nihad A. Hassan, First edition, 2019, Apress. 3 Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications,JoakimKävrestad,First edition, 2018,Springer International Publishing.
e-Resources & Other Digital Material
1. https://www.udemy.com/topic/computer-forensics/ 2. https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst

SOFTWARE TESTING METHODOLOGIES

Course Code	19CS4702C	**Year**	IV	**Semester**	I
Course Category	Professional Elective-V	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering, Software Requirements Management
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Understand fundamentals of software testing strategies and principles.	L2
CO2	Apply various software testing strategies to the projects and make an effective report.	L3
CO3	Apply concepts and principles of test suite management for efficient test casegeneration	L3
CO4	Analyze and choose suitable modern software testing tools for a given project	L4

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction:** Software testing definition, evaluation of software testing, software testing myths and facts, goals and model of software testing, software testing terminology, software testing life cycle, testing methodology.	**CO1**
II	**Dynamic testing:** Black-Box testing: Boundary value analysis, equivalence class testing. White-box testing: Introduction, basic path testing, loop testing. **Static testing:** inspections, structured walkthroughs, Technical Reviews	**CO1, CO2**
III	**Validation activities:** Module validation testing, integration testing, function testing, system testing, accepting testing. **Regression Testing:** Objectives of regression testing, regression testing	**CO1** **CO2**

	types, regression testing techniques.	
IV	**Test management:** Test organization, structure of testing group, test planning, test design and test specification. **Efficienttestsuitemanagement:**Introduction,minimizingthetestsuit eanditsbenefits,definingtest suite minimization problem, test suite prioritization, types of test case prioritization, prioritization techniques.	**CO1** **CO3**
V	**Automation and Testing Tools:** need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing, overview of some commercial testing tools. Testing Object Oriented Software: basics, Object oriented testing	**CO1, CO4**

Learning Resources
Text Books
1. Software Testing: Principles and Practices, Naresh Chauhan, Second edition, Oxford.
References
1. Software testing techniques, BarisBeizer, Second edition, 2009, International Thomson computer press,DreamTech. 2. Foundations of Software testing, Aditya P Mathur, Second edition, 2013, Pearson.
e-Resources and other Digital Material
1. https://nptel.ac.in/courses/106/105/106105150/ 2. http://www.nptelvideos.in/2012/11/software-engineering.html

Fundamentals of Block Chain Technology

Course Code	19CS4701D	**Year**	IV	**Semester**	I
Course Category	Program Elective-V	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Database Management System, Distributed Systems, Cryptography
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Understand the basic principles of block chain technology	**L2**
CO2	Apply cryptographic functions along with their implementation strategies.	**L3**
CO3	Analyze the various protocols and mining techniques in Block chain	**L4**

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Block chain Fundamentals:** Tracing Block chain's Origin, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business? **Introduction to Cryptography:** Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.	**CO1**
II	**Digital Signatures:** Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency.	**CO1,CO2**
III	Centralization vs. Decentralization, Distributed Consensus, Consensus without identity using a block chain, Incentives and proof of work. **Mechanics of Bit coin**: Bit coin transactions, Bit coin Scripts, Applications of Bit coin scripts, Bit coin blocks, The Bit coin network.	**CO1,CO3**
IV	**Storage of and Usage of Bit coins:** Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.	**CO1,CO3**

V	**Bit coin Mining:** The Task of Bit coin miners, Mining Hardware, Mining pools, Mining incentives and strategies. **Bit coin and Anonymity:** Anonymity Basics, Mixing, Zero coin and Zero cash	**CO3**

Learning Resources

Text Books

1. BlockChain for dummies, Manav Gupta, Second IBM Limited Edition, 2018, John Wiley & Sons.
2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, 2016.

References

1. Blockchain: Blueprint for a New Economy,Melanie Swan, First edition, 2015, O'Reilly Media.
2. Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, Mastering, Second edition, 2017, O'Reilly Media.

e-Resources and other Digital Material

1. https://nptel.ac.in/courses/106/104/106104220/
2. https://nptel.ac.in/courses/106/105/106105184/

Mobile Application Development Lab

Course Code	19CS3751	**Year**	IV	**Semester**	I
Course Category	**Program Core Lab**	**Branch**	CSE	**Course Type**	Practical
Credits	1	**L-T-P**	0-0-2	**Prerequisites**	Java, DBMS, Advanced Java and Web Technologies
Continuous Internal Evaluation :	25	**Semester End Evaluation:**	50	**Total Marks:**	75

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply the basic of android to develop android applications	**L3**
CO2	Develop various applications as an individual or team	
CO3	Develop an effective report based on various programs implemented	
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs generated using android application	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3											2		
CO2					3				3					
CO3										3				
CO4	3									3				
CO5		3												

Course Content		
Expt. No.1	Build mobile application based on the concept activity life cycle with Custom Toast.	CO1, CO2, CO3, CO4, CO5
Expt. No.2	Build mobile application using different layouts(use any 3 layouts)	CO1, CO2, CO3, CO4, CO5
Expt. No.3	Build mobile application using different dialogs(use any 2 dialogs)	CO1, CO2, CO3, CO4, CO5
Expt. No.4	Build mobile application using Menus and Action bar	CO1, CO2, CO3, CO4, CO5
Expt. No.5	Build mobile application to switch from one activity to another using Intent.	CO1, CO2, CO3, CO4, CO5
Expt. No.6	Build mobile application to demonstrate Dynamic Fragments	CO1, CO2, CO3, CO4, CO5
Expt. No.7	Build mobile application for CMS (Content Management System)with CURD operations	CO1, CO2, CO3, CO4, CO5
Expt. No.8	Build mobile application for Online Enquiry System with CURD operations	CO1, CO2, CO3, CO4, CO5
Expt. No.9	Build mobile application (case study) based on the choice of student/faculty	CO1, CO2, CO3, CO4, CO5

Learning Resources

Reference Books

1. Professional Android, Reto Meier, Ian Lake, Fourth Edition, 2018, Wrox
2. Head First Android Development: A Brain-Friendly Guide, Dawn Griffiths, David Griffiths, 2015, O′Reilly

***Note: The above experiments are listed in generic format. Course Coordinators are advised to implement the above generic experiments using emerging technologies like: Flutter / Android Studio / .net core 5 …**

IV B. TECH – II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19CS4801	ProgramElective-VI	3	0	0	3	30	70	100
	InterDisciplinaryElective-III	3	0	0	3	30	70	100
19CS3861	ProjectPhase-II	0	0	14	7	100	100	200
Total		**6**	**0**	**14**	**13**	**160**	**240**	**400**

Program Elective-VI

S. No	Stream	Course Title	Category	L	T	P	C
1	**AI & Machine Learning**	Natural Language Processing	PE	3	0	0	3
2	**Networks and Security**	Advances in Internet of Things	PE	3	0	0	3
3	**Software Engineering**	Secure Software Engineering	PE	3	0	0	3
4	**Distributed and Cloud Computing**	Big Data	PE	3	0	0	3

Natural Language Processing

CourseCode	19CS4801A	**Year**	IV	**Semester**	II
CourseCategory	Program Elective-VI	**Branch**	CSE	**CourseType**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
ContinuousInternal Evaluation :	30	**SemesterEnd Evaluation:**	70	**TotalMarks:**	100

CourseOutcomes		
Uponsuccessfulcompletionofthe course,thestudentwill beableto		
CO1	Understand the fundamental concepts of natural language processing/generation.	**L2**
CO2	Apply basic evaluating language models for the probability of the test set.	**L3**
CO3	Apply techniques for extracting limited forms of semantic content from texts.	**L3**
CO4	Analyze parsing algorithms through the use of context-free grammars and prepare an effective report.	**L4**

Syllabus		
UnitNo	**Contents**	**MappedCO**
I	**Regular Expressions, Text Normalization, Edit Distance-** Regular Expression, Words, Corpora, Text Normalization, Minimum Edit Distance. **N-Gram Language Models-**NGrams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, The web and stupid Backoff, Advanced Perplexity's Relation to Entropy.	**CO1, CO2**
II	**Labeling for Parts of Speech-** English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.	**CO1, CO2**
III	**Formal Grammars of English-** Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars. **Syntactic Parsing-** Ambiguity, CKY Parsing: A Dynamic Programming Approach, Span-Based Neural	**CO1, CO4**

	Constituency Parsing, Evaluating Parsers, Partial Parsing CCG Parsing.	
IV	**Dependency Parsing-** Dependency Relations, Dependency Formalisms, Dependency Treebanks, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing, Evaluation. **Representation of Sentence Meaning-** Computational Desiderata for Representations, Model-Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics.	**CO1, CO3**
V	**Semantic Parsing, Information Extraction-** Relation Extraction, Relation Extraction Algorithms, Extracting Times, Extracting Events and their Times, Template Filling. **Lexicons for Sentiment, Affect and Connotation-** Defining Emotion, Available Sentiment and Affect Lexicons, Creating Affect Lexicons by Human Labeling, Semi-supervised Induction of Affect Lexicons, Supervised Learning of Word Sentiment, Using Lexicons for Sentiment Recognition, Other tasks: Personality, Affect Recognition, Lexicon-based methods for Entity-Centric Affect.	**CO1, CO3**

Learning Resources
Text Books
1. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin, Third Edition, 2020.
References
1. Natural Language Processing Recipes, Akshay Kulkarni, AdarshaShivananda, 2019, Apress. 2. Applied Text Analysis with Python, Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, 2018, O'Reilly Media. 3. Natural Language Processing: An information Access Perspective by Kavi Narayana Murthy, 2006, EssEss Publications. 4. Statistical Language Learning, Charniack, Eugene, 1993, MIT Press.
e-Resources and other Digital Material
1. https://web.stanford.edu/~jurafsky/slp3/ 2. https://swayam.gov.in/nd1_noc19_cs56/preview 3. https://online.stanford.edu/courses/xcs224n-natural-language-processing-deep-learning 4. https://www.coursera.org/specializations/natural-language-processing

ADVANCES IN INTERNET OF THINGS

Course Code	19CS4801B	**Year**	IV	**Semester**	II
Course Category	**Program Elective-VI**	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Internet of Things
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basic concepts of IoT - Applications, Architectures	**L2**
CO2	Apply data and analytics for IoT	**L3**
CO3	Apply IoT in the areas of Manufacturing, Agriculture and develop applications for the benefit of society	**L3**
CO4	Analyze various smart components and architectures to develop smart cities and transportation applications	**L4**

Course Content		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges. **IoT Network Architecture and Design:** Drivers Behind New Network Architectures, Comparing IoT Architectures , A Simplified IoT Architecture, The Core IoT Functional Stack , IoT Data Management and Compute Stack	**CO1**
II	**Data and Analytics for IoT:** An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics	**CO2**
III	**IoT in Industry:**Manufacturing- An Introduction to Connected Manufacturing, An Architecture for the Connected Factory. **Smart Farming and Smart Agriculture:** Climate condition monitoring and automate system, IoT Based Smart Irrigation Monitoring and Controlling System, Monitoring and Discrimination of Plant Disease and Insect Pests based on agricultural IoT	**CO3**
IV	**IoT for Smart and Connected Cities:** An IoT Strategy for Smarter Cities, Smart City IoT Architecture, **Smart City Use-Case Examples**	**CO1, CO4**

V	**IoT for Transportation:** Transportation Challenges, IoT Use Cases for Transportation, An IoT Architecture for Transportation.	**CO1, CO4**

Learning Resources
Text Books
1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, 2017, Pearson Press. 2. AI, Edge and IoT-based Smart Agriculture, Ajith Abraham Sujata Dash Joel J.P.C. Rodrigues Biswaranjan Acharya Subhendu K. Pani, First Edition, 2021, Academic Press
Reference Books
1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases. Pethuru Raj and Anupama C. Raman, 2017, CRC Press. 2. "Internet of Things (A Hands-onApproach)", Vijay Madisetti and ArshdeepBahga, 1/e, VPT, 2014.
e-Resources and other Digital Material
1. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html.

Secure Software Engineering

Course Code	19CS4701C	**Year**	IV	**Semester**	II
Course Category	Program Elective-VI	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering, Information Security
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of secure software techniques in software development	**L2**
CO2	Apply secure software requirement and architecture models in software development with an effective report.	**L3**
CO3	Apply the Concepts of System Security and Complexity in Software Development Process	**L3**
CO4	Apply suitable framework for providing security to a project	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Security a software Issue:** Introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security **What Makes Software Secure**: Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties?	**CO1**
II	**Requirements Engineering for secure software**: Introduction, the SQUARE process Model, Requirements elicitation and prioritization.	**CO1, CO2**

III	**Secure Software Architecture and Design:**Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns **Secure coding and Testing:** Code analysis, Software Security testing, Security testing considerations throughput the SDLC.	**CO1, CO2**
IV	**Security and Complexity:**System Assembly Challenges: Introduction, security failures, functional and attacker perspectives for security analysis, system complexity drivers and security	**CO1, CO3**
V	**Governance and Managing for More Secure Software:** Introduction, Governance and security, Adopting an enterprise software security framework, How much security is enough?, Security and project management, Maturity of Practice	**CO1, CO4**

Learning Recourses
Text Books
1. Software Security Engineering, Julia H. Allen, 2009, Pearson Education.
References
1.Developing Secure Software, Jason Grembi, 2009, Cengage Learning. 2. Software Security, Richard Sinn, 2009, Cengage Learning
e-Resources and other Digital Material
1. https://nptel.ac.in/courses/106/105/106105150/ 2. http://www.nptelvideos.in/2012/11/software-engineering.html

Big Data

Course Code	19CS4701D	**Year**	IV	**Semester**	II
Course Category	**Program Elective-VI**	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data mining
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of big data	**L2**
CO2	Apply the concept of HDFS, Map reduce,Spark for storing and processing of Big data	**L3**
CO3	Apply Hive for working with Big data and formulate an efficient report	**L3**
CO4	Apply various analytics mechanisms to design a recommender system.	**L3**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Meet Hadoop:** Data, Data Storage and Analysis, Querying All Your data, Beyond Batch, Comparison with Other Systems: Relational database Management Systems, Grid Computing, Volunteer Computing, A Brief History of Apache Hadoop. **Map Reduce:** A Weather Dataset: Data Format, Analyzing the data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java Map Reduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed Map Reduce Job.	**CO1,CO2**
II	**The Hadoop Distributed Filesystem:** The Design of HDFS, HDFS Concepts, The Command Line Interface, Hadoop File systems, The Java Interface, Data Flow, Parallel Copying with distcp.	**CO1,CO2**

III	**Hive:** Hive Shell, An Example, Running Hive: Configuring Hive, Hive Services, The Metastore, Comparison with Traditional Databases: Schema on Read Versus Schema on write, Updates, transactions, and Indexes, SQL-on Hadoop Alternatives, **HiveQL:** Data Types, Operators and Functions and Tables: managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables and Dropping Tables.	**CO1,CO3**
IV	**Spark:** Installing Spark, An Example: Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables: Broadcast Variables, Accumulators, Anatomy of a Spark Job: Run: Job Submission, DAG Construction, Task Scheduling, Task Execution.	**CO1,CO2**
V	**Use case Study:** Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative Filtering System and Content Based Recommendations.	**CO1,CO4**

Learning Resources
Text Book
1. Hadoop: The Definitive Guide, Tom White, Fourth Edition, 2015, O'Reilly. 2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley
References
1. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers 2. Big Data and Analytics, Seema Acharya, SubhashiniChellappan, First Edition, 2015, Wiley. 3. Big data analytics with R and Hadoop, VigneshPrajapati, First Edition, 2013, SPD. 4. Spark: The Definitive Guide :Big Data Processing Made simple, Bill Chambers and MateiZaharia, First Edition, 2018, O'Reilly
e-Resources and other Digital Material
1. https://nptel.ac.in/courses/106/104/106104189/ 2.https://www.coursera.org/specializations/big-data 3..https://www.edx.org/course/big-data-fundamentals

Inter Disciplinary Elective (IDE)

Database Management Systems
(Inter Disciplinary Elective-I)

Offering Branches	CE,ME,EEE,ECE,IT	**Course Code**	19CS2501C
Course Category:	IDE	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial- Practical:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basic concepts of database management systems	**L2**
CO2	Apply normalization techniques for simple problems	**L3**
CO3	Apply SQL commands to create tables for a given database application	**L3**
CO4	Apply ER Model concepts to draw ER Diagrams for a given database application.	**L3**

Course Content		
UNIT-1	**Introduction to Databases:** Characteristics of the Database Approach, Advantages of using theDBMS Approach, A Brief History of Database Applications. **Overview of Database Languages and Architectures:** Data Models, Schemas and Instances,Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-Server Architecture for DBMS.	**CO1**
UNIT-2	**Relational Model:** The Relational Model Concepts, Relational Model Constraints andRelational Database Schemas. **SQL:** Data Definition, Constraints, Basic Queries and Updates, Views(Virtual Tables) inSQL	**CO1, CO3**
UNIT-3	**Conceptual Data Modeling :** High-Level Conceptual Data Models for Database Design, ASample Database Application, Entity Types, Entity	**CO1, CO4**

	Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types. **ER-Diagrams:** Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues	
UNIT-4	**Database Design Theory**: Functional Dependencies, Normal forms based on Primary Keys,Second and Third Normal Forms, Boyce-Codd Normal Form.	**CO1,CO2**
UNIT-5	**Transaction Processing**: Introduction, Transaction and System Concepts, Desirable Properties ofTransactions. **Introduction to Protocols for Concurrency Control in Databases:** Two-Phase LockingTechniques for Concurrency Control - Types of Locks and System Lock Tables.	**CO1**

Learning Resources

Text books

1. DATABASE SYSTEMS Models, Languages, Design and Application Programming, RamezElmasri, ShamkantB.Navathe, Sixth Edition, Pearson.

References

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, 3rd Edition, TMH.
2. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S.Sudarshan, 5th Edition, McGraw Hill.

e-Resources and other Digital Material

Introduction to Python Programming

(Inter Disciplinary Elective -III)

Offering Branches	CE,ME,EEE,ECE,IT	**Course Code**	19CS2801D
Course Category:	IDE	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial- Practical:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the basic constructs of Python Programming.	**L2**
CO2	Apply Python Programming constructs to solve problems	**L3**
CO3	Apply python packages to write programs for a given application.	**L3**
CO4	Analyze and choose appropriate data structure for solving problems	**L4**

Syllabus		
Course Content		
UNIT-1	**Introduction to Python** Features of Python, Writing and Executing First Python Program, Literal Constants, Variables and Identifiers, Reserved Words, Data Types, Input Operation, Operators and Expressions, Operations on Strings, Type Conversion, Conditional statements and iterative statements.	**CO1,CO2**
UNIT-2	**Functions in Python** Functions: Introduction, Built-in Math Functions, User Defined Functions: Function Call, Variable Scope and Lifetime, The return statement, Lambda Functions, Recursive functions Packages in python.	**CO1,CO2**

UNIT-3	**Strings and File Handling in Python** **Strings:** Introduction, Built-in String Functions, Slice Operation, Comparing Strings, Iterating String, Regular Expressions. **File Handling:** open, close, read and write operations.	**CO1, CO2**
UNIT-4	**Data Structures in Python** **Lists:** Accessing values in lists, Nested Lists, Basic List Operations. **Tuples:** Creating Tuple, Accessing values in a tuple, Basic TupleOperations. **Dictionaries**: Creating and Accessing Dictionaries, Built-in Dictionary functions, List Vs Tuple Vs Dictionary.	**CO1,CO4**
UNIT-5	**Packages:** Numpy–Create, reshape, slicing, operations such as min, max, sum, search, sort, math functions etc. Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions Matplotlib -- Visualizing data with different plots, use of subplots.	**CO1,CO3**

Learning Resources

Text books

1. Python Programming using Problem Solving Approach, ReemaThareja, 2017, OXFORD University Press
2. Python for Data Analysis, Wes McKinney, 2012, O.Reilly.

References

1. Core Python Programming, R. Nageswara Rao, 2018, Dreamtech press.
2. Programming with python, T R Padmanabhan, 2017, Springer.

e-Resources and other Digital Material

1. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
2. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf