# B Tech in Computer Science & Engineering

## THIRD SEMESTER

<table>
<thead>
<tr>
<th>Sub. Code</th>
<th>Subject Name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
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<tbody>
<tr>
<td>MAT 2155</td>
<td>Engineering Mathematics – III</td>
<td>2</td>
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<tr>
<td>CSE 2151</td>
<td>Computer Organization &amp; Architecture</td>
<td>3</td>
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<tr>
<td>CSE 2152</td>
<td>Data Structures and Applications</td>
<td>3</td>
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<tr>
<td>CSE 2153</td>
<td>Digital System Design</td>
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Total Contact Hours (L + T + P) = 15 + 5 = 20

## FOURTH SEMESTER

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<td>MAT 2256</td>
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Total Contact Hours (L + T + P) = 24 + 3 = 27

## FIFTH SEMESTER

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<tr>
<td>HUM 3052</td>
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Total Contact Hours (L + T + P) + OE = 10 + 5 = 15

## SIXTH SEMESTER

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<tr>
<td>HUM 3051</td>
<td>Engg Economics and Financial Management</td>
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<td>CSE 3251</td>
<td>Distributed Systems</td>
<td>3</td>
<td>1</td>
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<tr>
<td>CSE 3252</td>
<td>Parallel Computer Architecture and Programming</td>
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<tr>
<td>CSE 3254</td>
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Total Contact Hours (L + T + P) + OE = 14 + 3 = 17

## SEVENTH SEMESTER

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Total Contact Hours (L + T + P) +OE = 15 + 0 = 15

## EIGHTH SEMESTER

<table>
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<tbody>
<tr>
<td>CSE 4298</td>
<td>Industrial Training</td>
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<tr>
<td>CSE 4299</td>
<td>Project Work/Practice School</td>
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Total Contact Hours (L + T + P) +OE = 15 + 3 = 18
## Minor Specializations

### I. Computer Graphics & Visualization **
- CSE 4051: Augmented and Virtual Reality
- ICT 4033: Computer Graphics
- ICT 4031: Computer Vision
- CSE 4052: Digital Image Processing

### II. Computational Intelligence *
- CSE 4053: Artificial Intelligence
- ICT 4031: Computer Vision
- ICT 4032: Machine Learning
- CSE 4054: Soft Computing Paradigms

### III. Computer Networks and Security
- CSE 4055: Advanced Computer Networks
- CSE 4056: Information Security
- CSE 4057: Internet of Things
- CSE 4058: Principles of Cryptography

### IV. Data Analytics
- CSE 4059: Big Data Analytics
- ICT 4031: Computer Vision
- CSE 4060: Data Warehouse and Data Mining
- CSE 4061: Natural Language Processing

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### V. Business Management
- HUM 4051: Financial Management
- HUM 4052: Human Resource Management
- HUM 4053: Marketing Management
- HUM 4054: Operations Management

### VI. Material Science
- PHY ****
- CHM ****

### VII. Computational Mathematics
- MAT 4051: Applied Statistics and Time Series Analysis
- MAT 4052: Computational Linear Algebra
- MAT 4053: Computational Probability and Design of Experiments
- MAT 4054: Graphs and Matrices

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*Common to Computer Science stream.

**Common to Electrical and Computer science streams.

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***All minor specialization courses are also part of other programme electives.

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## Other Programme Electives
- CSE 4062: Android Application Development
- CSE 4063: Cloud Computing
- CSE 4064: Deep Learning
- CSE 4065: Design Patterns
- CSE 4066: Ethical Hacking and Cyber Security
- CSE 4067: Game Programming
- CSE 4068: High Performance Computer Architecture
- CSE 4069: Human Computer Interface
- CSE 4070: Information Retrieval
- CSE 4071: Microcontroller
- CSE 4072: Multimedia Technologies
- CSE 4073: Pervasive Computing
- CSE 4074: Social Network Analysis
- CSE 4075: Software Architecture
- CSE 4076: Software Testing and Analysis
- CSE 4077: Storage Device and Technology
- CSE 4078: Wireless Networks

## Open Electives
- CSE 4301: Essentials of Industrial Computing
- CSE 4302: Essentials of IT
- CSE 4303: Linux Programming
- CSE 4304: Principles of Database Systems
- CSE 4305: Principles of Soft computing
- CSE 4306: Principles of Software Engineering
- CSE 4307: Programming in C#
- CSE 4308: Programming in Java
- CSE 4309: Python Programming
- CSE 4310: Web Programming

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THIRD SEMESTER

MAT 2155: ENGINEERING MATHEMATICS III [2 1 0 3]


References:

4. Narasingh Deo, Graph theory with Applications to computer science, PHI, 2012

CSE 2153: DIGITAL SYSTEM DESIGN [3 1 0 4]

References


CSE 2151: COMPUTER ORGANIZATION AND ARCHITECTURE [3 1 0 4]

Number Representation and Arithmetic Operations, Character Representation, Memory locations and addresses, Memory operations, Addressing modes, CISC and RISC. Hardware for addition and subtraction, Multiplication, Hardware implementation, Booth’s algorithm, Division, Floating point representation, IEEE standard floating point representation, Floating point arithmetic. Bus organization, comparison of hardwired and micro-programmed approach, hardwired control design, Booths multiplier design, Micro-programmed multiplier control unit. Internal organization of memory chips, Structure of Larger Memories, Cache mapping functions, Replacement algorithms, Virtual memories. Accessing I/O devices, Interrupts, Enabling and Disabling Interrupts, DMA. Pipeline Organization, Data Dependencies, Handling Data Dependencies, Hardware Multithreading, SIMD Processing, Graphics Processing Units (GPUs), Shared Memory Multiprocessors, Interconnection Networks, Cache Coherence, Write-Through Protocol, Write-Back protocol, Directory-Based Cache Coherence.

References:

CSE 2152: DATA STRUCTURES AND APPLICATIONS [3 1 0 4]

Introduction - Pointers and Pointer Application, Accessing variables through pointers, pointers to pointers, pointer arithmetic and arrays, pointers and functions, Recursion- definition, recursive programs, efficiency of recursion, Stacks, queues, evaluation of expressions, multiple stacks and queues and its application, Linked lists representations- Singly, doubly, header node, circular along with the applications, Trees-Binary trees, representation, recursive/ non recursive inorder, preorder and post order tree traversal, level order traversal Binary search tree, creation, insertion deletion operations on binary search tree, Additional Binary Tree Operations, Threaded Binary Tree and applications.

References:

5. Debasish Samanta, Classic Data Structures, (2e), PHI Learning Pvt. Ltd., India, 2010

CSE 2154: OBJECT ORIENTED PROGRAMMING [3 1 0 4]

Introduction to OOP, Java Programming Fundamentals, Introducing Classes, Objects and Methods, A closer look at methods and classes, Inheritance basics, Constructors, using super, multilevel hierarchy, method overiding, Interfaces Fundamental, implementing an interface, Fundamentals of package, packages and member access, importing packages, Fundamentals of Exception handling, try, catch, throw, throws, user defined exceptions, Multithreading fundamentals, creating multiple threads, synchronization, thread communication, Generic fundamentals, Generic class and methods, bounded types, wildcard arguments, Introducing Javafx, Application Skeleton, Using buttons and events, Exploring Javafx Controls

References:

CSE 2162: DIGITAL SYSTEM DESIGN LAB [0 0 3 1]


References:


CSE 2161: DATA STRUCTURES LAB [0 0 3 1]

Reviewing the concepts of pointers, structures and recursion, Studying the operation of stacks and queues and the associated application programs, Creating dynamic allocation of memory for linked list and applying it to examples using singly, doubly and circular linked list and their applications, Creation of binary trees and the application associated with the trees.

References:

5. Debasis Samanta, *Classic Data Structures*, (2e), PHI Learning Pvt. Ltd., India, 2010
CSE 2163: OBJECT ORIENTED PROGRAMMING LABORATORY [0 0 3 1]

Simple Java programs using control structures and Arrays, Programs using Classes, objects, methods, Programs on Constructors and static members, Programs using Inheritance, Packages, Interfaces and Generics, Programs using Exceptions and Multithreading, GUI based programs using JavaFX

References:


CSE 2164: OPEN SOURCE TECHNOLOGIES LAB [1 0 3 2]

Vim, emacs, HTML, CSS, Report and presentation software: latex, beamer, drawing software, IDE, code reading, debugging, Basic Java, Java collections, interfaces, Java threads, Java GUI, Introduction to documentation, Version management, Unix basics, Unix tools, Bash scripting, Unix pipes, Python programming, Makefile, libraries and linking, Graph plotting software, Profiling tools

References:

1. Online tutorials for HTML/CSS, Inkscape, OODraw
2. Unix Man Pages for all unix tools
5. The Java Tutorials (http://docs.oracle.com/javase/tutorial/).
Basic Set theory, Axioms of probability, Sample space, conditional probability, total probability theorem, Baye’s theorem. One dimensional and two dimensional random variables, mean and variance, properties, Chebyshev’s inequality, correlation coefficient, Distributions, Binomial, Poisson, Normal and Chisquare. Functions of random variables: One dimensional and Two dimensional, F & T distributions, Moment generating functions, Sampling theory, Central limit theorem, Point estimation, MLE, Interval estimation, Test of Hypothesis: significance level, certain best tests; Chi square test.

References:


References:

1. Peter Linz, *an Introduction to Formal Languages and Automata*, (6e), Jones & Bartlett Learning, 2016

**CSE 2252: DESIGN AND ANALYSIS OF ALGORITHMS [3 1 0 4]**


**References:**


**CSE 2253: EMBEDDED SYSTEMS [3 1 0 4]**

Introduction to microprocessors, 8086 internal architecture, Introduction to programming the 8086, Addressing modes, assembler and assembler directives, 8086 instruction set-data transfer, arithmetic, bit manipulation, program execution transfer. Microcontrollers, differences between microprocessors and microcontrollers, an overview of ARM-Cortex- M architecture, The RISC and ARM design philosophy, ARM addressing modes, Instruction set-data transfer, arithmetic and logical, shift and rotate, branch instructions, Functions, Conditional execution, Input/output (I/O) and Timer/counter programming, I/O interfacing: LED, LCD, keyboard, stepper motor, ADC, and DAC, PWM, UART, Hardware and software synchronization, Multithreading, NVIC, Interrupts
References:

4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.

**CSE 2251: DATABASE SYSTEMS [2 1 0 3]**


References:


**CSE 2263: EMBEDDED SYSTEMS LAB [0 0 3 1]**

Basics of assembly language programming, data transfer, arithmetic operations, logical instructions, branch instructions, code conversion, packing and unpacking, sorting, searching,
recursion, I/O interfacing of LEDs, LCD, keyboard, 7 segment display, stepper motor, DAC and ADC, PWM.

References:

4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.

**CSE 2262: DATABASE SYSTEMS LAB [0 0 6 2]**

MS Access, Introduction to SQL, Intermediate SQL, Integrity Constraints in SQL, Additional Exercises on SQL, PL/SQL Basics, Exception Handling and Cursors, Additional Cursors constructs and Transactions, Procedures, Functions and Packages, Triggers, Mini Project

References:

2. Ivan Bayross, *SQL, PL/SQL*, (2e/3e), BPB Publications

**CSE 2261: ALGORITHMS LAB [0 0 3 1]**

Implement a doubly linked list & BST, GCD Techniques, Bubble sort, Selection sort, Linear search, String Matching, sorting algorithms, DFS, BFS, Topological sorting, AVL tree, 2-3 tree, Horspool algorithm, Open hash table, Floyd’s algorithm, Warshall’s algorithm, Greedy Techniques, Dijkstra's algorithm, Backtracking.

References:
FIFTH SEMESTER

HUM 3052: ESSENTIALS OF MANAGEMENT [2 1 0 3]


References:

CSE 3151: COMPILER DESIGN [2 1 0 3]


References:
1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, (2e), Pearson Education, 2010
References:

CSE 3152: COMPUTER NETWORKS [2 1 0 3]


References:


CSE 3154: SOFTWARE ENGINEERING [2 1 0 3]

References:

5. Ian Sommerville, *Software Engineering*, (9e), Addison-Wesley, 2011

**CSE 3163: OPERATING SYSTEMS LAB [0 0 6 2]**

Linux basic commands shell concepts and file filters, shell scripting-1, shell scripting-2, linux system calls, thread programming, interprocess communication, process synchronization, cpu scheduling algorithms, deadlock algorithms, memory management schemes, page replacement algorithms, disk scheduling algorithms

References:


**CSE 3161: COMPILER DESIGN LAB [0 0 6 2]**

Implement all the phases of a Mini compiler for a Language under Linux environment using compiler construction tools. This includes Preliminary Scanning Applications, Identification of Tokens in a given Program, Design & Implementation of Lexical Analyzer using Lex, Design & Implementation of Parser using Yacc, Generation of intermediate code and code generation.
References:

1. Allen L. Holub, *Compiler design in ‘C’,* (2e), Prentice hall, 1990

**CSE 3162: COMPUTER NETWORKS LAB [0 0 6 2]**


References:

SIXTH SEMESTER

HUM 3051: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]


References:

CSE 3251: DISTRIBUTED SYSTEMS [3 1 0 4]

CSE 3252: PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING [2103]

Introduction to parallel processing, SIMD Computer Organizations, Parallel Algorithms for Array processors, SIMD Matrix multiplication. MPI basic data types and functions, benchmarking parallel performance, MPI error handling functions. GPUs as parallel computers, Architecture of a modern GPU. OpenCL standard, OpenCL specification, Kernels and openCL execution model, Program layout, Memory model, Writing Kernels, OpenCL Device Architecture, OpenCL APIs and programs, CUDA Program Structure, Device memories and Data transfer, Kernel functions and Threads, Runtime APIs and Error Handling, CUDA Thread Organization, CUDA Device Memory types.

References:

CSE 3261: DISTRIBUTED SYSTEMS LAB [0 0 3 1]


References:


CSE 3263: PARALLEL PROGRAMMING LAB [0 0 3 1]

Introduction to Visual Studio and Basics of MPI, Point to Point Communications in MPI, Collective communications in MPI, Error Handling in MPI, OpenCL introduction and programs on vectors, OpenCL programs on strings and to check the execution time in OpenCL, OpenCL programs on matrix, OpenCL programs on sorting and searching, CUDA Programs on arrays and matrices, CUDA programs on strings.

References:

3. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, Tata McGraw Hill, 2011
CSE 3262: INTERNET TECHNOLOGIES LAB [1 0 3 2]

Introduction to HTML5, CSS AND Javascript. C# programming - variables, operations, conditional logics, loops, functions, arrays, classes, inheritance and polymorphism. Web forms and web controls, state management, validation, themes and master page. Introduction to the ADO.NET fundamentals, working with database, SQLDataSource control. Introduction to File, XML, MVC and developing AJAX web applications. Developing the mini project using web concepts.

References:

SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

EIGHTH SEMESTER

CSE 4298: INDUSTRIAL TRAINING

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

CSE 4299: PROJECT WORK/PRACTICE SCHOOL

The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATIONS

1. COMPUTER GRAPHICS & VISUALIZATION

ICT 4033: COMPUTER GRAPHICS [3 0 0 3]

Introduction: History of computer graphics and applications, Introduction to OpenGL, Geometric transformations: Homogeneous coordinates, affine transformations (translation, rotation, scaling, shear, reflection), concatenation, matrix stacks and use of model view matrix in OpenGL for these operations Examples, Viewing (3D), Visibility- z-Buffer, BSP trees, Open-GL culling, hidden-surface algorithms, Shading, Rasterization- Line segment and polygon clipping, 3D clipping, scan
conversion, polygonal fill, Bresenham's algorithm, Discrete Techniques: Texture mapping, compositing, textures in OpenGL; Ray Tracing, Representation and Visualization: Bezier curves and surfaces, B-splines, visualization, interpolation, marching squares algorithm.

References:


CSE 4052: DIGITAL IMAGE PROCESSING [3 0 0 3]

Introduction, components of image processing system, Spatial domain transformations, histogram processing, smoothing, sharpening spatial filters, Filtering in the frequency domain- Introduction to Fourier transform, image smoothing, image sharpening using frequency domain filters. Image restoration- Noise models, restoration using spatial filtering, periodic noise reduction by frequency domain filtering, Morphological image processing- Preliminaries, dilation and erosion, opening and closing, hit-or-miss transformation, basic algorithms, extension to gray-scale images, Image segmentation- Point, line, and edge detection, Thresholding, Region Segmentation Using Clustering and Superpixels, Graph Cuts, morphological watersheds, motion in segmentation.

References:

CSE 4051: AUGMENTED AND VIRTUAL REALITY [3 0 0 3]


References:

2. Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles & Practice, (1e), Addison-Wesley, 2016

ICT 4031: COMPUTER VISION [3 0 0 3]


References:
II COMPUTATIONAL INTELLIGENCE

ICT 4032: MACHINE LEARNING [3 0 0 3]

Introduction to Machine Learning, Mathematical Preliminaries, Supervised Learning-LMS, logistic regression, GDA, Naive Bayes, SVM, model selection, Learning theory-bias/variance tradeoff, union and Chernoff bounds, VC dimensions, Unsupervised learning-clustering, k-means, Gaussian mixture, factor analysis, PCA, ICA, Reinforcement learning-MDPs, Bellman equations, value and policy iteration, LQR, LQG, Q-learning, policy search, POMDPs

References:


CSE 4054: SOFT COMPUTING PARADIGMS [3 0 0 3]


References:

CSE 4053: ARTIFICIAL INTELLIGENCE [3 0 0 3]

Foundations of Artificial Intelligence, History of Artificial Intelligence, The state of the Art, Agents and Environments, The concept of Rationality, The Nature of Environments, The structure of Agents, Problem Solving agents, Example Problems, Searching for Solutions, Uninformed search strategies, Informed (Heuristic) search strategies, Heuristic functions, Games, Optimal decision in games, Alpha Beta Pruning, Knowledge based agents, Propositional logic, Propositional Theorem Proving, Representation revisited, Syntax and semantics of First order logic, Using First order logic, Knowledge engineering in first order, Ontological Engineering, Categories and objects, Reasoning systems for categories, Acting under uncertainty, Basic probability notation, Bayes’ rule, representing knowledge in uncertainties, semantics of Bayesian networks

References:


ICT 4031: COMPUTER VISION [3 0 0 3]


References:


III. COMPUTER NETWORKS AND SECURITY

**CSE 4055: ADVANCED COMPUTER NETWORKS [3 0 0 3]**


**References:**


**CSE 4058: PRINCIPLES OF CRYPTOGRAPHY [3 0 0 3]**

References:


**CSE 4056: INFORMATION SECURITY [3 0 0 3]**


IP Security Overview, Policy, Encapsulation, Ways of executing cybercrimes

References:


**CSE 4057: INTERNET OF THINGS [3 0 0 3]**

Introduction to internet of things, IoT in global context, Design Principles, IoT Technology Fundamental- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, IoT reference Architecture, IoT Domain Model, Functional Model,
Information Model, Communication Model, Deployment and Operational View, IoT Prototyping-
Prototyping Embedded Devices, Electronics, Sensors, Actuator, Embedded Computing Basics,
Arduino, Raspberry Pi, BeagleBone Black, IoT Use Cases - Industrial Automation, Smart Home,
Smart City, Commercial Building Automation.

References:


IV. DATA ANALYTICS

**CSE 4059: BIG DATA ANALYTICS [3 0 0 3]**

Introduction to NoSQL, Types and Advantages of NoSQL, Comparison of SQL, NoSQL and NewSQL, MongoDB: Features, Data types, Query Language; Cassandra: Features, Data types, Query Language. Core Hadoop components, Hadoop Ecosystem, YARN and MapReduce, Understanding I/O in MapReduce, Processing common serialization formats, Big data serialization formats, Organizing and optimizing data in HDFS, MapReduce with NOSQL as a data source, Applying MapReduce patterns to Big Data, Introduction to Data Analysis with Spark, Recommendation algorithm, Predicting with Decision Trees, Anomaly Detection with K-means Clustering, Latent Semantic Analysis, Analyzing Co-occurrence Networks.

References:

3. Ryza S., *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O’Reilly, 2017
CSE 4060: DATA WAREHOUSE AND DATA MINING [3 0 0 3]

Introduction to Data Warehouse and Data mining, Data Warehouse: Dimensional Modeling, ETL, Data Quality, OLAP, Data Pre-processing, Mining frequent patterns: Apriori Algorithm, FP – Growth without generating candidate generation, Frequent Itemsets from Vertical Data Format, Pattern Evaluation Methods, Classification: Basic Concepts, Decision Tree Induction, Bayesian classification, Rule-Based classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Model Evaluation, Cluster analysis: Measuring data similarity and dissimilarity, Overview of cluster analysis, Partitioning methods, Hierarchical methods, Density-Based methods, Evaluation of Clustering, Outliers, Case Studies

References:

1. Jiawei Han and Micheline Kamber, *Data Mining- Concepts and Techniques*, (3e), Morgan Kaufmann Publishers, 2011
2. Paulraj Ponniah, *Data Warehousing*, (2e), Wiley India Pvt. Ltd., 2010
3. Galit Shmueli, Nitin R. Patel, Peter C. Bruce, *Data Mining for Business Intelligence*, (2e), Wiley, 2010

CSE 4061: NATURAL LANGUAGE PROCESSING [3 0 0 3]


References:
2. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, (1e), O’Reilly Media, 2009

**ICT 4031: COMPUTER VISION [3 0 0 3]**


**References:**


**OTHER ELECTIVES**

**CSE 4064: DEEP LEARNING [3 0 0 3]**


References:
2. Simon Haykin, Neural Networks and Learning Machines, PHI, 2008
3. Andrew Ng’s Notes on Machine Learning from CS229.

CSE 4063: CLOUD COMPUTING [3 0 0 3]


References:
4. Scott D Lowe, Hyper converged Infrastructure implementation strategies, Actual Tech media, 2015
5. George Reese, Cloud application architectures: building applications and infrastructure in the cloud, O'Reilly Media, Inc., 2009.

CSE 4070: INFORMATION RETRIEVAL [3 0 0 3]

Introduction to Information Retrieval and its systems, Information Retrieval Strategies, Boolean Retrieval and Postings Lists, Information Retrieval Problem, Document Delineation and character sequence decoding, Dictionaries and tolerant retrieval and search strategies, Index construction and Index compression, types of indexes, parametric and zone indexes, vector space model,
evaluation in information retrieval, relevance assessment, probabilistic information retrieval, Binary independence model, Text classification – classification problems, classification models, clustering in information retrieval, clustering models, Evaluation in clustering, XML retrieval and its strategies, challenges and evaluation of XML retrieval, web crawling and link analysis.

References:


**CSE 4074: SOCIAL NETWORK ANALYSIS [3 0 0 3]**


References:


**CSE 4078: WIRELESS NETWORKS [3 0 0 3]**
Introduction to Wireless Networks: Evolution, Challenges, Introduction to Wireless Communication, Electromagnetic spectrum, Spectrum regulation, Wireless propagation, Modulation techniques, Multiple access for wireless systems, Cellular concept, Wireless services Ubiquitous Connectivity, Types of Wireless Networks, Analog Cellular Systems, AMPS, DAMPS, GSM, 3G Spectrum allocation, CDMA, WCDMA, 4G and Beyond, OFDM, Fixed Wireless Networks. IEEE 802.16, WLAN, applications, topology, requirements, Physical and MAC layers, IEEE 802.11a,b and g, Ad Hoc Networks: topology, Ad Hoc routing, VANETs, IMS architecture, IMS Call Flow, services within IMS, The 5G Internet, 5G Mobile Networks

References:


**CSE 4065: DESIGN PATTERNS [3 0 0 3]**


References:

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Pearson Education, 2004
3. James W Cooper, *Introduction to Design Patterns in C#*, IBM Watsor Research Center, 2002
4. Elisabeth Freeman, *Head First Design Patterns*, Oreilly, 2004
5. Alan Shalloway and James R Trott, *Design Patterns Explained*, (2e), Pearson Education, 2004

**CSE 4075: SOFTWARE ARCHITECTURE [3 0 0 3]**


**References:**


**CSE 4076: SOFTWARE TESTING AND ANALYSIS [3 0 0 3]**


**References:**


References:


CSE 4062: ANDROID APPLICATION DEVELOPMENT [3 0 0 3]

Mobility landscape, Mobile platforms, overview of Android platform, App user interface designing, Activity- states and life cycle, interaction amongst activities, Threads, Async task, Services, Notifications, Broadcast receivers, Telephony and SMS APIs, Native data handling, file I/O, shared preferences, mobile databases, enterprise data access, Content Providers, Graphics and animation APIs, multimedia, location based services, sensors, maps, Debugging mobile apps, testing Apps, test automation, packaging mobile apps, distributing apps.
References:

2. Anubhav Pradhan, Anil V Deshpande, Composing Mobile Apps, learn, explore apply using Android, (1e), Wiley India Pvt. Ltd., 2014
3. Van Drongelen, Mike, Android Studio Cookbook, Packt Publishing Ltd, 2015

CSE 4077: STORAGE DEVICE AND TECHNOLOGY [3 0 0 3]


References:

4. Marc Farley Osborne, Building Storage Networks, (2e), Tata Mcgraw Hill, 2001

CSE 4069: HUMAN COMPUTER INTERFACE [3 0 0 3]

References:


CSE 4066: ETHICAL Hacking AND CYBER SECURITY [3 0 0 3]


References:

2. William Stallings, Cryptography and Network security, (7e), Pearson, 2017

**CSE 4072: MULTIMEDIA TECHNOLOGIES [3 0 0 3]**


**References:**


**CSE 4073: PERVERSIVE COMPUTING [3 0 0 3]**

Pervasive Application Architecture, Context aware Computing, Application Examples Retail, Healthcare, Smart Home, Automation, Smart Vehicles, Wearable Computing,

References:


**CSE 4067: GAME PROGRAMMING [3 0 0 3]**


References:

3. Will Goldstone, *Unity 3.x Game Development Essentials: Game Development with C# and Javascript*, (2e), PACKT publishing, 2011
5. Matt Smith, Chico Queiroz, *Unity 4.x Cookbook*, (1e), PACKT publishing, 2013

**CSE 4068: HIGH PERFORMANCE COMPUTER ARCHITECTURE [3 0 0 3]**


**References:**


**OPEN ELECTIVES**

**CSE 4303: LINUX PROGRAMMING [3 0 0 3]**

Introduction to Linux, using the shell, shell variables and commands and creating a shell environment. File system, understanding the basics, metacharacters and operators, understanding file permissions, pattern matching with examples and programs. Understanding the system administration, exploring administrative commands. Editing files with vim, vi editors. sed and awk programming with command-line syntaxes. Managing running processes, managing foreground and background processes. Shell programming, understanding shell scripts and text
manipulation programs. Source code management and git version control, basic Linux system administration.

References:


**CSE 4304: PRINCIPLES OF DATABASE SYSTEMS [3 0 0 3]**


References


**CSE 4302: ESSENTIALS OF IT [3 0 0 3]**


**References:**

CSE 4301: ESSENTIALS OF INDUSTRIAL COMPUTING [3 0 0 3]


References:


CSE 4305: PRINCIPLES OF SOFT COMPUTING [3 0 0 3]


References:


**CSE 4306: PRINCIPLE OF SOFTWARE ENGINEERING [3 0 0 3]**


**References:**

1. Pankaj Jalote, *An integrated approach to software engineering*, (3e), Narosa 2005

**CSE 4307: PROGRAMMING IN C# [3 0 0 3]**


**References:**

CSE 4308: PROGRAMMING IN JAVA [3 0 0 3]

Java Programming Fundamentals, Introducing Data Types and Operators, Program Control Statements, Introducing Classes, Objects and Methods, More Data Types and Operators, A Closer Look at Methods and Classes, Inheritance basics, Member Access and Inheritance, Constructors and Inheritance, Interfaces- Interface Fundamentals, Creating and Implementing Interfaces, Packages- Package Fundamentals, Importing Packages, The Exception Hierarchy, Exception Handling Fundamentals, Throwing an Exception, Multithreading Fundamentals, The Thread class and Runnable Interface, Creating Threads, Synchronization, Using I/O, Byte Streams and Character Streams, Introducing JavaFX GUI Programming, Exploring JavaFX Controls

References:

3. Deitel and Deitel, Java How to Program, (10e), Pearson Edu., 2011

CSE 4310: WEB PROGRAMMING [3 0 0 3]


References:

1. Alexis Goldstein, Louis Lazaris, Estelle Weyl, HTML5 and CSS3 for The Real World, (2e), SitePoint, 2015

**CSE 4309: PYTHON PROGRAMMING [3 0 0 3]**

Getting started with python scripting. Using the file system, Reading and writing files, Numerical Computing In Python, SciPy package, Classes and object-oriented programming, Data types as objects, Graphical user interfaces, Regular expressions, Network, web, and database programming: Accessing databases in Python, Network programming in Python, Creating a Python web application, Sample project—creating a message wall, Web frameworks creating a model to add database service – using SQLite; Cloud computing: google app engine and web services: What is cloud computing, levels of cloud computing service, what is AappEngine, The sandbox and the App Engine SDK, Choosing an App Engine framework.

**References:**