

B TECH in COMPUTER SCIENCE & ENGINEERING

Year	THIRD SEMESTER						FOURTH SEMESTER					
II	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
	MAT 2155	Engineering Mathematics – III	2	1	0	3	MAT 2256	Engineering Mathematics – IV	2	1	0	3
	CSE 2151	Computer Organization & Architecture	3	1	0	4	CSE 2251	Database Systems	2	1	0	3
	CSE 2152	Data Structures and Applications	3	1	0	4	CSE 2252	Design and Analysis of Algorithms	3	1	0	4
	CSE 2153	Digital System Design	3	1	0	4	CSE 2253	Embedded Systems	3	1	0	4
	CSE 2154	Object Oriented Programming	3	1	0	4	CSE 2254	Formal Languages and Automata Theory	2	1	0	3
	CSE 2161	Data Structures Lab	0	0	3	1	****	Open Elective – I				3
	CSE 2162	Digital System Design Lab	0	0	3	1	CSE 2261	Algorithms Lab	0	0	3	1
	CSE 2163	Object Oriented Programming Lab	0	0	3	1	CSE 2262	Database Systems Lab	0	0	6	2
	CSE 2164	Open Source Technologies Lab	1	0	3	2	CSE 2263	Embedded Systems Lab	0	0	3	1
			15	5	12	24			12	5	9	24
	Total Contact Hours (L + T + P)		32			Total Contact Hours (L + T + P) + OE			26 + 3 = 29			
III	FIFTH SEMESTER						SIXTH SEMESTER					
	HUM 3152	Essentials of Management	2	1	0	3	HUM 3151	Engg Economics and Financial Management	2	1	0	3
	CSE 3151	Compiler Design	2	1	0	3	CSE 3251	Distributed Systems	3	1	0	4
	CSE 3152	Computer Networks	2	1	0	3	CSE 3252	Parallel Computer Architecture and Programming	2	1	0	3
	CSE 3153	Operating Systems	2	1	0	3	CSE ****	Program Elective – I	3	0	0	3
	CSE 3154	Software Engineering	2	1	0	3	CSE ****	Program Elective – II	3	0	0	3
	****	Open Elective – II				3	****	Open Elective – III				3
	CSE 3161	Compiler Design Lab	0	0	6	2	CSE 3261	Distributed Systems Lab	0	0	3	1
	CSE 3162	Computer Networks Lab	0	0	6	2	CSE 3262	Internet Technologies Lab	1	0	3	2
	CSE 3163	Operating Systems Lab	0	0	6	2	CSE 3263	Parallel Programming Lab	0	0	3	1
			10	5	9	24			14	3	9	23
	Total Contact Hours (L + T + P) + OE		24 + 3 = 27			Total Contact Hours (L + T + P) + OE			26 + 3 = 29			
IV	SEVENTH SEMESTER						EIGHTH SEMESTER					
	CSE ****	Program Elective – III	3	0	0	3	CSE 4298	Industrial Training				1
	CSE ****	Program Elective – IV	3	0	0	3	CSE 4299	Project Work/Practice School				12
	CSE ****	Program Elective – V	3	0	0	3	CSE 4296	Project Work (Only for B.Tech honour Students)				20
	CSE ****	Program Elective – VI	3	0	0	3						
	CSE ****	Program Elective – VII	3	0	0	3						
	****	Open Elective – IV				3						
		15	0	0	18						13	
	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

V. Material Science

PHY 4051: Physics of Low Dimensional Materials
PHY 4052: Physics of Photonic & Energy Storage Devices
CHM 4051: Chemical Bonding
CHM 4052: Chemistry of Carbon Compound

VI. Business Management

HUM 4051: Financial Management
HUM 4052: Human Resource Management
HUM 4053: Marketing Management
HUM 4054: Operation Management

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

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



THIRD SEMESTER

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

Boolean Algebra: Partial ordering relations, Poset, Lattices, Basic Properties of Lattices. Distributive and complemented lattices, Boolean lattices and Boolean Algebra. Propositional and Predicate Calculus: Well-formed formula, connectives, quantifications, Inference theory of propositional and predicate calculus. Elementary configuration: Permutations and Combinations, Generating function, Principle of inclusion and exclusion Partitions, compositions. Ordering of permutations: Lexicographical and Fikes. Graph theory: Basic definitions, Degree, regular graphs, Eulerian and Hamiltonian graphs, Trees and Properties, Center, radius and diameter of a graph, Rooted and binary trees, Matrices associated with graphs, Algorithms for finding shortest path, Algorithm. Group theory: Semi groups, Monoids, Groups-subgroups, Normal Subgroups, Cosets, Lagrange's Theorem, Cyclic groups.

References:

1. C.L.Liu, *Elements of Discrete Mathematics*, (2e), Mc Graw Hill, New Delhi, 2007
2. J.P.Trembaly and R.Manohar, *Discrete Mathematics Structures with application to computer science*, Tata Mc Graw Hill, 2012
3. E.S.Page and L.B.Wilson, *An Introduction to Computational Combinatorics*, Cambridge Univ. Press, 1979
4. Narasingh Deo, *Graph theory with Applications to computer science*, PHI, 2012

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:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, *Computer Organization and Embedded Systems*, (6e), McGraw Hill Publication, 2012
2. William Stallings, *Computer Organization and Architecture – Designing for Performance*, (9e), PHI, 2015
3. Mohammed Rafiquzzaman and Rajan Chandra, *Modern Computer Architecture*, Galgotia Publications Pvt. Ltd., 2010
4. D.A. Patterson and J.L.Hennessy, *Computer Organization and Design-The Hardware/Software Interface*, (5e), Morgan Kaufmann, 2014
5. J.P.Hayes, *Computer Architecture and Organization*, McGraw Hill Publication, 1998

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 and Introduction to the concepts of Optimal Binary Search Trees.

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, *A Structured Programming Approach Using C*, (3e), Cengage Learning India Pvt. Ltd, India, 2007
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson and Freed, *Fundamentals of Data Structures in C*, (2e), Silicon Press, 2007
3. Richard F. Gilberg, Behrouz A. Forouzan, *Data structures, A Pseudocode Approach with C*, (2e), Cengage Learning India Pvt. Ltd, India, 2009
4. Tenenbaum Aaron M., Langsam Yedidyah, Augenstein Moshe J., *Data structures using C*, Pearson Prentice Hall of India Ltd., 2007
5. Debasis Samanta, *Classic Data Structures*, (2e), PHI Learning Pvt. Ltd., India, 2010

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

Brief overview of Logic gates, Truth Tables, Sum-of-Products and Product-of-Sums forms, K-Map Simplification, Incompletely Specified Functions, Fan-in, Factoring, Functional decomposition, Multilevel NAND and NOR Circuits, Addition of unsigned and signed numbers, BCD Adder, Fast adder, Array multiplier, Multiplexer, Decoder, Encoder, Code converter, Arithmetic comparison circuits, Flip-Flops, Design of Synchronous Sequential Circuits-State reduction, State assignment, Ripple Counters, Registers, Shift Registers, Ring and Johnson Counters, Verilog for combinational and sequential circuits, Algorithmic State Machine Charts, Transistor Switches, NMOS, CMOS Logic Gates, Programmable Logic Devices, Transmission Gates, Tri-state drivers, Practical aspects, Simple processor and Bit count circuit design

References:

1. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, (3e), Tata McGraw Hill, 2014
2. Morris Mano M., *Digital Design*, (2e), PHI Learning, 2000
3. Donald D. Givone, *Digital Principles and Design*, Tata McGraw Hill, 2003
4. John F. Wakerly, *Digital design - Principles and practice*, (4e), Pearson Education, 2013

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

Introduction to OOP, Java Programming Fundamentals, Data types & Operators, Control structures, Introducing Classes, Objects and Methods, Inheritance: Inheritance basics, Constructors, Interfaces: Fundamentals, creating and implementing an interface, Packages: Fundamentals, packages and member access, Exception handling: Exception hierarchy and fundamentals, try block, multiple catch clauses, throw and throws, finally, user defined exceptions, Multithreaded Programming: Multithreading fundamentals, creating threads, thread priorities, synchronization, thread communication, Generics: Generic fundamentals, Generic class,

References:

1. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, *Fundamentals of Database Systems*, (6e), Pearson Education, United States of America, 2011
2. Thomas Connolly, Carolyn Begg, *Database Systems – A Practical Approach to Design, Implementation and Management*, (4e), Pearson Education, England, 2005
3. Peter Rob, Carlos Coronel, *Database Systems–Design, Implementation and Management*, (10e), Course Technology, Boston, 2013.

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

Fundamentals of Algorithms, Important Problem Types, Analysis of algorithm efficiency. Analysis Framework: Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Nonrecursive and Recursive Algorithms. Brute force Techniques, Divide and Conquer, Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting. Transform and Conquer: Presorting, BST, Heapsort. Space and Time tradeoffs: Input Enhancement in String Matching. Dynamic Programming: Warshall's and Floyd's Algorithms, The Knapsack Problem. Greedy Techniques: Prim's, Kruskal's and Dijkstra's Algorithm, Huffman Trees. Coping with limitations of algorithmic power, P, NP and NP-complete Problems, Backtracking: n-Queens problem, Hamiltonian Circuit Problem, Subset-Sum Problem. Branch and Bound: Assignment Problem, Knapsack Problem, TSP.

References:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, (3e), Pearson Education, 2011
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++*, (2e), University Press, 2007.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, (2e), PHI, 2006

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:

1. Douglas V. Hall and S S S P Rao, *Microprocessors and Interfacing*, (3e), McGraw Hill 2012.
2. Jonathan W. Valvano., *Embedded systems: real-time interfacing to ARM Cortex-M microcontrollers*, (4e), Createspace Independent Publishing Platform, 2014.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi, *ARM Assembly Language Programming & Architecture*, (2e), MicroDigitalEd, 2016
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.
5. Jonathan W. Valvano: *Embedded systems: Introduction to Arm(r) Cortex-M Microcontrollers*, (5e), Createspace Independent publishing platform, June 2017.
6. Toulson and Tim Wilmshurst., *Fast and Effective Embedded System Design applying the ARM mbed*, Elsevier, 2017.

CSE 2254: FORMAL LANGUAGES AND AUTOMATA THEORY [2 1 0 3]

Three Basic concepts, DFA, NFA and Equivalence of DFA and NFA, State Reduction, Regular Expressions, connection between regular expressions and regular languages, regular grammars, closure properties of regular languages, Identifying Non-regular languages, Context-Free grammars, Parsing and Ambiguity, Context-Free Grammars and programming languages, Methods for transforming Grammars, NPDA, Push Down Automata and Context-Free Languages, DPDA, Pumping Lemmas, Closure properties and Decision Algorithms for Context-Free Languages, The Standard Turing Machine, Nondeterministic Turing Machines, Linear Bounded Automata, Recursive and Recursively Enumerable Languages, Unrestricted grammars, Context-Sensitive Grammars and Languages, Chomsky Hierarchy.

References:

1. Peter Linz, *An Introduction to Formal Languages and Automata*, (6e), Jones & Bartlett Learning, 2016
2. John C Martin, *Introduction to Languages and the Theory of Computation*, (3e), McGraw Hill, India, 2007
3. J E Hopcroft, Rajeev Motwani & Jeffrey D Ullman, *Introduction to Automata Theory, Languages and Computation*, (3e), Pearson Education, 2006
4. K.L.P. Mishra, N.Chandrashekharan, *Theory of Computer Science*, (3e), PHI publications, 2007
5. Michael Sipser, *Theory of Computation*, Cengage Learning, 2007

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:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, (3e), Pearson Education, India, 2011.
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++*, (2e), University Press, 2007
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, (2e), PHI, 2006

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:

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGraw-Hill, 2011
2. Ivan Bayross, *SQL, PL/SQL*, (2e/3e), BPB Publications
3. G. Reese, *Database Programming with JDBS and Java*, (2e), O'Reilly, 2000

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:

1. Douglas V. Hall and S S S P Rao, *Microprocessors and Interfacing*, (3e), McGraw Hill 2012.
2. Jonathan W. Valvano., *Embedded systems: real-time interfacing to*

bounded types, wildcards, Generic methods, Generic restrictions, GUI Programming with Javafx: Introducing Javafx: Basic concepts, Application Skeleton, Using buttons and events, Exploring Javafx Controls, CERT Java Coding Standard: Rules and Recommendations.

References:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals – A Comprehensive Introduction*, (1e), McGrawHill, 2015
2. Herbert Schildt, *Java The Complete Reference*, (10e), Tata McGrawHill, 2017
3. Fred Long, Dhruv Mohindra, *Ebook: CERT Oracle Secure Coding Standard for Java*, Addison Wesley, 2013
4. Fred Long, Dhruv Mohindra, *Ebook: Java Coding Guidelines: 75 Recommendations for Reliable and Secure Programs*, Addison Wesley, 2014
5. Herbert Schildt, *Java A beginner's Guide*, (6e), 2014
6. Dietel and Dietel, *Java How to Program*, (9e), Prentice Hall India, 2012

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:

1. Behrouz A. Forouzan, Richard F. Gilberg, *A Structured Programming Approach Using C*, (3e), Cengage Learning India Pvt. Ltd, India, 2007
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson and Freed, *Fundamentals of Data Structures in C*, (2e), Silicon Press, 2007
3. Richard F. Gilberg, Behrouz A. Forouzan, *Data structures, A Pseudocode Approach with C*, (2e), Cengage Learning India Pvt. Ltd, India, 2009
4. Tenenbaum Aaron M., Langsam Yedidyah, Augenstein Moshe J., *Data structures using C*, Pearson Prentice Hall of India Ltd., 2007
5. Debasis Samanta, *Classic Data Structures*, (2e), PHI Learning Pvt. Ltd., India, 2010

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

Simulation of Logic Circuits Using Verilog: Verification of Logic Gates and logic expressions, Simplification of Expressions using Kmap: SOP and POS Forms, Multilevel NAND, NOR Circuits, Arithmetic Circuits: Half Adder, Full Adder, Multi-Bit Adder/Subtractor, BCD Adder, Multiplexers, Decoders and Encoders, Code Converters and Comparator, Flip-Flops: D, JK, and T Flip-Flops, Registers: Shift Register, Ring Counter, Johnson Counter, Binary Counters, Simple processor design

References:

1. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, (3e), Tata McGraw Hill, 2014
2. Morris Mano M., *Digital Design*, (2e), PHI Learning 2000

CSE 2163: OBJECT ORIENTED PROGRAMMING LAB [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:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals – A Comprehensive Introduction*, (1e), McGrawHill, 2015
2. Herbert Schildt, *The Complete Reference JAVA 2*, (10e), Tata McGrawHill, 2017
3. Dietel and Dietel, *Java How to Program*, (9e), Prentice Hall India, 2012

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
3. Advanced Bash Scripting Guide from the Linux Documentation Project (www.tldp.org).
4. The Python Tutorial Online Book (<http://docs.python.org/3/tutorial/index.html>).
5. The Java Tutorials (<http://docs.oracle.com/javase/tutorial/>).
6. Leslie Lamport, *Latex – A document preparation system*, Leslie Lamport, (2e), Addison-Wesley 1994

FOURTH SEMESTER

MAT 2256: ENGINEERING MATHEMATICS IV [2 1 0 3]

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:

1. P.L.Meyer, *Introduction to probability and Statistical Applications*, (2e), Oxford and IBH publishing, 1980
2. Miller, Freund and Johnson, *Probability and Statistics for Engineers*, (8e), PHI, 2011.
3. Hogg and Craig, *Introduction to mathematical statistics*, (6e), Pearson education, 2012
4. Ross Sheldon M, *Introduction to Probability and Statistics for Engineers and Scientists*, Elsevier, 2010

CSE 2251: DATABASE SYSTEMS [2 1 0 3]

Database-System Applications, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Database Architecture, Database Schemas, Keys, Relational Query Languages, Relational Operations, Overview of the Design Process, The Entity-Relationship Model, Extended E-R Features, Reduction to Relational Schemas, Features of Good Relational Design, Atomic Domains and Normalization, File concepts, Indices Concept, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Transaction Concept, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm, Overview, Measuring of Query Cost, Selection Operation, Sorting, Join Operation, Evaluation of Expressions.

ARM Cortex-M microcontrollers, (4e), Createspace Independent Publishing Platform, 2014.

3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi, *ARM Assembly Language Programming & Architecture*, (2e), MicroDigitalEd, 2016
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.
5. Jonathan W. Valvano: *Embedded systems: Introduction to Arm(r) Cortex-M Microcontrollers*, (5e), Createspace Independent publishing platform, June 2017.
6. Toulson and Tim Wilmshurst., *Fast and Effective Embedded System Design applying the ARM mbed*, Elsevier, 2017.

FIFTH SEMESTER

HUM 3152: ESSENTIALS OF MANAGEMENT [2 1 0 3]

Definition of management and systems approach, Nature & scope. The functions of managers. Corporate social responsibility. Planning: Types of plans, Steps in planning, Process of MBO, How to set objectives, Strategies, policies & planning premises. Strategic planning process and tools. Nature & purpose of organising, Span of management, Factors determining the span, Basic departmentation, Line & Staff concepts, Functional authority, Art of delegation, Decentralisation of authority. HR planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership- leadership behaviour & styles, Managerial grid. Basic control process, Critical control points & standards, Budgets, Non-budgetary control devices. Profit & loss control, Control through ROI, Direct, Preventive control. Managerial practices in Japan & USA, Application of Theory Z. The nature & purpose of international business & multinational corporations, Unified global theory of management. Entrepreneurial traits, Creativity, Innovation management, Market analysis, Business plan concepts, Development of financial projections.

References:

1. Harold Koontz & Heinz Weihrich., *Essentials of Management*, McGraw Hill, New Delhi, 2012.
2. Peter Drucker., *Management: Tasks, Responsibilities and Practices*, Harper and Row, New York, 1993.
3. Peter Drucker., *The Practice of Management*, Harper and Row, New York 2004.

CSE 3151: COMPILER DESIGN [2 1 0 3]

Introduction, Language Processors, The Structure of a Compiler, Lexical Analysis: Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, Design of Lexical Analyzer Generator, LEX Syntax Analysis: Introduction, Writing a Grammar, Parser Generator YACC, Top Down Parsing, Bottom Up Parsing, Introduction to LR parsing, More powerful LR parsers, Syntax-Directed Translation: Syntax-Directed Definitions, Application of Syntax- Directed Translation, Intermediate Code Generation: Variants of Syntax Trees, Three Address Code, Types and Declarations, Code Generation: Issues in Design of Code Generator, The Target Language, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization.

References:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers Principles, Techniques and Tools*, (2e), Pearson Education, 2010
2. Kenneth C. Louden, *Compiler Construction - Principles and Practice*, (1e), Thomson, 2007.
3. Allen L. Holub, *Compiler design in 'C'*, (2e), Prentice hall, 1990.
4. John R. Levine, Tony Manson, Doug Brown, *LEX & YACC*, (2e), O Reilly Media, 2012.
5. Vinu V. Das, *Compiler Design using FLEX and YACC*, Prentice-Hall, 2007

CSE 3152: COMPUTER NETWORKS [2 1 0 3]

What Is the Internet? The Network Core, Protocol Layers and their Service Models, History of Computer Networking, and the Internet. Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, SMTP, DNS, Peer-to-Peer Applications, Network Socket Programming. Introduction and Transport-Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control, Virtual Circuit and Datagram Networks, What's Inside a Router? The Internet Protocol (IP), Datagram Format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6, Routing Algorithms, Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks- Link- Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks(VLANs), Introduction to Physical Layer and Transmission Media.

References:

1. James F. Kurose & Keith W. Ross, *Computer Networking A Top-Down Approach*, (6e), Pearson Education, 2013
2. Larry L. Peterson and Bruce S. Davie, *Computer Networks- A Systems approach*, (5e), Elsevier, 2016
3. Behrouz A. Forouzan, Firouz Mosharraf, *Computer Networks A top Down Approach*, Mc-Graw Hill, 2012
4. Andrew S. Tanenbaum & David J. Wetherall, *Computer Networks*, (5e), Pearson Education, 2013

CSE 3153: OPERATING SYSTEMS [2 1 0 3]

Operating System Structure and Operations, Process Management, Memory Management, Storage Management, Operating System Services, User Operating System Interfaces, Types of System Calls, System Programs, Operating System Structure, System Boot ,Overview, Process Scheduling, Operations on Processes, Inter-process Communication, Multithreaded Models, Thread Libraries, Scheduling Algorithms, Thread Scheduling, Linux scheduling, Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Logical Versus Physical Address Space, Segmentation, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames, Thrashing, Disk Scheduling, Swap-Space Management, System Model, Deadlock: Deadlock prevention, Avoidance, Detection, Recovery, File Concept, Protection.

References:

1. Silberschatz, P.B. Galvin and G. Gagne, *Operating System Concepts*, (9e), Wiley and Sons (Asia) Pvt Ltd, 2013.
2. Milan Milenkovic, *Operating systems: Concepts and Design*, McGraw Hill, New York, 1987
3. H. M. Dietel, *An Introduction to Operating Systems*, Addison Wesley, 1990.
4. Andrew S. Tannebaum, *Operating System: Design and Implementation*, (3e), Prentice Hall of India, 2008
5. Maurice J Bach, *Design of UNIX Operating System*, Prentice Hall of India, 1988

CSE 3154: SOFTWARE ENGINEERING [2 1 0 3]

Evolution of engineering discipline, Software development Projects, Exploratory style of software development, Waterfall model and its extensions, Rapid Application Development, Agile development models, Spiral Model, Requirement Analysis And Specification, Software Design, Overview of the design Process, Cohesion and coupling, Layered arrangement of modules, Approaches to software design, Function-Oriented Software Design, Structured analysis, Developing the DFD Model of a system, Structured design, Detailed design, Design review, Object Modelling Using UML: UML, UML diagrams, Use case model, Class diagrams, Interaction diagrams, Activity Diagram, State chart diagram, Postscript, Design Patterns, An Object-Oriented Analysis and Design (OOAD) Methodology, Code review.

References:

1. Rajib Mall, *Fundamentals of Software Engineering*, (4e), PHI Learning, 2014
2. Hans Van Vliet, *Software Engineering: Principles and Practice*, (3e), Wiley India, 2012
3. Roger S. Pressman, *Software Engineering - A Practitioner's Approach*, (7e), McGraw-Hill International Edition, 2010
4. Bernd Bruegge, Allen H. Dutoit, *Object-Oriented Software Engineering using UML Patterns and Java*, (2e), Pearson Publication, 2011
5. Ian Sommerville, *Software Engineering*, (9e), Addison-Wesley, 2011
6. Nooper Davis, *Secure Software Development Life Cycle Processes*, Software Engineering Institute, Carnegie Mellon University, 2013.
7. Julie Cohen, Dan Plakosh, Kristi Keeler, *Robustness Testing of Software-Intensive Systems: Explanation and Guide*, Carnegie Mellon University, 2005.

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
2. John R. Levine, Tony Manson, Doug Brown, *LEX & YACC*, (2e), O Reilly Media, 2012
3. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers Principles, Techniques and Tools*, (2e), Pearson Education, 2010
4. Kenneth C. Louden, *Compiler Construction - Principles and Practice*, (1e), Thomson, 2007

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

Socket Programming Using UDP Protocols study various Network packets exchanged using Wireshark/tcpdump. Simple Client -Server Programs, Concurrent Server implementations Socket Programming Using TCP Protocols and study various Network packets exchanged using Wireshark/tcpdump. Simple Client -Server Programs, Concurrent Server implementations, Simple Network Application Program Development like FTP Network Design Experiments and Packet Monitoring Experiments with simulation tools like GNS3, Wireshark, tcpdump and NS2 or NS3 etc: Experiments to study Classful IPv4 Addressing, CIDR Notation Addressing, Subnetwork and Supernet work Design. Experiments to study working of Hubs, Bridges, Switches etc Devices. Configuration of Common Network Services like FTP, SSH, TELNET, DHCP Servers in Linux Operating systems.

References:

1. W. Richard Stevens, *UNIX Network Programming, Volume 1: The Sockets Networking API*, (3e), Addison-Wesley Professional Computing, 2003
2. Prof. Dayanand Ambawade, Deven N. Shah & Kogent Learning Solutions Inc, *Linux Lab: Hands on Linux*, Dreamtech Press, 2009

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:

1. Maurice Bach, *Design of Unix Operating System*, Prentice Hall India Learning Private Limited, 2015
2. Graham Glass, *Unix for Programmers and Users- A complete guide*, (3e), Prentice Hall India Learning Private Limited, 2003
3. Sumitabha Das, *Unix concepts and applications*, (4e), McGraw Hill Education, 2017
4. Neil Matthew, Richard Stones, *Beginning Linux Programming*, (4e), Wiley Publication, 2007
5. A. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts*, (9e), Wiley and Sons (Asia) Pte Ltd, 2013
6. Rachel Morgan- *Unix System*, McGraw Hill Education, 2007

SIXTH SEMESTER

HUM 3151: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

Nature and significance, Micro & macro differences, Law of demand and supply, Elasticity & equilibrium of demand & supply. Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of single, Uniform gradient cash flow. Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, Declining balance method of depreciation, Sum-of-the-years digits method of depreciation, Sinking fund and service output methods, Introduction to balance sheet and profit & loss statement. Ratio analysis - Financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios.

References:

1. Prasanna Chandra., *Fundamentals of Financial Management*, Tata Mc-Graw Hill Companies, New Delhi, 2005.
2. James L Riggs, David D Bedworth and Sabah U Randhawa., *Engineering Economics*, Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2004.
3. T. Ramachandran., *Accounting and Financial Management*, Scitech Publications Pvt. Ltd. India, 2001.
4. Eugene F. B. & Joel F. H., *Fundamentals of Financial Management*, (12e), Cengage Learning Publisher, 2009.
5. M. Y. Khan & P. K. Jain., *Financial Management*, (5e), Tata McGraw Hill Publication, New Delhi, 2008.
6. Thuesen G.J., *Engineering Economics*, Prentice Hall of India, New Delhi, 2005.
7. Blank Leland T. Tarquin Anthony J. *Engineering Economy*, McGraw Hill, Delhi, 2002.
8. Chan S. Park, *Fundamentals of Engineering Economics*, (3e), Pearson Publication, 2013.

CSE 3251: DISTRIBUTED SYSTEMS [3 1 0 4]

Design Goals, Types, Architectural Styles, Introduction to Erlang programming, syntax, functional programming, importance of recursion, collections, map/filter/reduce, conditional expressions and pattern matching, Processes, Threads, Virtualization, Clients, Servers, Code Migration, Erlang processes and process management, messages in Erlang, Remote procedure call, Message-oriented & Multicast communication, Distributed Objects & Remote Invocation, Names, Identifiers and Addresses, Flat naming, Structured naming, OTP behaviours, network programming in Erlang, working with Erlang nodes, creating and deploying Erlang applications, Distributed File Systems, File service architecture, Case study: Sun Network File System, Clock synchronization, Logical clocks, Mutual exclusion, Election algorithms, Consistency & Replication, Data-centric & Client-centric consistency models, Replica management, Consistency protocols.

References:

1. Maarten van Steen and Andrew S. Tanenbaum, *Distributed System*,s (3e), CreateSpace Independent Publishing Platform, February 2017.
2. Coulouris G., Dollimore J., and Kindberg T., *Distributed Systems – Concepts and Design*, (4e), Pearson, 2009.
3. Joe Armstrong, *Programming Erlang - Software for a Concurrent World*, (2e), The Pragmatic Programmers, 2013.
4. Ajay D. Kshemkalyani, and Mukesh Singhal, *Distributed Computing: Principles, Algorithms, and Systems*, Cambridge University Press; Reissue edition, March 2011.
5. Mei- Ling Liu, *Distributed Computing: Principles and Application*, Pearson Education, Inc. New Delhi. 2004.
6. *Learn You Some Erlang For Great Good!*
(<http://learnyousomeerlang.com/content>)

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:

1. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel Processing*, TMH Private Ltd., 2012.
2. V. Rajaraman, C. Siva Ram Murthy, *Parallel Computers Architecture and Programming* Prentice-Hall India, 2000
3. Michael J. Quinn, *Parallel Programming in C with MPI and OpenMP*, McGraw Hill Edition, 2003.
4. Benedict R. Gaster, Lee Howes, David R, Perhaad Mistry, Dana Schaa, *Heterogeneous Computing with OpenCL*, Elsevier Inc., 2012
5. D. Kirk and W. Hwu, *Programming Massively Parallel Processors –A Hands-on approach*, Elsevier Inc., 2010

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

Introduction to Erlang: Erlang syntax, Erlang shell, atoms, values, operators, functions, modules. Functional programming: recursion, collections, map/filter/reduce, pattern matching, case and other conditional expressions. Processes: process spawning, PIDs, sending and receiving messages. OTP (Open Telecom Platform) behaviours: supervisor, gen_server. Networking in Erlang: sockets, TCP gen_server. Erlang nodes: node naming, starting nodes, connecting to nodes, remote shells, messaging nodes. Erlang applications: creating applications, packaging applications, building. Implementation of classic distributed computing algorithms in Erlang.

References:

1. Joe Armstrong, *Programming Erlang*, (2e), Software for a Concurrent World, Pragmatic Programmers LLC, 2013.
2. *Learn You Some Erlang For Great Good!*
(<http://learnyousomeerlang.com/content>, accessed on 27th December, 2017)

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:

1. Matthew MacDonald, *Beginning ASP.NET 4.5 in C#*, Apress, 2012
2. Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, *Professional ASP.NET 4.5 in C# and VB*, Wrox, 2013.

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.

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.

PROGRAM ELECTIVES

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

Introduction of Virtual and Augmented reality, Definition and scope, A Brief History, 3 I's of Virtual Reality A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, Components of a VR System, Displays In augmented reality Multimodal Displays, Audio Displays Haptic, Tactile, and Tangible Displays, Displays, Visual Perception, Requirements and Characteristics, Multiple Models of I/O Gesture Interfaces Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces. Output Devices, Haptic Display, Graphics Displays, Sound Displays. ComputerVisionforAugmentedReality, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking, Computing Architectures for VR, The Rendering Pipeline, Workstation-Based Architectures, Distributed VR Architectures, Geometric Modeling, Kinematics Modeling, Physical Modeling, Behavior Modeling.

References:

1. Burdea, G. C. and P. Coffet, *Virtual Reality Technology*, (2e), Wiley-IEEE Press, 2006
2. Dieter Schmalstieg, Tobias Hollerer, *Augmented Reality: Principles & Practice*, (1e), Addison-Wesley, 2016
3. Tony Parisi, *Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile*, (1e), O'Reilly Media, 2015
4. Steve Aukstakalnis, *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)*, (1e), Addison-Wesley Professional, 2016
5. Jonathan Linowes, *Unity Virtual Reality Projects Paperback*, Packt Publishing ebooks Account, September 2015

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:

1. Donald Hearn and Pauline Baker, *Computer Graphics with OpenGL*, (4e), Pearson, 2014
2. Edward Angel, *Interactive Computer Graphics. A Top-Down Approach Using OpenGL*, (6e), Pearson Education, 2011
3. F. S. Hill Jr. and S. M. Kelley, *Computer Graphics using OpenGL*, (3e), Prentice Hall, 2006
4. Peter Shirley and Steve Marschner, *Computer Graphics*, (1e), A. K. Peters, 2010
5. Edward Angel, *Interactive Computer Graphics A Top-Down Approach Using WebGL*, (7e), Pearson Education, 2015

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

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:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, (4e), Pearson, 2017.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, (4e), CENGAGE Learning, 2014
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, *Digital Image Processing Using MATLAB*, (2e), Mc Graw Hill India, 2010
4. Gloria Bueno García, Oscar Deniz Suarez, José Luis Espinosa Aranda, Jesus Salido Tercero, Ismael Serrano Gracia, Noelia Vázquez Enano, *Learning Image Processing with OpenCV*, (1e), Packt Publishing, 2015

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:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence A Modern Approach*, (3e), Pearson 2010.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, *Artificial Intelligence*, (3e), Tata McGraw Hill, 2010

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

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:

1. Kevin P Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, *Foundations of Machine Learning*, MIT Press, 2012.
3. Daphne Koller and Nir Friedman, *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, (2e), Springer, 2013.

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

Introduction, Artificial Neural network –I, Artificial Neural Networks, Multilayer Perceptron, Modeling the Problem, Types of Data Involved, Training, Issues in ANN, Example of Time Series Forecasting Artificial Neural Networks II: Radial Basis Function Network, Learning Vector Quantization, Self-Organizing Maps, Recurrent Neural Network, Hopfield Neural Network, Adaptive Resonance Theory, Fuzzy Inference Systems: Fuzzy Systems, Fuzzy Logic, Membership Functions, Fuzzy Logical Operators, More Operations, Fuzzy Inference Systems, Type-2 Fuzzy Systems, Other Sets, Evolutionary Algorithms: Evolutionary Algorithms, Biological Inspiration, Genetic Algorithms, Hybrid Systems, Evolutionary Neural Networks.

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, *Real Life Applications of Soft Computing*, CRC Press, Taylor and Francis Group, London, 2010
2. Timothy J. Ross, *Fuzzy Logic With Engineering Applications*, Wiley Publication, 2010
3. S.N. Sivanandam, S.N. Deepa, *Principles of Soft Computing*, (2e), Wiley Publication, 2010
4. S. Rajasekaran and G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms*, PHI Learning, 2010
5. J.S.R. Jang, *Neuro-Fuzzy and Soft Computing*, PHI 2003

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

IPv6 Addressing, IPv6 Protocol, ICMPv6 Protocol, Transition From IPv4 to IPv6, Network Management, SNMP, ASN, Multimedia, Compression, Multimedia Data, Multimedia in the Internet, Real-Time Interactive Protocols, Peer-to-Peer Paradigm, Introduction, Chord, Pastry, Kademlia, Bittorrent, Quality of Service, Data-Flow Characteristics, Flow Control to Improve QoS, Integrated Services (INTSERV), Differentiated Services (DIFFSERV), Software Defined Networks, How SDN Works, OpenFlow Specification, Content Delivery Networks, Why Performance Matters, Examining Internet Bottlenecks, Edge Operations, The Akamai HD Networks.

References:

1. Forouzan, *Data Communications and Networking*, (5e), Mc-Graw Hill Publication, 2012.
2. Paul Goransson, Chuck Black, Timothy Culver, *Software Defined Networks: A Comprehensive Approach*, Morgan Kaufmann, 2016
3. Gilbert Held, *A Practical Guide to Content Delivery Networks*, (2e), CRC Press, 2010

4. Peter Loshin, *IPv6: Theory, Protocol, and Practice*, Morgan Kaufmann, 2004
5. Mani Subramanian, *Network Management: Principles and Practice*, (2e), Pearson Education, 2012
6. Srinivas Vegesna, *IP Quality of Service*, Cisco Press, 2001

CSE 4056: INFORMATION SECURITY [3 0 0 3]

What is security? CNSS Security Model, Components of an Information System, Approaches to Information Security Implementation, The Systems Development Life Cycle, Malicious Software Types, Vulnerability Exploit, Social Engineering, System Corruption, Attack Agent, Information Theft, Stealthing, Counter measures, Distributed Denial of Service Attacks, Intrusion Detection, Need for Firewalls, Database Security, Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port Based Network Access Control, Cloud security risks and countermeasures, Transport Layer Security, HTTPS, Email threats, Pretty Good Privacy (PGP). IP Security Overview, Policy, Encapsulation, Ways of executing cybercrimes.

References:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, (7e), Prentice Hall, 2017
2. Michael E. Whitman and Herbert J. Mattord, *Principles of Information Security*, (4e), Cengage Learning India Publication, 2011.
3. Charles P. Pfleeger and Shari Lawrence Pfleeger, *Security in Computing*, (4e), PHI, 2009
4. Joseph Migga Kizza, *A Guide to Computer Network Security*, Springer International edition, 2009
5. Atul Kahate, *Cryptography and Network Security*, Tata McGraw-Hill Publishing, 2008
6. Bruce Schneier, *Applied Cryptography-Protocols, Algorithms, and source code in C*, (2e), John Wiley & Sons, Inc., 2013

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:

1. McEwen A., *Designing the Internet of Things*, Wiley, 2014
2. Holler J., *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, Academic Press, 2014.
3. Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*, Apress Publications, 2013
4. Pethuru R., *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017
5. Vijay M., *Internet of Things (A Hands-on-Approach)*, Universities Press, 2014
6. Daniel M., *Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications*, Wiley, 2013.

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

Security Goals, Attacks, Services, Mechanisms, Symmetric Cipher Model, Block Ciphers and DES, Strength of DES, Block Cipher Design Principles. AES, Equivalent Inverse Cipher. Block Cipher Operation-Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption. Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat and Euler theorems, Testing for Primality, Chinese Remainder theorem, Discrete Logarithms. Pseudorandom Number Generation, Stream Ciphers, RC4. Public Key Cryptography and RSA. D-H Key Exchange, ElGamal System. Cryptographic Hash Functions. Message Authentication Codes, Security of MACs, HMAC.

References:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, (7e), Prentice Hall, 2017.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, *Cryptography and Network Security*, (2e), McGraw Hill, 2008
3. Atul Kahate, *Cryptography and Network Security*, Tata McGraw-Hill Publishing, 2008
4. Bruce Schneier, *Applied Cryptography-Protocols, Algorithms, and source code in C*, (2e), John Wiley & Sons, Inc., 2013

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:

1. Acharya S., *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
2. Holmes A., *Hadoop in Practice*, (2e), Manning Publications, 2015
3. Ryza S., *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017
4. White T., *Hadoop: The definitive guide*, (4e), O'Reilly, 2015
5. Sadalage P., *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, (1e), Addison-Wesley, 2012

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

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
4. Ian H Witten, Eibe Grank, Mark A Hall, *Data Mining, Practical Machine Learning Tools and Techniques*, (3e), Morgan Kaufmann Publishers, 2011

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

Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithm. Survey of English Morphology, Finite-State Morphological Parsing, Building a Finite-State Lexicon, FSTs for Morphological Parsing, Lexicon-Free FSTs. Words and sentence tokenization, Detecting and Correcting Spelling Errors. Case study: Normalizing Text, Segmentation. N-Grams, Unsmoothed N-Grams, Smoothing, Interpolation, and Back-off. English Word Classes, Tag-sets for English, Part-of-Speech Tagging, The Noisy Channel Model for Spelling. Case study: Automatic Tagging. Constituency, Some Grammar Rules for English, The Penn Treebank project, Dependency Grammar. Parsing with Context Free Grammars, CKY algorithm. Statistical Parsing.

References:

1. Daniel Jurafsky & James H. Martin, *Speech and Language Processing*, (2e), Pearson, 2009.
2. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, (1e), O'Reilly Media, 2009
3. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya, *Natural Language Processing: A Paninian Perspective*, Prentice-Hall of India, New Delhi, 1995
4. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python – Analysing Text with natural language toolkit*, O'Reilly Media, 2009
5. Chris Manning, Hinrich Schutze, *Foundations of Statistical Natural Language Processing*, MIT Press, Cambridge, 1999.

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:

1. Mednieks, Zigurd R., et al., *Programming Android*, O'Reilly Media, Inc., 2012
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
4. Lee, Wei-Meng, *Beginning Android 4 Application Development*, John Wiley & Sons, 2012
5. <https://developer.android.com/guide/index.html>
6. Meier, Reto, *Professional Android 4 Application Development*, John Wiley & Sons, 2012

CSE 4063: CLOUD COMPUTING [3 0 0 3]

Introduction to Cloud Computing, Virtualization and Infrastructure as a service, Hyper converged Infrastructure, Virtual Machines Provisioning and Migration Services, Services and Service Oriented Architectures, Message-Oriented Middleware, Portals and Science Gateways, Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, SLA Management, SLA Management in Cloud, Automated Policy-based Management. Cloud Security Fundamentals, Vulnerability Assessment, Security and Privacy, Cloud Computing Security Architecture.

References:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, *Cloud Computing Principles and Paradigm*, Wiley Publications, 2013.
2. Matthew Portnoy *Virtualization Essentials*, John Wiley and Sons Publication, 2012
3. Thomas Erl, *Service oriented Architecture*, Pearson publications, 2016
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.
6. Kai Hwang, Geoffrey Fox, Jack Dongarra, Todd Green, *Distributed and Cloud Computing: Clusters, Grids, Clouds and The Future Internet*, Morgan Kaufmann Publishers, 2011

CSE 4064: DEEP LEARNING [3 0 0 3]

Introduction, Mathematical Preliminaries, Machine Learning Basics: Learning, Supervised and Unsupervised learning algorithms, Deep Feedforward Networks: Hidden units, architecture design, Backpropagation algorithm, Regularization for Deep Learning: Parameter Norm Penalties, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise-Robustness, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Optimization for Training Deep Models: Challenges in Neural Network Optimization, Convolutional Networks, Recurrent and Recursive Networks, Practical Methodology: Performance Metrics, Default Baseline Models, Selecting hyper parameters, Debugging Strategies.

References:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press 2016.
2. Simon Haykin, *Neural Networks and Learning Machines*, PHI, 2008
3. Andrew Ng's *Notes on Machine Learning* from CS229.

CSE 4065: DESIGN PATTERNS [3 0 0 3]

What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern, Factory Pattern, Abstract Factory Pattern, Builder Pattern, Prototype Pattern, Singleton Pattern, Chain of Responsibility Pattern, Command Pattern, Interpreter Pattern, Iterator Pattern, Mediator Pattern, Memento Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template Pattern, Visitor Pattern, Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Facade Pattern, Flyweight Pattern, Proxy Pattern, Case study: Discussion on real time examples.

References:

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Pearson Education, 2004
2. G Lasater, *Design patterns*, Wordware publishing Inc, 2007
3. James W Cooper, *Introduction to Design Patterns in C#*, IBM Watson 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
6. Craig Larman, *Applying UML and Patterns, an introduction to OOAD and the unified process*, (2e), Pearson, 2002
7. Bruce Powell, *Real-Time Design Patterns: Robust Scalable Architecture for Real-Time Systems*, 2003

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

Computer Security concepts- Introduction to ethical hacking- Port Scanning- Types of port scans- Enumerating Windows operating systems- NETBIOS enumeration tools- DumpSec-Hyena- Nessus and

open VAS- Tools for identifying vulnerabilities-Built-in windows tools-Best practices in hardening windows systems-Patching systems-Antivirus solutions Windows OS vulnerabilities-Hacking web servers-Understanding web application vulnerabilities- Application vulnerabilities and counter measures-Tools for web attackers and security testers-Cybercrime: Mobile and Wireless devices- Tools and methods used in cybercrime- Cybercrimes and cybersecurity: Legal Perspectives.

References:

1. Michael T. Simpson, Nicholas.D.Antill, *Hands-On Ethical Hacking and Network Defense*, (3e), Cengage Learning, 2016
2. William Stallings, *Cryptography and Network security*, (7e), Pearson, 2017
3. Sumit Belapure, Nina Godbole, *Cyber Security: Understanding cybercrimes, Computer Forensics and Legal perspectives*, Wiley India, 2011
4. Rafay Baloch, *Ethical hacking and penetration testing guide*, CRC Press, Taylor & Francis Group, 2015
5. Kimberly Graves, *Official Certified Ethical Hacker Study Guide*, 2010
6. Mark Taber, *Maximum Security: A Hacker's Guide to Protecting Your Internet Site and Network*, 1997

CSE 4067: GAME PROGRAMMING [3 0 0 3]

Building Blocks of Game Design Basics, Game Design Atoms, Chance & Skill in Games and Game Genres Elements of Chance, Elements of Strategic Skill, Elements of Twitch Skill, Chance & Skill, Finding the Balance, Genres of Games, Unity Basics Enter the Third Dimension: Getting to Grips with 3D, Rigidbody Physics, Prototyping and Scripting Basics, Environment and Characters Creation in Unity Creating the Environment: Using the Terrain Editor, Player Characters and further Scripting: Working with the Inspector, Anatomy of a Character, Scripting for Character Movement, Colliders and Rigid Body in Unity Interactions: Adding the Outpost, Collisions and Triggers, Collection, Inventory and HUD: Writing the Player Inventory, Restricting Outpost Access, Displaying the Power Cell HUD, Coconut Shy Game.

References:

1. Brathwaite, Brenda, and Ian Schreiber, *Challenges for Game Designers: Non-digital Exercises for Video Game Designers*, Course Technology, Cengage Learning, 2017
2. Ernest Adams, *Fundamentals of Game Design*, (2e), New Riders, Pearson, 2010
3. Will Goldstone, *Unity 3.x Game Development Essentials: Game Development with C# and Javascript*, (2e), PACKT publishing, 2011
4. Tracy Fullerton, *Game Design Workshop: A Playcentric Approach to Creating Innovative Games*, (3e), CRC Press, 2014.
5. Matt Smith, Chico Queiroz, *Unity 4.x Cookbook*, (1e), PACKT publishing, 2013
6. Herbert Schildt, *C# 4.0 The Complete Reference*, Tata McGraw-Hill, 2017

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

Review of SIMD Computer Organization, SIMD interconnection networks, Parallel Algorithms for Array processors, Data flow computers, Symmetric Multiprocessor Organization, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Synchronization, Models of Memory Consistency, Clusters, Operating System Design Issues, Cluster Computer Architecture, Blade Servers, Clusters Compared to SMP, Multicore Computers, Hardware Performance Issues: Increase in Parallelism, Power Consumption, Software Performance Issues: Software on Multicore, Multicore Organization, Intel x86 Multicore Organization: Intel Core Duo, Intel Core i7, Supercomputers, types of supercomputers.

References:

1. William Stallings, *Computer Organization and Architecture – Designing for Performance*, (8e), Pearson Prentice Hall, 2010.
2. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel*

Processing, TMH Private Ltd., 2012.

3. John L. Hennessy & David A. Patterson, *Computer Architecture: A Quantitative Approach*, (5e), Morgan Kaufmann, 2014.
4. https://en.wikipedia.org/wiki/Supercomputing_in_India

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

The human: Introduction, Frameworks and HCI, Industrial interfaces, Interaction styles, Navigation in 3D and 2D, Elements of the WIMP interface, The context of the interaction, Half the picture, Experience, engagement and fun. Paradigms, Interaction design basics, HCI in the software process, Design rules, Universal design, Implementation support, Design Focus, Evaluation techniques, User support, Cognitive models: Goal and task hierarchies, GOMS saves money, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures, Socio-organizational issues and stakeholder requirements: Communication and collaboration models: Introduction, Face-to-face communication, Task analysis.

References:

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, *Human-Computer Interaction*, (3e), Edition Pearson, 2014
2. Donald A. Norman, *The design of everyday things*, (2e), Currency and Doubleday, 2012
3. Rogers Sharp Preece, *Interaction Design: Beyond Human Computer Interaction*, (2e), Wiley 2012
4. Guy A. Boy, *The Handbook of Human Machine Interaction*, Ashgate publishing Ltd, 2011

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:

1. Christopher D Manning, Prabhakar Raghavan and Hinrich Schutze, *Introduction to Information Retrieval*, Cambridge University Press, 2008
2. Stefan Buttcher, Charles L.A. Clarke and Gordon V. Cormack., *Information Retrieval – Implementing and Evaluating search engines*, (6e), MIT Press, 2011
3. Baeza Yates and Ribeiro Neto., *Modern Information Retrieval*, (2e), Addison Wesley, 2010
4. Soumen Charabarti, *Mining the Web*, Morgan-Kaufmann, 2003
5. David A Grossman, OphitFrieder, *Information Retrieval – Algorithms and Heuristics*, (2e), Springer, 2004

CSE 4071: MICROCONTROLLER [3 0 0 3]

Embedded Systems, Approaches to Embedded Systems, Anatomy of a Typical Small Microcontroller, The Texas Instruments MSP430: The Outside View, The Inside View, Memory, Central Processing Unit, Exceptions, Development Environment, The C Programming Language, Assembly Language, Demonstration Boards, Hardware, First Program on a Conventional Desktop Computer, Light LEDs in C and in Assembly Language, Read Input from a Switch, Automatic Control: Flashing Light by Software Delay, Use of Subroutines, Flashing Light by Polling Timer_A, Central Processing Unit, Addressing Modes, Instruction Set, Resets, Clock System, Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Flash Memory Structure,

Flash Memory Control Registers, Flash Memory Code Examples, Bootstrap Loader, MSP430 Power Consumption Characteristics, MSP430 Low-Power Modes, A Sample Application.

References:

1. John H. Davies, *MSP430 Microcontroller Basics*, (1e), Newnes Publications, Elsevier, 2008.
2. Chris Nagy, *Embedded Systems Design Using the TI MSP430 Series*, Newnes Publications, Elsevier, 2012.
3. Manuel Jimenez, Rogelio Palomera, Isidoro Couvertier, *Introduction to Embedded Systems: Using Microcontrollers and the MSP430*, (1e), Springer, 2014.
4. Michael J Pont, *Embedded C*, (1e), Pearson Education, 2005.

CSE 4072: MULTIMEDIA TECHNOLOGIES [3 0 0 3]

Introduction, Multimedia, Application and networking Terminology, Multimedia information representation, Digitization Principles, Compression Principles, Text, Image, Audio and Video Compression, Notion of synchronization, Basic synchronization issues, Synchronization Reference model, Synchronization in a Distributed Environment, Synchronization Specification Methods, Collaboration dimensions, Group Communication Architectures, Session Management, Network Services and Protocols for Multimedia Communication- Quality of Multimedia data transmission, Content Distribution Network, Broadcast/Multicast-Video-on-Demand, for Heterogeneous Users, Application-Layer Multicast, Cloud Computing for Multimedia Services.

References:

1. Li, Ze-Nian, Drew, Mark S., Liu, Jiangchuan, *Fundamentals of Multimedia*, (2e), Springer, 2014
2. Fred Halsall, *Multimedia Communications - Applications, Networks, Protocols and Standards*, (1e), Pearson Education India, 2002
3. Ralf Steinmetz and Klara Nahrstedt, *Multimedia: Computing, Communications and Applications*, Pearson Education India, 2012
4. Ralf Steinmetz and Klara Nahrstedt, *Multimedia Fundamentals- Volume 01 Media coding and content processing*, Pearson Publication, 2003
5. K R Rao, Zoran S Bojkovic and Dragorad A Milovanovic, *Introduction to Multimedia Communications*, Wiley Publications, 2009

CSE 4073: PERVASIVE COMPUTING [3 0 0 3]

Introduction to Pervasive Computing: Basics, Characteristics- interaction transparency, context awareness, autonomy experience capture, Pervasive computing infrastructure, Architecture for pervasive computing, Device Technologies, Human-Machine Interfaces, Biometrics, Voice Technologies, Basics of Speech Recognition, Privacy and Security, Energy Constraints, Smart Devices and Services, Sensor Networks, WWW architecture, Protocols, Components of the WAP architecture, WAP infrastructure, WAP security issues, Wireless Markup Language, Pervasive Networks, Scalability & Availability, Development of pervasive computing Web Applications, Pervasive Application Architecture, Context aware Computing, Application Examples Retail, Healthcare, Smart Home, Automation, Smart Vehicles, Wearable Computing,

References:

1. Jochen Burkhardt, *Pervasive Computing: Technology and Architecture of Mobile Internet Applications*, Pearson Education, 2002
2. Stefan Poslad, *Ubiquitous Computing: Smart Devices, Environments and Interactions*, (2e), Wiley, 2010
3. Laurence T. Yang, *Handbook On Mobile And Ubiquitous Computing Status And Perspective*, CRC Press, 2012
4. John Krumm, *Ubiquitous computing fundamentals*, CRC Press, 2016
5. Seng Loke, *Context-Aware Computing Pervasive Systems*, Auerbach Pub., Taylor and Francis Group, 2007
6. Guruduth S. Banavar, Norman H. Cohen, and Chandra

Narayanaswami, *Pervasive Computing: An Application - Based Approach*, Wiley Interscience, 2012

7. Frank Adelstein, S K S Gupta, G G Richard, and L Schwiebert, *Fundamentals of Mobile and Pervasive Computing*, Tata McGraw-Hill, 2005
8. A. Genco, S. Sorce, *Pervasive Systems and Ubiquitous Computing*, WIT Press, 2012

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

Introduction to Social Web, Nodes, Edges and Network Measures, Describing Nodes and Edges, Describing Networks, Layouts, Visualizing network features, The role of Tie strength, Measuring Tie strength and its network structures, network propagation, Link prediction, entity resolution, Case study, Introduction to community discovery, communities in context, quality functions, The Kernighan-Lin algorithm, Agglomerative algorithms, spectral algorithms, multi-level graph partitioning, Markov clustering, Other approaches, Introduction to social influence, Influence related statistics, social similarity and influence, Homophily, Existential Test for social influence, Influence and actions, Influence and interactions, influence maximization in viral marketing.

References:

1. Jennifer Golbeck., *Analysing the Social Web*, Morgan Kaufmann publications, 2013
2. Charu C. Aggarwal, *Social Network Data Analytics*, Springer publications, 2011
3. John Scott, *Social Network Analysis*, (3e), Sage publications limited, 2013
4. Jay Goldman, *Facebook Cookbook*, O'Reilly, 2009
5. Shamanth Kumar, Fred Morstatter, Huan Liu, *Twitter Data Analytics*, Springer publications, 2013

CSE 4075: SOFTWARE ARCHITECTURE [3 0 0 3]

Understanding Software Architecture, Definitions of Software Architecture, Architectures and Technologies, Introducing the Case study, Requirements Overview, Project Context, Business Goals, Software Quality Attributes, Performance, Scalability, Modifiability, Security, Availability, Integration, Design Trade-offs, Middleware Architectures and Technologies, Application Servers, Software Architecture Process, Documenting Software Architecture, Case Study, Design and The Challenges of complexity, Aspect Oriented Architectures, Model Driven Architecture, Service Oriented Architectures and Technologies, The Semantic Web.

References:

1. Gorton Ian, *Essential Software Architecture*, (2e), Springer International Architecture, 2011
2. Bass Len, Clements Paul, Kazman, Rick, *Software Architecture in Practice*, (2e), Pearson, 2003
3. Bosch Jan, *Design and Use of Software Architecture*, Addison Wesley, 2000
4. Rozanski Nick & Woods Eoin, *Software Systems Architecture*, Addison Wesley, 2005

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

Introduction, Software Quality, Behaviour and Correctness, Correctness versus Reliability, Testing and Debugging, V-Model, Boundary Value Analysis, Robustness Testing, Worst Case Testing, Special Value Testing, Random Testing, Equivalence Class Testing, Decision Tables, Test Cases based on Decision Tables, Test adequacy basics, Adequacy criteria based on control flow, data flow concepts, Adequacy criteria based on data flow, Test Assessment using Mutation, Regression Test Process, Selecting Regression Tests, Test Design, Using JUnit or NUnit, Stubs and Mocks, Integration errors, Dependence, OO Versus Non-OO programs, Integration Hierarchy, Automated test generation techniques.

References:

1. Aditya P Mathur, *Foundations of Software Testing*, (2e), Pearson Education, 2008
2. Paul C. Jorgensen, *Software Testing A Craftsman's Approach*, (3e), 2013
3. Mauro Pezze, Michal Young, *Software Testing and Analysis: Process, Principles and Techniques*, Wiley, 2008
4. Gopalaswamy Ramesh, Srinivasan Desikan, *Software testing Principles and Practices*, (2e), Pearson, 2007

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

Evolution of Storage Technology and Architecture, Data Center Infrastructure, Virtualization and Cloud computing. Components of a Storage System Environment, Disk drive Performance, Logical Components of the Host, Direct-Attached storage, Disk performance, command queuing, flash drives. RAID Techniques, RAID Levels, Hot Spares. Types of Intelligent Storage Systems, Components of FC SAN, Switched Fabric Ports, World Wide Names, Zoning, Switched Fabric Login Types, Components of NAS, Object Storage and Retrieval in OSD, Benefits, Content addressed storage, Information Availability, BC Terminology, Backup Purpose and Considerations, Recovery Considerations, Local Replication Technologies, Remote Replication Technologies, Three-Site Replication.

References:

1. G.Somasundaram, Alok Shrivastava, *Information Storage and Management-Storing, Managing, and Protecting Digital Information in classic, virtualized and cloud environments*, (2e), EMC Education Services, John Wiley & Sons Inc., 2012
2. Marc Farley, *Storage Networking Fundamentals*, (1e), CISCO Systems, 2004
3. Robert Spalding, *Storage Networks: The Complete Reference*, Tata McGraw Hill, 2003
4. Marc Farley Osborne, *Building Storage Networks*, (2e), Tata McGraw Hill, 2001

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:

1. R Nicopolitidis et al, *Wireless networks*, (1e), Wiley, 2011
2. Jeffrey Bannister, Paul Mather and Sebastian Coope, *Convergence technologies for 3G networks, IP, UMTS, EGPRS and ATM*, John Wiley & Sons Publications, 2004
3. Jonathan Rodriguez, *Fundamentals of 5G Mobile Networks*, Wiley, 2015
4. Hannes Hartenstein, *VANET: Vehicular Applications and Inter-Networking Technologies*, (1e), John Wiley and Sons, 2010
5. Kaveh Pahlavan, Prashant Krishnamurthy, *Principles of Wireless Networks*, Prentice Hall, 2011
6. Ajay R. Mishra, *Cellular Technologies for Emerging Markets: 2G, 3G and Beyond*, John Wiley & Sons, 2010
7. Vijay K Garg, *Wireless Communication and Networking*, 2007

OPEN ELECTIVES

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

Introduction, Programming techniques, Introduction to object oriented concepts, Advanced concepts in object oriented technology, Object oriented design methodology, Introduction to Analysis of algorithms, Code tuning techniques, Analysis of algorithms, Analysis of some well-known algorithms, Intractable problems, Evolution of software, Software development models, Requirement analysis and design, Software construction, Software testing and software quality, Introduction to Web Technologies, Internetworking concepts, Architecture and protocol, The World Wide Web, web applications, Security in applications and issues in web based applications.

References:

1. Foundation Program Team, *Foundation Program – Vol. 2*, (3e), Education and Research, Infosys Technologies, 2012
2. Foundation Program Team, *Foundation Program – Vol. 3*, (3e), Education and Research, Infosys Technologies, 2012
3. Comer Douglas E, *Computer Networks and Internets*, (6e), Pearson, 2014

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

Fundamentals of Computer Architecture, Organization of a Simple Computer, Execution of Instructions, Input/Output Devices, Measurement of CPU Performance, Operating System Concepts, Memory Management, Process Management, Basic Concept of Multiprogramming, Multitasking and Multiprocessing, Interprocess Communication, File Management and Device Management, Disk Scheduling, Introduction to DBMS and Entity Relationship Modelling, Converting ER diagram to Schema, Introduce Functional Dependency and Basics of Normalization, Introduce three Normal Forms, SQL, Data Definition Language (DDL) statements, Data Manipulation Language (DML) statements and Data Control Language (DCL).

References:

1. Foundation Program Team, *Foundation Program – Vol. 1*, (3e), Education and Research, Infosys Technologies, 2012
2. Foundation Program Team, *Foundation Program – Vol. 2*, (3e), Education and Research, Infosys Technologies, 2012
3. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, (7e), John Wiley & Sons, 2014
4. Milenkovic Milan., *Operating Systems Concepts and Design*, (2e), McGraw Hill Education, 2001
5. Henry F Korth, Abraham Silberschatz and Sudarshan, *Database system concepts*, (6e), McGraw-Hill Education, 2013

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:

1. Christopher Negus, *Linux Bible*, (8e), John Wiley & Sons Publication, 2012
2. Ellen Siever, Stephen Figgins, Robert Love, and Arnold Robbins, *Linux in a Nutshell*, (6e), O'Reilly Media Publication, 2009
3. Sumitabha Das, *UNIX Concepts and Applications*, (4e), Tata McGraw Hill Publications, 2011

4. Neil Matthew & Richard Stones, *Beginning Linux Programming*, (4e), Wrox Publication, 2008
5. Eric Foster Johnson, John C Welch, Micah Anderson, *Beginning Shell Scripting*, Wrox publication, 2005

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

Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators, Structure of Relational Databases, Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity- Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Nested Subqueries, Additional Basic Operations, Null Values, Modification of the Database, Features of Good Relational Design, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, RAID, File Organization, Basic Concepts, Ordered Indices, Transaction Concept, A simple Transaction model, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Lock-Based Protocols, Recovery and Atomicity.

References:

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGrawHill, New York, 2011
2. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, *Fundamentals of Database Systems*, (6e), Pearson Education, United States of America, 2011
3. Thomas Connolly, Carolyn Begg, *Database Systems – A Practical Approach to Design, Implementation and Management*, (4e), Pearson Education, England, 2005
4. Peter Rob, Carlos Coronel, *Database Systems–Design, Implementation and Management*, (10e), Course Technology, Boston, 2013

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

Artificial Neural Networks: Definition, Benefits of Artificial Neural Networks, Human Brain, Terminology, Neuron Models, Activation Functions, Network Architectures, Learning Process, Types of Learning: Error-correction, Memory Based, Hebbian, Competitive, and Boltzmann Learning. Types of Neural Networks: Feed Forward Neural Network: Single Layer Perceptron, Limitations, Multi-Layer Perceptron, Back Propagation Algorithm, Practical Considerations, Radial Basis Function Network. Recurrent Networks: Hopfield Network, Recurrent Multi-Layer Perceptron, Second Order Networks, Learning Algorithms. Self-Organizing Map, Neural Network Applications. Fuzzy Logic: Fuzzy Logic Applications. Pattern Recognition, Control Engineering, Image Processing. Genetic Algorithms.

References:

1. Simon S. Haykin, *Neural Networks- A Comprehensive Foundation*, Prentice Hall, 2005
2. Li Min Fu, *Neural Networks in Computer Intelligence*, Tata McGraw Hill Edition, 2008
3. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, (3e), John Wiley & Sons, 2010
4. B. Yegnanarayana, *Artificial Neural Networks*, Prentice Hall, 2006
5. S.N. Sivanandam, S. N. Deepa, *Principles of Soft Computing*, Wiley India, 2008
6. D.E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Pearson Education, 2009

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

The Problem Domain, The Software Engineering Challenges, The Software Engineering Approach. Software Process, Desired Characteristics of Software Process, Software Development process models. Software Requirements, Problem Analysis, Requirement Specifications, Functional Specification with Use Cases, Process Planning, Effort Estimation, Project Scheduling and Staffing, Software Configuration Management Plan. Design Principle, Module Level Concepts, Design Notations and Specifications, Structured Design Methodology. OO Analysis and OO Design, OO Concepts, Unified Modelling Language. Programming Principle and Guidelines, Coding Process, Testing Fundamentals, Black Box Testing, White Box Testing, Testing Process.

References:

1. Pankaj Jalote, An integrated approach to software engineering, (3e), Narosa, 2005
2. Ian Sommerville, Software Engineering, Pearson, (9e), 2010
3. Rajib Mall, Fundamentals of Software Engineering, (3e), PHI learning 2009
4. Roger S. Pressman, Software Engineering A Practioner's Approach, (6e), McGraw-Hill, 2005

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

NET Architecture: Applications Using C# C# Basics: Advanced concepts: Delegates, Events, Memory Management under the Hood, Freeing Unmanaged Resources, strings, and regular expressions, Collections, Reflections, Errors and Exceptions. The .NET environment: Working with Visual Studio .NET 2003 (higher version can also be considered. E.g.: 2017), Assemblies and Structure, Cross-Language Support, Global Assembly Cache, Creating Shared Assemblies. .NET Security: Role-Based Security, Managing Security Policy, Threading. Localization: Namespace System. Globalization, Resources, Localization Example Using Visual Studio .NET, Creating a Windows Form Application, Graphics with GDI+, Introduction to WCF and WPF.

References:

1. Simon R., Christian N., Karli W., Jay G., Morgan S. and Bill E., Professional C#, (3e), Wrox Publishers, 2004
2. Joseph A. and Ben A. C# 5.0 in a Nutshell, (5e), O'Reilly Publishers, 2012
3. Eric G., A Programmers introduction to C#, (2e), Apress Publishers, 2000
4. Ben A., Peter D., Brad M., C# Essentials, (2e), O'Reilly Publisher 2001
5. Online material: Microsoft MSDN website

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:

1. Herbert Schildt and Dale Skrien, Java Fundamentals- A Comprehensive Introduction, (1e Revised), Tata McGraw Hill, 2017
2. Herbert Schildt, The Complete Reference Java, (9e), Tata McGraw-Hill, 2014
3. Deitel and Deitel, Java How to Program, (10e), Pearson Edu., 2011
4. E Balaguruswamy, Programming with Java A Primer, (4e), Tata McGraw-Hill, 2010

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:

1. Hans Peter Langtangen, Python Scripting for Computational Science, (3e), Springer Publishers, 2014
2. Naomi R. Ceder, The Quick Python Book, (2e), Manning Publications Co., 2010
3. Wesley J. Chun, Core Python Applications Programming, (3e), Prentice Hall Publishers, 2012
4. Bill Lubanovic, Introducing Python - Modern Computing in Simple Packages, O'Reilly Publication, 2015
5. Allen B. Downey, Think Python-How to think like a computer scientist, (2e) O'Reilly Publication, 2015

CSE 4310: WEB PROGRAMMING [3 0 0 3]

Introduction to HTML5 and CSS3, Markup, HTML5 Style, More HTML5 Semantics, HTML5 Forms, HTML5 Audio and Video. Introducing CSS3, CSS3 Gradients and Multiple, CSS3 Transforms and Transitions, Embedded Fonts and Multicolumn Layouts. Introduction to JavaScript, The Grammar of JavaScript, Adding Logic and Control to Your Programs. Introduction to jQuery, Action/Reaction: Making Pages Come Alive with Events, Animations and Effects, Common jQuery Tasks, Enhancing Web Forms.

References:

1. Alexis Goldstein, Louis Lazaris, Estelle Weyl, HTML5 and CSS3 for The Real World, (2e), SitePoint, 2015
2. David Sawyer McFarland, JavaScript and jQuery The Missing Manual, (3e), O'Reilly Media, Inc., 2014
3. Matthew MacDonald, HTML5: The Missing Manual, (2e), O'Reilly Media, 2013
4. Jon Duckett, Gilles Ruppert, Jack Moore, JavaScript and JQuery: Interactive Front-End Web Development, John Wiley & Sons, 2014
5. Ed Tittel, Chris Minnick, Beginning HTML5 & CSS3 for Dummies, A Wiley Brand, 2013

OPEN ELECTIVES

MCA 4301: INTRODUCTION TO DATABASE SYSTEMS WITH MYSQL [3 0 0 3]

Modeling and Designing Databases, Database Design Process, Entity-Relationship Model, Basic Concepts, Constraints, Design of ER database schema, Reduction of ER to schema, Relational model, Super, candidate, primary, foreign key, Schema Diagram, Relational Database design, Functional dependencies, Normal forms, Creating a MySQL Database, Table, Modifying table, constraints, indexes, Basic SQL, Inserting Data, Selecting Data, Updating Data, Deleting Data, MySQL Functions, Numeric, String, Date /Time, Advanced Queries, Sorting, Multiple tables, Inner Join, Left Join, Right Join, Natural Join, Nested queries, Generating summaries, COUNT(), MIN(), MAX(), SUM(), AVG(), Group By, Statistical techniques, Calculating Descriptive statistics, Per-Group Descriptive Statistics, Generating frequency distribution, Calculating correlation coefficients, assigning ranks, Stored routines, stored procedure, stored function, Triggers, Events to schedule Database actions, Managing users and privileges, Importing and Exporting data, importing data with LOAD data and mysql import, importing csv files, exporting query results, tables, importing XML.

References:

1. Paul Dubois, MySQL Cookbook, O'REILLY, First Edition, 2007.
2. Larry Ullman, Visual Quick Start guide MySQL, Pearson Education, 2nd Edition, 2007.
3. Seyed M. M, Saied Tahaghoghi and Hugh Williams, Learning MySQL, O'Reilly, 2006.
4. Russell J.T. Dyer, MySQL in a Nutshell, O'REILLY, 2nd Edition, 2008.

MCA 4302: INTRODUCTION TO VR AND AR TECHNOLOGIES [3 0 0 3]

Introduction: Input Devices, Output Devices, Displays, Computing Architectures for VR, The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures, Modeling, Geometric Modeling, Physical Modeling, Behavior Modeling, Model Management, VR Programming and other Toolkits. Introduction to Unity 3D Engine, 2D Game concepts and basic scripting, 3D Game concepts and environment creation, Advanced game concepts. Introduction to Unity AR: Foundation and Vuforia, working with Vuforia in Unity, ARCore in unity, Mini project on AR. Introduction to VR, Unity for Google cardboard, Basic VR app development for Cardboard, Develop for a specific VR platform.

References:

1. Jonathan Linowers, Krystian Banbilinski, Augmented Reality for Developers, Packt Publishers, 2017.
2. Edward Lavieri, Getting started with Unity 5, Packt publishing, 2015.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley-IEEE Press, 2003.
4. Sherman, W.R. & A. Craig, Understanding, Virtual Reality: Interface, Application and Design, Morgan Kaufmann, San Francisco, CA, 2003.
5. Philippe Fuchs, Guillaume Moreau, Pascal Guitton, Virtual Reality: Concepts and Technologies, CRC, Taylor and Francis, 2011.

MCA 4303: INTRODUCTION TO LINUX AND SHELL SCRIPTING [3 0 0 3]

Introduction to UNIX/LINUX Operating System: OS concepts, Linux overview, key features of Linux, pros and cons of Linux. Processes: Processes and Files, I/O redirection and pipes, process creation, process attributes standard process file descriptors. File and Process

commands. File systems: Files and directories, file naming and wildcards, file attributes, file permissions. Regular Expressions & filters: find, grep, cut, sort, grep patterns. AWK and SED. Shell and Shell Scripting: The need for shell, types of shells, interactive uses of shell, using shell for creating user commands, functions. Bash shell features: Statements, data structure, built-in commands, environment customization primitives. Linux Editors.

References:

1. Richard Blum and Christine Bresnahan, Linux Command Line Shell Scripting BIBLE, 3rd Edition, Wiley, 2015.
2. Mark Sobel. A Practical Guide to Linux commands Editor and shell programming, Prentice Hall, 2nd Edition, 2010.
3. Stephen G. Kochan. Unix Shell Programming, 3rd Edition, SAMS Publications, 2003.
4. Bash Reference Manual Downloadable from GNU Project.
5. Brian W Kerningham and Rob Pike. The Unix Programming Environment, PHI Learning Pvt. Ltd., 2009.

MCA 4304: INTRODUCTION TO DATA ANALYTICS [3 0 0 3]

Introduction - data science, need for analytics, steps in data analysis projects, Data- sources of data, data sets, data warehouses, data types, privacy and confidentiality, samples vs. population. Data summarization and visualization – tables and graphs. Data Preprocessing- cleaning, transformation, dimensionality reduction. Data Analysis and Visualization – descriptive, inferential statistics, uni-variate and multi-variate analysis. Grouping – Cluster Analysis- distance measures, partitioning, hierarchical, density based methods. Market Basket Analysis, Association Analysis, Market Basket Analysis. Classifiers- Bayesian, k-nearest neighbor, neural network, Support Vector Machine, Decision Trees. Prediction- Regression models, Evaluating Classification and Predictive performance, ensemble methods. Anomaly Detection. Forecasting models.

References:

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
3. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Intelligence, John Wiley & Sons, 2014.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2011.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley, 2005.

Minor Specialization: Computational Mathematics

MAT 4051: APPLIED STATISTICS AND TIME SERIES ANALYSIS [2 1 0 3]

Stochastic and deterministic dynamic mathematical models – forecasting and control, transfer function models, models for discrete control systems. Basic ideas in model building- linear and multiple linear regression. Basic concepts in stochastic processes and Markov chains, Mean square distance, mean square error prediction, prediction of covariance stationary process, ergodic theory and stationary process, applications of ergodic theory, spectral analysis of covariance stationary processes, Gaussian systems, stationary point processes, level crossing problems. ARIMA models, Autoregressive models, moving average models, duality, model properties, parameter estimates, forecasts. Volatility models: ARCH and GARCH modelling, testing strategy for heteroscedastic models, volatility forecasts, Black Scholes model.

References:

1. G.E.P. Box, G. M. Jenkins, G. C. Reinsel and G M Ljung, *Time Series Analysis-Forecasting and Control*, (5e), Wiley Series, 2016.
2. Anderson T W, *The Statistical Analysis of Time Series*, John Wiley, New York, 1994
3. Samuel Karlin, Howard M Taylor, *First Course in Stochastic process*, Academic Press, New York,
4. C. Chatfield, *The Analysis of Time Series – An Introduction*, Chapman and Hall / CRC, (4e), 2004
5. David Ruppert, *Statistics in Finance*, Springer Publications, 2004

MAT 4052: COMPUTATIONAL LINEAR ALGEBRA [2 1 0 3]

Matrix Analysis: Basic Ideas from Linear algebra, vector norms, matrix norms, orthogonality and SVD, Projections and CS decomposition, the sensitivity of square linear systems. General Linear Systems: Triangular systems, The LU factorization, Round off analysis of Gaussian elimination, Pivoting, Improving and estimating accuracy. Orthogonalization and least squares: Householder and Givens matrices, The QR factorization, The full rank LS problem, Other orthogonal factorizations, The rank deficient LS problem, Weighing and iterative improvement, square and underdetermined systems. The symmetric Eigen value problem: Eigen values properties and decompositions, Power iterations, the symmetric QR algorithm, Jacobi methods, Tridiagonal Methods, Computing the SVD, some generalized eigen value problems.

References:

1. Gene H. Golub and Charles F. Van Loan, *Matrix Computations*, (4e), Johns Hopkins University Press, 2013.
2. Gilbert Strang, *Linear Algebra and its applications*, (4e), Wellesley Cambridge press, 2009.
3. David S. Watkins, *Fundamentals of Matrix Computations*, (3e), Wiley, New York, 2010.
4. Roger a Horn, *Matrix Analysis*, (2e), Cambridge University Press, 2013.

MAT 4053: COMPUTATIONAL PROBABILITY AND DESIGN OF EXPERIMENTS [2 1 0 3]

Sampling and sampling distributions, Most powerful tests, Uniformly most powerful tests, Likelihood ratio tests, The sequential probability ratio test, Randomized Designs, Inferences about the differences in Means, Paired Comparison Designs, Inferences about the variance of normal distributions, Monte Carlo estimation methods. The analysis of variance, RCBD, LSD and Related Designs, The Graeco - Latin square Design, Balanced Incomplete Block Designs, PBIBD Introduction to Factorial Designs, The Two Factor factorial design, Blocking in a factorial

design, 2^k Factorial Design, Blocking and Confounding in the 2^k Factorial Design, Partial Confounding. Two level fractional factorial designs, three level and mixed level factorial and fractional factorial designs, 3^k Factorial Design, Confounding in the 3^k Factorial Design, Fractional replication of the 3^k Factorial Design, Factorials with mixed levels.

References:

1. Robert V Hogg and Allen Craig, *Introduction to Mathematical Statistics*, (4e), Macmillan
2. M N Murthy, *Sampling Theory and Methods*, Statistical Publishing Society, 1967
3. C Radhakrishna Rao, *Linear Statistical Inference and its applications*, (2e), Wiley Series.
4. Douglas C Montgomery, *Design and Analysis of Experiments*, (8e), Wiley Series, 2012,
5. D D Joshi, *Linear Estimation and Design of Experiments*, New Age International Publishers, 2009

MAT 4054: GRAPHS AND MATRICES [2 1 0 3]

Graphs and subgraphs, walks, paths and connectedness, distance as a metric, degrees, regular graphs, cubic graphs, bipartite graphs, self-complementary graphs, operations on graphs, extremal graphs, cut points, bridges and blocks, block graphs and cut point graphs. Trees and their characterizations, centres and centroids, block-cut point trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, graphical variations of Menger's theorem. Traversability: Eulerian graphs and Hamiltonian graphs. Line graphs and total graphs. Line graphs and traversability, coverings and independence, critical points and lines. Planarity: Plane and planar graphs, outer planar graphs, Kuratowski's theorem, vertex colouring. Incidence Matrix: Rank, minors, path matrix, 0-1 incidence matrix. Adjacency Matrix: Eigen values of some graphs, determinant, bounds, energy of a graph, antiadjacency matrix of a directed graph, non-singular trees. Laplacian Matrix: Basic properties, computing Laplacian eigen values, matrix tree theorems, bounds for Laplacian spectral radius, edge-Laplacian of a tree.

References:

1. F. Harary, *Graph Theory*, Narosa Publishers, 1988.
2. J.A Bondy and U.S.R Murthy, *Graph Theory with Applications*, (5e), Elsevier Publishing Co., 1982.
3. D.B. West, *Introduction to Graph Theory*, Pearson Education, Inc., 2001.
4. R.B Bapat, *Graphs and Matrices*, Hindustan Book Agency, 2010.
5. Lowell W Beineke and Robin J Wilson, *Topics in Algebraic Graph Theory*, Cambridge University Press, 2005.

OPEN ELECTIVES

MAT 5301: APPLIED GRAPH THEORY [2 1 0 3]

Graphs and applications of the theorems by Havel and Hakimi, Erdos and Gallai. Cut points, bridges and blocks, block graphs and cut point graphs. Trees and their characterizations, centre and centroids, block-cut points trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, Whitney's theorem. Traversability-Eulerian, Hamiltonian, line graphs and total graphs. Traversability, coverings and independence, theorem of Gallai, critical points and lines. Planarity, genus, thickness, crossing number. Colorability, chromatic number and its bounds, Nordhaus Gaddum theorems, the four and five colour theorems, chromatic polynomial. Matrix Representation -Incident matrix, Adjacency matrix, cycle matrix, cutset matrix, path matrix, Digraphs, Matrix - tree theorem on number of spanning trees. Tournament. Graph theoretic Algorithms: Computer representation of graphs-Input and output, Algorithms for connectedness, Spanning Tree, Fundamental Circuits, Directed Circuits and Shortest paths.

References:

1. F. Harary, *Graph theory*, Narosa Publishers
2. Narsingh Deo, *Graph theory with applications to Engineering and Computer Science*, Prentice Hall.
3. Robin J. Wilson, *Introduction to Graph theory*, Logman

MAT 5302: APPLIED LINEAR ALGEBRA [2 1 0 3]

Finite dimensional vector spaces, subspaces, linear independence, basis and dimension. Sum and intersection of subspaces. Algebra of linear transformations, range and null space of a linear transformation, Inner-product spaces, metric spaces and Banach spaces, Gram Schmidt orthogonalization, linear operators and their adjoint, self adjoint, unitary and normal transformations, polar decomposition. Matrix algebra, simultaneous equations, Eigen values, characteristic vectors, Cayley-Hamilton theorem, minimal polynomial, Application of eigen values to solve simultaneous difference and differential equations. Quadratic forms and their classification, constrained optimization. Some computational methods of linear algebra.

References:

1. Gantmacher F.R., *The Theory of Matrices*, Chelsea.
2. Gilbert Strang, *Linear Algebra and its applications*, Thomson Learning
3. David C. Lay, *Linear Algebra and its applications*, Pearson Education

MAT 5303: APPLIED NUMERICAL METHODS [2 1 0 3]

Matrix Algebra : Solution for linear system of equations – Direct methods: Gauss elimination method, Gauss Jordan method, Crout's (LU decomposition) method. Iterative methods, Jacobi Gauss Seidel and successive over relaxation methods. Computation of inverse of a matrix: Jordan method, Triangularization method, Choleski's method, partition method. Eigen value & Eigen vectors: Given's method for real symmetric matrices, Jacobi's method for real symmetric matrices, Power method. Numerical Solution of Ordinary Differential Equations: Single step methods, Runge-Kutta method, Adam Bashforth's predictor corrector method, Milne's predictor and corrector method. Numerical Solution of Partial Differential Equations: Finite difference approximation to derivatives of Parabolic, Elliptic. Explicit finite difference method, implicit method.

References:

1. Jain, Iyengar and Jain: *Numerical methods for Scientific and Engineering Computations*, New Age Publishers
2. Carnahan, Luther and Wikes: *Applied Numerical Methods*, John Wiley
3. Conte S.D and Boor, *Introduction to Numerical analysis*, McGraw Hill.

MAT 5304: MATHEMATICAL MODELLING [2 1 0 3]

Introduction, Techniques, classification and characteristics of mathematical models, mathematical modeling through algebra, ordinary differential equations of first order. Mathematical modeling through systems of ordinary differential equations of first order, Prey-Predator model Mathematical modeling through systems of ordinary differential equations, modeling in medicine A model for diabetic mellitus. Modelling

on population dynamics Mathematical modelling through difference equations. Some simple models. Modelling of economics and finance through difference equations, population dynamics and generation of models through difference equations, modeling in probability theory, examples. Optimization models: Mathematical modeling through linear programming. Mathematical modelling through graphs: elements of graphs, digraphs. Mathematical models for blood flow. Mathematical model for Peristaltic transport of two layered.

References:

1. J N Kapur, *Mathematical Modelling*, New age international publishers, (2e), 2015.
2. J N Kapur *Mathematical Models in biology and medicine*, East-West press.
3. J N Kapur *Mathematical models of environment*, INS Academy, New Delhi

MAT 5305: OPTIMIZATION TECHNIQUES [2 1 0 3]

Formulation, Linear programming-simplex method, Penalty coarse methods, 2-phase method. Dual Simplex method. Duality theory. Transportation problem-Vogel's approximation method, MODI method, Assignment problem-Hungarian method. Project Management - Networks, Project planning and control using PERT and CPM. Project crashing. Game theory - 2 persons zero sum games, Minimax principle, games with mixed strategies. Dominance theory, solution using Linear programming.

References:

1. Bronson Richard - *Theory and Problems of Operations Research*- Schaum series- MGH
2. P.K. Gupta & Man Mohan - *Operations Research* - Sultan Chand & Sons
3. Hamdy A. Taha - *Operations Research* PHI

MAT 5306: STOCHASTIC PROCESSES AND RELIABILITY [2 1 0 3]

Static probabilities: Review and prerequisites generating functions, difference equations. Dynamic probability: definition and description with examples. Markov chains, transition probabilities, Chapman Kolmogorov equations. Classification of states, chains of Markov process. Stability of Markov systems, limiting behaviour, random walk. Poisson Processes : assumptions and derivations, related distributions, birth and death processes. Queueing System, general concepts, Model M/M/1 and M/M/S, steady state behaviour, transient behaviour. Wiener processes and Gaussian processes. Differential equations of a Wiener process, Kolmogorov equations, Ornstein - Unlenbeck Process. White noise. Reliability Theory : Definition of Reliability, types of failure, Hazard rate, Laws of failure - normal, exponential & Weibull failure laws - System reliability - in series, in parallel series - parallel system, Parallel - series system & related problems.

References:

1. Medhi. J., *Stochastic Processes*, Wiley Eastern.
2. Bhat U R, *Elements of Applied Stochastic Processes*, John Wiley.
3. A Papoulis, *Probability, Random Variables and Stochastic Processes*, McGraw Hill.

Minor Specialization: Business Management

HUM 4051: FINANCIAL MANAGEMENT [2 1 0 3]

Introduction and objectives of financial management, Evolution of corporate finance, responsibilities. Types of accounts, Golden rules of accounting, Preparation of Journal, Ledger, Trial balance and final accounts. Sources of long term finance, Characteristics of equity capital, Preference capital, Debenture capital & Term loans. Valuation of securities, Concepts, Bond valuation and related models, Bond value theorems, Yield to maturity. Equity valuation; Dividend capitalization approach, Leverage, Operating leverage, Financial leverage, Total leverage, Indifference point analysis. Working capital management, Capital budgeting: appraisal criteria, pay-back period, Average rate of return, Net present value, Benefit cost ratio and Internal rate of return. Risk analysis in capital budgeting, Cost of capital: introduction, cost of debt capital, Preference capital and Equity capital, Weighted average cost of capital, Determination of proportions, Cash management, Dividend decisions.

References:

1. Prasanna Chandra., Fundamentals of Financial Management, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2006.
2. I M Pandey, Financial Management, Vikas Publishing House Pvt Ltd., New Delhi, 2015.
3. N Ramachandran & Ram Kumar Kakani, Financial Accounting for Management, 3/e, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2011.
4. Eugene F Brigham & Michael C E, Financial Management: Theory and Practice. 12e, Cengage Learning, India, 2008.
5. Maheshwari S.N., Financial Management, Sultan Chand & Co., New Delhi, 2002.

HUM 4052: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

Introduction, Scope of HRM, Objectives of HRM, Functions, Activities, Roles, HRD organization and responsibilities. Evolution of HRM, Influence of various factors on HRM. Human resource planning: Introduction, Strategic considerations, Nature and scope, Human Resources Inventory, Job analysis, Job design, Job description, Job specification and Job evaluation. Employee Recruitment & Selection: Policy, Process, Tests, modern methods, Interview, Provisional selection, Medical/Physical examinations, Placement, Induction programs and socialization. Training and development: Basic concepts, Employees training Process, Planning, Preparation of trainees, Implementation, Performance evaluation and Follow-up training. Competency Mapping and Career development programmes. Performance appraisal and Merit rating, Promotion, transfers and separations, Wages and salaries administration, Discipline and grievances. Industrial and labour relations and Trade Unionism Overview: Collective bargaining and maintaining Industrial health.

References:

1. Michael Armstrong ., A Handbook of Human Resource Management Practice: 10th Edition, New Delhi, Kogan Page India, 2006
2. Gary Dessler & Biju Varkey ., Human Resource Management: 12th Edition Dorling Kindersley (India), Noida, 2011
3. T.V. Rao and Pereira D F., Recent experiences in Human Resources Development, Oxford and IBH Publishing, 1986.
4. Subbrao A., Essentials of Human Resource Management and industrial Relations, Himalaya Publishing House, 1999.
5. Aswathappa K, Human Resource Management, Text & Cases McGrawHill 7th Edition, 2006
6. N G Nair and Latha Nair., Personnel Management and Industrial Relations, S. Chand Company, 1995.

HUM 4053: MARKETING MANAGEMENT [2 1 0 3]

Marketing definition, scope and concepts, Adapting marketing to the New Economy, Marketing strategic planning. Market Demand, Marketing Environment, Marketing Information System, Marketing Research. Segmentation, Targeting and Positioning, Buying Behaviour: Consumer Markets and Business Markets, Competition: Identifying competitors, analysing competitors. Product Life Cycle: Product life-cycle marketing strategies. New Market Offerings: New product development and challenges, Branding. Designing and Managing Services, Price Strategies, Retailing, Wholesaling, Integrated Marketing Communications, Digital Marketing and Trends, International Marketing

References:

1. Philip Kotler, Kevin Keller, Abraham Koshy & Mithileshwar Jha, Marketing Management – A South Asian Perspective, Pearson Education Inc, New Delhi, 2012.
2. Arun Kumar & N Meenakshi, Marketing Management, Vikas Publishing House Pvt Ltd, New Delhi, 2011.
3. Varshney R L and Gupta S L., Marketing Management, Sultan Chand & Sons, New Delhi, 2004.
4. Adrian Palmer., Principles of Marketing, Oxford University Press, New York, 2000.

HUM 4054: OPERATIONS MANAGEMENT [2 1 0 3]

Introductions to operations management – process view and supply chain view, types of production activities, competitive priorities and capabilities. Break-even analysis, evaluating services or products, evaluating processes - make or buy decision, decision making under risk, and decision trees. Introduction to forecasting, importance and uses of forecasting, demand patterns, demand management options, judgement methods, causal methods - linear regression, time series method – naïve method, moving average, weightage moving average, and exponential smoothing curve. Planning long-term capacity, measures of capacity and utilization, economies of scale, diseconomies of scale, capacity timing and sizing strategies, sizing capacity cushions, timing and sizing expansion – expansionist strategy, wait and see strategy, and a systematic approach to long term capacity decision. Levels in operations planning and scheduling across the organization, sales and operation planning strategies- chase strategy, level strategy, operations planning using linear programming technique, scheduling job and facility scheduling, and work for scheduling. Theory of constraints, managing bottle necks in manufacturing and service processes, identifying bottle necks, relieving bottle necks, drum buffer rope system, and managing constraints in a line system. Supply chain design across the organization, supply chains for services and manufacturing, measures of supply chain performance - inventory measures, financial measures, inventory and supply chains - pressures for small inventories, pressures for large inventories, types of inventory, inventory reduction tactics, and inventory placement. Costs of quality, total quality management, acceptance sampling, statistical process control - control charts, and process capability. Continuous improvement using lean systems, different types of wastes, strategic characteristics of a lean system, designing lean system layout, and Kanban system.

References:

1. Krajewski L. J., Ritzman L. P., Malhotra M., and Srivastava S. K., *Operations Management*, 11th edition, Pearson Education (Singapore) Pvt. Ltd., Delhi, 2016.
2. Heizer J. and Render B., *Operations Management*, 11th edition. Pearson Education India, 2016.
3. Khanna R. B., *Production and Operations Management*, 2nd edition, PHI Learning Private Limited, 2015.

OPEN ELECTIVES

HUM 4301: COMMUNICATIVE ENGLISH [3 0 0 3]

(Offered for Lateral Entry Students only)

Common Errors in English: Subject Verb Agreement; Uses of Tenses / Sequence of Tense; Prepositions; Articles; Special Usages; Creative Writing Essay: Types of Essays, Argumentative Essay, Descriptive/ Expository/Narrative Essays; Reading Comprehension; Dynamic text; Critical Evaluation; Group Discussions; Presentation Skills; Essay writing.; Audio texts/speeches -Practice listening skills- summary, commentary, listening exercises. Video Speeches -Theme based speeches - motivational, informative, technical, and persuasive, discussions. Speech - Elements of a good speech, types of speeches, model speech, Speech exercises, individual presentations, peer and facilitator feedback. Formal/Informal communication. Communication Styles- formal and informal, standard English and variations in usages, examples and analysis of faulty usages; Correspondence: formal/informal letters and emails.

References:

1. Green David., *Contemporary English Grammar, Structures and Composition* Chennai: Macmillan Publications.
2. Thompson AJ & Martinet AB., *A Practical English Grammar*, OUP.
3. Turton N D , Heaton J B., *Longman Dictionary of Common Errors*, 1998.
4. Meenakshi Raman & Sangita Sharma., *Technical Communication; Principles and Practice*, Oxford University Press, 2011.

HUM 4302: FILM STUDIES [2 1 0 3]

History of invention of motion pictures - Daguerre, Muybridge, Edison, Skaldanowsky Brothers, Lumieres; Evolution of film – Lumieres, Melies, Porter, Griffith, Basic techniques – Mise-en-scene, Mise-en-shot, Deepfocus Photography, Longtake, Continuity, Editing, Montage, German Expressionism; French Impressionism; Soviet Montage cinema; Hollywood cinema, Italian Neo-realism; French Nouvelle Vague, Documentary, Directors – Eisenstein, Kurosawa, Godard, Chaplin, Bergman; Mohsen Makmalbaf, Majid Majidi, Keislowksi, Zhang Yimou, Kim Ki Duk, “New Wave” Cinema in India - Bengali; Malayalam; Kannada; Hindi, To be screened- Bicycle Thieves, The 400 blows, Rashomon, Wild strawberries, Battleship Potemkin, Cabinet of Dr. Caligari, The kid, Children of heaven, Hero, Ghatashraddha, Pather Panchali, Mathilukal.

References:

1. Bordwell, David and Thompson, Kristin., *Film Art: an Introduction*, 7th ed. New York: McGraw-Hill Co., 2004.
2. Kavin, Bruce., *How Movies Work*. Berkeley and Los Angeles: University of California Press, 1992.
3. Cook, David A., *A History of Narrative Film*, 4th ed. New York: W.W. Norton & Co., 2004.

HUM 4303: GERMAN FOR BEGINNERS [3 0 0 3]

Text selections, dialogue and exercises which have been designed to give the absolute beginner grounding in the rudiments of the German language, as well as providing background information about the history, life and culture in Germany. Introduction to the German alphabet and the German language – dialogues & conversations – pronunciation, basic vocabulary lists - key points of grammar - background information about the history and culture of Germany - exercises on vocabulary, grammar and German culture - reading & listening comprehension.

References:

1. Sally Johnson, Natalie Braber., *Exploring the German Language*, (2E), Cambridge University Press. 2008.
2. Charles Russ., *The German Language Today: A Linguistic Introduction*, Routledge. 1994.

HUM 4304: BUILDING BRIDGES: INDO-EUROPEAN INTERCULTURAL DYNAMICS [3 0 0 3]

The challenges of Intercultural communication - interacting in a diverse world, understanding cultures, alternative views of reality, cultural stereotyping. Foundational Theories in Intercultural Communication - Edward Hall, Samovar, G Hofstede, Understanding cultural Dimensions and Cultural Stereotyping- collectivism/ individualism, power distance, masculine/feminine, cultural metaphors, Intercultural Business Communication Competence - The Role of Language in Intercultural Business Communication , Nonverbal Language in Intercultural Communication, Cultural influence on interpersonal communication, Intercultural Dynamics in the multicultural organizations.

References:

1. Dodd, Carley H. *Dynamics of Intercultural Communication*, McGraw-Hill, Boston. 1998.
2. Gannon M J and Pillai R. *Understanding Global Cultures*, Sage Publications, California. 2010.
3. Hall, E. T. *The dance of life: The other dimension of time*, Random House, New York. 1983.
4. Hofstede, Geert., *Cultures' Consequences, Comparing Values, Behaviors, Institutions, and Organizations across Nations*, Sage Publications, Thousand Oaks, CA. 2001.
5. Martin, J.N. & Nakayama, T.K., *Intercultural communication in contexts*. 4th Edition. Mountain View, CA: Mayfield. 2007.
6. Samovar, L A and Porter, R., *Communication between Cultures*, Cengage Learning, Wadsworth, CA. 2007.

HUM 4305: INTERPRETATION OF LITERARY TEXTS [3 0 0 3]

Texts-static, dynamic, cryptic and delphic ; Language of literature; Form and structure; Literature verses popular fiction; Text and discourse; Authors and critics; Theories and approaches to literary texts; Formalism, Structuralism, Marxism, Feminism, Deconstruction; Ideational functions and textual Functions; Class, gender and textuality; Race and nationality; Genre, phonological deviations –sound patterns and figures of speech ; Pragmatic approach to literature ; Understanding syntax, Lexical and syntactic analysis of literary texts; Point of view in literary texts and foregrounding; Prediction and making sense of a text; Stylistic analysis of a novel; Kinds of meaning, Rhetorical structure; Pragmatics and discourse analysis; Interpreting cohesive devices and complex functional values; Stylistic approach to literature ; Elements of literary style; Stylistic analysis of selected short stories, Poems, Novels and Plays; Genre, the plot setting, characterization, tone and themes; Stylistics and its implications on narrative techniques; Intertextuality and conceptual blending; Identifying patterns in the texts; Meaning making process in literature; Imagery, metaphor as a mode of thought; Coherence and Cohesion; Context, turn taking and Adjacency Pair; Pro-forms, Discourse markers, Lexical cohesion and presupposition; Recognizing text organization; Critical texts, Shared assumptions on critical texts; The role of schema and the concept of speech acts in literary texts.

References:

1. Austin, J.L., *How to do Things with Words*, Longman, London, 1992.
2. Barthes. R., *Introduction to the Structural Analysis of Narratives*, Fontana, London, 1977.
3. Blake.N.F., *An Introduction to the Language of Literature*, Macmillan, London. .1990.
4. Carter, R. (ed.), *Language and Literature: An introductory Reader in Stylistics*, Allen and Unwin, London, 1982.
5. Cook, G., *Discourse and Literature*, Oxford University Press, London, 1994.
6. Harold, C.M.(ed.), *Style in Prose Fiction*, Columbia University Press, New York.
7. Leech, G.N., *A Linguistic Guide to English Poetry*, Longman, London, 1969.

HUM 4306: PUBLIC SPEAKING [3 0 0 3]

Public Speaking -Introduction to Public speaking- Voice modulation, Sounds/accent (basics), Articulation, Anxiety management, Logical arguments, Concept of purpose, Audience, Smart use of Body language. Types of speech-Informative speeches - designing and delivery- Persuasive speeches – designing and delivery- Impromptu speeches – designing and delivery -Special occasion speeches- designing and delivery, Presentations - planning and execution -Types of presentation - Informative-Planning and delivery - Persuasive - Planning and delivery - Motivational - Planning and delivery, Other forms of speaking – Debates, Seminars, Panel Discussion, Group Discussion, Tall Tales, Turn Coat, Art of Evaluation-Providing feedback- planning, designing and delivering constructive feedback - Receiving feedback – making use of relevant feedback -Techniques of providing feedback- Speech analysis –Role of the Evaluator.

References:

1. Duarte Nancy., *Resonate: Present Visual Stories that Transform Audiences*, John Wiley and Sons, 2010.
2. Minto Barbara., *The Pyramid Principle: Logic in writing, thinking and Problem Solving*, Financial Times Prentice Hall, 2002.
3. Berkun Scott., *Confessions of a Public Speaker*, O'Reilly Media, 2009.
4. Goodale Malcolm., *Professional Presentations*, Cambridge University Press, 2005.
5. Carnegie Dale., *The Art of Public Speaking*, 1905.

HUM 4307: INTRODUCTION TO PSYCHOLOGY [3 0 0 3]

Psychology - Meaning, Nature and Scope, Defining Psychology, Meaning of the term Behavior, Nature of Psychology, Scope of Psychology: Branches and fields of Psychology. Development of Psychology - Historic Sketch of Psychology, Modern Age of Psychology, Gestalt Psychology, Psycho Analysis, Contemporary Psychology. Systems of Psychology- The Nervous System, Nature V/s Nurture, Sensation and perception, States of Consciousness. Methods of Psychology - Classical Conditioning, Introspection Method, Naturalistic Method, Experimental Method, Differential Method, Clinical Method, Psycho Physical Method. Personality- Personality types, Personality Disorders, Abnormal psychology, Treatment of personality disorders. Thinking - Nature of Thinking, Types of Thinking, Language and Intelligence. Discussion, Presentation and Assignments.

References:

1. Boring, E.G., Langfield, H.S. & Weld, H.P., *Foundations of Psychology*, Asia Publishing House, Calcutta, 1963.
2. Carson, R.C., Butcher, J.N. & Coleman, J.C., *Abnormal Psychology & Modern Life*, (8th ed) Scoff, Foresman & Co. 1988.
3. Lahey, B.B., *Psychology: An Introduction*, 6th Ed., Tata McGraw Hill, New York, 1965.
4. Olson, M.; Hergenhahn, B.R., *Introduction to the Theories of Learning*, Prentice-Hall India, 2009.

HUM 4308: INTRODUCTION TO PHILOSOPHY, RELIGION AND CULTURE [3 0 0 3]

Notions of Philosophy; The Origin and Development of Philosophy; Ancient Philosophy; Medieval Philosophy; Modern Philosophy; Contemporary Philosophy; Indian Philosophy; Comparative Religion; Western Philosophy; The Relevance of Philosophy; Branches of Philosophy; Methods of Philosophy; Philosophy and other Branches of Study; Some Problems of Philosophy; Themes of Philosophy; Mind and Body, and the Problem of Universal; Change/Movement time and place; Existence of God and Evolution; Indian Culture; Social Ethics; Logic and Scientific Methods; Philosophy of Language.

References:

1. Aquinas, Thomas., *On Being and Essence*. Trans. Armand Maurer. Canada: Pontifical Institute of Mediaeval Studies, 1968.
2. John-Terry, Chris., *For the Love of Wisdom: An Explanation of the meaning and Purpose of Philosophy*. New York: Alba House, 1994.
3. Maritain, Jacques., *An Introduction to Philosophy*, London: Sheed and Ward. 1979.
4. Radhakrishnan, S. (Ed)., *History of Philosophy Eastern and Western Vol.II* George Allen and Unwin Ltd., London, 1953.
5. Wallace, William., *The Elements of Philosophy*. New York: Alba House, 1990.

HUM 4309: CREATIVE WRITING [3 0 0 3]

Various literary/prose forms and their characteristics; techniques and strategies for reading; nuances of language and meaning in reading and writing; Writing Exercises - techniques and strategies of writing creatively; Critical Concepts and Terms in Literary Writing; Writing Exercises; creative writing output.

References:

1. Milan Kundera ., *The Art of the Novel*.
2. The Art of Fiction: Illustrated from Classic and Modern Texts, David Lodge

HUM 4310: GRAPHIC NOVELS: HISTORY, FORM AND CULTURE [3 0 0 3]

Part I: The History of Comic Books, Part 1: Developing a Medium Defining comic books as a medium-Relationships between comic books and other forms of sequential art-The (continental) roots of comics as an art form -The ways in which comic strips and pulps contributed to the emergence of the comic book. The History of Comic Books, Part 2: The Maturation of the Medium-Influence of underground movement, ways in which mainstream publishers began to address more relevant topics, proliferation of independent comics, the increase in the profile and prominence of the medium due to ambitious projects. Part II: Creating the Story: Graphic Storytelling and Visual Narrative-Some narrative structures commonly found in comic books -The types and techniques of encapsulation-The nature of the relationship between the pictorial and linguistic elements of comic books Experiencing the Story: The Power of Comics - About diegetic images that show the world of the story-About interpretive images that comment on the story-The impact art style has on the emotional reactions of the reader; and how the meaning of each image is affected by the relationship to other images in that particular book, in other texts, and in the reader's personal experience-Part III: Comic Book Genres-the definition of genre and the role it plays in shaping the creation of comics products- the characteristics of genres, including character types, narrative patterns, themes, and other conventions-how the example genres of teen humor, romance, funny animals, horror, and memoir developed in comics, and what characterizes each-how the hybridization of genres helps experimentation and expansion of narrative possibilities.

References:

1. Roger Sabin., *Comics, Comix and Graphic Novels*.
2. Robert Petersen, Allan Moore., *Comics, Manga and Graphic Novels: A History of Graphic Narrative*3. *Comics as Performance, Fiction as Scalpel*.
3. Jeet Heer, Kent Worcester., *Arguing Comics: Studies in Popular culture*.

HUM 4311: MANAGEMENT INFORMATION SYSTEMS [3 0 0 3]

Management information system: Introduction to management, information and system. System concepts, general model of a system and types of systems. Evolution of MIS, models and resources used in the MIS model. Structure of MIS, operating elements of an information system, synthesis of the structure. Information systems for different applications: Transaction processing systems, Human resource management systems and Marketing-application areas. Production planning and Office automation systems. Role of management information in decision making: Concepts of decision making, Decision making process and information needs at different levels of management. Herbert. A. Simon model. Phases in the decision making process, Programmed vs non-programmed decisions, General model of human as an information processor, Allen Newell Simon model. Decision support systems -structure, elements and working. Information as a strategic resource. MIS as a technique for making programmed decisions: Behavioral models of the decision maker and methods. MIS support for decision making. Role of MIS in Organizations -recent trends and e-commerce applications. Development of customized management information system approaches: SDLC -phases in SDLC, Strategic and project planning for MIS, conceptual design and detailed design phases: general business planning and MIS response. MIS Planning and planning cycle. Conceptual system design and Detailed System design. MIS System Implementation, and Pit falls: Pit Falls in MIS development, Fundamental weaknesses, soft spots in planning, design problems and review.

References:

1. Gordon B. D. and Margrethe H. O., (2005), "Management Information Systems", McGraw-Hill, New York.
2. Kenneth L. and Price J. P., (2003), "Management Information Systems", Macmillan.
3. Jawadekar W. S., (2000) "Management Information System", Tata McGraw Hill.
4. Senn J. A., (2003), "Analysis & Design of Information System", McGraw Hill International Student Edition.
5. Mudrick; Ross (1997) "Information Systems for Modern Management" Prentice Hall of India.
6. James A. O'Brien (1995) "Management Information Systems, Galgotia Publications.

HUM 4312: ENTREPRENEURSHIP [3 0 0 3]

Entrepreneur: Meaning of entrepreneur, evolution of the concept, functions of an entrepreneur, types of entrepreneur, and intrapreneur. Concept of entrepreneurship - evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India, barriers for entrepreneurship. Small scale industry: Definition, characteristics, need and rationale. Objectives, scope, role of Small Scale Industries (SSI) in economic development, advantages of SSI, steps to start an SSI - government policy towards SSI, different policies of SSI, impact of liberalization, privatization, and Globalization. Effect of WTO/GATT and supporting agencies of government for SSI. Institutional support: Different Schemes: TECKSOK, KIADB; KSSIDC; KSMC; DIC Single Window Agency: SISI, NSIC, SIDBI, and KSFC, New schemes and support for start-ups and new venture under Govt. of India. Preparation of Business plan and project report: components of a successful plan. Meaning of project, project identification, project selection, project report, need and significance of report, contents, formulation, guidelines by planning commission for project report. Network analysis, errors in project report, project appraisal. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study and documentation and evaluation.

References:

1. Vasant Desai., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House, 2007.
2. David H. Holt Entrepreneurship: New Venture Creation, Published by prentice Hall, 1991.
3. Poornima. M. Charantimath., Entrepreneurship Development, Pearson Education, 2006.
4. S.S. Khanka., Entrepreneurship Development, S.Chand & Co, 2007.



Minor Specialization: Material Science

PHY 4051: PHYSICS OF LOW DIMENSIONAL MATERIALS [3 0 0 3]

Thin films: Thick and Thin Film Materials, preparation by physical and chemical methods. Thickness measurement techniques. Theories of nucleation - Capillarity and atomistic theory, effect of deposition parameters on nucleation and growth of thin films. Epitaxial growth. Reflection and Transmission at interface between isotropic transparent media. Reflectance and Transmittance in thin films. Antireflection coatings. Electrical conduction in discontinuous metal films - Quantum mechanical tunneling model. Conduction in continuous metal and semiconducting films. Thermoelectric power in metal films. thin film resistors, thermopiles. Quantum well devices.

Nanomaterials: Chemical Synthesis of Nanoparticles: Bottom up approach. Functionalized nanoparticles in different medium. Size control. Self assembly. Nanoparticle arrays. Semiconductor nanoparticles- synthesis, characterization and applications of quantum dots. Magnetic nanoparticles- assembly and nanostructures. Manipulation of nanoscale biological assemblies. Carbon nanotubes and fullerene as nanoclusters. Nanostructured films. Physical Methods of Nanostructure Fabrication: Top down approach. Nanopatterning- Lithography- Optical, X-ray and Electron beam lithography. Ion- beam lithography.

References:

1. Chopra K. L., *Thin Film Phenomena*, Mc Graw Hill, 1969
2. Milton Ohring, *Materials Science of Thin Films*, Elsevier, 2001
3. Heavens O. S., *Optical Properties of Thin Solid Films*, Dover, 1955
4. Liz-Marzan L. M. and Kamat P. V. (Eds), *Nanoscale Materials*, Kluwer, 2003
5. Nalwa H. S. (Ed), *Nanostructured Materials and Nanotechnology*, Academic, 2002

PHY 4052: PHYSICS OF PHOTONIC AND ENERGY STORAGE DEVICES [3 0 0 3]

Semiconductors: Direct and indirect band gaps. Carrier concentrations at thermal equilibrium. Fermi level. Degenerate and non-degenerate semiconductors. Semiconductor Crystal growth techniques Contact phenomenon- semiconductor-semiconductor, metal-semiconductor contacts. Schottky and Ohmic contacts. Preparation of semiconductor devices. IC technology, elements of lithography.

Photonic Devices: LED and semiconductor lasers: Radiative and non-radiative transitions, diode laser, population inversion, laser operating characteristics, efficiency, photoconductor, photodiode, avalanche photodiode, phototransistor, material requirement for solar cells, theory and types of solar cells.

Fuel cells: Hydrogen energy – merits as a fuel – production of hydrogen, Hydrogen Fuel cells – introduction – difference between batteries and fuel cells, components of fuel cells, principle of working of fuel cell, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages of fuel cell power plant. Types of fuel cells. Application of fuel cells – commercially available fuel cells.

References:

1. Neamen Donald A., *Semiconductor Physics and Devices, basic principles*, Tata McGraw-Hill, 2002
2. Sze S. M., *Physics of Semiconductor Devices*, John Wiley & Sons, 2007
3. Larminie J. and Dicks A., *Fuel Cell Systems Explained*, Wiley, 2003
4. Xianguo Li, *Principles of Fuel Cells*, Taylor and Francis, 2005
5. S. Srinivasan, *Fuel Cells: From Fundamentals to Applications*, Springer, 2006

OPEN ELECTIVES

PHY 4301: FUNDAMENTALS OF ASTRONOMY AND ASTROPHYSICS [3 0 0 3]

Introduction to astronomy and astrophysics. Properties of ordinary stars: Brightness of starlight; the electromagnetic spectrum; Colours of stars; stellar distances; absolute magnitudes; HR diagram. Stellar evolution: Formation of star; the main sequence; stellar structure; evolution off the main sequence; planetary nebulae; white dwarfs. The death of high mass stars: Supernovae; neutron stars; pulsars; stellar black holes. Normal Galaxies: Types of galaxies; Dark matter in galaxies. Cosmology: The scale of universe; expansion of the universe; open or closed universe; the big bang; the cosmic background radiation; big bang nucleosynthesis. Astronomical instruments.

References:

1. Marc L Kutner, *Astronomy: A physical Perspective (2e)* Cambridge University Press, 2003
2. Baidyanath Basu, *An Introduction to Astrophysics (2e)*, PHI Learning Pvt. Ltd, 2011.
3. Michael Zeilik, *Introductory Astronomy and Astrophysics (4e)*, Saunders College Pub. 1992.

PHY 4302: PHYSICS OF ENGINEERING MATERIALS [3 0 0 3]

Types of magnetism, ferromagnetic domains, soft and hard magnetic materials, ferrites, magnetic storage, Superconducting materials, Applications of superconductors, Nano-materials, bottom-up and top-down methods, Quantum dots and nano-carbon tubes, Composite materials, micromechanics of composites - Density, Mechanical and Thermal properties, Semiconductors, Metals, semiconductors and insulators, Direct and indirect band-gap semiconductors, Intrinsic and extrinsic semiconductors, Diffusion and drift processes, Crystal growth techniques, Preparation of semiconductor devices.

References:

1. William F. Smith, *Principles of Materials Science and Engineering (2e)*, McGraw-Hill International Edition, 1990.
2. Nalwa H.S., *Nanostructured Materials and Nanotechnology (2e)*, Academic, 2002.
3. Chawla K. K. *Composite Materials- Science & Engineering (3e)*, Springer-Verlag, 2012.
4. Streetman Ben G. and Banerjee Sanjay Kumar, *Solid State Electronic Devices (6e)* PHI Learning Private Limited, 2012.

PHY 4303: RADIATION PHYSICS [3 0 0 3]

Radiation Sources: Fast electron sources-Heavy charged particle sources-Sources of electromagnetic radiation-Neutron sources. Radiation Interaction: Photoelectric and Compton process -pair production. Interaction of heavy charged particles-stopping power-Energy loss characteristics- Bragg curve-Particle range-range straggling- stopping time-energy loss in thin absorbers-Interaction of fast electrons-absorption of beta particles-interaction of gamma rays-gamma ray attenuation-Interaction of neutrons-neutron cross section-neutron induced nuclear reactions. Radiation Detectors and Instrumentation: Semiconductors diodes-JFET-MOSFET-Integrated Circuits-OPAMP and their characteristics-Differential Amplifier-Operational amplifier systems-Pulse Amplifiers. Principles of radiation detection and measurements-Gas filled detectors-Ionisation chambers-Proportional counters-GM counters-Scintillation detectors-Semiconductor detectors-Thermo luminescent Dosimeters-Radiation spectroscopy with scintillators-Gamma spectroscopy-Multichannel pulse analyzer-Slow neutron detection methods-Reactor instrumentation. Industrial uses of nuclear measurements: Radiation detection in industrial environments-Measuring systems for industrial problems-Determination of physical material characteristics by nuclear measurements-Level height determination-Density measurements-Quantity measurements-Thickness measurement-coating thickness measurement.

References:

1. Knoll G. F., *Radiation Detection and Measurement (3e)*, Wiley 2010
2. Boylestad R. L., *Electronic Devices and Circuit theory (11e)*, Pearson Education 2016
3. Malvino A. P., *Electronic Principles (7e)*, TMH 2010
4. Foldiak G., *Industrial Applications of Radioisotopes*, Elsevier Science Ltd 1986

PHY 4304: SOLID STATE PHYSICS [3 0 0 3]

Review of Crystal structure: Lattice, basis and unit cell, crystal system, symmetry, crystal planes and miller indices, reciprocal lattice, Bragg's law, experimental methods of x-ray diffraction, types of crystal binding, analysis of stress and strain in crystals. Electrical conduction: Free electron gas model, Sommerfield quantum theory, Fermi energy, parameters of free electron gas at absolute zero, electrical conductivity, Drude-Lorentz theory and Sommerfield theory of electrical conductivity, Band theory of solids, electrical conduction in metals, insulators and semiconductors. Dielectrics: Static dielectric constant, polarization and polarizability, local field, ferroelectricity, piezoelectricity, frequency dependence of polarizability (electronic, ionic and dipolar), dielectric losses, requirements of insulating materials, applications of dielectric materials. Magnetism: Classification of magnetic materials, classical theory of diamagnetism and paramagnetism, Weiss theory of ferromagnetism, ferrites, hard and soft magnetic materials, garnets, magnetic bubbles, ceramic magnets, applications of magnetic materials

References:

1. Kittel C., *Introduction to Solid State Physics (7e)*, Wiley 1996.
2. Rao A., *A first course Solid State Physics*, Asiatech publications 2000.
3. Pillai S.O., *Solid State Physics (6e)*, New age international publications 2006.
4. Wahab M. A., *Numerical problems in Solid State Physics*, Alpha science international publications 2011.
5. Gupta H. C., *Solid State Physics*, Vikas publishing house Pvt. Ltd. 1996.

PHY 4305: MODERN OPTICS [3 0 0 3]

Optics: Review of geometrical and physical optics, Dual nature of light, Electromagnetic spectrum, Optical devices, mirrors, lenses, prisms, grating, beam splitters, zone plate, polaroids. Light sources, emission profile. Elements of lasers: Basic requirements in a laser, characteristic properties of lasers. Q-switched and mode locked lasers. CO₂, Nd: YAG lasers. Applications. Introduction to Non-linear optics. Optoelectronic devices and its application: Photo diodes, solar cells, LED, and diode lasers. DBR and DFB lasers, CCD. Optical Communication: Conceptual picture of the optical communication system, Modulation and Detection

Schemes, properties of optical fibers, discussion on device requirements, OEICS. Optical storage devices: Data recording and read out from optical discs. Holographic data storage systems.

References:

1. Ghatak A., *OPTICS (4e)*, Tata McGraw Hill Publishing Company Ltd. 2009.
2. Singh J., *Optoelectronics: An Introduction to Materials and Devices*, TATA McGraw- Hill Companies, Inc. 2014.
3. Wilson & Hawkes, *LASERS*, Prentice-Hall of India Pvt. Ltd. 1987.
4. Hugh Bennett, *Understanding Recordable & Rewritable DVD*, OSTA.org.
5. Hugh Bennett, *Understanding CD-R & CD-RW*, OSTA.org.

PHY 4306: INTRODUCTORY QUANTUM MECHANICS [3 0 0 3]

Review of certain basics : Limitations of classical physics, wave-particle duality, De Broglie's hypothesis, matter as wavepacket, Heisenberg's uncertainty principle, Mathematical Formalism : operators; commutation relation; orthonormal functions; eigenvalues and eigenfunctions; the Dirac notation; the postulates of quantum mechanics. The Schrödinger Equation : Introduction, wavefunctions, time dependent Schrödinger equation, conservation of probability, expectation values, Ehrenfest's theorem, time independent Schrödinger equation, stationary states, Schrödinger equation in one dimension : the infinite square potential well; the finite square potential well; the potential barrier; tunneling; the harmonic oscillator. Quantum mechanics in three dimensions: Schrödinger equation in spherical coordinates, separation of variables, the angular equation, the radial equation, Applications (energy eigenvalues and eigenfunctions): the rigid rotator; the hydrogen atom; angular momentum. Identical Particles. Some applications of quantum mechanics in nuclear physics, condensed matter physics, and spectroscopy: alpha decay, nanostructures, STM, vibrational and rotational spectra of molecules etc.

References:

1. Verma H.C., *Quantum Physics (2e)*, Surya Publications. 2016.
2. Gasiorowicz S., *Quantum Physics (3e)*, Wiley India Pvt Limited. 2007.
3. Jain M. C., *Quantum Mechanics: A Textbook for Undergraduates*, PHI Learning Private Limited 2012.
4. Griffiths D. J., *Introduction to Quantum Mechanics (2e)*, Pearson Education.
5. Eisberg R. and Resnick R., *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2e)*, Wiley-India Pvt Limited. 2009.

Minor Specialization: Material Science

CHM 4051: CHEMICAL BONDING [3 0 0 3]

Introduction to bonding, Classification. Ionic bond- Lattice energy, Born Haber cycle, Radius-ratio rules, Properties of ionic compounds, Covalent character in ionic bonds. Covalent bond-Covalency, Valence bond theory, Sigma and pi bond, Hybridization, VSEPR Theory, Molecular orbital theory, Bond order, Properties of covalent compounds. Coordination bond - Primary and Secondary valencies, ligands, Valence bond theory of complexes, Crystal field theory of octahedral and tetrahedral complexes, Low and high spin complexes. Metallic bond-Band theory of metals, Conductors, semiconductors and insulators. Secondary bonding- Hydrogen bonding, London forces and dipole-dipole interactions.

References:

1. J D Lee, "Concise Inorganic chemistry", Wiley India, 2012
2. B R Puri , L R sharma and K C Kalia, "Principle of Inorganic chemistry", Vishal Publishing Co., Punjab, 2017.
3. D F Shriver, P W Atkins, "Inorganic chemistry", Oxford India, 2014
4. A F Cotton, "Basic Inorganic chemistry", Wiley Publishers, 2007

CHM 4052: CHEMISTRY OF CARBON COMPOUNDS [3 0 0 3]

Introduction to Organic Compounds: Classification, Nomenclature; Alkanes: Homologous series, Preparation; Cycloalkanes: Ring size and strain, Applications; Alkenes: Markovnikov and anti-Markovnikov addition reactions, Reduction, applications; Alkynes: Acidity, preparation, Reduction of alkynes, applications; Alkyl halides: SN1, SN2, E1 and E2 reaction mechanisms; Alcohols: Classification, Acidity, organo-metallic reagents; Aromatic compounds: Electrophilic and nucleophilic substitution reactions; Mechanism of some named reactions; Carbonyl compounds: aldehydes and ketones, carboxylic acids and carboxylic acid derivatives; Heterocyclic compounds: Nomenclature, synthesis and reactivity of thiophene, pyrrole and furan; Carbon materials: Fullerenes, carbon thin films, nanotubes and carbon fibers; Carbon nanotubes: SWNT, MWNT, synthesis, properties and applications; Carbon nanomaterials applications.

References:

1. B S Bahl and Arun Bahl, "Advanced Organic Chemistry", S Chand, New Delhi, 2012.
2. Robert T. Morrison and Robert N. Boyd, "Organic Chemistry", Pearson, New Delhi, 2016.
3. P.S. Kalsi, "Organic Reactions and Their Mechanisms", New Age International Private Limited, New Delhi, 2017.
4. Ashutosh Tiwari and S. K. Shukla, "Advanced Carbon Materials and Technology", John Wiley & Sons, 2013.
5. Bhushan ed., "Springer Handbook of Nanotechnology", Springer Publishers, Berlin, 2004.

OPEN ELECTIVES

CHM 4301: ANALYTICAL METHODS AND INSTRUMENTATION [3 0 0 3]

Spectroscopic methods of analysis: Properties of EMR, General features of spectroscopy, Types of molecular spectra, Interaction of EMR with matter, Instrumentation, Applications, Theory, Instrumentation and applications of Microwave, Raman, Infrared, UV-Visible, NMR spectroscopic techniques. Chromatographic Techniques: General

concepts, Classification, Principles, Experimental techniques of CC, HPLC, TLC, GC and their applications. Electroanalytical methods: Basic principles and applications of conductometric, potentiometric titrations.

References:

1. D.A. Skoog, J. Holler, F.T.A. Nieman, *Principles of Instrumental Analysis*, 5thEdn, Saunders, Philadelphia, 1992
2. D. A. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, 5thEdn, Saunders College Publishing, Philadelphia, 1988
3. *Vogel's Textbook of Quantitative Chemical Analysis*, G.H. Jeffery, John Wiley & Sons Inc, 5thEdn, 1989

CHM 4302: FUNDAMENTALS OF INDUSTRIAL CATALYTIC PROCESSES [3 0 0 3]

Adsorption & Catalysis: Physisorption and chemisorption, Adsorption isotherms, Factors influencing adsorption, Adsorption of gases by solids, Adsorption from solution, Introduction to catalysis, Energetics, Catalytic cycles Solutions & Solubility: Ideal and non-ideal solutions, Raoult's law, Thermodynamics of ideal solutions, Vapor pressure and boiling point composition curves, Distillation behaviour of completely miscible & immiscible liquid systems, Azeotropes Colligative Properties: Determination of molar masses from vapor pressure lowering, Osmotic pressure, Boiling point elevation and Depression of freezing point, Vant Hoff's factor Colloids: Types, Preparation and purification of sols, General properties, Optical, Electrical & Kinetic properties of sols, stability of sols, Application of colloids, Emulsions & Gels- Types, Preparation, Properties and their applications.

References:

1. *Principles of Physical Chemistry*, B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publications, New Delhi, (23e), 2008
2. *Principles of Physical Chemistry*, S.H. Maron, C.F. Prutton, IBH Publishing co. New Delhi, (4e), 1985
3. *Fundamentals of Analytical Chemistry*, D.A. Skoog, D.M. West, F.J. Holler, R. Crouch, (4e), Thomson-Brooks, 2007

CHM 4303: SUSTAINABLE CHEMICAL PROCESSES AND PRODUCTS [3 0 0 3]

Introduction and principles of green chemistry, Examples, Atom economy, carbon efficiency, life cycle analysis, sustainable products, process and synthesis catalysis and green chemistry, examples of fine and bulk chemicals production, catalysts for clean technology. Application of ecofriendly approach to waste treatment. Cleaner production processes, clean synthesis in lab Scale, industrial examples, use of ecofriendly energies. Bio-pesticides, polymers & pharmaceutical products. Electrochemical synthesis, Alternate reaction media using water and other green solvents, ionic liquids & supercritical fluids; phase transfer catalysis.

References:

1. P.T. Anastas, J. C. Warner, *Green Chemistry: Theory and Practice*, Oxford Univ. Press, Oxford, 2008
2. A.S. Matlack, *Introduction to Green Chemistry*, Marcel Dekker, New York, 2001
3. P. T. Anastas, R. H. Crabtree, *Handbook of Green Chemistry and Catalysis*, Wiley-VCH, Weinheim, 2009

Inter Institute Open Electives

Centre for Creative and Cultural Studies (CCCS), Manipal

IIE 4301: ART APPRECIATION [3 0 0 3]

How to read a visual, how to enjoy or feel an art form, what is Creative Thinking? Indian Art: Heritage & Culture; Art Appreciation: Western Art, Artist & Art Movements: Raja Ravi Verma, Tagore, Da Vinci, Van Gogh; Aesthetics: Beauty, Feel & Expression; Art & Science; Art & Film; Art: Freedom & Society, to be an art literate. A journey to immerse in the world of Art.

IIE 4302: INDIAN CULTURE AND CINEMA - AN INTRODUCTION [3 0 0 3]

Introduction to Idea of Culture, Identity and tradition, Indian Cultural History, Indian cultural history, Time and space, Indian Art and heritage, Indus valley civilization – Indian Independence, Post-colonial India, Modern India, Indian Cinema, Body, language and feel, Film and culture, Evolution, Interpretation and Reflection, Indian Cinema, Media and the medium, Pioneers and classical films, Culture and art of cinema, Culture, Cinema and Society, Revolutions, ideas, innovations, Culture, Cinema and Peace, Message, purpose and the challenge.

Manipal Institute of Management, Manipal

IIE 4304: CORPORATE FINANCE [3 0 0 3]

Introduction to Corporate Finance, Financial Goal, Agency Problems, Managers vs Shareholders Goals, Concepts of Value and Return, Capital Budgeting Decisions, Cost of Capital, Calculation of the Cost of Capital in Practice, Financial and Operating Leverage, Capital Structure, Relevance of Capital Structure, Irrelevance of Capital Structure, Relevance of Capital Structure, Dividend Theory, Dividend Relevance, Dividend Relevance, Dividend and Uncertainty, Dividend Irrelevance, Principles of Working Capital Management.

References:

1. Brealey, R., Myers, S., Allen, F., & Mohanty, P. (2014). Principles of Corporate Finance (11e). New Delhi: Mc Graw Hill Education (India) Private Limited.
2. Pandey, I. M. (2014). Financial Management (10e). New Delhi: Vikas publishers.
3. Ross, S. A., Westerfield, R. W., Jaffe, J., & Kakani, R. K. (2014). Corporate Finance (10e). New Delhi: Mc Graw Hill Education (India) Private Limited.
4. Parasuraman, N. R. (2014). Financial Management - A Step-by-Step Approach (1e.). New Delhi: Cengage Learning India Private Limited.

IIE 4305: INTERNATIONAL BUSINESS MANAGEMENT [3 0 0 3]

Historical perspective of international business, International business environment, Modes of entering international business, Cross-Culture and dynamic market understanding, Differences in Culture, Theories of international business, World Bank, World trade organization, Multinational Corporations and their involvement in International Business, Tariffs and quotas, Balance of Payment Account.

References:

1. Hill Charles, W. L., & Jain Arun, K. (2011). International Business: Competing in the Global Marketplace. (8e), Tata McGraw Hill.
2. Kumar, S. P., & Sanchari, S. (2012). International Business Management-AGlobal Perspective. New Delhi: Excel Books.

IIE 4306: BRAND MANAGEMENT [3 0 0 3]

Introduction to brand management, Developing a brand strategy, Brand resonance and brand value chain, Designing and implementing brand marketing programs to build brand equity, Measuring and interpreting brand performance, Designing and implementing brand architecture strategies, Managing brands.

References:

1. Keller, K. L., Parameswaran, M. G., Jacob, I. (2015). Strategic Brand Management (4e). Noida, India: Pearson Prentice Hall Publication.
2. Rowles, D., (2014). Digital Branding (1e.). UK: Kogan Page Limited.
3. Kapferer, J. N., (2012). The New Strategic Brand Management: Advanced Insights and Strategic Thinking (5e). UK: Kogan Page Limited

Centre for Integrative Medicine & Research (CIMR)

IIE 4307: YOGA [3 0 0 3]

Aim, Objectives, Meanings and Definitions of Yoga, History of Yoga, Concepts and misconceptions of Yoga, Schools of Yoga, Ashtanga Yoga

Subjects by Industry Experts

IIE 4308: HEALTH ECONOMICS [3 0 0 3]

Economics: Understanding Economics, Efficiency, Rational decision making, Opportunity costs, Supply and demand, Price discovery, Health economics: Defining health, Human capital, what does supply and demand mean in the context of health? Arrow on the uncertainty and welfare economics, The Moral hazard, DALY and QALY, Efficiency: The Production possibility frontiers. The production function for health care. Health policy, Defining equity, Standards of healthcare provision Epidemiology, The Healthcare sector, The demand for health, Disease prevalence, The pharmaceuticals market, Cross country case studies.

References:

1. Sloan, Frank A., and Chee-Ruey Hsieh. Health economics. MIT Press, 2012
2. Annemans, L. Health economics for non-economists. An introduction to the concepts, methods and pitfalls of health economic evaluations. Academia Press, 2008
3. Jeffery, Roger. The politics of health in India. University of California Press, 1988.

IIE 4309: DIGITAL MEDICINE [3 0 0 3]

Present day practice of medicine. Limitations of scalability in the present framework. Introduction to computing, algorithms, big data, semantic web, mobility. Communication-WAN/LAN, 3G/4G and 5G. Patient/Electronic Health records. Experience with these records elsewhere Wearables, the physics of data capture. Practical demonstration of wearables Genomics, an introduction. Computational genomics including the software. Imaging –an introduction-ionizing and non-ionizing. Imaging software and science of diagnosis. How all the four 4 pillars-PHR/EHR, Wearables, Genomics and Imaging come together with software as the glue to change the world of medicine.

References:

1. David Mount. Bioinformatics: Sequence and Genome Analysis. CSHL, 2001
2. Durbin, Richard, Sean Eddy, Anders Krogh, and Graeme. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1999

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IIE 4310: MEDICAL EMERGENCY AND FIRST AID [3 0 0 3]

Principles of First Aid, First aid kit and equipment, emergency drugs, scene assessment, safety and identifying hazards, patient assessment, Basic Life Support and AED, triage, extrication/stretchers, ambulance. Describe the causes, signs and symptoms and management of respiratory emergencies, acute gastro-intestinal emergencies, musculoskeletal emergencies, dental, ENT and eye emergencies, renal emergencies, nervous system emergencies, hematological emergencies, endocrine emergencies, toxicological emergencies, environmental emergencies, pediatric emergencies, psychiatric emergencies, obstetrical emergencies

References:

1. Pollak, A.N. (2005). Emergency care and transportation of the sick and injured. Massachusetts: Jones and Bartlett publishers.
2. Keen, J. H. (1996). Mosby's Critical Care and Emergency Drug Reference. Missouri: Mosby's year book.
3. Walsh, M. (1990). Accident and emergency nursing. A new approach. Oxford: Butterworth Heinemann Ltd.
4. Sbaih, L. (1992). Accident and emergency Nursing. A nursing model. London: Chapman and Hall.
5. Sbaih, L. (1994). Issues in accident and emergency Nursing. London: Chapman and Hall.
6. Bourg, P., & Rosen, S. P. (1986). Standardized nursing care plans for emergency departments. Missouri: The C. V. Mosby Company.
7. Howard, P.K., & Steinmann, R. A. (2010). Sheehy's Emergency Nursing principles and practice. Missouri: Mosby Elsevier.
8. Sira, S. (2017). First Aid Manual for Nurses (First ed.), New Delhi: CBS Publishers & Distributors Pvt. Ltd.

IIE 4311: LIFE STYLE MODIFICATION AND COMPLEMENTARY AND ALTERNATIVE THERAPIES [3 0 0 3]

Principles and concepts of life style modification and various complementary and alternative therapies, Demonstrate skill in performing different yoga asanas, guided imagery/Progressive muscle relaxation, meditation & Pranayama, reflexology, massage therapy, aerobics, laughter therapy

References:

1. Bhat Krishna K. The power of yoga. Suyoga publications; DK, 2006
2. M.M.Gore. Anatomy & Physiology of yogic practices; (5e), New age book.
3. K N Udupa. Stress and its management by yoga. (2e). Motilal Banarsidas publishers Pvt. Ltd, Delhi, 2007.
4. Yoga and total health. A monthly journal on the yoga a way of life.
5. Swami Satyananda Saraswati. Dynamics of yoga. (2e), Bihar school of yoga, Bihar 1997.

Welcomegroup Graduate School of Hotel Administration, Manipal

IIE 4312: INDIAN CUISINE AND CULTURE PRACTICAL [3 0 0 3]

Introduction to Indian cuisine, Basic Indian gravies, Rice cooking, Preparation of various rice products, Tandoor Cooking, Indian sweets, Comfort Food, Regional and sub-regional cuisine.

IIE 4313: FOUNDATION COURSE IN BAKING AND PATISSERIE PRACTICAL [3 0 0 3]

Introduction to Patisserie and Baking Principles, Special emphasis placed on the study of ingredient functions, Students will have the opportunity to apply basic baking techniques, Understanding fundamentals of yeast dough production, Emphasis on the application of ingredient functions, product identification and recipe interpretation occurs

throughout the course, Pastry Basics and Pie dough, The fundamental production of classical European pastry based desserts are included, Techniques of Cake Making, Techniques of Cookie making, The course emphasizes the preparation and makeup techniques of various cookies.

References:

1. Wayne Gisslen – Professional Baking, (5e), John Wiley USA.
2. Haneman L.J. Bakery: Flour Confectionery HEINMAN.
3. Mermaid Books The Book Of Ingredients DOWELL PHILIP.
4. John Wiley Understanding Baking AMENDOLA JOSEPH.
5. New Age International, A Professional Text to Bakery and Confectionery, KINGSLEE JOHN.
6. Virtue And Company Ltd., The New International Confectioner: WILFRED J. FRANCE.
7. Charrette Jacques, Great Cakes and Pastries, TEUBNER CHRISTIAN.
8. Joseph Amendola, Baker's Manual, (5e), NICOLE REES.
9. Joseph Amendola, Understanding Baking, (3e), NICOLE REES.
10. Culinary Institute Of America, Baking and Pastry: Mastering the Art and Craft, JOHN WILEY.

IIE 4314: GLOBAL CUISINE & CULTURE- PRACTICAL [3 0 0 3]

European Cuisine: Familiarization of ingredients, recipes and preparation of different countries. North American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. South American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Asian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Australian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. African Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Molecular Gastronomy: Additives, Tools, and Recipes. Processed Food: Comparison and Critiquing. Mediterranean and European cuisine: Familiarization of ingredients, recipes and preparation of different countries.

References:

1. The Professional Chef - The Culinary Institute of America
2. Practical Cookery - Kinton, Ceserani and Foscett
3. Food Production Operation - Parvinder S. Bali
4. Professional Cooking - Wayne Gisslen
5. Cookery for the Hospitality Industry - Dodgshun Peters
6. Modern Cookery - Thangam E Phillips

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IIE 4315: REPORTING AND WRITING [3 0 0 3]

Introduction to news writing news in different media, news, definition of news, news values; types of news other theoretical issues relating to news writing. News Reporting Basic of news writing: structure of news reports; writing the lead; the changes in the composition of the lead; techniques of news gathering; sources of news. Reporting various types of reporting (Objective, Interpretative, Investigative.) General assignment reporting/working on a beat. Reporting for news agency, periodicals and magazines. Interviewing: doing the research, conducting the interview, types and formats of interviews, writing interviews

References:

1. Mencher, Melvin (2006): News Reporting and Writing, Mac-Graw Hill, Boston.
2. Scalnan, Christopher (2000): Reporting and Writing: Basics for the 21st Century, Harcourt College Publishers.
3. Harrington Walt (1997) Intimate Journalism: The Art and Craft of Reporting Everyday Life, Sage Publications.
4. Carole, Rich (2007), Writing and Reporting News: A Coaching Method, Thomson Learning Inc. Kamath, K.V. (1993): Journalists' Handbook, Vikas Publishing House.
5. Aggarwal, Vir Bala (2006): Essentials of Practical Journalism, Concept Publishing Company.

IIE 4316: INTRODUCTION TO ADVERTISING & PUBLIC RELATIONS [3 0 0 3]

Introduction to advertising; Evolution and history of advertising; Influence of advertising on society and ethics. Advertising as part of marketing mix; Structure and types of ad agencies; Advertising planning; creative strategy and implementation (media strategy). The essentials of advertising on different media platforms – print, broadcast, internet and new media; discuss the difference in planning and execution using examples or campaign case studies. Public Relations-scope; definition; evolution; establish difference between PR and advertising; Identifying stakeholders and various Public Relation tools. Steps in developing a PR program/campaign-stating the problem, planning and programming, action and evaluation; Crisis communication; Ethical issues in Public Relations.

References:

1. Butterick, K (2012): Introducing Public Relations: Theory and Practice. New Delhi: SAGE Publications India Pvt. Ltd.
2. Cutlip, Center & Broom, (2000): Effective Public Relations.USA: Prentice Hall International.
3. Jaishri Jethwaney and Shruti Jain, (2012): Advertising Management. New Delhi: Oxford University Press
4. Reddi, C.V.N. (2009): Effective Public Relations and Media Strategy. New Delhi: PHI Learning Pvt. Ltd.
5. Sharma, S. & Singh, R. (2009): Advertising Planning and Implementation. New Delhi: PHI Learning Pvt. Ltd.

IIE 4317: BASIC PHOTOGRAPHY [3 0 0 3]

Photo Journalism: History of Photography and Photo Journalism. Photo Journalism: Definition, Nature, Scope and Functions of Photo Journalism – Qualification and Responsibilities of Photo Journalists, News Photographers and News Value, Types and Sources. Selection, Criteria for News Photographs – Channels of News Pictures – viz., Wire, Satellite, Agency, Stock, Picture Library, Freelancer, Photo Editing, Caption Writing, Photo – Presentation. Legal and Ethical aspects of Photography – Professional Organizations – Camera – Components and Types of Camera – Types of Lens, Types of Films, Types of Filters – Importance of Light and Lighting Equipments – Camera Accessories – Picture appreciation. Digital Camera – Digital Technology and its future – Darkroom Infrastructure – Film developing and Printing

References:

1. Basic Photography – Newnes
2. The Hamlyn Basic Guide to Photography – Hamlyn
3. Hamlyn Encyclopedia of Photography – Hamlyn
4. Photographing People – Guglielmezei
5. History of Photography – Cyernshem G R
6. Photo Journalism – Rothsteline
7. Techniques of Photo Journalism – Milten Feinberg
8. Freelance Photography – Jechsend Gedsey
9. Picture Editing – Stanley E Kalish and Clifton C Edom
10. News Photography – Jack Price
11. 1000 Ideas for better News Picture – High Sidley and Rodney Fox

IIE 4318: MEDIA PRODUCTION TECHNIQUES [3 0 0 3]

Print design elements – typography, colours, spacing, pictures, logos, graphics, principles of layout and design – basic writing skills. Photography – SLR camera, Lenses, Apertures and Shutter speeds, Exposure, Understanding light, Filters and accessories, composing a picture, developing and printing, creating special effects. Digital photography – digital camera – digital technology and its future. Television – Introduction to AV Media-pre-production, production, post-production. Show packaging-Camera-characteristics, parts and

functions; Mounting accessories and movements. Shots-Types and Uses; Basic composition. Practical video recording process. Radio – Introduction to Radio-Microphone types, characteristics and uses; Cables and Connectors. Recording device-Types and Characters, Audio editing, Programme formats-news, drama, feature and PSA's and Advertising.

References:

1. Gerald Millerson, "Effective TV production"
2. Peter Jarvis, "The Essential TV director's Handbook"
3. Hamlyn "Basic guide to photography"
4. Ralph Milton "Radio programming – a basic training manual"
5. Tomlinson Holman "Sound for film and television"
6. Reporting and writing by Melwin Mencher

IIE 4319: GRAPHIC & SKETCHING [3 0 0 3]

Basic Art Principles: Element of Art & Design, Contour Drawing, Composition Principles, Pencil shading, creating geometry model and shading. Basic Perspective: Still life sketching & Drawing, Styles of shading, Introduction to colors, color still life painting, Layout Design, Creating concepts for Design. Skeleton System, Body Proportions, Upper Body, Lower Body, Back, Hands and Legs. Text: Human Anatomy by Victor Perard, Dynamic Anatomy by Burne Hogarth. Gesture Drawing Tips, Line of Action, Dynamic Poses, Body Weight and Gravity, Clothing. Text: Figure Drawing by Anthony Ryder.

List of Practical's:

- ▶ 10 Drawings of Human Anatomy Study In Pencil
- ▶ 50 Drawings of Gesture Drawing In Pencil
- ▶ 5 Contour Drawing
- ▶ 2 Still Life Pencil Shading
- ▶ 2 Color Still Life
- ▶ 2 Layout Design

References:

1. Mastering Composition: Techniques and Principles to Dramatically Improve Your Painting (Mastering (North Light Books)) Hardcover – 25 Jan 2008 by Ian Roberts
 2. Layout Essentials: 100 Design Principles for Using Grids (Design Essentials) Paperback – 1 by Beth Tondreau
 3. Pencil Drawing: Learn how to develop drawings from start to finish with techniques for shading, contrast, texture, and detail (Artist's Library) Paperback – 1 Jan 1988 by Gene Franks
 4. Drawing the Head and Figure – Jack Hamm
 5. Dynamic Anatomy – Burne Hogarth
 6. The artists complete guide to Human figure Drawing – Anthony Ryder
 7. Human Anatomy – Victor Perard
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