राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR
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Department of Information Technology

Updated Schemes of B.Tech. Programme as per 49th Senate

BTech (IT) 6th Semester

National Institute of Technology Raipur (Dept of Information Technology)												
Course of Study and Scheme of Examination							B. Tech. 6th Semester				Branch:IT	
S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1	IT106101IT	Compiler Design	3	1	0	20	30	-	50	-	100	4
2	IT106102IT	Artificial Intelligence	3	1	0	20	30	-	50	-	100	4
3	IT106103IT	Computer Graphics	3	1	0	20	30	-	50	-	100	4
4	Program Elective (EXX2)		3	0	0	20	30	-	50	-	100	3
5	Program Elective (EXX3)		3	0	0	20	30	-	50	-	100	3
6	Open Elective (OXX2)		3	0	0	20	30	-	50		100	3
7	IT106401IT	Artificial Intelligence lab	0	0	2	40	-	20	-	40	100	1
8	IT106402IT	Computer Graphics Lab	0	0	2	40	-	20	-	40	100	1
												23

Subject Code	Program Elective (EXX2)
IT106201IT	Cryptography and Network Security
IT106202IT	Process Mining
IT106203IT	Cyber Law
IT106204IT	Cloud and IoT Security
Subject Code	**Program Elective (EXX3)**
IT106205IT	Cellular Mobile Computing
IT106206IT	Quantum Computing
IT106207IT	Advanced Database Management System
IT106208IT	Secure Coding
Subject Code	**Open Elective (0XX2)**
IT106301IT	Machine Learning
IT106302IT	Graph Theory
IT106303IT	Computational Geometry
IT106304IT	Data Science and Analytics

Compiler Design

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-1-0, (4)	Core	IT106101IT

[Pre-requisites: Mathematics, Brief knowledge of programming languages, Data Structure, and Algorithm Design]

Course Objectives

1. The Objective of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers.
2. Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

Course Content

Unit 1: Introduction

Introduction to Compiler, single and multi-pass compilers, Translators, Phases of Compilers,Compiler writing tools, Bootstrapping, Back patching. Finite Automata and Lexical Analyzer: Role of Lexical Analyzer, Specification of tokens, Recognition of tokens, Regular expression, Finite automata, from regular expression to finite automata transition diagrams, Implementation of lexical analyzer Tool for lexical analyzer LEX, Error reporting.

Unit2: Syntax Analysis and Parsing Techniques

Context free grammars, Bottom-up parsing and top down parsing. Top down Parsing: elimination of left recursion, recursive descent parsing, Predicative Parsing, Bottom Up Parsing: Operator precedence parsing, LR parsers, Construction of SLR, canonical LR and LALR parsing tables, Construction of SLR parse tables for Ambiguous grammar, the parser generator – YACC, error recovery in top down and bottom up parsing.

Unit 3: Syntax Directed Translation & Intermediate Code Generation

Synthesized and inherited attributes, dependency graph, Construction of syntax trees, bottom up and top down evaluation of attributes, S-attributed and L-attributed definitions, Postfix notation; Three address codes, quadruples, triples and indirect triples, Translation of assignment statements, control flow, Boolean expression and Procedure Calls.

Unit4: Runtime Environment& Code Optimization and Generation

Storage organization, activation trees, activation records, allocation strategies, Parameter passing symbol table, dynamic storage allocation.

Basic blocks and flow graphs, Optimization of basic blocks, Loop optimization, Global data flow analysis, Loop invariant computations. Issue in the design of Code generator, register allocation, the target machine, and simple Code generator.

Course Materials

Required Text: Textbooks

1. Compilers-Principles, Techniques and Tools, Alfred V. Aho, Ravi Sethi and Ullman J.D.Addison Wesley.
2. Principle of Compiler Design, Alfred V. Aho, and J.D. Ullman, Narosa Publication.

Optional Materials: Reference Books

1. Compiler design in C, A.C. Holub, PHI.
2. Compiler construction (Theory and Practice), A.Barret William and R.M. Bates, Galgotia Publication.
3. Compiler Design, Kakde.

Artificial Intelligence

[6thSemester, Third Year]

Course Description			
Offered by Department	Credits	Status	Code
Information Technology	3-1-0, (4)	Core	IT106102IT

[Pre-requisites: Data Structures, Discrete Structures]

Course Objectives

1. Acquire advanced Data Analysis skills.
2. Stay Industry relevant and grow in your career.
3. Apply AI methods, techniques, and tools for the automation in real time systems.

Course Content

Unit 1: General Issues and Overview of AI

The AI problems: what is an AI technique; Level of model, criteria for success, Characteristics of AIapplications, Intelligent Agents,Problem Solving, State Space Search, Production systems, Problem characteristics, Production System characteristics, Issues in thedesign of search program, Data driven and goal driven search, Exhaustive searches: Depth first &Breadth first search. Case study: Sophia the first Humanoid robot.

Unit 2: Problem Solving through Searching

Heuristics & Heuristic function, Heuristic Search – Generate & test, Hill climbing; Branch and Boundtechnique; Best first search & A* algorithm, AND/OR Graphs, Problem reduction and AO* algorithm,Constraint Satisfaction problems, Means End Analysis, Adversarial search: Game Playing, Minimax search procedure, Alpha-Beta cut-offs, Additional Refinements.

Unit 3: Knowledge and Reasoning

Introduction to knowledge representation-Propositional calculus, First Order Predicate Calculus,conversion to clause form, Unification Theorem proving by Resolution, Natural Deduction,InferenceMechanisms, Knowledge representation issues-Representation and mapping,Approaches to Knowledge representation, Frame Problem, Structured knowledge representation,Semantic Networks, Frame representation and Value Inheritance, Conceptual Dependency andScripts, Introduction to Agent based problem solving,Source of Uncertainty, Probabilistic Reasoning and Uncertainty, Probability theory, Bayes Theorem, Non-MonotonicReasoning. Case Study: Industrial AI Robots.

Unit 4: Applications of AI&Expert Systems

Natural language processing: overview, Basic steps followed for the NLP, concept of NLP, Parsing,machine translation, Planning Overview - An Example Domain: The Blocks Word, Component of Planning Systems, Goal Stack Planning (linear planning); Non-linear Planning using constraintposting. Learning, Rote Learning; Learning by Induction, Learning in Problem Solving, Explanation based learning and Discovery, Introduction to LISP and PROLOG, Introduction toExpertSystems, characteristics, Architecture of Expert Systems, Development of Expert System, Software Engineering and Expert System, Expert System Life Cycle model, Expert System Shells; Knowledge Acquisition; Case Study: Autonomous Vehicles.

Course Materials

Required Text: Textbooks

1. Elaine Rich and Kevin Knight: Artificial Intelligence- Tata McGraw Hill.
2. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norvig, Pearson Education, 2nd Edition.
3. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems- Prentice Hall ofIndia.
4. Joseph C Giarratano, Gary D Riley: Expert System Principles & Programming, 4th Edition.

Optional Materials: Reference Books

1. Nils J.Nilsson: Principles of Artificial Intelligence- Narosa Publishing house.
2. Artificial Intelligence, Winston, Patrick, Henry, Pearson Education.
3. Artificial Intelligenece by Gopal Krishna, Janakiraman.

Computer Graphics

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-1-0, (4)	Core	IT106103IT

[Pre-requisites: Computer Programming]

Course Objectives

1. Understanding two- and three-dimensional representation of objects
2. Understanding models to represent real world objects onto screen.

Course Content

Unit 1: Overview of Graphics System

Basics of Computer Graphics, I/O devices, Raster scan & Random scan system, line and circle generation methods, Filled area primitive, solid area filling algorithms.2-D Transformation, basic geometric transformations, Transformation in homogeneous coordinate system, Line Clipping algorithms; Cohen-Sutherland algorithm, Midpoint subdivision algorithm, Cyrus beck algorithm,

Unit 2: Three dimensional transformations and Curve Design

3-D transformations, Projection: parallel projection, perspective projection, Vanishing points. Polygon Clipping

Parametric curves, Need for cubic parametric curves c0, c1, c2 continuity, Bezier curves, Generation though ernstein polynomials, Condition for smooth joining of 2 segments, Convex Hull property, BSplineCurves: Properties of B-spline curves, Finding Knot vectors-uniform and open uniform, Nonuniform, rational B-splines, Beta splines, Subdividing curves, Drawing curves using forward differences.

Unit 3: Hidden Surface Removal &Fractals

Hidden Surface Removal: Back face removal, Floating Horizon method for curved objects, Z-Bufferor depth buffer algorithm, Painters algorithm (Depth sorting method), Binary space partitioning trees, Scan-line algorithm, Warnock's algorithm. Fractals: self-similar fractals-fractal dimension, Generation of Terrain-random mid point displacement, Grammar based models, Self-squaring fractals. Soild Modelling: Generation through sweep techniques, Constructive sold geometry,.

Unit 4 : Shading, Color Issues and Animation

Illumination model, Computing reflection vector, Gouraud and Phog shading, Texture mapping &their characteristics, Handling shadows, Radiosity, Lambert's Law, Modelling transparency, Colorissues: color model for Images, Additive and Subtractive colour models, Wavelength spectrum, CIE colour standards. Animation: Procedural animation, morphing, creating key frames, steps for creating animation, Frame by Frame animation.

Course Materials

Required Text: Text books

1. Computer graphics, Hearn and Baker, PHI
2. Computer Graphics, Foley, PE-LPE,

Optional Materials: Reference Books

1. Procedural Elements of Computer graphics, Rogers, McGraw Hill
2. Computer graphics, Harringtons S., McGraw Hill.
3. Computer Graphics, Schoum Series.

Cryptography and Network Security

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106201IT

[Pre-requisites: Computer Networks]

Course Objectives

1. Training students to master the basic principles, knowledge, and skills about network security.
2. They will learn how to apply cryptography as a tool for maintaining confidentiality, along with hash functions and digital signatures helping in message integrity and authentication.
3. Learn to Analyze encryption algorithms.
4. Design and Develop intrusion detection system

Course Content

Unit 1: Introduction

Introduction to Security attacks, services And mechanisms, Introduction to cryptology, Classical Encryption techniques Cipher Principles, Data Encryption Standard,TripleDES,Block Cipher Design Principles and Modes of Operation,evaluation criteria for AES, AES Cipher.

Unit 2: Key Management

Introduction to Number Theory,Public Key Cryptography and RSA,ElGamalCryptosystem,Diffie-Hellman key Exchange, Elliptic Curve Architecture and Cryptography.

Unit 3: Authentication requirements and applications

Authentication functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, Digital Signature Standard.Kerberos, X.509 Authentication Service, Electronic Mail Security – PGP – S/MIME

Unit 4 Web security:

Security Socket Layer (SSL)&Transport Layer Security (TLS), Secure Electronic Transaction (SET). System security: intruders, viruses and related threads, firewall design principles.

Course Materials

Required Text: Text books

1. William Stallings, “Cryptography And Network Security – Principles and Practices”, Prentice Hall of India, Third Edition 2003.
2. BehrouzForouzan, ”Cryptography and Network Security” Tata McGraw-Hill ,1e (special Indian Edition), 2007.

Optional Materials: Reference Books

1. AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
2. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Pearson Education, 2003.
4. Menezes, A.J.; Van Oorschot, P.C.; Vanstone, S.A. Handbook of applied cryptography. CRC Press, 1997.

Process Mining

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106202IT

[Pre-requisites: Data Structures, Data Mining]

Course Objectives:

1. To study the basic concepts of the Process Mining
2. To understand the theoretical foundations of process mining
3. To understand real-life data sets helping them understand the challenges related to process discovery, conformance checking, and model extension.
4. To relate Process Mining Techniques with other analysis techniques like simulation, business intelligence, data mining, Machine Learning, and Verification.
5. To apply basic process discovery techniques such as alpha algorithms to learn a process model from an event log (both manually and using tools).

Course Content

Unit-1

Organization, Introduction and foundations of Process Mining and Analytics, Petri net analysis

Unit-2:

Basic process discovery, Advanced process discovery- Discovery Algorithms

Unit-3:

Quality Dimensions, Process mining methodology, Conformance checking

Unit-4:

Process enhancement, Process model matching and similarity, Process quality and simulation Machine learning in process mining

Required Text: Text/Reference books:

1. Wil van der Aalst, “Process Mining: Data Science in Action”, Springer-Verlag, Berlin, 2016
2. Video lectures based on https://www.coursera.org/learn/process-mining and https://www.futurelearn.com/courses/process-mining
3. Process Mining in Action https://fluxicon.com/book/read/

Cyber Law

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106203IT

[Pre-requisites: Cryptography and Network Security]

Course Objectives

1. To understand key terms and concepts in Cryptography, Governance and Compliance.
2. To analyzing the nature of attacks through cyber/computer forensics software/tools.
3. To develop cyber security strategies and policies.
4. To demonstrate a critical understanding of the Cyber law with respect to Indian IT/Act 2008.

Course Content

Unit 1: Introduction to Cyberspace and Cybercrimes

Cyber Space: Understanding Cyber Space, Defining Cyber Laws Jurisdiction in Cyber Space: Concept of Jurisdiction, Internet Jurisdiction, Indian Context of Jurisdiction. UnderstandingCyber Crimes: Defining Crime, Crime in context of Internet – Actus Reus/ Mens Rea, Types of crime in Internet, Computing damage in Internet crime. Cyber Crimes: Fraud, Hacking, Mischief, Trespass, Defamation, Stalking, Spam. Web hosting and web Development agreement, Legal and Technological Significance of domain name.

Unit 2: IT ACT 2000

Overview of IT Act 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm: Public Cryptography, Private Cryptography; Electronic Governance: Legal Recognition of Electronic Records, Legal Recognition of Digital Signature; Certifying Authorities, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication; Alternative Dispute Resolution, Online Dispute Resolution (ODR).

Unit 3: Trademarks and Patents

Legal Issues in Internet and Software Copyright: Jurisdiction Issues and Copyright, Infringement, Remedies of Infringement, Multimedia and Copyright issues, Software Piracy, Patents: Understanding Patents, International context of Patents,Indian Position on Computer related Patents. Trademarks: Understanding Trademarks, Trademark Law in India, Infringement and Passing Off, Trademarks in Internet, Domain name registration, Domain Name Disputes & WIPO.

Unit 4: Cyber Law and Related Legislation and E-Commerce and Legal Issues

IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections: Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act; Law Relating To Employees And Internet, Hierarchy of courts. Electronic Money, Regulating e-transactions, Role of RBI and Legal issues, Transnational Transactions of E-Cash, Credit Card and Internet, Laws relating to Internet credit cards, Secure Electronic Transactions, Electronic Data Base and its Protection.

Course Materials

Required Text: Text books

1. Cyber law simplified: Vivek Sood , Tata McGraw Hill Education Pvt Ltd , 2001, fifth reprint 2009.
2. Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher.
3. Information Security policy &implementation Issues, NIIT, PHI.

Optional Materials: Reference Books

1. Cyber CRIME notorious Aspects of the Humans & net Criminals activity in Cyber World Barna Y Dayal D P Dominant Publisher.
2. Cyber Crime Impact in the new millennium, Marine R.C. Auther press.
3. Spam Attack, Cyber Stalking & abuse, Barna Y, Dayaal D P Dominant publisher.
4. Frauds & Financial crisis in Cyber space, Barna Y, Dayal D P, Dominant publisher.

Cloud & IoT Security

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106204IT

[Pre-requisites: Data Structures, Discrete Structures]

Course Objectives:

6. To study the basic concepts of the Cloud and IoT security
7. To understand and study the different IoT Architectures and Protocols
8. To study the fundamental of the Security Requirements in Cloud and IoT Architecture

Course Content

Unit-1 Fundamentals of IoT and Cloud Computing: Evolution of Internet of Things, Enabling Technologies, IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

Unit-2: IoT Architectures and Protocols: M2M high-level ETSI architecture, IETF architecture for IoT, OGC architecture. IoT reference model: Domain model, information model, functional model, communication model. IoT reference architecture. Protocol Standardization for IoT: Efforts, M2M and WSN Protocols, SCADA and RFID Protocols. IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks. Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Layer Protocols: CoAP and MQTT.

Unit-3: Securing the IoT: Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications. Security Architecture in the Internet of Things, Security Requirements in IoT, Insufficient Authentication/Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability, Attacks Specific to IoT. Vulnerabilities. Secrecy and Secret-Key Capacity, Authentication/Authorization for Smart Devices, Transport Encryption, Attack & Fault trees.

Unit-4: Cloud Security for IoT: Cloud services and IoT: offerings related to IoT from cloud service providers, Cloud IoT security controls, and an enterprise IoT cloud security architecture. New directions in cloud enabled IoT computing.

Required Text: Text/Reference books:

1. Xu, L. D., & Li, S. (2017). Securing the Internet of Things. Elsevier.
2. Weippl, E. (2018). Internet of Things Security: Fundamentals, Techniques and Applications. River Publishers.
3. Russell, B., & Van Duren, D. (2016). Practical internet of things security. Packt Publishing Ltd.
4. Hu, F. (2016). Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations. CRC Press.
5. Zhou, H. (2012). The internet of things in the cloud: a middleware perspective. CRC press.
6. Hersent, O., Boswarthick, D., & Elloumi, O. (2011). The internet of things: Key applications and protocols. John Wiley & Sons.
7. Gupta, B., Agrawal, D., Handbook of Research on Cloud Computing and Big Data Applications in IoT, IGI Global, USA, ISBN13: 9781522584070, 2019.
8. Granjal, J., Monteiro, E., & Silva, J. S. (2015). Security for the internet of things: a survey of existing protocols and open research issues. IEEE Communications Surveys & Tutorials, 17(3), 1294-1312.

Cellular Mobile Computing

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106205IT

[Pre-requisites: Computer Networks]

Course Objectives

1. To understand the concept of basic cellular system.
2. To know the types of channel coding techniques, data transmission modes and services of GSM, CDMA.
3. To have an insight into the various propagation models used in mobile communication.
4. To study the recent trends adopted in cellular systems and wireless standards.

Course Content

Unit 1: Introduction to Wireless Network System

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Adhoc Networks, Sensor Networks, Third Generation (3G) Wireless Networks,.

Unit 2: The Cellular Network Concept- System Design

Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel , Soft handoff, hard handoff ,Handoff Strategies, Channel assignment strategies, Large scale path loss:-Free Space Propagation loss equation, Pathloss of NLOS and LOS systems, , Outdoor propagation model, Indoor propagation models

Unit 3: Wireless LAN

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum - IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security, IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

Unit 4: Mobile computing

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations, Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

Course Materials

Required Text: Text books

1. Jochen Schiller, Mobile Communications, Addison Wesley.
2. Asha Mehrotra, GSM System Engineering, Artech House Publishers.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House Publishers.

Quantum Computing

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106206IT

[Pre-requisites: Data Structures, Discrete Structures, Digital Logic]

Course Objectives:

1. To understand the basic concepts and terminology related to Quantum Computing
2. To understand the basic concepts of Quantum Algorithm
3. To study the application of the Quantum Computing

Course Content

Unit-1: Introduction to Quantum computing

Foundations of Quantum Computing: Qubit and Quantum State, Quantum Gates and Circuits, quantum circuit model, working with one qubit and the Bloch sphere, working with two qubits and entanglement,

Unit-2: Basics of Linear Algebra: Dirac Notation Vectors, Complex Conjugate & Norm Analysing, Pauli gates, Analysing Cascade of gates, Analysing Two-qubit gates, Tensor Product (example)

Unit-3: Quantum Algorithms

Classical and quantum algorithms, Deutsch–Jozsa algorithm: Moderate improvements for searching, Oracles: Representing classical functions, in quantum algorithms, Deutsch–Jozsa algorithm

Unit-4: Applied Quantum computing

Searching with quantum computers, Searching unstructured data, Grover's search algorithm Arithmetic with quantum computers: Factoring quantum computing into security, Classical algebra and factoring, Quantum arithmetic: Adding with qubits. Multiplying with qubits in superposition, Modular multiplication in Shor's algorithm

Required Text: Text/Reference books:

1. Nielsen, Michael A., and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge, UK: Cambridge University Press, September 2000. ISBN: 9780521635035.
2. Kaiser, Sarah C., and Christopher Granade, "Learn quantum computing with python and Q#: A hands-on approach", Simon and Schuster, 2021
3. Hirvensalo, Mika, "Quantum computing" Springer Science & Business Media, 2003.

Advanced Database Management System

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106207IT

[Pre-requisites: Database System Concepts]

Course Objectives

1. To understand the basic concepts and terminology related to distributed DBMS and its design.
2. To design and develop query processing strategies.
3. To understand transaction processing and concurrency control in distributed databases.
4. To understand reliability and replication concepts in distributed databases.

Course Content

Unit-1: Overview of Distributed Database and Distributed Database Design

Distributed Database Management Systems - Promises of distributed database, design issues of distributed databases, distributed database architecture, Distributed Database Access Primitives, Integrity Constraints in Distributed Databases, Data fragmentation, horizontal fragmentation, vertical fragmentation,Allocation of Fragments, allocation problem, allocation model, Translation of Global Queries to Fragment Queries, The Equivalence Transformation for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping - Aggregate Function Evaluation, Parametric Queries, Database Integration, Schema Matching, Schema Integration, Schema Mapping.

Unit 2: Query Decomposition and Data Localization

Overview of Query Processing-objectives, Characterization of Query Processors, Layers of Query Processing, Query Decomposition and Data Localization- Localization of Distributed Data, Optimization of Distributed Queries, Centralized Query Optimization, Join Ordering in Distributed Queries, Distributed Query Optimization.

Unit 3: Distributed Transaction Management and Concurrency Control

Introduction to Transaction Management, Properties of Transactions, Types of Transactions, Distributed Concurrency Control, Taxonomy of Concurrency Control Mechanisms, Locking Based Concurrency Control Algorithms, Timestamp Based Concurrency Control Algorithms, Optimistic Concurrency Control Algorithms, Deadlock Management - The System R* ,The Architecture of System R*, Compilation - Execution and Recompilation of Queries, Protocols for Data Definition and Authorization in R*, Transaction and Terminal Management.

Unit 4: Reliability, Replication and Current Trends

Distributed DBMS Reliability, Reliability Concepts and Measures, Failures in Distributed DBMS, Local Reliability Protocols, Distributed Reliability Protocols, Data Replication, Consistency of Replicated Databases, Update Management Strategies, Replication Protocols, Current trends in No SQL, New SQL data management issues on the cloud, Stream data management.

Course Materials

Required Text: Text books

1. Stefano Ceri, GuiseppePelagatti, "*Distributed Databases - Principles and Systems*", Tata McGraw Hill, 2008.
2. Ozsu M.T., Sridhar S., "*Principles of Distributed database systems*", Pearson education, 2011.
3. Korth& Sudarshan, *"Database system concept",* Tata McGraw Hill, 2008.

Optional Materials: Reference Books

1. Raghu RamaKrishnan, JohnaasGehrke, "*Database Management Systems*", TataMcGrawHill, 2000.
2. Elmasri, Navathe, "*Fundamentals of Database Systems*", Addison-Wesley, Fifth Edition 2008.
3. Peter Rob, Carlos Coronnel, "*Database Systems- Design, Implementation and Management*", Course Technology, 2000.

Secure Coding

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Program Elective	IT106208IT

[Pre-requisites: Data Structures, Discrete Structures]

Course Objectives:

1. To study the basic concepts of the secure Coding design concept
2. To understand and study the different Security Vulnerabilities and threats.
3. To study the fundamental of the Secure Coding Techniques and Design

Course Content

Unit-1: Secure Coding through Threat modelling: Identifying the Threats by Using Attack Trees and rating threats using DREAD, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization. Defence in Depth and Principle of Least Privilege.

Unit-2: Security issues and Vulnerabilities

Security, CIA Triad, Viruses, Trojans, and Worms in a Nutshell, Security Concepts- exploit, threat, vulnerability, risk, attack. Malware Terminology: Rootkits, Trapdoors, Botnets, Key loggers, Honeypots. Active and Passive Security Attacks. IP Spoofing, Tear drop, DoS, DDoS, XSS, SQL injection, Smurf, Man in middle, Format String attack. **Types of Security Vulnerabilities**- buffer overflows, Invalidated input, race conditions, access-control problems, weaknesses in authentication, authorization, or cryptographic practices. Access Control Problems.

Unit-3 Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, **Insecure Coding Practices in Java Technology**. ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. **Security Issues in C Language:** String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based countermeasures using Stack Guard and Proposlice. Socket Security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM.

Unit-4 Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Inter-process Communication, Securing Signal Handlers, and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters.

Required Text: Text/Reference books:

1. Michael Howard and David LeBlanc, “Writing Secure Code”, Microsoft Press.
2. Jason Deckar, “Buffer Overflow Attacks: Detect, Exploit, Prevent”, Syngress.
3. Frank Swiderski and Window Snyder, “Threat Modelling”, Microsoft Professional’s

Machine Learning

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT106301IT

[Pre-requisites: Data Mining, DBMS, Data Structure]

Course Objectives

1. To understand Data Science concepts, techniques, and applications.
2. To understand the underlying principle of Data Science, Statistics and Analytics techniques.
3. To understand different tools to solve real life problems.

Course Content

Unit-1 Introduction:

Introduction to Data Science, Data Science and Machine Learning, Application of Data Science, Mathematical
Foundations of Data Scienceand Machine Learning, Random Variables and Probabilities, Probability Theory , ProbabilityDistributions.

Unit-2 Data Analytics Approaches:

Introduction to data analytics, Concept of supervised and unsupervised learning, Statistical concepts used in data science, Difference between population and sample, Types of variables, Measures of central tendency, Measures of variability, Coefficient of variance, Skewness and Kurtosis, Inferential statistics: Normal distribution, Test hypotheses Central limit theorem, Confidence interval, T-test, Type I and II errors, Student's T distribution. Introduction to SPSS Tool for statistics.

Unit-3 Ensemble Learning Approaches:

Concept of ensemble learning, Bagging, Random forests, Boosting, Gradient Boosting, Stacking, Parameter
tuning: Hyper parameter tuning, regularization and generalization. Effects of Underfitting and over-fitting, Hidden
Markov models.

Unit-4 Machine Learning Tools:

Introduction to Python: Environment set-up, Jupyter overview, Python Numpy, Python Pandas, Python Matplotlib, Introduction to R: An introduction to R, Data structures in R, Data visualization with R, Data analysis with R.

Course Materials

Required Text: Textbooks

1. Introduction to Statistics by Gareth M James, Daniela Witten, Trevor Hastie, Robert Tibshirani
2. Data Science handbook by Carl Shan, William Chen, Hanry Wang, Max Song
3. Doing Data Sciences by Rachel Schutt and Cathy O Neil, O'Reilly 2013
3. M. Mitchell, Machine Learning (1 ed.), McGraw Hill, 2017.
4. E. Alpay din,Introduction to Machine Learning (3 ed.), PHI, 2015.

Optional Materials: Reference Books

1. Machine Learning: An Algorithmic Perspective by Stephen Marsland, published by CRC Press.
2. Understanding Machine Learning: From Theory to Algorithms by Shai Shalev -Shwartz and Shai BenDavid, Cambridge University Press.
3. Hands-On-Machine-Learning-with -Scikit-Learn-and-TensorFlow (O'reiley)
4. Probabilistic Graphical Models: Principles and Techniques (Adaptive Computation and MachineLearning series) 1st Edition by Daphne Koller, Nir Friedman

Graph Theory

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT106302IT

[Pre-requisites: Discrete Mathematics]

Course Objectives

1. **To introduce the basic knowledge about graphs, their properties and applications as models of networks.**
2. **To formulate problems in terms of graphs, solve problems, and apply algorithms**
3. **To be familiar with a wide variety of graph theoretic ideas, notation, algorithms, and useful proof techniques.**
4. To distinguish a game situation from a pure individual's decision problem.

Course Content

Unit-1: Graphs and relations:

Graphs and relations Sub graphs, Isomorphism, Degrees, Directed graphs, Graph Models, Graphic sequence, Special classes of graphs, Trees.

Unit-2: Graph connectivity and searching:

Multiple connectivity, Trees, the MST problem, Distance in graphs, graph metrics, Concepts of route planning in graphs.

Unit-3: Network flows:

The "max-flow min-cut" theorem via Ford-Fulkerson's algorithm, Applications to connectivity and representatives, matching in graphs, Packing problems, Enumeration.

Unit-4: Graph colouring

Graph colouring: Edge and list colourings, Drawings and planar graphs, Duality, Euler's formula and its applications, computationally hard graph problems, Intersection graph representations, chordal graphs, Structural width measures, Graph minors, Graph embeddings on surfaces, Crossing number, Ramsey theory

Course Materials

Required Text: Text books

1. Diestel, Reinhard, "Graph theory," 3rd ed. Berlin: Springer, 2006.
2. J. A. Bondy and U. S. R. Murty, "Graph Theory," volume 244 of Graduate Texts in Mathematics. Springer, 1st edition, 2008.

Optional Materials: Reference Books

1. **Douglas. B. West, "Introduction to Graph Theory", Second edition. PrenticeHall,2005**
2. J. A. Bondy and U. S. R. Murty, "Graph Theory with Applications," http://www.math.jussieu.fr/~jabondy/books/gtwa/gtwa.html, 2008

Computational Geometry

[6thSemester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT106303IT

[Pre-requisites: Mathematics-I]

Course Objectives

1. Introduce rigorous algorithmic analysis for problems in Computational Geometry.
2. Discuss applications of Computational Geometry to graphical rendering.
3. Introduce the notions of Delaunay Triangulations.
4. Develop expected case analyses for linear programming problems in small dimensions.

Course Content

Unit1:

Geometric primitives , Line intersection using Sweep Line, No Class "Meshing Roundtable" Using Permutations for Topological Information, Triangulating a Polygon using Line Sweep.

Unit 2:

2D/3D-Linear Programming Smallest Enclosing Disc, Trapizodial Decomposition, Trapizodial Maps and tails Est., Seidel's Triangulating a Polygon , 2D convex hull: Output-sensitive and Random Incremental.

Unit 3:

Geometric Transforms , Delaunay Triangulation Min-Max angle Thm , 3D Convex Hull , 2D Incremental Delaunay, Mesh Generation Quadtree.

Unit 4:

Delaunay Refinement, Thanksgiving Holiday, Bezier Curves and de Casteljau Algorithm, B-splines, Subdivsion Surfaces.Convexifying Polygonal Cycles, Surface Reconstruction.

Course Materials

Required Text: Text books

1. Computational Geometry Algorithms and Applications, 2nd ed., by de Berg, van Kreveld, Overmars, and Schwarzkopf (Springer-Verlag, 2000).

Optional Materials: Reference Books

1. M. Bern and D. Eppstein. Mesh generation and optimal triangulation. Computing in Euclidean Geometry (2nd ed.), D.-Z. Du and F. Hwang (eds.), World Scientific, 1995, 47-123.
2. H. Edelsbrunner. Triangulations and meshes in computational geometry. ActaNumerica (2000), 133-213.

Data Science & Analytics

[6th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Information Technology	3-0-0, (3)	Open Elective	IT106304IT

[Pre-requisites: Nill]

Course Objectives:

1. To understand the basics of data science, data analytics and modelling.
2. To learn about data optimization and application in real-world problems.
3. To get knowledge and develop skills in data process, analysis, and management.
4. To understand and demonstrate proficiency with statistical analysis of data.

Course Content

Unit-1: Introduction to Data Science and Statistics

Data science, 3 Vs of Data, Introduction to Statistics, Collection of data, classification and tabulation of data, Types of data: Primary data, Secondary data, Presentation of data Diagrammatic and Graphical Representation, Machine Learning (Supervised, Unsupervised Learning & reinforcement)

Unit-2: Data Analysis

Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization; Levels of Measurement; Data management and indexing; Descriptive Statistics; Measures of central tendency; Measures of location of dispersions; Basic analysis techniques: Statistical hypothesis generation and testing; Chi-Square test; t-Test; Analysis of variance; Correlation analysis; Maximum likelihood test; Data analysis techniques: Regression analysis; Classification techniques; Clustering; Association rules analysis.

Unit-3: Data Visualization

Data pre-processing, exploratory data analysis and high -quality visualization. Advanced scientific plots -stacked histograms for multivariate data, bi-variate scatter plots, parallel coordinate plot, table plot, mosaic plot etc.

Unit-4: Data Modelling

Data Modelling: Introduction; Uses of Data Modelling Tools; Three Perspectives of a Data Model; Data Modelling Techniques: Linear Regression; Non-linear models; Supported Vector Machines. Linear Discriminant Analysis, Linear Discriminant Analysis, Quadratic Discriminant Analysis, K-Nearest Neighbours.

Required Text: Text/Reference books:

1. Lillian Pierson, “Data Science for Dummies”, For Dummies; 2nd edition.
2. Joel Grus, “Data Science from Scratch: First Principles with Python”, Shroff /O'Reilly;
3. SecondEdition, 2019.
4. Data Science: Theories, Models, Algorithms, And Analytics by Sanjiv Ranjan Das
5. Allen B. Downey, “Think Stats Exploratory Data Analysis in Python”, Green Tea Press, 2nd Edition, 2014.
6. Practical Statistics for Data Scientists, Peter Bruce & Andrew Bruce.3. John D. Kelleher and Brendan Tierney “Data Science” The MIT Press; Illustrated edition, 2018.
7. Andrew Oleksy, “Data Science with R: A Step By Step Guide with Visual Illustrations & Examples”, 2018.

Artificial IntelligenceLab

[6thSemester, Third Year]

Course Description			
Offered by Department	Credits	Status	Code
Information Technology	0-0-2, (1)	Lab	IT106401IT

List of 10 -15 Assignment/Practical will be allotted by the instructor in the respective Lab.

Computer Graphics Lab

[6thSemester, Third Year]

Course Description			
Offered by Department	Credits	Status	Code
Information Technology	0-0-2, (1)	Lab	IT106402IT

List of 10 -15 Assignment/Practical will be allotted by the instructor in the respective Lab.