Teaching Scheme of B.Tech.-IV (CSE) (Semester VII)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Software Engineering (Core-15)	CS401	5	3	1	2	100	25	50	175
2	Innovation, Incubation and Entrepreneurship	HU410	3	3	0	0	100	0	0	100
3	Core Elective-3	CS4AA	3	3	0	0	100	0	0	100
4	Core Elective-4	CS4BB	3	3	0	0	100	0	0	100
5	Summer Training*	CS403	2	0	0	0	0	0	50	50
6	Project Preliminaries	CS405	3	0	0	6	0	0	150	150
	Total		**19**	**12**	**1**	**8**	**400**	**25**	**250**	**675**
	Total Contact Hours per week			**21**						

*Summer training is to be organized in the summer vacation after 6th Semester.
Practical Examination Scheme (Internal 50% and External 50%)

Core Elective-3 (CS4AA):

1	Computer Graphics (CS421)	4	Video Codec standards and Design (CS427)
2	Blockchain Technology (CS423)	5	Computational Geometry (CS429)
3	Smartphone Computing and Applications (CS425)		

Core Elective-4 (CS4BB):

1	Data Warehousing and Mining (CS441)	4	Audio and Speech Signal Processing (CS447)
2	High Performance Computing (CS443)	5	Service Oriented System (CS449)
3	Security in Resource Constrained Environment (CS445)		

Teaching Scheme of B.Tech.–IV (CSE) (Semester VIII)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Core Elective-5	CS4XX	3	3	0	0	100	0	0	100
2	Core Elective-6	CS4YY	3	3	0	0	100	0	0	100
3	Core Elective-7	CS4ZZ	3	3	0	0	100	0	0	100
4	Cyber Law and Forensics (Core-16)	CS402	4	3	0	2	100	0	50	150
5	Project	CS404	6	0	0	12	0	0	300	300
	Total		**19**	**12**	**0**	**14**	**400**	**0**	**350**	**750**
	Total Contact Hours per week			**26**						

Practical Examination Scheme (Internal 50% and External 50%)

Core Elective-5 (CS4XX):

1	Social Network Analysis (CS422)	4	Cellular Network and Mobile Computing (CS428)
2	Network and System Security (CS424)	5	System Analysis and Simulation (CS432)
3	Advanced Computer Architecture (CS426)		

Core Elective-6 (CS4YY):

1	Big Data Analytics (CS434)	4	Advanced Database Management System (CS442)
2	Deep Learning (CS436)	5	Web Engineering (CS444)
3	Advanced Compiler Design (CS438)		

Core Elective-7 (CS4ZZ):

1	Foundations of Automatic Verification (CS446)	4	Research Methodologies (CS454)
2	Secure Software Engineering (CS448)	5	Ethical Hacking (CS456)
3	Animation & Rendering (CS452)		

B.Tech. IV (CSE) Semester – VII
SOFTWARE ENGINEERING (CORE-15)
CS401

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand various phases of software development lifecycle.
CO2	apply appropriate software modelling and testing techniques for the given application scenario.
CO3	analyse various tools and techniques used in software development lifecycle.
CO4	evaluate the software for quality and risk factors.
CO5	design and develop software systems using appropriate software processes.

2. Syllabus

- **INTRODUCTION** **(02 Hours)**

  Software Process - Software Development Life Cycle – Software Qualities - Problems with Software Production – Brooke's No Silver Bullet.

- **SOFTWARE LIFE-CYCLE MODELS** **(04 Hours)**

  Build-and-Fix, Waterfall, Rapid Prototyping, Incremental, Spiral, Agile, Comparison, ISO 9000 – CMM levels – Comparing ISO 9000 and CMM.

- **SOFTWARE REQUIREMENTS AND ANALYSIS** **(06 Hours)**

  Techniques - Feasibility Analysis - Requirements Elicitation – Validation - Rapid Prototyping - OO Paradigms vs. Structured Paradigm - OO Analysis (Modules, Object, Cohesion, Coupling, Objects and Reuse) - CASE tools.

- **SOFTWARE SPECIFICATIONS** **(12 Hours)**

  Specification Document – Specification Qualities, Uses, Classification – Operational Behavioural – DFD, Overview of UML Diagrams, Finite State Machines, Petri nets – Descriptive Specifications – ER Diagrams, Logic, Algebraic Specs - Comparison of Various Techniques and CASE Tools.

- **FORMAL METHODS IN SOFTWARE ENGINEERING** **(06 Hours)**

  Formal Specifications, Software Verification & Validation, Clean Room Engineering, - Formal Approaches, Model Checking – SPIN Tool for Distributed Software.

- **CASE TOOLS, ISO AND CAPABILITY MATURITY MODEL** **(04 Hours)**

CASE Tools - Stepwise Refinement - Cost-Benefit Analysis - Scope of CASE - Versions Control - Current State of the Art in Software Engineering-Current State of the Art.

- **SOFTWARE TESTING PRINCIPLES (06 Hours)**

  Non-execution & Execution based Testing – Automated Static Analysis – Test-Case Selection - Black-Box and Glass-Box Testing - Testing Objects - Testing vs. Correctness Proof.

- **ADVANCED TOPICS (02 Hours)**

- **Tutorials will be based on the coverage of the above topics separately (14 Hours)**

- **Practicals will be based on the coverage of the above topics separately (28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials:

1 Based on: SDLC.

2 Based on: Requirements engineering.

3 Based on: Data flow diagram.

4 Based On: Use case, Sequence diagrams, Collaboration diagrams.

5 Based on: FSM, Petri nets.

6 Based on: Logic specification, Algebraic specification.

7 Based on: Software cost estimation and quality assurance.

8 Based on: Software test case designing.

4. Practicals:

1 Splint tool- Introduction, Installation and Exploring Tool.

2 Designing C program fragment for all class of errors listed for splint tool and to Compare the outputs of Splint and the Standard C compiler.

3 Spin tool and Promela language introduction, Spin installation, Exploring tool and language usage.

4 Designing promela models and their verification in Spin.

5 Mini project : Identifying and formulating a software engineering problem, identifying it's specifications, designing it using various models introduced in classes, implementing prototype of that system, and testing the software systems that meets specification, performance, maintenance and quality requirements.

6 Implementation of testing tools.

7 Implementation of software development models.

8 Implementation of agile technology based software development.

5. Books Recommended:

1. Rajib Mall: “Fundamentals of Software Engineering”, 4/E, PHI Learning, 2015.
2. Sommerville: “Software Engineering”, 9/E, Pearson Education, 2010.
3. Stephen R Schach: “Object Oriented and Classical Software Engineering”, McGraw-Hill 8/E, 2010.
4. Roger S Pressman: “Software Engineering – A Practitioner’s Approach”, McGraw-Hill 7/E, 2010.
5. Pankaj Jalote: “An Integrated approach to Software Engineering”, Narosa, 3/E, 2005.

ADDITIONAL REFERENCE BOOKS

1. Ghezzi, Jazayeri, Mandrioli: “Fundamentals of Software Engineering”, 2/E, Pearson Education, 2002.
2. Stephen R Schach: “Software Engineering with JAVA”, TMH, 1999.

B.Tech. IV (CSE) Semester – VII
INNOVATION, INCUBATION AND ENTREPRENEURSHIP
HU410

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

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1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	explain the concepts of entrepreneurship.
CO2	develop skills related to various functional areas of management (Marketing Management, Financial Management, Operations Management, Personnel Management etc.).
CO3	develop skills related to Project Planning and Business Plan development.
CO4	demonstrate the concept of Innovation, Intellectual Property Rights (IPR) and Technology Business incubation.
CO5	build knowledge about Sources of Information and Support for Entrepreneurship.
CO6	develop entrepreneurial culture.

2. Syllabus

- **CONCEPTS OF ENTREPRENEURSHIP** **(10 Hours)**

  Scope of Entrepreneurship, Definitions of Entrepreneurship and Entrepreneur, Characteristics of an Entrepreneur, Entrepreneurial Development models and Theories, Entrepreneurs Vs Managers Classification of Entrepreneurs; Major types of Entrepreneurship – Techno Entrepreneurship, Women Entrepreneurship, Social Entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Rural Entrepreneurship, Family Business etc.; Problems for Small Scale Enterprises and Industrial Sickness; Entrepreneurial Trait Tests; Entrepreneurial Environment – Political, Legal, Technological, Natural, Economic, Socio – Cultural etc. ; Motivation; Business Opportunity Identification.

- **FUNCTIONAL MANAGEMENT AREA IN ENTREPRENEURSHIP** **(12 Hours)**

  Marketing Management: Basic concepts of Marketing, Development of Marketing Strategy and Marketing plan, Online Marketing, New Product Development Strategy.

  Operations Management: Basic concepts of Operations management, Location problem, Development of Operations strategy and plan.

  Personnel Management: Main operative functions of a Personnel Manager, Development of H R strategy and plan.

  Financial Management: Basics of Financial Management, Ratio Analysis, Capital Budgeting, Working Capital Management, Cash Flow Statement, Break Even Analysis.

- **PROJECT PLANNING** **(06 Hours)**

Product Development – Stages in Product Development; Feasibility analysis – Technical, Market, Economic, Financial etc.; Project report; Project appraisal; Setting up an Industrial unit – procedure and formalities in setting up an Industrial unit; Business Plan Development.

- **PROTECTION OF INNOVATION THROUGH IPR** **(04 Hours)**

  Introduction to Intellectual Property Rights – IPR, Patents, Trademarks, Copy Rights.

- **INNOVATION AND INCUBATION** **(06 Hours)**

  Innovation and Entrepreneurship, Creativity, Green Technology Innovations, Grassroots Innovations, Issues and Challenges in Commercialization of Technology Innovations, Introduction to Technology Business Incubations, Process of Technology Business Incubation.

- **SOURCES OF INFORMATION AND SUPPORT FOR ENTREPRENEURSHIP** **(04 Hours)**

  State level Institutions, Central Level institutions and other agencies.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Desai Vasant, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, India, 6th Revised Edition, 2011.
2. Charantimath P. M., "Entrepreneurial Development and Small Business Enterprises", Pearson Education, 3rd Edition, 2018.
3. Holt David H., "Entrepreneurship: New Venture Creation", Pearson Education, 2016.
4. Chandra P., "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill, 9th Edition, 2019.
5. Banga T. R. & Shrama S.C., "Industrial Organisation& Engineering Economics", Khanna Publishers, 25th Edition, 2015.

ADDITIONAL REFERENCE BOOKS

1. Prasad L.M., "Principles & Practice of Management", Sultan Chand & Sons, 8th Edition,2015.
2. Everett E. Adam, Ronald J. Ebert, "Production and Operations Management", Prentice Hall of India, 5th edition, 2012.
3. Kotler P., Keller K. L, Koshi A.& Jha M., "Marketing Management – A South Asian Perspective", Pearson, 14th Edition, 2014.
4. Tripathi P.C., "Personnel Management & Industrial Relations", Sultan Chand & sons, 21st Edition, 2013.
5. Chandra P., "Financial Management", Tata McGraw Hill, 9th Edition, 2015.

B.Tech. IV (CSE) Semester – VII
COMPUTER GRAPHICS (CORE ELECTIVE-3)
CS421

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

computer graphics

https://youtube.com/playlist?list=PLWPirh4EWFpHukXICQrDcmjZUa2WlLMAb

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand Computer Graphics Systems, scan conversion process, object representation, object filling and related algorithms.
CO2	use geometric transformations on graphics objects and apply them in composite form.
CO3	analyse various techniques of clipping, transformations and projection to extract scene and transform it to display device.
CO4	evaluate various techniques for effective scene generation with special effects and animation.
CO5	create an application using computer graphics tools and software's in the development of computer games, information visualization and business applications.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview, Classification, Characteristics and Advantages of Computer Graphics, Coordinate Representation, Raster Scan & Random Scan methods, Video Basics, Display devices, Interactive Devices and Hardcopy Devices. Digital Images, Image Formation, Image Representation and Modelling, Overview of Image and Graphics Applications, Graphics Libraries & Graphic Software's.

- **GRAPHICS PRIMITIVES** **(08 Hours)**

  Line, Circle, Ellipse Generating Algorithms, Character Generation, Polygon Drawing and Representation, Polygon Filling Algorithms – Scanline Algorithms, Edge List Algorithm, Edge Fill Algorithm, Fence Fill Algorithm, Edge Flag Algorithm, Seed Fill Algorithms, Simple Seed Fill, Scan Line Seed Fill Algorithms.

- **2D AND 3D TRANSFORMATIONS** **(08 Hours)**

  Representation of Objects in Matrix Form, 2-D Transformations, Homogeneous Coordinates, Combined Transformations, Transformation between Coordinate Systems, Affine Transformation, 3-D Transformation, Multiple Transformation, Coordinate Transformation.

- **3D PROJECTION** **(04 Hours)**

  Introduction to Projection, Categories of Projection, Parallel Projection, Perspective Projection, 3-D Viewing and Viewing Parameters.

- **CLIPPING** **(08 Hours)**

  Viewing Transformation, Window to Viewport Coordinate Transformation, Point Clipping, Line Clipping, Cohen-Sutherland Line Clipping algorithm, Mid-Point Line Clipping Algorithm, Polygon Clipping, Sutherland-Hodgeman Algorithm, Weiler Atherton Algorithm; Curve Clipping, Text Clipping, Interior Exterior Clipping, 3- D Clipping, 3-D Mid-Point Subdivision Algorithm.

- **ADVANCE TOPICS** **(08 Hours)**

  Overview of Hidden Lines and Visible Surface Methods, Fundamentals of Curve Generation, Illumination, Shading Lighting, Color and Animation, Special-Purpose Graphics Hardware, Recent Developments.

- **Tutorials will be based on the coverage of the above topics separately.** **(14 Hours)**

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Peter Shirley, Steve Marschner and others, “Fundamentals of Computer Graphics”, 4/E, A K Peters/CRC Press, 2015.
2. James D. Foley, Andries van Dam, Steven K. Feiner, F. Hughes John, “Computer Graphics: Principles and Practice in C”, Addison Wesley, 2/E, 2012.
3. D. Hearn and M. Baker, “Computer Graphics with OpenGL“, 3/E, Pearson India, 2013.
4. Edward Angel, “Interactive Computer Graphics - A Top-Down Approach Using OpenGL”, 5/E, Pearson Education, 2012.
5. F. S. Hill Jr. and S. M. Kelley, “Computer Graphics using OpenGL”, 3/E, Pearson India, 2015.

B.Tech. IV (CSE) Semester – VII
BLOCKCHAIN TECHNOLOGY (CORE ELECTIVE - 3)
CS423

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the need, functions and challenges of blockchain technology.
CO2	deploy smart contracts for given use cases.
CO3	analyse blockchain based system structure and security offered therein.
CO4	asses functions, benefits and limitations of various blockchain platforms.
CO5	design and develop solution using blockchain technology in various application domains.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Introduction to Blockchain Technology, Concept of Blocks, Transactions, Distributed Consensus, the Chain and the Longest Chain, Cryptocurrency, Blockchain 2.0, Permissioned Model of Blockchain, Permission less Blockchain.

- **DECENTRALIZATION USING BLOCKCHAIN (06 Hours)**

  Methods of Decentralization, Disintermediation, Contest-Driven Decentralization, Routes to Decentralization, the Decentralization Framework Example, Blockchain and Full Ecosystem Decentralization, Storage, Communication, Computing Power and Decentralization, Smart Contracts, Decentralized Autonomous Organizations, Decentralized Applications (DApps), Requirements and Operations of DApps, DApps Examples, Platforms for Decentralizations.

- **CRYPTO PRIMITIVES FOR BLOCKCHAIN (04 Hours)**

  Symmetric and Public Key Cryptography, Cryptographic Hard Problems, Key Generation, Secure Hash Algorithms, Hash Pointers, Digital Signatures, Merkle Trees, Patricia trees, Distributed Hash Tables.

- **BITCOINS AND CRYPTOCURRENCY (06 Hours)**

  Introduction, Digital Keys and Addresses, Private and Public Keys in Bitcoins, Base58Check Encoding, Vanity Addresses, Multi Signature Addresses, Transaction Lifecycle, Data Structure for Transaction, Types of Transactions, Transaction Verification, The Structure of Block in Blockchain, Mining, Proof of Work, Bitcoin Network and Payments, Bitcoin Clients and APIs, Wallets, Alternative Coins, Proof of Stake, Proof of Storage, Various Stake Types, Difficulty Adjustment and Retargeting Algorithms, Bitcoin Limitations.

- **SMART CONTRACTS** **(02 Hours)**

  Smart Contract Templates, Oracle, Smart Oracle, Deploying Smart Contract on Blockchain.

- **PERMISSIONED BLOCKCHAIN** **(05 Hours)**

  Models and Use-cases, Design Issues, Consensus, Paxos, RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance.

- **DEVELOPMENT TOOLS AND FRAMEWORKS** **(05 Hours)**

  Solidity Compilers, IDEs, Ganache, Metamask, Truffle, Contract Development and Deployment, Solidity Language, Types, Value Types, Literals, Enums, Function Types, Reference Types, Global Variables, Control Structures, Layout of Solidity Source Code File.

- **HYPERLEDGER** **(05 Hours)**

  The Reference Architecture, Requirements and Design Goals of Hyperledger Fabric, The Modular Approach, Privacy and Confidentiality, Scalability, Deterministic Transactions, Identity, Auditability, Interoperability, Portability, Membership Services in Fabric, Blockchain Services, Consensus Services, Distributed Ledger, Sawtooth Lake, Corda.

- **BLCOKCHAIN USE-CASES AND CHALLENGES** **(05 Hours)**

  Finances, Government, Supply Chain, Security, Internet of Things, Scalability and Challenges, Network Plane, Consensus Plane, Storage Plane, View Plane, Block Size Increase, Block Interval Reduction, Invertible Bloom Lookup Tables, Private Chains, Sidechains, Privacy Issues, Indistinguishability Obfuscation, Homomorphic Encryption, Zero Knowledge Proofs, State Channels, Secure Multiparty Computation, Confidential Transactions.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. Imran Bashir, “Mastering Blockchain”, 2/E, Packt publishing, Mumbai, 2018.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 2/E, O’Reilly, 2014.
3. Melanie Swan, “Blockchain Blueprint for a New Economy”, 1/E, O'Reilly Media, 2015.
4. Don and Alex Tapscott, “Blockchain Revolution”, 1/E, Penguin Books Ltd, 2018.
5. Alan T. Norman, “Blockchain Technology Explained”,1/E, CreateSpace Independent Publishing Platform, 2017.

B.Tech. IV (CSE) Semester – VII
SMARTPHONE COMPUTING AND APPLICATIONS
(CORE ELECTIVE-3)
CS425

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about different types of mobile operating systems and architecture.
CO2	setup, configure, deploy and run applications on smart phone using state of the art IDE and/or tools.
CO3	debug and troubleshoot the issues related to operating system, database, security, etc.
CO4	evaluate effectiveness of different mobile operating systems.
CO5	design and develop different smart phone applications.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Introduction to Mobile Computing, Introduction to Android Development Environment, Mobile Devices vs. Desktop Devices, ARM and Intel Architectures, Power Management, Screen Resolution, Touch Interfaces, Application Deployment, App Store, Google Play, Windows Store, Development Environments: XCode, Eclipse, VS2012, PhoneGAP, etc., Native vs. Web Applications, Factors in Developing Mobile Applications: Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User, Graphics and Multimedia: Performance and Multithreading, Graphics and UI Performance, Android Graphics, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.

- **MOBILE OS ARCHITECTURE** **(09 Hours)**

  Comparing and Contrasting Architectures of All Three – Android, iOS and Windows, Underlying OS, Kernel Structure and Native Level Programming. Approaches to Power Management, Security. Android/iOS/Win 8 Survival and Basic Apps: Building a Simple “Hello World” App in All Three Applications, App-structure, Built-in Controls, File Access, Basic Graphics. Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing.

- **ANDROID/IOS/WIN APPLICATIONS** **(12 Hours)**

  DB Access, Network Access, Contacts/Photos/etc. Underneath the Frameworks: Native Level Programming on Android, Low-Level Programming on (jailbroken) iOS, Windows Low Level APIs. Intents and Services: Android Intents and Services, Characteristics of Mobile Applications,

Successful Mobile Development; Storing and Retrieving Data: Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider; Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App.

- **ADVANCE TOPICS** **(06 Hours)**

  Power Management: Wake Locks and Assertions, Low-Level OS Support, Writing Power-Smart Applications. Augmented Reality via GPS and Other Sensors: GPS, Accelerometer, Camera. Mobile Device Security in Depth: Mobile Malware, Device Protections, iOS "Jailbreaking", Android "rooting" and Windows "defenestration"; Security and Hacking: Active Transactions, More on Security, Hacking Android.

- **MOBILE PRIVACY AND SECURITY** **(06 Hours)**

  Side Channel Attacks, Inference Algorithms, Hardware Loopholes, Sensor Data Leaks, Case Studies.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Tomasz Nurkiewicz and Ben Christensen, "Reactive Programming with RxJava", O'Reilly Media, 2016.
2. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", Big Nerd Ranch LLC, 2nd edition, 2015.
3. Cristian Crumlish and Erin Malone, "Designing Social Interfaces", 2nd edition, O'Reilly Media, Inc., 2014.
4. Maximiliano Firtman, "Programming the Mobile Web", O'Reilly Media Inc., 2nd edition, 2013.
5. Suzanne Ginsburg, "Designing the iPhone User Experience: A User-Centered Approach to Sketching and Prototyping iPhone Apps", Addison-Wesley Professional, 2010.

ADDITIONAL REFERENCE BOOKS

1. Brian Fling, "Mobile Design and Development", O'Reilly Media Inc., 2009.
2. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design and Development", Prentice Hall, 2004.

B.Tech. IV (CSE) Semester – VII
VIDEO CODEC STANDARD AND DESIGN
(CORE ELECTIVE - 3)
CS427

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand image and video compression standards and related algorithms.
CO2	apply motion Estimation and Compensation techniques to enhance Motion Model.
CO3	analyse working of various coding methods and Video Coding Standards to undertake meaningful CODEC design.
CO4	evaluate Control Parameters and Status Parameters for design of a CODEC to improve Performance.
CO5	carry out design and testing of a video CODEC for the given application.

2. Syllabus

- **IMAGE AND VIDEO COMPRESSION FUNDAMENTALS (06 Hours)**

  Image Compression Fundamentals, Classification of Image Compression Algorithms, Lossless and Lossy Compression Algorithms, Various Image and Video Standards.

- **MOTION ESTIMATION AND COMPENSATION (06 Hours)**

  Introduction, Motion Estimation and Compensation, Full Search Motion Estimation, Comparison of Motion Estimation Algorithms, Sub-Pixel Motion Estimation, Choice of Reference Frames, Enhancements to the Motion Model, Implementation.

- **CODING (06 Hours)**

  Discrete Wavelet Transform, Fast Algorithms for the DCT, Separable Transforms, Flow Graph Algorithms, Distributed Algorithms, Other DCT Algorithms, Implementing the DCT, Software DCT, Hardware DCT, Quantization, Types of Quantizing methodologies: Related Design, Implementation, Vector Quantization.

- **VIDEO CODING STANDARDS : H.261, H.263 AND H.26L (06 Hours)**

  H.261, H.263 and H.26L, Motion Estimation and Compensation, Transform Coding, Entropy Coding, Pre and Post Processing, Rate, Distortion and Complexity, Transmission of Coded Video, Platforms, And Video CODEC Design.

- **VIDEO CODING STANDARDS : JPEG AND MPEG (06 Hours)**

Introduction, The International Standard Bodies, The Expert Groups, The Standardization Process, Understanding and Using the Standards, JPEG, Motion JPEG, MPEG , JPEG-2000, lMPEG- 1, MPEG-2, MPEG-4.

- **VIDEO CODEC DESIGN** **(06 Hours)**

Introduction, Video CODEC Interface, Coded Data In/Out, Control Parameters , Status Parameters, Design of a Software CODEC, Design Goals, Specification and Partitioning, Designing the Functional Blocks, Improving Performance, Testing, Design of a Hardware CODEC: Design Goals.

- **ADVANCED TOPICS** **(06 Hours)**

Current Standard Evolution, Video Coding Research, Platform Trends, Application Trends, Video CODEC Design, Contemporary Research Topics.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. Iain E. Richardson, “Video Codec Design: Developing Image and Video Compression Systems” 1/E, Wiley, 2002.
2. Iain E. Richardson, “H.264 and MPEG-4 Video Compression: Video Coding for Next Generation Multimedia “, 1/E, Wiley, 2008.
3. M. Ghanbari, “Standard Codecs: Image Compression to Advanced Video Coding (Telecommunications)”, 3/E, Institution of Engineering and Technology, 2010.
4. Khalid Sayood, “Lossless Compression Handbook (Communications, Networking and Multimedia)”, 1/E, Academic Press, 2002.
5. Aaron Owen and Andy Beach, “Video Compression Handbook, 2E, Peachpit Press, ISBN:9780134846736, July 2018.

B.Tech. IV (CSE) Semester – VII
COMPUTATIONAL GEOMETRY (CORE ELECTIVE - 3)
CS429

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand fundamental problems within computational geometry and general techniques for solving problems.
CO2	apply geometric techniques to real-world problems in various application domains viz., graphics rendering, geographical information systems and robotics.
CO3	analyse geometrical algorithmic techniques for large domains.
CO4	evaluate geometric algorithms and determine its significance and merits with respect to given criteria.
CO5	design and develop algorithms and data structures to solve geometric problems.

2. Syllabus

- **INTRODUCTION** **(02 Hours)**

  Convex Hulls, Degeneracies and Robustness, Application domains.

- **LINE SEGMENT INTERSECTION** **(04 Hours)**

  Line Segment Intersection, Doubly-Connected Edge List, Computing the Overlay of Two Subdivisions, Boolean Operations.

- **POLYGON TRIANGULATION AND PARTITIONING** **(04 Hours)**

  Art Gallery Theorems, Triangulation, Area of Polygon, Monotone Partitioning, Trapezoidalization, Partition into Monotone Mountains, Linear Time Triangulation, Convex Partitioning.

- **CONVEX HULLS** **(04 Hours)**

  The Complexity of Convex Hulls in 2D and 3D Space, Computing Convex Hulls, The Analysis, Convex Hulls and Half-Space Intersection.

- **LINEAR PROGRAMMING** **(04 Hours)**

  The Geometry of Casting, Half-Plane Intersection, Incremental Linear Programming, Randomized Linear Programming, Unbounded Linear Programs, Linear Programming in Higher Dimensions, Smallest Enclosing Discs.

- **ORTHOGONAL RANGE SEARCHING** **(04 Hours)**

1-Dimensional Range Searching, Kd-Trees, Range Trees, Higher-Dimensional Range Trees, General Sets of Points.

- **VORONOI DIAGRAMS** **(04 Hours)**

  Definition and Basic Properties, Computing the Voronoi Diagram, Voronoi Diagrams of Line Segments, Farthest-Point Voronoi Diagrams, Connection to Convex hulls.

- **POINT LOCATION** **(04 Hours)**

  Point Location and Trapezoidal Maps, Randomized Incremental Algorithm, Dealing with Degenerate Cases, Tail Estimate.

- **MOTION PLANNING** **(04 Hours)**

  Shortest Path, Moving a Disk, Translating a Convex Polygon, Moving a Ladder, Robot Arm Motion, Separability.

- **ARRANGEMENT AND DUALITY** **(04 Hours)**

  Computing the Discrepancy, Duality, Arrangements of Lines, Levels and Discrepancy.

- **ADVANCED TOPICS** **(04 Hours)**

  Interval Trees, Priority Search Trees, Segment Trees, Binary Space Partitions, Robot Motion Planning, Quadtrees, Visibility Graphs.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. Joseph O'Rourke, Computational geometry in C, Cambridge University Press, 1998.
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Computational Geometry - Algorithms and Applications, 3/E, Springer, 2008.
3. Franco P. Preparata and Michael Ian Shamos, Computational geometry, Springer, 1985.
4. Csaba D. Toth, Joseph O'Rourke, Jacob E. Goodman, “Handbook of Discrete and Computational Geometry (Discrete Mathematics and Its Applications)”, 3rd Edition, Chapman and Hall/CRC, 2017.
5. Mark de Berg, Marc van Kreveld, Mark Overmars, “Computational Geometry: Algorithms and Applications”, 1st Edition, Springer, 2013.

B.Tech. IV (CSE) Semester – VII
DATA WAREHOUSING AND MINING (CORE ELECTIVE - 4)
CS441

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs):

At end of the course, student will be able to

CO1	understand concepts of Data Warehouse and Data Mining and various application domains of DW and DM.
CO2	apply high dimensional modelling and OLAP operations of DW along with Data Mining solutions.
CO3	analyse DM algorithms to solve real world problems.
CO4	evaluate different data mining techniques like data compression, classification, prediction, clustering and association rule mining.
CO5	design and innovate a solution for the given problem.

2. Syllabus

- **OVERVIEW** **(02 Hours)**

  Motivation for Data Mining , Definition and Functionalities, Classification of DM Systems, Integration of a Data Mining System with a Database/Data Warehouse, Issues in DM – KDD Process.

- **DATA PREPROCESSING AND DATA MINING PRIMITIVES** **(06 Hours)**

  Need to Pre-process the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation, Data Mining Primitives: What Defines a Data Mining Task?

- **CLASSIFICATION** **(07 Hours)**

  Issues Regarding Classification and Prediction, Categorization of Classification Methods, Decision Tree, Bayesian Classification, Rule Based, CART, Neural Network, CBR, Rough set Approach, Fuzzy Logic, Genetic Algorithms, Prediction Methods, Linear and Nonlinear Regression, Logistic Regression.

- **CLUSTERING** **(07 Hours)**

  Types of Data in Cluster Analysis, Categorization of Major Clustering Methods, Similarity and Distance Measures, Hierarchical Algorithms, Partitioned Algorithms, Clustering Large Databases.

- **ASSOCIATION RULE MINING** **(06 Hours)**

  Data Generalization and Summarization-Based Characterization, Attribute Relevance, Class Comparisons, Association Rule Mining Introduction, Market Basket Analysis - Basic Concepts, Finding Frequent Item Sets, Apriori Algorithm, Generating Rules, Improved Apriori Algorithm, Incremental ARM, Associative Classification – Rule Mining, FP Growth Rule Mining Algorithm.

- **INTRODUCTION TO DATA WAREHOUSING** **(04 Hours)**

  Need of Reporting and Analysing data, Raw Data to Valuable Information-Lifecycle of Data, Business Intelligence (BI) and DW in Today's Perspective, Decision Support Systems, Difference Between database System and Data Warehouse, Overview of the Components of DW, Data Warehouse Life Cycle, Data Warehousing Components, Data Warehousing Architecture, On Line Analytical Processing, Categorization of OLAP Tools.

- **ARCHITECTURE OF BUSINESS INTELLIGENCE AND DATAWAREHOUSE** **(06 Hours)**

  BI and DW Architectures and its Types - Relation Between BI and DW - OLAP (Online analytical processing) Definitions - Difference between OLAP and OLTP, Multi-dimensional Analysis , Data Cubes, Drill-down and Roll-up - Slice and Dice or Rotation, OLAP Models , ROLAP versus MOLAP – defining.

- **DM AND DW FOR BUSINESS APPLICATION** **(04 Hours)**

  Data Mining for Business Applications like Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation, Retail Industry, Telecommunications Industry, Banking & Finance and CRM, Social Media Data Analysis etc.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. J. Han and M. Kamber, "Mining: Data Concepts and Techniques", 3rd Edition, Morgan Kaufman, 2011. ISBN 978-0-12-381479-1.
2. Margaret Dunham, "Data Mining: Introductory and Advanced Topics:", 3rd Edition, Published by Prentice Hall.ISBN-13: 978-8177587852.
3. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining, and OLAP", 2nd Edition, Tata McGraw- Hill, 2004. ISBN 13: 9780070587410.
4. George M Marakas, "Modern Data Warehousing, Mining and Visualization", 2nd Edition, Pearson Education. ISBN 13: 9780131014596.
5. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", 3rd Edition, Pearson Education Limited. ISBN-13: 978-1118530801.

B.Tech. IV (CSE) Semester – VII
HIGH PERFORMANCE COMPUTING (CORE ELECTIVE - 4)
CS443

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	learn concepts, issues and limitations related to parallel computing architecture and software development.
CO2	apply different parallel models of computation, parallel architectures, interconnections and various memory organization in modern high performance architectures.
CO3	analyze the algorithms to map them onto parallel architectures for parallelism.
CO4	evaluate the performance of different architectures and parallel algorithms with different aspects of real time problems.
CO5	design parallel programs for shared-memory architectures and distributed-memory architectures using modern tools like OpenMP and MPI, respectively for given problems.

2. Syllabus

- **PARALLEL PROCESSING CONCEPTS (08 Hours)**

  Levels of Parallelism (Instruction, Transaction, Task, Thread, Memory, Function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc.), Architectures: N-wide Superscalar Architectures, Multi-core, Multi-threaded.

- **FUNDAMENTAL DESIGN ISSUES IN PARALLEL COMPUTING (06 Hours)**

  Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms.

- **FUNDAMENTAL LIMITATIONS FACING PARALLEL COMPUTING (06 Hours)**

  Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their Limitations, Power-Aware Computing and Communication, Power-Aware Processing Techniques, Power-Aware Memory Design, Power-Aware Interconnect Design, Software Power Management

- **PARALLEL PROGRAMMING (10 Hours)**

  Programming Languages and Programming-Language Extensions for HPC, Inter-Process Communication, Synchronization, Mutual Exclusion, Basics of Parallel Architecture, Parallel Programming Parallel Programming with OpenMP and (Posix) Threads, Message Passing with

MPI.

- **PARALLEL PROGRAMMING WITH CUDA** **(08 Hours)**

  Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in High Performance Computing Architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Micro architecture and Intel Nehalem Micro architecture), Memory Hierarchy and Transaction Specific Memory Design, Thread Organization.

- **ADVANCE TOPICS** **(04 Hours)**

  Petascale Computing, Optics in Parallel Computing, Quantum Computers.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. John L. Hennessy and David A. Patterson, “Computer Architecture -- A Quantitative Approach”, 4th Edition, Morgan Kaufmann Publishers, 2017, ISBN 13: 978-0-12-370490-0.
2. Barbara Chapman, Gabriele Jost and Ruud van der Pas, “Using OpenMP: portable shared memory parallel programming”, The MIT Press, 2008, ISBN-13: 978-0-262-53302-7.
3. Marc Snir, Jack Dongarra, Janusz S. Kowalik, Steven Huss-Lederman, Steve W. Otto, David W. Walker, “MPI: The Complete Reference, Volume2”, The MIT Press, 1998, ISBN: 9780262571234.
4. Pacheco S. Peter, “Parallel Programming with MPI”, Morgan Kaufman Publishers, 1992, Paperback ISBN: 9781558603394.
5. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html.

B.Tech. IV (CSE) Semester – VII
SECURITY IN RESOURCE CONSTRAINED ENVIRONMENT
(CORE ELECTIVE - 4)
CS445

Scheme

L	T	P	Credit
3	0	0	03

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1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the significance of security in embedded devices, design issues in the security protocols, characteristics of Wireless Sensor Network along with types of probable attacks.
CO2	apply the security mechanisms in embedded systems and Wireless Sensor Networks using various tools.
CO3	debug, trouble shoot basic issues in RTOSs, resource constrained devices and provide security to devices.
CO4	create and evaluate the solution thoroughly using simulators like TOSSIM, Contiki, Cooja.
CO5	design security protocols for a typical Wireless Sensor Network/IoT Systems.

2. Syllabus

- **INTRODUCTION TO EMBEDDED SECURITY** **(04 Hours)**

  Introduction, Review of Security Basics, Services & Mechanisms, Security Requirements in Embedded Systems. Design Challenges in Security for Embedded Systems, Security Gap, Typical Generic Security Threats in Embedded Systems.

- **WIRELESS SENSOR NETWORKS AS EMBEDDED SYSTEMS** **(06 Hours)**

  Evolution of Human Computer Interfaces, Ubiquitous Computing, Pervasive Computing, The Illustrative Sensor Motes, Typical Configurations, Deployment Models and Issues, Typical Applications, Security Issues, Security in Wireless Sensor Networks, Typical Attacks and Countermeasures. The Denial of Service Attacks on Wireless Sensor Networks.

- **TINYOS OPERATING ENVIRONMENT** **(03 Hours)**

  Hands-on on the TinyOS Operating Environment, the NesC Programming Language. The TOSSIM Simulator. The Avrora Emulator. The TinySec Environment and its Files. Hands-on on ContikiCooja Simulator.

- **SECURE DATA AGGREGATION IN WIRELESS SENSOR NETWORKS** **(08 Hours)**

  Motivation for Secure Data Aggregation in Wireless Sensor Networks. End-to-End and Hop-by-Hop Secure Data Aggregation and Issues, Design of a Hop-by-Hop Link Layer Security Protocol in Wireless Sensor Networks. Design Issues Viz. Security Issues, Performance Issues, Ciphers, Initialization Vector, Message Authentication Code, Authenticated Encryption

Modes. Investigating Replay attacks in Link Layer Security Architectures and Typical Mitigation Approaches. The Replay Protection Algorithms Continued. Flexibly Configurable Link Layer Security Architecture for Wireless Sensor Networks.

- **END-TO-END SECURE DATA AGGREGATION IN WIRELESS SENSOR NETWORKS (05 Hours)**

The End-to-End Secure Data Aggregation in Wireless Sensor Networks. The Concept of Fully Homomorphic Encryption, Using the Classical Homomorphic Encryption Algorithms for Privacy in WSNs. Different Approaches to Offer Data Integrity viz. using Conventional MAC - Aggregate MAC, Homomorphic MAC Hybrid Secure Data Aggregation, Malleability Resilient Concealed Data Aggregation.

- **CIPHERS IN THE RESOURCE CONSTRAINED DEVICES (07 Hours)**

Lightweight Ciphers for RFID Devices. The AES Cipher Working and Demo in WSNs. Assignment on AES Encryption Decryption Routines. The TEA Cipher Operation, Demo of Executing RC5 and XXTEA Ciphers in TinySec Environment. Case Study of the Ciphers – Representative Ciphers from the List viz. TEA, XXTEA, RC5, miniAES, PRESENT, Simon, Speck – their Encryption, Decryption and Key Management Routines. Doing Hand Computation of the Intermediate Ciphertext at each Stage in all these Ciphers.

Public Key Infrastructure in Wireless Sensor Networks, The TinyPK Protocol as a Case Study. Attribute Based Encryption and its Motivation for Embedded Systems.

- **SECURITY AND PRIVACY ISSUES IN IOT SYSTEMS (05 Hours)**

The Internet of Things, Architecture, Constituent Elements, The Security and Privacy Issues in IoT Systems, Overview of the IoT Protocols Viz. Continua for Home Health Devices, DDS, DPWS: WS-Discovery-SOAP-WS Addressing-WDSL-XML Schema, HTTP/REST, MQTT, UPnP, XMPP, ZeroMQ. The IoT Security Protocols viz. ZigBee, Bluetooth, 6LowPAN, RPL. The CoAP.

- **SIDE CHANNEL ATTACKS IN EMBEDDED SYSTEMS (02 Hours)**

Introduction, Side Channel Attacks, Passive Versus Active Attacks, Timing, Analysis, Power Analysis, Electromagnetic Analysis, Analysis Tools and Equipment.

- **MISCELLANEOUS TOPICS (02 Hours)**

Overview of Security Support in Data Protection Protocols for the Embedded Systems. SSL, IPSec, IKE, and TLS in Resource Constrained Devices.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. Fei Hu., “Security and Privacy in Internet of Things (IOT's): Models, Algorithms and Implementations Handcover”, 1st Edition, CRC Press, 2016.
2. R.Giladi, N. Dimitrios, “Security and Embedded Systems”, VOL 2, IOS Press, 2006.
3. A.G. Voyiatzis, A.G. Fragopoulos, and D.N. Serpanos “Security in Embedded Systems Design

Issues in Secure Embedded Systems", 1st Edition, CRC press,2005.

4. R. Zurawski, "Embedded Systems Handbook", 1st Edition, CRC Press,2006.
5. T. Stapko, "Practical Embedded Security: Building Secure Resource-Constrained Systems", 2nd Editions, Newnes, 2007.

B.Tech. IV (CSE) Semester – VII
AUDIO AND SPEECH SIGNAL PROCESSING
(CORE ELECTIVE - 4)
CS447

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge of audio and speech production mechanism with signal processing fundamentals.
CO2	apply the knowledge of time and frequency domain analysis methods for audio and speech signal processing.
CO3	analyse the signals for feature extraction as per the requirement of different applications.
CO4	evaluate signals using different modelling, classification and regression techniques.
CO5	build the efficient applications for recognition, classification, synthesis and translation for usage in different fields.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Basic of Signal, Fundamentals of Sound, Speech Production, Frequency Spectrum, Transforms, Human Auditory System, Physics of Audio Signal Generation, Acoustics and Hearing, Discrete Signal Representation and Formats, Convolution, Linearity, Time Variant and Invariant System, Different Types of Digital Filters.

- **SIGNAL PROCESSING** **(06 Hours)**

  Properties of Audio and Speech Signal, Audio Signal Features, Short Time Fourier Transform, Audio Effects, Harmonics, Spectrogram, Audio and Speech Signal Compression, Speech Production, Equalization, Perceptual Audio Coding, Sound Synthesis, Pattern Recognition, Acoustics and Auditory Perception, Auto Correlation Function, Power Spectral Density Function, Wiener Filter.

- **AUDIO PROCSSING** **(10 Hours)**

  Psychoacoustic Representation, Compression Schemes, MP3 and Other Formats, Sound Mixture Organization, Code Book, Audio Coding, Linear Prediction Coding, Noise Reduction, Music Signal Processing, Modulation, Filters for Audio Signal Processing, Echo Cancellation, Music Analysis and Retrieval, Acoustic Source Localization and Tracking.

- **SPEECH SIGNAL** **(10 Hours)**

Articulatory Phonetics, Models of Speech Production, Waveform Coding, Time Domain Analysis, Frequency Domain Analysis, Speech Features: Energy, Magnitude, Zero-crossing, Autocorrelation, Silence, Linear Prediction, Acoustic Feature Extraction, Ceptral Processing, Pitch, Mel Frequency Cepstral Coefficients, Speech Recognition, Speaker Recognition, Linear Discriminant Analysis, Principle Component Analysis, Hidden Markov Models, Acoustic Classification Methods: Bayes Methods, Gaussians Mixture Models.

- **ADVANCE TOPICS** **(10 Hours)**

Independent Component Based Analysis, Neural Network Based Processing, Blind Source Separation, Recognition, Transcription, Enhancement, Coding, Synthesis as well as Applications to Advanced Fixed and Wireless Communication Systems, Speech Conversion, Deep Learning and Audio Activity Detection.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. Zölzer, Udo, "Digital Audio Signal Processing", John Wiley & Sons Ltd., 2nd edition, 2008.
2. Quatieri, T.F., "Discrete-time speech signal processing: principles and practice", 1st Edition, Upper Saddle River, NJ: Prentice Hall, 2002.
3. Gold, B.; Morgan, N.; Ellis, D., "Speech and audio signal processing: processing and perception of speech and music", 2nd rev. ed. Wiley-Blackwell, 2011.
4. Dutoit, T.; Marqués, F.; Rabiner, L.R., "Applied signal processing: a MATLAB-based proof of concept", 1st Edition, New York; London:Springer, 2009.
5. Rabiner, L.R.; Schafer, R.W., "Theory and applications of digital speech processing", 1st Edition, Prentice Hall, 2010.

ADDITIONAL REFERENCE BOOKS

1. Huang, Y.A.; Benesty, J. (eds.), "Audio signal processing for next-generation multimedia communication systems", New York: Kluwer Academic Publishing, 2004.

B.Tech. IV (CSE) Semester – VII
SERVICE ORIENTED SYSTEM (CORE ELECTIVE - 4)
CS449

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of course, students will be able to**	
CO1	acquire knowledge of SOA ecosystem from a business/technical perspective.
CO2	apply SOA and web services concepts for application design and development.
CO3	analyze different web services in terms of business/technical perspective.
CO4	evaluate SOA based system in terms of business/technical perspective.
CO5	design and develop SOA based system.

2. Syllabus

- **INTRODUCTION** **(10 Hours)**

  XML Document Structure, Well Formed and Valid Documents, Namespaces, DTD, XML Schema, X-Files, Parsing XML using DOM –SAX, XML Transformation and XSL, XSL Formatting, Modelling Databases in XML.

- **SERVICE ORIENTED ARCHITECTURE** **(10 Hours)**

  Characteristics of Service Oriented Architecture, Comparing SOA with Client-Server and Distributed Architectures, Characteristics of SOA, Benefits of SOA, Principles of Service Orientation, Service Layers, Business Process Management.

- **WEB SERVICES** **(14 Hours)**

  SOA and Web Services, Web Services Protocol Stack, Service Descriptions, WSDL, Messaging with SOAP, Service Discovery, UDDI, Service Level Interaction Patterns, XML and Web Services, Enterprise Service Bus, Message Exchange Patterns, WS Transactions, Web Services Technologies, JAX-RPC, JAX-WS, Web Service Standards, WS-RM, WS-Addressing, WS-Policy, Service Orchestration and Choreography, Composition Standards , BPEL, Service Oriented Analysis and Design, Search Engine Optimization.

- **BUILDING SOA-BASED APPLICATIONS** **(08 Hours)**

  Service Oriented Analysis and Design, Service Modelling, Design Standards and Guidelines, Composition, WS-BPEL, WS-Coordination, WS-Policy, WS-Security, SOA Support in Java, B2B and B2C E-commerce Development, REST Architecture, REST Full APIs, Micro Service Architecture for Highly Scalable Applications.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", 1st Edition, Pearson Education, 2005.
2. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", 1st Edition, Pearson Education, 2005.
3. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004.
4. James McGovern,SameerTyagi, Michael E.Stevens, Sunil Mathew, "Java Web Services Architecture", 1st Edition, Morgan Kaufmann Publishers, 2003.
5. Ron Schmelzer et al. "XML and Web Services", 1st Edition, Pearson Education, 2002.

ADDITIONAL REFERENCE BOOKS

1. Frank P.Coyle, "XML, Web Services and the Data Revolution", Pearson Education, 2005.

B.Tech. IV (CSE) Semester – VIII
SOCIAL NETWORK ANALYSIS (CORE ELECTIVE - 5)
CS422

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the social network data, relations among data, identification of network structure and relevant programming.
CO2	apply the model for the solution of social network problem statement to generate data sets, relations, graph.
CO3	analyze the problem solution for social network analysis considering social influence.
CO4	evaluate programming solutions with different aspects of social network analysis.
CO5	design an innovative optimised solution for the social network application problem using network dynamics.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Introduction of Social Networks, Social Networks Data, Development of Social Network Analysis, Analyzing Social Network Data, Formal Methods, Paths and Connectivity, Graphs to Represent Social Relations, Working with Network Data, Network Datasets, Strong and Weak Ties, Closure, Structural Holes, and Social Capital, Measures for Social Network Analysis.

- **SOCIAL INFLUENCE** **(09 Hours)**

  Homophily, Mechanisms Underlying Homophily, Social Influence, Affiliation, Identification of Roles, Tracking Link Formation in OnLine Data, Spatial Model of Segregation - Positive and Negative Relationships , Structural Balance, Applications of Structural Balance, Weaker Form of Structural Balance.

- **WEB INFORMATION NETWORKS** **(09 Hours)**

  The Structure of the Web, World Wide Web, Information Networks, Hypertext, and Associative Memory, Web as a Directed Graph, Bow-Tie Structure of the Web, Link Analysis and Web Search, Searching the Web: Ranking, Link Analysis using Hubs and Authorities, Page Rank, Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search, Social Network Visualization.

- **SOCIAL NETWORK MINING** **(08 Hours)**

  Social Networks, Geography, Neighbourhood Effects, Clustering of Social Network Graphs: Betweenness, Girvan Newman Algorithm, Discovery of Communities, Cliques and Bipartite Graphs, Graph Partitioning Methods, Matrices, Eigen Values, Simrank.

- **NETWORK DYNAMICS** **(08 Hours)**

  Network Effects of Local Social Networks and Global Social Networks, Spread of Behaviour, Cascading Behaviour in Networks: Diffusion in Networks, Modelling Diffusion, Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model, Six Degrees of Separation, Structure and Randomness, Decentralized Search, Empirical Analysis and Generalized Models, Analysis of Decentralized Search, Problem Solving.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2/E, 2014, ISBN: 9781316638491.
2. Borgatti, S. P., Everett, M. G. & Johnson, J. C., “Analyzing social networks”, SAGE Publications Ltd; 1/E, 2013, ISBN: 9781446247419.
3. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning about a highly connected world”, Cambridge Univ. Press, 2010, ISBN: 9780521195331.
4. Robert A., Hanneman and Mark Riddle, “Introduction to social network methods”, University of California, 2005.
5. John Scott, “Social Network Analysis: A Handbook”, SAGE Publications Ltd; 2/E, 2000, ISBN: 9780761963394.

ADDITIONAL REFERENCE BOOKS

1. Wasserman S. & Faust K., “Social Network Analysis: Methods and Applications”, Cambridge University Press, 1/E, 1994, ISBN: 9780521387071.

B.Tech. IV (CSE) Semester – VIII
NETWORK AND SYSTEM SECURITY (CORE ELECTIVE - 5)
CS424

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	gain knowledge of network and system security attacks and its prevention mechanisms.
CO2	apply different security mechanisms for given application scenario.
CO3	perform security analysis of network and system security protocols.
CO4	evaluate security protocols for different metrics like functionality, cost and efficiency.
CO5	design and integrate security protocols depending on organization's requirement.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Network and System Security, Security Attacks, Security Requirements, Confidentiality, Integrity, and Availability, Security Mechanisms, NIST Security Standards, Assets and Threat Models.

- **REVIEW OF CRYPTOGRAPHIC TOOLS** **(04 Hours)**

  Number Theory, Prime Numbers, Modular Arithmetic, Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudorandom Numbers.

- **SYSTEM SECURITY** **(10 Hours)**

  User Authentication - Means of Authentication, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Access Control-Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, Example: UNIX File Access Control, Role-Based Access Control, Database Security-The Need for Database Security, Database Access Control, Inference, Statistical Databases, Database Encryption, Cloud Security, Malicious Software, Intruders, Denial of Service and Distributed Denial of Service attacks, Intrusion Detection and Prevention.

- **SOFTWARE SECURITY AND TRUSTED SYSTEMS** **(12 Hours)**

  Buffer Overflow-Stack Overflows, Defending Against Buffer Overflows, Other Forms of Overflow Attacks, Software Security-Software Security Issues, Handling Program Input, Writing Safe Program Code, Interacting with the Operating System and Other Programs, Handling Program Output, Operating System Security-System Security Planning, Operating Systems Hardening, Application Security, Security Maintenance, Linux/Unix Security, Windows Security, Virtualization Security, Trusted Computing and Multilevel Security-The Bell-LaPadula Model for Computer Security, Other Formal Models for Computer Security,

The Concept of Trusted Systems, Application of Multilevel Security, Trusted Computing and the Trusted Platform Module, Common Criteria for Information Technology Security Evaluation, Assurance and Evaluation.

- **NETWORK SECURITY** **(10 Hours)**

  Internet Security Protocols and Standards-Secure E-mail and S/MIME, Pretty Good Privacy (PGP), Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, IPSec Protocol, Internet Authentication Applications-Kerberos, X.509, Public-Key Infrastructure, Federated Identity Management, Wireless Network Security-Wireless Security Overview, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Network Management Security-SNMP Protocol.

- **ADVANCED TOPICS** **(02 Hours)**

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. William Stallings, Computer Security: Principles and Practice, 2/E, Pearson, 2012.
2. John Vacca, Network and System Security, 2/E, Elsevier, 2013.
3. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
4. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2001.
5. William Stallings, Cryptography and Network Security, 7/E, Pearson, 2018.

B.Tech. IV (CSE) Semester – VIII
ADVANCED COMPUTER ARCHITECTURE
(CORE ELECTIVE - 5)
CS426

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	describe the various architectural concepts to optimize and enhance the classical Von Neumann architecture into high performance computing hardware systems.
CO2	interpret performance of different pipelined processors and multiprocessor architecture.
CO3	identify, compare and assess issues related to memory, control and I/O functions.
CO4	evaluate the programming solution based on parallelism.
CO5	design solutions in the area of advanced computer architecture.

2. Syllabus

- **OVERVIEW OF VON NEUMANN ARCHITECTURE** **(04 Hours)**

  Instruction Set Architecture, The Arithmetic and Logic Unit, The Control Unit, Memory and I/O Devices and Their Interfacing to the CPU; Measuring and Reporting Performance; CISC and RISC Processors.

- **PIPELINING** **(04 Hours)**

  Basic Concepts of Pipelining, Data Hazards, Control Hazards, and Structural Hazards; Techniques for Overcoming or Reducing the Effects of Various Hazards.

- **INSTRUCTION LEVEL PARALLELISM** **(06Hours)**

  ILP Concepts, Pipelining Overview, Compiler Techniques for Exposing ILP, Dynamic Branch Prediction, Dynamic Scheduling, Multiple instruction Issue, Hardware Based Speculation, Static Scheduling, Multi-threading, Limitations of ILP, Case Studies.

- **DATA-LEVEL PARALLELISM** **(06 Hours)**

  Vector Architecture, SIMD Extensions, Graphics Processing Units, Loop Level Parallelism.

- **THREAD LEVEL PARALLELISM** **(06 Hours)**

  Symmetric and Distributed Shared Memory Architectures, Performance Issues, Synchronization, Models of Memory Consistency, Case studies: Intel i7 Processor, SMT & CMP Processors.

- **MEMORY AND I/O** **(06 Hours)**

  Cache Performance, Reducing Cache Miss Penalty and Miss Rate, Reducing Hit Time, Main Memory and Performance, Memory Technology, Types of Storage Devices, Buses, RAID, Reliability, Availability and Dependability, I/O Performance Measures.

- **MULTIPROCESSOR ARCHITECTURE** **(06 Hours)**

  Taxonomy of Parallel Architectures; Centralized Shared-Memory Architecture, Synchronization, Memory Consistency, Interconnection Networks; Distributed Shared-Memory Architecture, Cluster Computers.

- **NON VON NEUMANN ARCHITECTURES:** **(04 Hours)**

  Data Flow Computers, Reduction Computer Architectures, Systolic Architectures.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. J. L. Hennessy, and D.A. Patterson, "Computer Architecture: A quantitative approach", Fifth Edition, Morgan Kaufman Publication, 2012.
2. M. J. Flynn, "Computer Architecture: Pipelined and Parallel Processor Design", 1st Edition, Narosa Publishing House, 2011.
3. J.P. Shen and M.H. Lipasti, "Modern Processor Design", 1st Edition, MC Graw Hill, Crowfordsville, 2005.
4. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", 1st Edition, MC Graw-Hill International Edition, 2000.
5. Sima D, Fountain T and Kacsuk P," Advanced Computer Architectures: A Design Space Approach", 1st Edition, Addison Wesley, 2000.

B.Tech. IV (CSE) Semester – VIII
CELLULAR NETWORK AND MOBILE COMPUTING
(CORE ELECTIVE - 5)
CS428

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the signalling system and different spread spectrum techniques.
CO2	apply the signal estimation and equalization techniques.
CO3	analyze the cellular system and mobile applications for different types of networks like GSM, GPRS, CDMA and Adhoc.
CO4	evaluate the performance of the protocols, mobile applications and network solutions for wireless communication.
CO5	design and develop the techniques to solve the issues of communication in different types of networks.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Wired Network vs. Wireless Network, Overview of Wireless Applications, Wireless Transmission: Path Loss, Multi-path Propagation, Doppler Shift, Fading, Time Division Multiplexing, Frequency Division Multiplexing, Spread Spectrum Technique, Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum, CDMA - Code Division Multiple Access, OFDM - Orthogonal Frequency Division Multiple Access, Satellite Communication.

- **WIRELESS CHANNEL** **(08 Hours)**

  Statistical Modeling of Multipath Fading Channel, Frequency Selective and Non-selective Fading Channels, Flat Fading Channels, Path-loss, Propagation Model, Shadowing, Rayleigh Fading, Equalization, Channel Modeling and Estimation, Blind Channel Estimation, AWGN Channel.

- **CELLULAR SYSTEM** **(10 Hours)**

  Cellular Network Organization, Cellular System Evolution, Cellular Fundamentals: Capacity, Topology, Operation of Cellular Systems, Cellular Geometry, Frequency Reuse, Cell Spitting, Sectoring, Handoff, Power Control, Case study: Global System for Mobile communication (GSM) Network, General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA 2000), Cordless System, Wireless Local Loop, Mobility Management-Location Management, HLR-VLR Scheme, Hierarchical Scheme, Predictive Location Management

Schemes, Types of Interference, Estimation of Adjacent Channel Interference and Co-channel Interference, Trunk Efficiency, Grade of Service, Blocking Probabilities, Propagation Models, Frequency Management and Channel Assignment.

- **AD HOCWIRELESS NETWORK** **(08 Hours)**

Cellular vs. Ad Hoc, Applications, Issues, MAC protocols, Routing Protocols, Transport Layer Protocol, Multicasting protocols, Wireless Access Protocol, Standards: IEEE 802.11, Wi-Fi, Wireless Broadband-Wi-MAX, Bluetooth, IEEE 802.15, Security in Wireless Network, Hyper LAN.

- **MOBILE COMPUTING** **(10 Hours)**

Mobile Computing, Issues: Resource Management, Interference, Bandwidth, Frequency Reuse, Mobile Data Transaction Models, File Systems, Mobility Management, Security, Mobile Computing Architecture, Mobile IP Protocol, Mobile TCP Protocol, Wireless Application Protocol, Security Issues in Mobile Computing, Server-Client programming.

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. William Stallings, "Wireless Communications & Networks", 2/E, Pearson Education India, Reprint 2007.
2. Jochen Schiller, "Mobile Communications", 2/E, Pearson Education India, reprint 2007.
3. T S Rappaport, "Wireless Communications: Principles & Practice", 2/E, Pearson Education, 2002.
4. C E Perkins, "Ad Hoc Networking", 1st Edition, Addison Wesley, 2000.
5. Asoke K Talukder, Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, Tata McGraw-Hill , Third reprint 2006.

ADDITIONAL REFERENCE BOOKS

1. Sandeep Singhal, "The Wireless Application Protocol", Addison Wesley, India, reprint 2001.
2. C. Siva Ram Murthy and B. S. Manoj,“Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson education 2007.
3. Gottapu Sasibhushana Rao, “Mobile Cellular Communication”, Pearson, 2013.

B.Tech. IV (CSE) Semester – VIII
SYSTEM ANALYSIS AND SIMULATION
(CORE ELECTIVE - 5)
CS432

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the important elements of discrete event simulation and modelling paradigm.
CO2	interpret the model and apply the results to resolve critical issues in a real world environment.
CO3	identify and analyse the system requirements using various system analysis techniques.
CO4	use computer simulation software to solve and interpret the results.
CO5	develop skills to apply simulation software to construct and execute goal-driven system models.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Introduction, Organizational and Business Context of System Development.

- **APPROACHES TO SYSTEMS DEVELOPMENT AND PROJECT MANAGEMENT** **(08 Hours)**

  System Development Methodologies, Models, Tools and Techniques for Developing Quality Software.

- **SYSTEM ANALYSIS ACTIVITIES** **(08 Hours)**

  Define, Prioritise, and Evaluate Requirements of an Information System as well as Build General and Detailed Models that Specify the System Requirements.

- **ESSENTIALS OF SYSTEM DESIGN** **(09 Hours)**

  Describe, Organize and Structure the Components of a System, Including Decisions About the System's Hardware, Software, and Network Environment, Designing Effective User and System Interfaces Considering Human-Computer Interaction Principles.

- **ADVANCE SYSTEM DESIGN CONCEPTS** **(08 Hours)**

  Apply Object-Oriented Design in Order to Build Detailed Models that Assist Programmers in Implementing the System, Store and Exchange Data in the System by Considering Database Management and Security Issues, and Creating Database Models and Controls, Making the System Operational.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. J. W. Satzinger, R. B. Jackson and S. D. Burd, "Systems Analysis and Design in a Changing World", 6th ed. Boston, USA: Thomson Course Technology, 2012.
2. Averill M. Law, "Simulation modelling and analysis (SIE)", 4th Edition, Tata McGraw Hill India, 2007.
3. David Cloud, Larry Rainey, "Applied Modelling and Simulation", Tata McGraw Hill, India.
4. Gabriel A. Wainer, "Discrete-event modelling and simulation: a practitioner's approach", 1st Edition, CRC Press, 2009.
5. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, "Theory of modelling and simulation: integrating discrete event and continuous complex dynamic systems", 2nd Edition, Academic Press, 2000.

ADDITIONAL REFERENCE BOOKS

1. Walter J. Karplus, George A. Bekey, Boris Yakob Kogan, "Modelling and simulation: theory and practice", 1st Edition, Springer, 2003.

B.Tech. IV (CSE) Semester – VIII
BIG DATA ANALYTICS (CORE ELECTIVE - 6)
CS434

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the key requirements and issues in big data management and its associated applications in intelligent business and scientific computing.
CO2	use state of the art big data analytics techniques and algorithms.
CO3	analyze large sets of data to discover patterns and other useful information.
CO4	compare and evaluate the impact of big data analytics tools and techniques.
CO5	develop big data solutions using state of the art analytics tools/techniques.

2. Syllabus

- **INTRODUCTION – DATA WAREHOUSING, DATA MINING (09 Hours)**

  Define Data Warehousing and Data Mining - The Building Blocks, Defining Features – Data Warehouses and Data Marts, Overview of the Components, Metadata in the Data Warehouse, Need for Data Warehousing, Basic Elements of Data Warehousing, Trends in Data Warehousing.

- **CONCEPTS AND TECHNIQUES IN DATA WAREHOUSING (08 Hours)**

  OLAP (Online analytical processing) Definitions, Difference Between OLAP and OLTP, Dimensional Analysis, Define Cubes, Drill-down and Roll-up - Slice and Dice or Rotation, OLAP Models, ROLAP versus MOLAP, Defining Schemas: Stars, Snowflakes and Fact Constellations.

- **CONCEPT DESCRIPTION AND ASSOCIATION RULE MINING (08 Hours)**

  Introduction to Concept Description, Data Generalization and Summarization-based Characterization, Analytical Characterization, Class Comparisons, Descriptive Statistical Measures, Market Basket Analysis- Basic Concepts, Association Rule Mining, The Apriori Algorithm, Mining Multilevel Association Rule Mining, Mining Multidimensional Association Rule Mining.

- **INTRODUCTION TO CLASSIFICATION AND PREDICTION (09 Hours)**

  Introduction to Classification and Prediction, Issues Regarding Classification, Classification using Decision Trees, Bayesian Classification, Classification by Back Propagation, Prediction Classification Accuracy.

- **ADVANCED TOPICS (08 Hours)**

  Clustering, Spatial Mining, Web Mining, Text Mining, Map-Reduce and Hadoop Ecosystem.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, Jun 22, 2011.
2. Paulraj Ponnian, "Data Warehousing Fundamentals", 1st Edition, John Willey, May 24, 2010.
3. Robert D. Schneider, Hadoop for Dummies, 1st Edition, Wiley India, Apr 14, 2014.
4. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms", 3rd Edition, John Wiley &Sons Inc., Nov 12, 2019.
5. M. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson, Sep 1, 2002.

B.Tech. IV (CSE) Semester – VIII
DEEP LEARNING (CORE ELECTIVE - 6)
CS436

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand fundamental principles, theory and approaches for learning with deep neural networks.
CO2	learn different types of Neural Network and Deep Neural Networks.
CO3	apply NN and DNN for various learning tasks in different domains.
CO4	evaluate various NN and DNN by performing complex statistical analysis for DL techniques.
CO5	design DL algorithms for real-world problems.

2. Syllabus

- **INTRODUCTION TO DEEP LEARNING (02 Hours)**

  Basics of Human learning, Attributes of learning algorithms, Applications, Learning techniques, Types of Learning algorithms, Basics of Deep learning.

- **NEURAL NETWORKS BASICS (08 Hours)**

  Biological Neuron, Idea of Computational Units, Output vs Hidden Layers; Linear vs Nonlinear Networks, McCulloch–Pitts Model, Thresholding Logic, Linear Perceptron, Perception Learning Algorithm, Linear Separability. Convergence Theorem for Perception Learning Algorithm, Learning via Gradient Descent, Logistic Regression, Back Propagation Models, Feed Forward Model Empirical Risk Minimization, Regularization, Auto Encoders, Continuous and Discrete Distributions; Maximum Likelihood, Cost Functions, Hypotheses and Tasks; Training Data; Cross Entropy, Bias-variance Trade Off, Regularization, Activation Function : Sigmoid, Tanh, RELU, Softmax; Types of Neural Network : Feed Forward Neural Network , Radial Basis Function Neural Network, Convolution Neural Network, Recurrent Neural Network(RNN) Long Short Term Memory, Modular Neural Network; Simple Word Vector Representations: Word2vec, GloVe.

- **DEEP NEURAL NETWORKS (12 Hours)**

  Deep Learning Models : Restricted Boltzmann Machines, Deep Belief Nets, Convolutional Model; Deep Neural Networks: Difficulty of Training Deep Neural Networks, Greedy Layerwise Training; Better Training of Neural Networks: Newer Optimization Methods for Neural Networks (Adagrad, Adadelta, Rmsprop, Adam, NAG), Second Order Methods for Training, Saddle Point Problem in Neural Networks, Regularization Methods (Dropout, Drop Connect, Batch Normalization);Recurrent Neural Networks: Back Propagation Through Time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs ;Convolution Neural Networks: LeNet, AlexNet; Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, Gradient Computations in RBMs, Deep Boltzmann

Machines.

- **RECENT TRENDS** **(12 Hours)**

  Auto Encoders (Standard, Denoising, Contractive, etc), Variational Auto Encoders, Adversarial Generative Networks, Maximum Entropy Distributions, Guest Lecture, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning.

- **APPLICATIONS** **(08 Hours)**

  Vision, NLP, Speech; Deep Learning Platforms and Software Libraries:-H2O.ai, DatoGraphLab, Theano, Caffe, TensorFlow etc.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series)", MIT Press, 2016.
2. Russell, S. and Norvig, N. "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall Series in Artificial Intelligence Pearson, 2015.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning (Information Science and Statistics)", 3rd Edition, Springer, 2016.
4. Raúl Rojas, "Neural Networks - A Systematic Introduction", 2nd Edition, Springer-Verlag, Berlin, New-York, 2013.
5. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", 1st Edition, O'reily, 2017.

B.Tech. IV (CSE) Semester – VIII
ADVANCE COMPILER DESIGN
(CORE ELECTIVE - 6)
CS438

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand compiler structure and overall compilation process.
CO2	apply code generation and optimization techniques for machine-independent optimization.
CO3	analyse processor architecture, scheduling and pipeling to achieve Instruction Level parallelism and optimize for parallelism and locality.
CO4	evaluate various inter procedural analysis methods to analyze a program with multiple procedures.
CO5	design and develop the mechanism required for compiling advanced language translators.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Overview of the Translation Process, Compiler Structure, and Compilation Process, Difference between Interpreter, Assembler and Compiler, Phases of Compiler, Programming Language Grammars, Lexical Analysis, Syntax Analysis, Intermediate Code Generation and Run Time Environment.

- **CODE GENERATION** **(06 Hours)**

  Issues in the Design of Code Generation, Addresses in Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Simple Code Generator, Peephole Optimization, Optimal code Generation for Expression, Dynamic Programming Code Generation.

- **MACHINE-INDEPENDENT OPTIMIZATION** **(06 Hours)**

  Scope for Optimization, Data and Control Flow Analysis, Constant Propagation, Partial Redundancy Elimination, Loops in Flow Graph, Region Based Analysis, Symbolic Analysis.

- **INSTRUCTION LEVEL PARALLELISM** **(06 Hours)**

  Processor Architecture, Code Scheduling Constraints, Basic Block Scheduling, Global Code Scheduling, Software Pipelining.

- **OPTIMIZING FOR PARALLELISM AND LOCALITY** **(06 Hours)**

  Parallelization and Multiprocessors, Iteration Spaces, Affine Array Indexes, Data Reuse, Array Data Dependant Analysis, Synchronization Free Parallelism, Synchronization Between Parallel Loops, Pipelining, Locality Optimization, Uses of Affine Transforms.

- **INTERPROCEDURAL ANALYSIS** **(06 Hours)**

  Need for Inter Procedural Analysis, Logical Representation of Data Flow, Pointer Analysis, Context Insensitive Inter Procedural Analysis, Context Sensitive Pointer Analysis, Datalog Implementation.

- **ADVANCED TOPICS** **(04 Hours)**

  Code Profiling, Parallelization and Vectorization, Garbage Collector, Just in Time Compilation and Recent Developments.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Aho, Sethi, Ullman, Compilers, "Principles, Techniques, and Tools", 2nd Edition, Addison Wesley, 2011.
2. Nandini Prasad, "Principles of Compiler", 3rd Edition, Cengage Publication, 2017.
3. Steven Muchnick, "Advanced Compiler Design and Implementation", 1st Edition M. Kaufmann, 1997.
4. R. Wilhelm and D. Maurer, "Compiler Design (International Computer Science Series)", 1st Edition, Addison Wesley, 1995.
5. V. Raghavan, "Principles of Compiler Design", 1st Edition, TMG publication, 2017.

B.Tech. IV (CSE) Semester – VIII
ADVANCED DATABASE MANAGEMENT SYSTEMS
(CORE ELECTIVE - 6)
CS442

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will**	
CO1	understand advanced database techniques for storing a variety of data with various database models.
CO2	apply various database techniques/functions with Object Oriented approach to design database for real life scenarios.
CO3	analyse the problem to design database with appropriate database model.
CO4	evaluate methods of storing, managing and interrogating complex data.
CO5	develop web application API's, distributed databases with the integration of various programming languages.

2. Syllabus

- **DISTRIBUTED DATABASE CONCEPTS** **(06 Hours)**

  Overview of Client - Server Architecture and its Relationship to Distributed Databases, Concurrency Control Heterogeneity Issues, Persistent Programming Languages, Object Identity and its Implementation, Clustering, Indexing, Client Server Object Bases, Cache Coherence.

- **PARALLEL DATABASES** **(06 Hours)**

  Parallel Architectures, Performance Measures, Shared Nothing/Shared Disk/Shared Memory Based Architectures, Data Partitioning, Intra-operator Parallelism, Pipelining, Scheduling, Load Balancing.

- **QUERY PROCESSING** **(06 Hours)**

  Index Based, Cost Estimation, Query Optimization: Algorithms, Online Query Processing and Optimization, XML, DTD, XPath, XML Indexing, Adaptive Query Processing.

- **ADVANCED TRANSACTION MODELS** **(06 Hours)**

  Save Points, Sagas, Nested Transactions, Multilevel Transactions, Recovery: Multilevel Recovery, Shared Disk Systems, Distributed Systems 2PC, 3PC, Replication and Hot Spares, Data Storage, Security and Privacy Multidimensional K- Anonymity, Data Stream Management.

- **MODELS OF SPATIAL DATA** **(05 Hours)**

  Conceptual Data Models for Spatial Databases (e.g. Pictogram Enhanced ERDs), Logical Data Models for Spatial Databases: Raster Model (Map Algebra), Vector Model, Spatial Query

Languages, Need for Spatial Operators and Relations, SQL3 and ADT, Spatial Operators, OGIS Queries.

- **WEB ENABLED APPLICATIONS** **(05 Hours)**

  Review of 3-Tier Architecture - Typical Middle-ware Products and Their Usage. Architectural Support for 3 -Tier Applications: Technologies Like RPC, CORBA, COM, Web Application Server - WAS Architecture Concept of Data Cartridges - JAVA/HTML Components, WAS.

- **OBJECT ORIENTED DATABASES** **(04 Hours)**

  Notion of Abstract Data Type, Object Oriented Systems, Object Oriented DB Design. Expert Databases: Use of Rules of Deduction in Databases, Recursive Rules.

- **ADVANCED TOPICS** **(04 Hours)**

  No SQL Databases, Unstructured Databases, Couchbase, MangoDB, Cassendra, Redis, Memcached.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. R. Elmasri and S. Navathe, “Fundamentals of Database Systems”, 5th Edition, Benjamin-Cummings Pearson Education India, 2007.
2. Avi Silberschatz, Hank Korth, and S. Sudarshan, “Database System Concepts”, 5th Edition, McGraw Hill, 2005.
3. S. Shekhar and S. Chawla, “Title Spatial Databases: A Tour”, 1st Edition, Prentice Hall, 2003.
4. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, “Database Systems”, 2nd Edition, Pearson, 2008.
5. Carlos Coronel, Steven Morris, “Database Systems: Design, Implementation, & Management”, 11th Edition, Cengage Learning, 2014.

B.Tech. IV (CSE) Semester – VIII
WEB ENGINEERING (CORE ELECTIVE - 6)
CS444

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the web application development methodologies, web application architecture, modelling and testing techniques.
CO2	apply the knowledge of web application development steps to configure the web application project to solve the given problem.
CO3	analyze the given problem statement for which web application is required and debug, troubleshoot the basics issues with web application.
CO4	test the web application, manage web resources and also evaluate quality of web project.
CO5	develop the web project, maintain and manage changes in the web project for given problems.

2. Syllabus

- **INTRODUCTION (05 Hours)**

  Web Application, Categories of Web Applications, Characteristics of Web Applications, Product-Related Characteristics, Usage Related Characteristics, Development-Related Characteristic, Concepts And Reference Model Web Engineering: Introduction And Perspectives, Evolution of Web Engineering, Web Engineering Resources Portal (WEP): A Reference Model And Guide.

- **REQUIREMENTS ENGINEERING ACTIVITIES (04 Hours)**

  Introduction, Principles for Requirement Engineering of Web Applications, Adapting Requirement Engineering Methods to Web Application Development, Requirement Types, Notations, Tools.

- **WEB APPLICATION DEVELOPMENT (04 Hours)**

  Web Application Development Methodologies, Relationship Analysis- A Technique to Enhance Systems Analysis For Web Development, Engineering Location-Based Services in the Web, Tools.

- **WEB APPLICATION ARCHITECTURES & MODELLING (06 Hours)**

  Categorizing Architectures, Specifics of Web Application Architectures, Components of a Generic Web Application Architecture, Layered Architectures, 2-Layer Architectures, N-Layer Architectures, Data-Aspect Architectures, Database-Centric Architectures, Architectures for Web Document Management, Architectures for Multimedia Data, Modelling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modelling Requirements, Hypertext Modelling, Hypertext Structure Modelling Concepts, Access Modelling Concepts, Relation to Content Modelling, Presentation Modelling, Relation to Hypertext Modelling, Customization

Modelling, Relation to Content.

- **TESTING WEB APPLICATIONS** **(07 Hours)**

  Introduction, Fundamentals, Terminology, Quality Characteristics, Test Objectives, Test Levels, Role of the Tester, Test Specifics in Web Engineering, Test Approaches, Conventional Approaches, Agile Approaches, Test Scheme, Three Test Dimensions, Applying the Scheme to Web Applications, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing, Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, Test Automation, Benefits and Drawbacks of Automated Test, Test Tools.

- **WEB METRICS AND QUALITY** **(03 Hours)**

  Models and Methods, Architectural Metrics for Web Application: A Balance Between Rigor and Relevance, The Equal Approach to the Assessment of Web Application Quality, Web Cost Estimation.

- **WEB RESOURCE MANAGEMENT** **(03 Hours)**

  Models and Techniques, Ontology-Supported Web Content Management, Design Principles And Applications of XML.

- **WEB MAINTENANCE AND EVOLUTION** **(04 Hours)**

  Techniques and Methodologies, Program Transformations for Web Application Restructuring, The Requirements of Methodologies for Developing Web Applications, A Customer Analysis-Based Methodology for Improving Web Business Systems.

- **WEB PROJECT MANAGEMENT** **(06 Hours)**

  Understanding Scope, Refining Framework Activities, Building a Web Team, Managing Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Achyut Godbole, Atul Kahate “Web Technologies”, 3rd Edition, Tata McGraw Hill, India, 2017, ISBN: 978-1259062681.
2. Peter Smith, “Professional Website Performance”, 1st Edition, Wiley India Pvt. Ltd, 2012, ISBN: 9781118487525.
3. Roger Pressman and David Lowe, “Web Engineering: A Practitioner's Approach”, 1st Edition, McGraw-Hill, 2009, ISBN:0073523291, 9780073523293.
4. J. Governor, D. Hinchcliffe and D. Nickull, “Web 2.0 Architectures: What Entrepreneurs and Information Architects Need to Know”, 1st Edition, O'Reilly, 2009, ISBN: 9780596514433.
5. Andrew King, “Website Optimization”, 1st Edition, Shroff Publishers, India, 2009, ISBN: 9788184045628.

ADDITIONAL REFERENCE BOOKS

1. Guy W. Lecky-Thompson, "Just Enough Web Programming with XHTML, PHP, and Mysql", 1st Edition, Cengage Learning, 2008, ISBN 9781598634815.

B.Tech. IV (CSE) Semester – VIII
FOUNDATIONS OF AUTOMATIC VERIFICATION
(CORE ELECTIVE - 7)
CS446

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand automatic verification of programs using different techniques like, propositional logic and predicate logic.
CO2	apply methods of program verification for the given problem and represent system using Binary Decision Diagrams.
CO3	analyse the programs for correctness and complexity.
CO4	evaluate different programs using model checking methods.
CO5	design and develop a framework for software verification.

2. Syllabus

- **PROPOSITIONAL LOGIC (02 Hours)**

  Declarative Sentences, Natural Deduction, Rules for Natural Deduction, Derived Rules, Natural Deduction in Summary, Provable Equivalence, An Aside: Proof by Contradiction, Propositional Logic as a Formal Language, Semantics of Propositional Logic, The Meaning of Logical Connectives, Mathematical Induction, Soundness of Propositional Logic, Completeness of Propositional Logic, Normal Forms, Semantic Equivalence, Satisfiability and Validity, Conjunctive Normal Forms and Validity, Horn Clauses and Satisfiability, SAT Solvers, A Linear Solver, A Cubic Solver.

- **PREDICATE LOGIC (02 Hours)**

  The Need for a Richer Language, Predicate Logic as a Formal Language, Free and Bound Variables, Substitution, Proof Theory of Predicate Logic, Natural Deduction Rules, Quantifier Equivalences, Semantics of Predicate Logic, Models, Semantic Entailment, The Semantics of Equality, Undecidability of Predicate Logic, Expressiveness of Predicate Logic, Existential Second-Order Logic, Universal Second-Order Logic, Micromodels of Software, State Machines, Software Micromodel.

- **VERIFICATION BY MODEL CHECKING (06 Hours)**

  Motivation for Verification, Linear-Time Temporal Logic, Syntax of LTL, Semantics of LTL, Practical Patterns of Specifications, Important Equivalences Between LTL Formulas, Adequate Sets of Connectives for LTL, Model Checking: Systems, Tools, Properties, Example: Mutual Exclusion, The NuSMV Model Checker, Running NuSMV, Mutual Exclusion Revisited, The Ferryman, The Alternating Bit Protocol, Branching-Time Logic, Syntax of CTL, Semantics of CTL, Practical Patterns of Specifications, Important Equivalences Between CTL Formulas, Adequate

Sets of CTL Connectives. CTL* and The Expressive Powers of LTL and CTL, Boolean Combinations of Temporal Formulas in CTL, Past Operators in LTL, Model-Checking Algorithms, The CTL Model-Checking Algorithm, CTL Model Checking With Fairness, The LTL Model-Checking Algorithm, The Fixed-Point Characterisation of CTL, Monotone Functions.

- **PROGRAM VERIFICATION** **(04 Hours)**

  Need for Specification and Verification of Code, A Framework for Software Verification, Hoare Triples, Partial and Total Correctness, Program Variables and Logical Variables, Proof Calculus for Partial Correctness, Proof Rules, Proof Tableaux, Proof Calculus for Total Correctness, Programming by Contract.

- **BINARY DECISION DIAGRAMS** **(06 Hours)**

  Representing Boolean Functions, Propositional Formulas and Truth Tables, Binary Decision Diagrams, Ordered BDDs, Algorithms for Reduced OBDDs, The Algorithm Reduce, The Algorithm Apply, The Algorithm Restrict, The Algorithm Exists, Assessment of OBDDs, Symbolic Model Checking, Representing Subsets of the Set of States, Representing the Transition Relation, Implementing the Functions pre∃ and pre∀, Synthesising OBDDs, A Relational Mu-Calculus, Syntax and Semantics, Coding CTL Models and Specifications, BDD-Based Symbolic Model Checking.

- **SAT SOLVING** **(04 Hours)**

  CDCL SAT Solvers: Organization, CDCL SAT Solvers, SAT-Based Problem Solving, Armin Biere and Daniel Kröning, Bounded Model Checking on Kripke Structures, Bounded Model Checking for Hardware Designs, Bounded Model Checking for Software, Encodings into Propositional SAT.

- **SATISFIABILITY MODULO THEORIES** **(04 Hours)**

  SMT in Model Checking, The Lazy Approach to SMT, Theory Solvers for Specific Theories, Combining Theory Solvers, SMT Solving Extensions and Enhancements, Eager Encodings to SAT, Additional Functionalities of SMT Solvers.

- **COMPOSITIONAL REASONING** **(02 Hours)**

  Reasoning with Assertions, Automata-Based Assume-Guarantee Reasoning.

- **ABSTRACTION AND ABSTRACTION REFINEMENT** **(06 Hours)**

  Simulation and Bisimulation Relations, Abstraction Based on Simulation, Counter Example-Guided Abstraction Refinement (CEGAR), Abstraction Based on Modal Simulation, Completeness, Predicate Abstraction for Program Verification, Characterizing Correctness via Reachability, Characterizing Correctness via Inductiveness , Solving Refinement Constraints for Predicate Abstraction.

- **MODEL CHECKING CASE STUDIES** **(06 Hours)**

  Equational Logic Frameworks, Real-time Frameworks, Reactive Frameworks, Pi-calculus, Tree Automata and Weak Second-Order Logic with k Successors (WSkS), Automatic Verification of Finite State Systems: Case Study of Languages and Systems like Z, B, Spin, PVS, Step.

(Total Contact Time: 42 Hours)

3. Books Recommended:

1. Bloem Roderick, Clarke Edmund, M. Henzinger, Thomas A. Veith, Helmut, "Handbook of Model Checking", Springer International Publishing, 2018, ISBN: 978-3-319-10575-8,3319105752, 978-3-319-10574-1.
2. Michael Huth Mark Ryan, "Logic in Computer Science: Modelling and Reasoning about Systems", 2nd Edition, Cambridge University Press New York, NY, USA, 2004, ISBN:052154310X.
3. P. Cousot, Jan Van Leeuwen (edited by), "Methods and Logics for Proving Programs in Handbook of Theoretical Computer Science", The MIT Press, 1994.
4. Robinson, Alan JA, and Andrei Voronkov, "Handbook of Automated Reasoning", 2nd Edition, Gulf Professional Publishing, 2001.
5. Antoni Ligeza, "Logical Foundations for Rule-Based Systems (Studies in Computational Intelligence)", 2nd Edition, Springer, 2006.

ADDITIONAL REFERENCE BOOKS

1. Uwe Schöning, "Logic for Computer Scientists (Modern Birkhauser Classics)", 1st Edition, Birkhauser, 2008.

B.Tech. IV (CSE) Semester – VIII
SECURE SOFTWARE ENGINEERING (CORE ELECTIVE - 7)
CS448

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the security field and its key concept.
CO2	catch attack patterns.
CO3	analyse the risk behind any system/code.
CO4	evaluate the attack as well as cybercrimes.
CO5	design a system with minimal risk and attack possibilities.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Software Security, Security in SDLC, Review of Software Engineering Concepts, SDLC, Software Qualities, Interdependence of Software Qualities, Security as a Software Quality, Review of Information Security Concepts, Software Security vs. Information Security vs. Application Security, Terminologies, The Trinity of Trouble viz. Connectivity, Extensibility and Complexity, Studies of Various Catastrophes Due to Insecure software, Model Based Security Engineering, Three Pillars of Software Security, Security in Software Lifecycle.

- **ATTACKS AND TYPES OF ATTACKERS (06 Hours)**

  Attacks-Types, Methods, Attacks in Each Phase of Software Life Cycle, Motivation for Attackers, Methods for Attacks: Malicious Code, Hidden Software Mechanisms, Social Engineering Attacks, Physical Attacks, Non-malicious Dangers to Software, Attacks in Each Phase of Software Life Cycle, Security Vulnerabilities and Attack Taxonomy in Internet of Things and Cyber Physical Systems, Attack Trees, Attack Trees for BGP, PGP, PGP Probable Vulnerabilities.

- **SECURITY VULNERABILITIES-I (06 Hours)**

  Introduction to Stack Analysis, Hands on Stack Analysis using gcc Compiler and sdb Debugger Tool, Methods of Attack, Taxonomy of Security Vulnerabilities, Introduction to Code Reviews and Static Informal Reviews, Formal Inspections. Code Coverage and Code Coverage Criteria viz. Statement Coverage, Branch Coverage, Condition Coverage, Path Coverage, Illustrations.

- **SECURITY VULNERABILITIES-II (04 Hours)**

  Format String Vulnerabilities, Race Conditions Vulnerability, Examples of TOCTOU Race Conditions in Linux Environment, Code Injection and its Types, SQL Injection, Interpreter Injection; Weak Session Cookies, Buffer Over flows, Hidden Form Fields, Fail Open Authentication, Cross-site Scripting.

- **INTRODUCTION TO PETRINETS (04 Hours)**

  Petrinet as a Modelling Tool, Graphical Notations, Modelling Deadlocks and Starvation, Coloured

Petrinets, Simulations of Real time Applications using Petrinets

- **INTEGRATING SECURITY INTO SDLC. (02 Hours)**

  Risk Management and Threat Modelling Methodologies, Software Risk Assessment and Threat Modelling Methodologies, Secure Development Cycle Activities and Practices.

- **USECASE MODELLING (04 Hours)**

  Usecases, Sequence Diagram, Collaboration Diagram, Illustrations of Kerberos and SET Through Sequence Diagram.

- **ATTACK PATTERNS (04 Hours)**

  The Attack Patterns, Illustrations, Review of Design Patterns in SE and Multi-tier architecture, Attack Proles, Attack Proles from Attack Patterns, Usage of Attack Proles, Using Attack Patterns in Attack Proles, Generating Attack Patterns, Case Studies, Abuse Cases, Misuse Cases, Using Attack Patterns to Generate an Abuse Case Model and Anti-Requirements, Finite State Machines for Security Requirements, Case Studies, Security Patterns.

- **ARCHITECTURAL RISK ANALYSIS (04 Hours)**

  Introduction to UMLSEC AND SECUREUML, Risk Analysis using Z for Secure Specifications, Introduction To Penetration Testing.

- **SECURE PROGRAMMING (04 Hours)**

  Common Software Security Bugs and Coding Errors.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Gary McGraw, “Software Security: Building Security”, 2nd Edition, Addison Wesley Software Security Series, 2006.
2. Theodor Richardson, Charles Thies, “Secure Software Design”, 2nd Edition, Jones and Bartlet Learning, 2013.
3. Ghezzi, Jazayeri, Mandrioli, “Fundamentals of Software Engineering”, 2nd Edition, Pearson EDU, 2003.
4. Mark Merkow, “Secure, Resilient, and Agile Software Development”, 1st Edition, Auerbach Publications, 2019.
5. Jason Grembi, “Secure Software Development: A Security Programmer's Guide”, 1st Edition, Cengage Learning, 2008.

B.Tech. IV (CSE) Semester – VIII
ANIMATION & RENDERING (CORE ELECTIVE - 7)
CS452

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the fundamentals of animation, drawings, images and lighting.
CO2	apply the knowledge of mathematics, graphics, rendering in making of animation and rendering.
CO3	analyse the different light and sound sources, its effects and characterizing the animated character with different visual effects.
CO4	evaluate the different scenario generated using sound and light for animation and rendering.
CO5	create 2D-3D animated movies, advertisement, children educational tool kits, and developing tools for awareness among the society.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  History, Fundamentals of Images, Video, Sound and Audio, Traditional Art, 2D Animation, Lighting, Texture, Rendering, Colour, Key Frames, Video Composition, Graphics Principles, Affine Transformation, Projection, Rotation, Illumination, Reflection, Refraction, Shadow, Focusing, 3D Model, Media Technology, Basic Mathematics: Polynomials, Graphs, Trigonometry, Vector, Differentiation.

- **VISUAL EFFECTS AND RENDERING** **(06 Hours)**

  Concepts of Light, Material Property, Spotlight, Free Lights, Directional Light, Ray Tracing, Radiosity Computation, Surface Property, Surfacing, Volume Rendering, Light Fields, Procedural and Image-based Texturing and Shading, Non-photorealistic Rendering, Creation and Management of Layers, Parallel Rendering, Rigging and Animation, 3D Lighting, Editing, Colour Grading, Special Effects.

- **ANIMATION DESIGN** **(06 Hours)**

  Observational Drawing, Characters, Shapes, Verbal Articulation, Storytelling, Translating Sequential Images Into Action, Frame Creation, Scripting, Gestures, Expression, Nonverbal Communication, Motion, Attitude and Body Language of Characters, 2D and 3D Composition, Lip Syncing, Morphology, 3D Animation, Shadow Effects, Mesh Representation, Recoil Effects, Stretching, Squash, Overlapping Action, Object Behaviour and Time Synchronization, Humour, Deformers, Blend Shaping, Action and Reaction, Scene Timing and Invisible Activity, Polygon Modelling, Nurbs Modelling.

- **VIDEO PROCESSING** **(06 Hours)**

Fundamentals of Video Production, Still Images, Blurring and Focusing, Camera Functioning, Framing, Photography, Cinematography, Morphology, Visual Design, Filming, Sound and Audio Processing, Filters, Tracking, Image Sequences and Object Layers, Video Codecs, Video Streaming, Video Editing.

- **AUDIO PROCESSING** **(04 Hours)**

  Basic of Signals, Fundamentals of Sound, Audio Features, Transforms, Recording, Analysis and Synthesis, Dynamics of Sound, Sound Tracks, Digital Filters, Spectrum, Formats, Recording and Effects, Equalizer, Mixer, Post Processing of Recorded Sound, Musical Instruments and Spectrum Analysis.

- **ADVANCED TOPICS** **(12 Hours)**

  Creating a Walkthrough, Dynamic FX, Dynamic Simulations of Collision, Rigid Bodies, Fire and Fluid Simulation, VFX Technology, MAYA Basic Workflow and Interface, Objects Hierarchy and Animation Design, Crowd Control, Advanced Modelling Methods, Highlights of Constitutional Rule and Laws, Copyright Act, IT Act, etc.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Watt A. and M. Watt, "Advanced Animation and Rendering Techniques: Theory and Practice", 2nd Edition, Addison-Wesley, 1992.
2. Mascelli Joseph V, "The Five C's of Cinematography: Motion Pictures Filming Techniques", 1st Edition, Silman-James Press, 1998.
3. Preston Blair, "Cartoon Animation", 1st Edition, Walter Foster Publishing Inc., CA, 1995.
4. Richard Taylor , "Encyclopedia of Animation Techniques",2nd Edition, Book Sales, 2004.
5. David Lewis Yewdall, "Practical Art of Motion Picture Sound", 2nd Edition, Focal Press, 2003.

ADDITIONAL REFERENCE BOOKS

1. Foley, J.D., A. Van Dam, S. Feiner, and J. Hughes, "Computer Graphics: Principles and Practice", 2nd Edition in C, Addison-Wesley, 1996.
2. Zölzer, Udo, "Digital Audio Signal Processing", 2nd Edition, John Wiley & Sons Ltd, 2008.
3. B. Gold, N. Morgan, D. Ellis, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", 2nd Edition, John Wiley & Sons Ltd, 2011.
4. Ed Hooks, "Acting for Animators", 2nd Edition, Routledge, 2013.
5. Harold Whitaker and John Halas, "Timing for Animation", 2nd Edition, Focal Press, Oxford, 2002.
6. John Culhane, "Disney's Aladdin – The Making of an Animated Film Hyperion", NY, 1992.
7. Dave Smith, "The Official Encyclopedia – Disney A to Z", Hyperion, 1996.
8. Leonard Maltin, "Mice and Magic – A History of American Animated Cartoons Plume", Penguin

Books. USA, 1990.

9. Bob Thompson, “Disney’s Art of Animation – From Mickey Mouse to Hercules Hyperion”, NY, 1997.
10. Donald Craften, “Before Mickey – The Animated Film [1898 – 1928]”, the University of Chicago Press, 1993.
11. Peter Hames (edited by), “Dark Alchemy: The Films of Jan Svankmajer”, 2nd Edition, Wallflower Press, 2008.
12. Robert Russett, “Experimental Animation: Origins of a New Art Cecile Starr”, 1st Edition, Da Capo, 1988.
13. Daniel Arijon, “Film Technique”, 1st Edition, Silman-James Press, 1991.
14. David Sonnensch, “Sound Design: The Expressive Power of Music, Voice and Sound Effects in Cinema”, 2nd Edition, Michael Wiese Productions, 2013.
15. Tomlinson Holman, “Sound for Film and Television”, 2nd Edition, Focal Press, 2001.

B.Tech. IV (CSE) Semester – VIII
RESEARCH METHODOLOGY
(CORE ELECTIVE - 7)
CS454

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand different research techniques to perform the research in academic as well as real life.
CO2	apply sampling techniques and develop hypothesis on the real world problems.
CO3	perform, evaluate, analyse and interpret the research design through project development and case study analysis using appropriate tools.
CO4	evaluate the outcomes in terms of hypothesis testing and accepting or rejection the decision based on the problem statement.
CO5	design, develop and innovate a research strategy for complex engineering problems.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Research: Definition, Characteristics, Motivation and Objectives, Research Methods vs Methodology, Types of Research – Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.

- **RESEARCH METHODOLOGY** **(04 Hours)**

  Research Process, Formulating the Research Problem, Defining the Research Problem, Research Questions, Research Methods vs. Research Methodology.

- **RESEARCH DESIGN** **(04 Hours)**

  Concept and Importance in Research, Features of a Good Research Design, Exploratory Research Design, Concept, Types and Uses, Descriptive Research Designs, Concept, Types and Uses, Experimental Design: Concept of Independent & Dependent variables.

- **LITERATURE REVIEW** **(04 Hours)**

  Review Concepts and Theories, Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis.

- **DATA MODELING AND SIMULATIONS** **(08 Hours)**

  Mathematical Modeling, Experimental Skills, Simulation Skills , Data Analysis and Interpretation.

- **TECHNICAL WRITING AND TECHNICAL PRESENTATIONS** **(04 Hours)**

- **TOOLS AND TECHNIQUES FOR RESEARCH (06 Hours)**

  Methods to Search Required Information Effectively, Reference Management Software, Software for Paper Formatting, Software for Detection of Plagiarism.

- **CREATIVITY AND ETHICS IN RESEARCH, INTELLECTUAL PROPERY RIGHTS (04 Hours)**

- **DISCUSSION AND DEMONSTRATION OF BEST PRACTICES (04 Hours)**

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. John W. Creswell, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", 2nd Edition, SAGE Publications, 2002.
2. C.R. Kothari, "Research Methodology: Methods and Techniques", 4th Edition, New Age International, 2012.
3. David Silverman, "Qualitative Research", 4th Edition, SAGE Publications Ltd, 2016.
4. Norman K. Denzin, Yvonna Sessions Lincoln, "Handbook of Qualitative Research", 2nd Edition, SAGE Publications Ltd, 2011.
5. Michael Quinn Patton, "Qualitative research and evaluation methods", 3rd Edition, SAGE Publications Ltd, 2002.

B.Tech. IV (CSE) Semester – VIII
ETHICAL HACKING (CORE ELECTIVE - 7)
CS456

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of core concepts related to information security and ethical hacking.
CO2	install, configure, and use different state of the art hacking software on a closed network environment.
CO3	analyze the vulnerabilities related to computer system and networks using state of the art tools and technologies.
CO4	evaluate best practices in information security to maintain confidentiality, integrity and availability.
CO5	implement effective solutions for ethical hacking in different environments.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Ethical Hacking: Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms.

- **INFORMATION AND NETWORK SECURITY** **(09 Hours)**

  Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering System and Network Vulnerability and Threats to Security , Various Types of Attack and the Various Types of Attackers in the Context of the Vulnerabilities Associated With Computer and Information Systems and Networks Physical Security, Steganography.

- **ETHICAL HACKING – 1** **(12 Hours)**

  Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow.

- **ETHICAL HACKING – 2** **(12 Hours)**

  Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hacking Basic Ethical Hacking Tools and Usage of These Tools in a Professional Environment. Legal, Professional and Ethical Issues Likely to Face the Domain of Ethical Hacking. Ethical Responsibilities, Professional Integrity and Making Appropriate Use of the Tools and Techniques Associated With Ethical Hacking.

(Total Contact Time: 42 Hours)

3. Books Recommended:

1. Dominic Chell, Tyrone Erasmus, Shaun Colley, Oflie Whitehouse," The Mobile Application Hacker's Handbook", 2nd Edition, Wiley, 2015.
2. Michael Gregg, "Certified Ethical Hacker (CEH) Cert Guide", 2nd Edition, Pearson India, 2014.
3. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", 2nd Edition, CRC Press, 2017.
4. Allen Harper, Shome Harris, Jonathan Ness,Chris Eagle, Gideon Lenkey, TerronVilliams "Gray Hat Hacking The Ethical Hakers Handbook", 3rd Edition, TMH, 2011.
5. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", 2nd Edition, Elsevier, 2013.

ADDITIONAL REFERENCE BOOKS

1. Jon Erickson "HACKING: The art of Exploitation", 2nd Edition, William Pollock No Starch Press, 2008.

B.Tech. IV (CSE) Semester – VIII
CYBER LAW AND FORENSICS (CORE-16)
CS402

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the basics of cyber law and cyber forensics with respect to Indian IT Act.
CO2	apply knowledge of cyber law to provide solutions to cyber security.
CO3	analyze various computer forensics technologies and systems.
CO4	evaluate and assess the methods for data recovery and digital evidence collection.
CO5	give solutions to real life problems using state of the art cyber forensics tools and techniques.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Cyber Security and its Problem-Intervention Strategies: Redundancy, Diversity and Autarchy, Cyber-Crime and The Legal Landscape Around the World, Why Do We Need Cyber Laws, Cyber Forensics Fundamentals, Benefits of Forensics, Cyber Forensics Evidence and Courts, Legal Concerns and Private Issues.

- **CYBER LAWS -1** **(08 Hours)**

  The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber Law, Technology and Students: Indian Scenario.

- **CYBER LAWS -2** **(08 Hours)**

  Private Ordering Solutions, Regulation and Jurisdiction For Global Cyber Security, Copyright Source of Risks, Pirates, Internet Infringement, Fair Use, Postings, Criminal Liability, First Amendments, Data Losing, Cyber Ethics - Legal Developments, Cyber Security in Society, Security in Cyber Laws Case Studies, General Law and Cyber Law-A Swift Analysis.

- **CYBER FORENSICS -1** **(09 Hours)**

  Cyber Investigation - Procedure for Corporate High-Tech Investigations, Understanding Data Recovery Workstation and Software, Conducting and Investigations, Data Acquisition - Understanding Storage Formats and Digital Evidence, Determining the Best Acquisition Method, Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Remote Network Acquisition Tools, Other Forensics Acquisitions Tools.

- **CYBER FORENSICS -2** **(09 Hours)**

  Current Cyber Forensics Tools- Software and Hardware Tools, Validating and Testing Forensic Software, Addressing Data-Hiding Techniques, Performing Remote Acquisitions, E-Mail

Investigations- Investigating Email Crime and Violations, Understanding E-Mail Servers, Specialized E-Mail Forensics Tool.

- **Practicals will be based on the coverage of the above topics.** **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

3. Practicals:

1 Introduction to various software tools related to cyber law and cyber forensics.

2 Practical based on disk forensics.

3 Practical based on network forensics.

4 Practical based on device forensics.

5 Practical based on email security.

6 Practical using forensic tools for image and video fraud.

7 Practical using on e-commerce related cyber-attacks.

8 Practical based on social network and online transactions related cyber threats.

4. Books Recommended:

1. Sunit Belapure and Nina Godbole, Cyber "Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley India Pvt. Ltd, 2011.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", 1st Edition, Cambridge University Press, 2006.
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", 1st Edition, Springer-Verlag, 1997.
4. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", 1st Edition, Addison Wesley, 2002.
5. B. Nelson, A. Phillips, F. Enfinger, C. Stuart, "Guide to Computer Forensics and Investigations, 2nd Edition, Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

ADDITIONAL REFERENCE BOOKS

1. J. Vacca, "Computer Forensics: Computer Crime Scene Investigation", 2nd Edition, Charles River Media, 2005, ISBN: 1-58450-389.