ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
COMPUTER SCIENCE AND ENGINEERING

3rd SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 3rd Semester: Computer Science and Engineering

Semester III/B.TECH/CSE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	MA181301B	Mathematics III-B (for branches CSE and ECE/ETE)	2	1	0	3	30	70
2	CSE181302	Object Oriented Programming using C++	3	0	0	3	30	70
3	CSE181303	Digital Systems	3	0	2	4	30	70
4	CSE181304	Data Structure and Algorithms	3	0	0	3	30	70
5	CSE181305	Basics of Signals and Systems	3	0	0	3	30	70
6	MC181306	Constitution of India	2	0	0	0 (PP/NP)	-	100
Practical								
1	CSE181312	Object Oriented Programming using C++ Lab	0	0	4	2	15	35
2	CSE181314	Data Structure and Algorithms Lab	0	0	4	2	15	35
3	SI181321	Internship-I (SAI - Social)	0	0	0	1	-	100
TOTAL			16	1	10	**21**	**180**	**620**
Total Contact Hours per week : 27								
Total Credits: 21								

N.B. MC181306 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)

Detailed Syllabus

Course Code	Course Title	Hours per week L-T-P	Credit C
MA181301B	**Mathematics III-B** (for branches CSE and ECE/ETE)	**2-1-0**	**3**

Module 1: (25 hours)

Probability

Probability space, conditional probability, Bayes' Theorem, independence; Discrete random variables, Independent random variables, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Joint Distribution.

Continuous Probability Distributions:

Continuous random variables and their properties with special reference to normal distribution.

Test of significance, Chi-square Test, Elements of Markov Chain.

Module 2: (15 hours)

Statistics:

Measures of Central tendency: Moments, skewness and Kurtosis, Correlation and regression – Rank correlation, Curve fitting by the method of least squares- fitting of straight lines.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
7. Statistical Methods: An Introductory Text- J.Medhi, New Age International Publishers

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181302	**Object Oriented Programming using C++**	**3-0-0**	**3**

Abstract data types and their specification, how to implement an ADT, Concrete state space, concrete invariant, abstraction function, implementing operations

Features of object-oriented programming, Encapsulation, object identity, polymorphism

Inheritance in object oriented design

Design patterns, introduction and classification, the iterator pattern, Model-view-controller pattern

Commands as methods and as objects, implementing object oriented language features

Memory management, Streams, Generic types and collections

The concepts should be practiced using C++

Textbooks/References:

1. C++: The Complete Reference, Herbert Schildt, McGraw Hill Education
2. The C++ Programming Language, Bjarne Stroustrup
3. Object-Oriented Programming with C++, Balaguruswamy, McGraw Hill Education

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181303	**Digital Systems**	**3-0-2**	**4**

MODULE 1: Fundamentals of Digital Systems and logic families
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

MODULE 2: Combinational Digital Circuits
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Substractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

MODULE 3: Sequential circuits and systems
A 1-bit memory, the circuit properties of Bi stable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

MODULE 4: A/D and D/A Converters
Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

MODULE 5: Semiconductor memories and Programmable logic devices.
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Textbooks/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181304	**Data Structure and Algorithms**	**3-0-0**	**3**

MODULE 1:
Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off, Searching: Linear Search and Binary Search Techniques and their complexity analysis.

MODULE 2:
Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation –corresponding algorithms and complexity analysis, ADT queue, Types of Queue: Simple Queue, Circular Queue, multilevel queue, Priority Queue, double ended queue; Operations on each types of Queues: Algorithms and their analysis.

MODULE 3:
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and their complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis, Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

MODULE 4:
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Textbooks/References:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
3. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181305	**Basics of Signals and Systems**	**3-0-0**	**3**

MODULE 1:
Signals and systems as seen in everyday life and in various branches of engineering and science, Signal properties: periodicity, absolute inerrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, Realizability, examples.

MODULE 2:
Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections, Characterization of causality and stability of LTI systems, System representation through differential equations and difference equations. State-space Representation of systems, State-Space Analysis, Multi-input, multi-output representation, State Transition Matrix and its role, Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

MODULE 3:
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients, Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform(DTFT) and the Discrete Fourier Transform (DFT), Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior, the z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

MODULE 4:
The Sampling Theorem and its implications, Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold, Aliasing and its effects, Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Textbooks/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India,1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181306	**Constitution of India**	**2-0-0**	**0 (PP/NP)**

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

MODULE 1: History of Making of the Indian Constitution:

a) History
b) Drafting Committee, (Composition & Working)

MODULE 2: Philosophy of the Indian Constitution:

a) Preamble
b) Salient Features

MODULE 3: Contours of Constitutional Rights & Duties:

a) Fundamental Rights
b) Right to Equality
c) Right to Freedom
d) Right against Exploitation
e) Right to Freedom of Religion
f) Cultural and Educational Rights
g) Right to Constitutional Remedies □Directive Principles of State Policy □Fundamental Duties.

MODULE 4: Organs of Governance:

a) Parliament

b) Composition
c) Qualifications and Disqualifications
d) Powers and Functions
e) Executive
f) President
g) Governor
h) Council of Ministers
i) Judiciary, Appointment and Transfer of Judges, Qualifications
j) Powers and Functions

MODULE 5: Local Administration:

a) District's Administration head: Role and Importance,
b) Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
c) Pachayati raj: Introduction, PRI: Zila Pachayat.
d) Elected officials and their roles, CEO Zila Pachayat: Position and role.
e) Block level: Organizational Hierarchy (Different departments),
f) Village level: Role of Elected and Appointed officials,
g) Importance of grass root democracy

MODULE 6: Election Commission:

a) Election Commission: Role and Functioning.
b) Chief Election Commissioner and Election Commissioners.
c) State Election Commission: Role and Functioning.
d) Institute and Bodies for the welfare of SC/ST/OBC and women.

Textbooks/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181312	**Object Oriented Programming using C++ Lab**	**0-0-4**	**2**

LIST OF EXPERIMENTS

I) Define a class in C++ to represent a bank account. Include the following data members:

1. Name of the depositor
2. Account number
3. Type of account
4. Balance amount in the account

Member functions:
1. To assign initial values
2. To deposit an amount
3. To withdraw an amount after checking the balance
4. To display name and balance

Write a main program to test the classe. Modify the program for handling 10 customers.

II) Write a class in C++ to represent a vector (a series of float values). Include member functions to perform the following tasks:
(a) To create the vector
(b) To modify the value of a given element
(c) To multiply by a scalar value
(d) To display the vector in the form (10, 20, 30, ...)
Write a program to test the class. Then, modify this class and also the program so that it can add two vectors and display the resultant vector.

III) A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the required copies are available, the total cost of the requested copies is displayed; otherwise the message "Required copies not in stock" is displayed. Design a system in C++ using a class called “books” with suitable member functions and constructors. Use new operator in constructors to allocate memory space required.

IV) Create a C++ class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

V) Assume that a bank maintains two kinds of accounts for customers, one called as Savings account and the other as current account. The savings account gives compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed. Create a C++ class **account** that stores customer name,

account number and type of account. From this, derive the classes **curr_acct** and **sav_acct** to make them more specific to their requirements. Include necessary member functions in order to achieve the following tasks:

a) Accept deposit from a customer and update the balance
b) Display the balance
c) Compute and deposit interest
d) Permit withdrawal and update the balance
e) Check for the minimum balance, impose penalty and update the balance

VI) Create a base class in C++ called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class a member function **get_data ()** to initialize base class data members and another member function **display_area ()** to compute and display the area of figures. Make **display_area ()** a virtual function and redefine this function in the derived classes to suit their requirements. Using these classes, design a program that will accept the dimensions of a triangle or a rectangle interactively and display the area.

VII) Implement a template class in C++ for stack data structure and show how it can be used inside main function.

VIII) Write a program in C++ to implement the following design patterns in C++:

a) MVC pattern
b) Iterator pattern

IX) Write a program in C++ that reads a text from keyboard and displays the following information on screen in two columns:

a) Number of lines
b) Number of words
c) Number of characters

Strings should be left justified and numbers should be right justified in a suitable field width.

X) Write a program in C++ to illustrate command design pattern in C++.

XI) Write a C++ program to implement a dynamic array class and illustrate its use inside main function.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181314	**Data Structure and Algorithms Lab**	**0-0-4**	**2**

LIST OF EXPERIMENTS

1. Write a program to implement a stack using array. Moreover, show how this stack can be used to check whether a string is a palindrome or not.
2. Write a program to implement a circular queue using array.
3. Write a program to implement a singly linked linear list along with operations of traversing, insertion, deletion and display.
4. Write a program to implement a priority queue using a linked linear list.
5. Write a program to implement a circular doubly linked linear list along with operations of traversing, insertion, deletion and display.
6. Write a program to implement bubble sort, selection sort, insertion sort and quick sort in a menu driven program.
7. Write a program to create a binary search tree along with the operations of searching and deletion. Moreover, perform a post order traversal of this tree.
8. Write a program to implement (a) heap sort and (b) merge sort on a list of numbers stored in an array.
9. Write a program to represent a graph in memory and then to perform breadth first search and depth first search on this graph.
10. Write a program to perform linear search and binary search on a list of numbers stored in an array.
11. Write a program to perform searching using hashing. Use probing or chaining techniques for resolving collision.
12. Write a program to merge two singly linked non circular lists.

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH

COMPUTER SCIENCE AND ENGINEERING

4th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure

(From Academic Session 2018-19 onwards)

B. Tech 4th Semester: Computer Science and Engineering

Semester IV/ B. TECH/CSE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	CSE181401	Discrete Mathematics	3	1	0	4	30	70
2	CSE181402	Computer Organization and Architecture	3	0	2	4	30	70
3	CSE181403	Operating System	3	0	0	3	30	70
4	CSE181404	JAVA Programming	2	0	4	4	30	70
5	CSE181405	Graph Theory	3	0	0	3	30	70
6	MC181406	Environmental Science	2	0	0	0 (PP/NP)	-	100
Practical								
1	CSE181413	Operating System Lab	0	0	4	2	15	35
2	CSE181417	IT Workshop (SciLab/Python)	0	1	2	2	15	35
TOTAL			16	2	12	**22**	**180**	**520**
Total Contact Hours per week : 28								
Total Credit: 22								

N.B. 1. MC181406 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)

2. 2-3 weeks Mandatory Academia Internship need to be done in the 4th semester break and the report is to be submitted and evaluated in 5th semester

Detail Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181401	**Discrete Mathematics**	**3-1-0**	**4**

MODULE 1:
Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

MODULE 2:
Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination

MODULE 3:
Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

MODULE 4:
Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text / Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics a Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata McGraw-Hill
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson,

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181402	**Computer Organization and Architecture**	**3-0-2**	**4**

MODULE 1:
Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

MODULE 2:
Introduction to x86 architecture and instruction set.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

MODULE 3:
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards,

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency,

MODULE 4:
Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Text / Reference Books:

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.
3. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
4. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
5. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181403	**Operating System**	**3-0-0**	**3**

MODULE 1:
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine, Case study on UNIX and WINDOWS Operating System.

MODULE 2:
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF, Process management in UNIX

MODULE 3:
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer-Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc., System V IPC

MODULE 4:
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

MODULE 5:
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation –Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures –Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, first in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU), Memory Management in UNIX

MODULE 6:
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Example operating system: Unix/Linux

Text / Reference Books:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
4. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
5. Design of the UNIX Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
6. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181404	**JAVA Programming**	**2-0-4**	**4**

MODULE 1:
Basics of Java language, control structures, classes and objects, inheritance, interfaces, collections

MODULE 2:
Working with User Interfaces – JAVA AWT Package, Basics User Interface Components (Labels, buttons, Check boxes, Radio buttons, choice Menu or Choice Lists, Text fields, Text areas, scrolling list, scroll bars, panels and frames), Layouts(Flow, Grid, Border, Card),event-driven programming-event driven programs, event handling process, Java's event types, JAVA Swings- Comparison between Swing and AWT, Java swing packages, Swing basic containers, Swing components, event handling using Java swing, using dialogs, Joptionpane class, input dialog boxes, Timers and Sliders, Tables, Borders for components.

MODULE 3:
Introduction to Threads in Java, basics of Networking in Java, TCP and UDP sockets, Client server application, connecting to the Web

MODULE 4:
JAVA database connectivity, JDBC/ODBC Bridge, JAVA.SQL package, connecting to remote data base, Data manipulation and Data navigation

Text / Reference Books:

1. Deitel & Deitel, JAVA: How to Program, Pearson education
2. Deitel & Deitel, Internet and World Wide Web How to Program, Pearson education
3. Ivan Bay Ross, Web Enabled Commercial Application using Java 2, BPB publication (1998)
4. David Flanagan, Java Script the Definitive Guide, O"relly, 5e (2006)

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181405	**Graph Theory**	**3-0-0**	**3**

MODULE 1:
Basics – Graphs, degree sequences, distance in graphs, complete, regular and bipartite graphs, basic properties.

MODULE 2:
Structure and Symmetry – Cut vertices, bridges and blocks, auto Orphism groups, reconstruction problem.

MODULE 3:
Trees and connectivity – Properties of trees, Arboricity, vertex and edge connectivity, Mengers theorem

MODULE 4:
Eulerian and Hamiltonian graphs – Characterization of Eulerian graphs -Sufficient conditions for Hamiltonian graphs.

MODULE 5:
Coloring and planar graphs – vertex and edge coloring, perfect graphs, planar graphs, Euler's theorem, Kuratowski's theorem, coloring of planar graphs, Crossing number and thickness.

MODULE 6:
Matching, factors, decomposition and domination

MODULE 7:
Extremal Graph theory – Turan's theorem, Ramsay's theorem, Szemeredi's regularity lemma, applications

Text / Reference Books:

1. Graph Theory, by J. A. Bondy and U. S. R. Murthy, Springer Verlag
2. Introduction to Graph Theory by D. B. West, PHI, 2004
3. Graph Theory, by R. Diestel: Springer Verlag

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181406	Environmental Science	2-0-0	0

MODULE 1: Environment and Ecology

i. Introduction
ii. Environment and Ecology
iii. Objectives of ecological study
iv. Aspects of Ecology
    a) Autecology
    b) Synecology
v. Ecosystem
    a) Structural and functional attributes of an ecosystem
    b) Food chain and food web
    c) Energy flow
    d) Biogeochemical cycles

MODULE 2: Land: Use and Abuse

i. Land use: Impact of land – use on environmental quality
ii. Land degradation
iii. Control of land degradation
iv. Waste land
v. Wet lands

MODULE 3: Water Pollution

a) Introduction
b) Water quality standards
c) Water pollution
d) Control of water pollution
e) Water pollution legislations
f) Water quality management in Rivers

MODULE 4: Air Pollution

i. Introduction
    a) Air pollution system
    b) Air pollutants
ii. Air pollution laws
iii. Control of air pollution
    a) Source correction method
    b) Pollution control equipment

MODULE 5: Noise Pollution

i. Introduction
ii. Sources of noise pollution
iii. Effects of noise
    a) Physical effects
    b) Physiological effects
    c) Psychological effects
iv. controls of Noise pollution

Text / Reference Books:

1. Environmental engineering and management by Dr Suresh Dhameja
2. Environmental studies by Dr B.S. Chauhan
3. Environmental science and engineering by Henry and Hence
4. Environmental studies for undergraduate course by Dr Susmitha Baskar
5. Chemistry for environmental engineering and science by Clair Sawyer

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181413	**Operating System Lab**	**0-0-4**	**2**

LIST OF EXPERIMENTS

1. Write programs for simulation of different CPU scheduling policies and memory management techniques.
2. Write programs to demonstrate use of Fork system call with getpid(), getppid(), and join().
3. Write programs for inter process communication in Linux using:
    a) PIPES
    b) Message queue
    c) Shared memory
4. Write programs for handling of Thread using Pthread library (semaphore and deadlock)
5. Write programs for understanding various features of Shell Scripts
6. Experiment with Makefile and creation of Header file

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181417	**IT Workshop (Scilab/Python)**	**0-1-2**	**2**

LIST OF EXPERIMENTS

1. Write programs on string, list, tuple, array and dictionary

2. Write a program to create a class that performs basic calculator operations

3. Write programs for understanding features like NumPy, SciPy, doctest, os, tkinter

4. Write a program to implement a queue

5. Write program for binomial distribution and normal distribution

6. Write program for finding moment, skewness and kurtosis

7. Write program for performing Chi Square test

8. Write program for performing linear regression

9. A project using Python is to be done in groups.

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
GUWAHATI

Course Structure and Syllabus
(From Academic Session 2018-19 onwards)

B.TECH

COMPUTER SCIENCE AND ENGINEERING
5TH SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure

(From Academic Session 2018-19 onwards)

B. Tech 5th Semester

Semester V/ B.TECH/Computer Science and Engineering

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	CSE181501	Database Management System	3	0	0	3	30	70
2	CSE181502	Design and Analysis of Algorithm	3	0	2	4	30	70
3	CSE181503	Formal Language and Automata Theory	3	0	0	3	30	70
4	CSE1815PE1*	Program Elective-1	3	0	0	3	30	70
5	HS181506	Engineering Economics	3	0	0	3	30	70
Practical								
1	CSE181511	Database Management System Lab	0	0	4	2	15	35
2	CSE181516	Web Programming	0	1	4	3	15	35
3	SI181521	Internship-II (SAI – Academia)	0	0	0	1	-	100
TOTAL			15	1	10	**22**	**180**	**520**
Total Contact Hours per week : 26								
Total Credits: 22								

PROGRAMME ELECTIVE – 1 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1815PE11	Microcontrollers and Applications
2	CSE1815PE12	Queuing Theory and modelling
3	CSE1815PE13	Information Retrieval
4	CSE1815PE14	Computer Graphics
5	CSE1815PE1*	Any other subject offered from time to time with the approval of the University

Detail syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181501	**Database Management System**	**3-0-0**	**3**

MODULE 1:
Database System Architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML)

Data Models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations

MODULE 2:
Relational Query Languages
Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS -MYSQL, ORACLE, DB2, SQL server
Relational Database Design
Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design
Query Processing and Optimization
Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms

MODULE 3: Storage Strategies
Indices, B-trees, hashing

MODULE 4: Transaction Processing
Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery

MODULE 5: Database Security
Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection

MODULE 6: Advanced Topics
Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining

Textbooks/Reference Books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181502	**Design and Analysis of Algorithm**	**3-0-2**	**4**

MODULE 1: Introduction
Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

MODULE 2: Fundamental Algorithmic Strategies
Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack, text/string matching, subset sum, TSP; Heuristics –characteristics and their application domains.

MODULE 3: Graph and Tree Algorithms
Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

MODULE 4: Data structures
red black trees, Fibonacci heap, binomial heap; Sorting- linear time, Amortized complexity, Median and order statistics

MODULE 5: Tractable and Intractable Problems
Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques

MODULE 6: Advanced Topics
Approximation algorithms, Randomized algorithms, Evolutionary algorithms, Class of problems beyond NP – P SPACE

Textbooks/Reference Books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and Éva Tardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms—a Creative Approach, 3RD Edition, Udi Manber, Addison-Wesley, Reading, MA.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181503	**Formal Language and Automata Theory**	**3-0-0**	**3**

MODULE 1: Finite Automata and Regular Expressions
Deterministic and non-deterministic finite automata, regular expressions, two way finite automata, finite automata with output: Mealy and Moore machines; Properties of Regular Sets: Pumping lemma, closure properties, decision algorithm, MyHill-Nerode theorem and minimization of finite automata.

MODULE 2: Context-Free Grammars (CFG)
CFGs, derivation trees, simplification, Chomsky normal forms, Greibach normal forms; Pushdown Automata (PDA): Definitions, relationship between PDA and context free languages; Properties of Context-Free Languages: Pumping lemma, closure properties, decision algorithm

MODULE 3: Turing Machines
The Turing machine model, computable languages and functions, techniques for Turing machine construction, modification of Turing machines, church's hypothesis, Turing machines as enumerators; Undesirability: properties of recursive and recursively enumerable languages, universal Turing machines, rice's theorem, post correspondence problem, Greibach's theorem, introduction to recursive function theory, oracle computation; Chomsky Hierarchy: regular grammars, unrestricted grammars, context sensitive languages, relations between classes of languages

Textbooks/Reference books:

1. Mishra &Chandrasekharan, Theory of computer science: Automata language and computation, Prentice Hall of India, 3rd Ed, 2007
2. P. Linz, Introduction to Formal Language and Computation, Narosa, 2nd Edition, 2006
3. Nasir & Sirmani, A Text Book on Automata Theory, Cambridge University Press, 2008
4. H. R. Lewis & C. H. Papadimitriou, Elements of the Theory of Computation, Prentice Hall of India, 2nd Edition, 2006

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1815PE11	**Microcontrollers and Applications**	**3-0-0**	**3**

MODULE 1: Fundamentals of Microprocessors

Fundamentals of Microprocessor Architecture, 8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers, Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems, Overview of the 8051 family

MODULE 2:

The 8051 Architecture, Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles

MODULE 3: Instruction Set and Programming, Addressing modes

Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs, C language programs, Assemblers and compilers, Programming and debugging tools.

MODULE 4: Memory and I/O Interfacing

Memory and I/O expansion buses, control signals, memory wait states, Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory, devices

Module 5: External Communication Interface: Synchronous and Asynchronous Communication. RS232, SPI, I2C, Introduction and interfacing to protocols like Blue-tooth and Zig-bee

Module 6: Applications: LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing

Textbooks / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning, 2004
3. R. Kamal, “Embedded System”, McGraw Hill Education, 2009
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1815PE12	**Queuing Theory and Modelling**	**3-0-0**	**3**

MODULE 1: Introduction

When simulation is appropriate and when not, advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queuing systems, on-demand and inventory systems, simulation for reliability analysis etc.

MODULE 2: General Principles

Concepts in discrete event simulation: event scheduling/time advances algorithms, world views. List Processing: properties and operations, data structures and dynamic allocation, techniques

Module 3: Simulation Software

Integrated environments. Examples and review of some existing software popular and useful in the industry, e.g., Arena, Auto Mod, Extend, Flexsim, Micro Saint, Pro Model, Quest, SIMUL8, WITNESS etc. Simulation using languages and environments like C++/Java/GPSS/SSF etc. Experimentation and Statistical-Analysis Tools: common features and relevant current products

MODULE 4:

Statistical Models in Simulation-Terms and concepts, statistical Models, review of discrete and continuous distributions. Review of Poisson (stationary and non-stationary) processes, empirical distributions; elementary Queuing Theory- Basic Structure of Queuing Models, Input Source (Calling Population), Queue, Queue Discipline, Service Mechanisms. Notations and relationships between *L*, *W*, *Lq*, and *Wq*. Little's Formula, role of Exponential Distribution and Properties, Birth and Death Processes. M/M/s queues. Finite queue variation in M/M/s/K models with different s values. Finite Calling Population cases, Queuing Models involving Non-Exponential Distributions: M/G/1, M/D/s, M/E k/s (involving Erlang distribution), Models without a Poisson Input, Models involving hyper exponential distributions, Priority Discipline Queuing Models: Preemptive and Non-Preemptive with results, properties and server number variations, Queuing Networks: Equivalence Property, Infinite Queues in Series and Product Form Solutions, Jackson Networks

MODULE 5:

Application of Queuing Models- Review of Characteristics (calling population system capacity, arrival processes, behavior and disciplines, service times and mechanisms etc.) and notations, Application of Long-Run Measures of Performance: Time average in system, average time spent per customer, Little's Formula and server utilization, costs, Steady State behavior of Infinite (M/G/1, M/M/c/infinity, M/M/c/N/infinity) and finite(M/M/c/K/K) Calling Population Models, Use of Network of Queues

MODULE 6:
Random Number Generation- Properties. Generation of Pseudo-Random Numbers, Techniques for Generation of Pseudo-Random Numbers: Linear Congruential, Combined Linear Congruential, Random Number Streams, Tests for Random Numbers: Frequency Tests and Tests for Autocorrelation, Random Variate Generation- Inverse Transform Techniques for Exponential, Uniform, Weibull, Triangular and for Empirical Continuous Distributions, Acceptance-Rejection Techniques for Poisson (Stationary and Non-Stationary) Distribution and Gamma Distribution. Special Properties like the Direct Transformation for the Normal and Lognormal Distributions, Convolution Method and others

MODULE 7:
Input Modeling- Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile- Quantile Plots, parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased estimators, Goodness of Fit Tests applied to Simulation inputs: Chi-Square and Chi-Square with Equal Probabilities, Kolmogorov-Smirnov Tests, p-Values and Best Fits, Verification and Validation of Simulation Models- Verification and Validation of Simulation Models. Calibration and Validation: Face Validity, Validation of Assumptions, Input-Out Transformation Validation

MODULE 8:
Output Analysis of a Single Model- Output analysis and types of simulation, Stochastic Nature of the Output Data. Measures of Performance and Estimation: Point Estimation and Confidence-Interval Estimation. Output Analysis for Terminating Simulations and Estimation of Probabilities, Output Analysis of Steady State Simulations: Initialization Bias, Error Estimation, Replications, Sample Size and Batch Means for Interval Estimation.

MODULE 9:
Comparison and Evaluation of Alternative System Designs- Comparison of Two System Designs.; Sampling with Equal and Unequal Variances, Common Random Numbers, Confidence Intervals with Specified Precision, Comparison of Several System Designs: Bonferroni Approaches to Multiple Comparisons and to Screening and to Selection of the Best. Meta modeling L Sample Linear Regression, Testing for Significance, Multiple Linear Regression, Random Number Assignment for Regression, Optimization via Simulation: Robust Heuristics

MODULE 10:
Simulation of Computer Systems- Simulation Tools: Process Orientation and Event Orientation. Model Input: Modulated Poisson Process and Virtual-Memory Referencing, High-Level Simulation, CPU and Memory Simulations. Simulation of Computer Networks- Traffic Modeling, Media Access Control: Token-Passing Protocols and Ethernet, Data Link Layer, TCP, Model Construction

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, Discrete-Event System and Simulation, Prentice Hall of India, New Delhi, 2005
2. Averill M. Law, Simulation modeling and analysis (SIE), Tata McGraw Hill India, 2007
3. David Cloud, Larry Rainey, Applied Modeling and Simulation, Tata McGraw Hill, India.

Reference Books:

1. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009.
2. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, Theory of modeling and simulation: integrating discreteevent and continuous complex dynamic systems, Academic Press, 2000.
3. Averill M. Law, W. David Kelton, Simulation modeling and analysis, McGraw Hill, 2000.
4. Walter J. Karplus, George A. Bekey, Boris Yakob Kogan, Modeling and simulation: theory and practice, Springer, 2003
5. Stanislaw Raczynski, Modeling and simulation: the computer science of illusion, Wiley, 2006.
6. Mohammad Salameh Obaidat, Georgios I. Papadimitriou, Applied system simulation: methodologies and application, Springer, 2003.
7. VanDijk, Nico M.; Boucherie, Richard J. (Eds.) 2011. Queueing Networks: A Fundamental Approach. 798 p.148 illus. Springer.
8. Bhat, U. Narayan, An Introduction to Queueing Theory: Modeling and Analysis in Applications, Springer 2008 (Birkhäuser Boston)
9. James J. Nutaro, Building software for simulation: theory and algorithms, with applications in C++. Wiley, 2010

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1815PE13	**Information Retrieval**	**3-0-0**	**3**

MODULE 1: Introduction
Basics of Information Retrieval and Introduction to Search Engines; Boolean Retrieval-: Boolean queries, Building simple indexes, processing Boolean queries

MODULE 2:
Term Vocabulary and Posting Lists- Choosing document units, Selection of terms, Stop word elimination, Stemming and lemmatization, Skip lists, Positional postings and Phrase queries; Dictionaries and Tolerant Retrieval: Data structures for dictionaries, Wildcard queries, Permu term and K-gram indexes, Spelling correction, Phonetic correction

MODULE 3:
Index Construction- Single pass scheme, distributed indexing, Map Reduce, Dynamic indexing; Index Compression - Statistical properties of terms, Zipf's law, Heap's law, Dictionary compression, Postings file compression, Variable byte codes, Gamma codes

MODULE 4:
Vector Space Model- Parametric and zone indexes, Learning weights, Term frequency and weighting, Tf- Idf weighting, Vector space model for scoring, variant tf-idf functions

MODULE 5:
Computing Scores in a Complete Search System- Efficient scoring and ranking, Inexact retrieval, Champion lists, Impact ordering, Cluster pruning, Tiered indexes, Query term proximity, Vector space scoring and query operations

MODULE 6:
Evaluation in Information Retrieval: Standard test collections, unranked retrieval sets, Ranked retrieval results, Assessing relevance, User utility, Precision and Recall**,** Relevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Evaluation of relevance feedback

MODULE 7:
Probabilistic Information Retrieval- Review of basic probability theory, Probability ranking principle, Binary independence model, Probability estimates, probabilistic approaches to relevance feedback. Text Classification- Rocchio classifier, K Nearest neighbor classifier, Linear and nonlinear classifiers, Bias-variance tradeoff, Naïve Bayes and Support Vector machine based classifiers

MODULE 8:
Text Clustering- Clustering in information retrieval, Evaluation of clustering, K Means and Hierarchical clustering, Introduction to Linear Algebra, Latent Semantic Indexing.

Textbooks/Reference Books:

1. C. D. Manning, P. Raghavan, and H. Schutze, *An Introduction to Information Retrieval*, Cambridge University Press, 2009.
2. R. Baeza-Yates and B. Ribeiro-Neto, *Modern Information Retrieval, Pearson Education*, 1999

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1815PE14	**Computer Graphics**	**3-0-0**	**3**

MODULE 1: Display Devices
Refresh cathode ray tubes, random scan and raster scan devices, color CRT monitors, 3-D monitors. Display Processor- random scan system and raster scan system, Interactive Input methods: Input devices, logical classification of input devices, input functions, Interactive picture construction techniques, Graphics software-co-ordinate representation, graphics functions, software standards- GKS, PHIGS etc.

MODULE 2: Output Primitives
Points and lines, loading and frame buffer, line drawing algorithms - DDA, Bresenham's line drawing algorithms; circle generating algorithm-midpoint Circle algorithm. Attributes of output primitives: Lane attributes, curve attributes, color tables, area fill attributes, character attributes, bundled attributes, anti-aliasing

MODULE 3: Two Dimensional Viewing
Viewing, pipelines, windowing concepts, clipping algorithms, polygon clipping, Structure and Hierarchical models- Concept, editing, structure, basic modeling concepts

MODULE 4:
3-D Concepts: 3-D viewing- view plane, dimension of window projections, 3-D display techniques; 3-D object representation- polygon surfaces; curved lines and surfaces- Spline curved, Bezier curves and surfaces; constructive solid geometry methods; Oc trees, Fractal geometry methods; 3-D transformations

MODULE 5: Visible Surface Detection Methods
classification of algorithms, comparisons of algorithms, Illuminations Models and surface rendering models- Halftone patterns, Ray tracing

MODULE 6:
Introduction to color models and applications, design of animation sequences, animation language, Use of graphics of Java language, Graphics part of Java has to be covered in this course

Textbooks/Reference Books:

1. D. Hearn and P. M. Backer, Computer Graphics, Prentice Hall of India, 1986.
2. W. K. Giloi, Interactive Computer Graphics, Prentice Hall of India, 1978
3. W. Newman and R. F. Sproul, Principles of Interactive Computer Graphics, McGraw Hill Publication, 1980.
4. D. F. Rogers, Procedural Elements of Computer Graphics, McGraw-Hill Publication, 1983.
5. S. Harington, Computer Graphics: A Programming Approach, Tata McGraw-Hill Publication.

6. D. F. Rogers, Mathematical Elements of Computer Graphics, McGraw-Hill Publications, 1983

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181506	**Engineering Economics**	**3-0-0**	**3**

Course Outcomes (COs):

The students will be able to

1. Acquire knowledge about economics its nature, scope and importance.
2. Understand the economic laws, principles, and theories and their relevance in present day situation.
3. Develop the ability of critical thinking to meet the challenges at the national and global problems.
4. Apply knowledge in finding out socio-economic problems and appropriate measures to deal with them.
5. Equip students with vital knowledge to run government and non-government institutions and bodies.
6. Assemble knowledge which is vital for industry and research and evolve proper policy for economic development.

MODULE 1: Introduction to Economics (3 Lectures)

Meaning and Definition of Economics, Nature and Scope of Economics, Concept of Micro and Macro Economics.

MODULE 2: Utility Analysis (3 Lecture)

Meaning of Utility, Utility Function, Consumers Equilibrium, Concept of Indifference Curve, properties of Indifference Curve, Equilibrium under Indifference Curve.

MODULE 3 : Demand and Supply Analysis (4 Lectures)

Law of Demand, Demand Function, Elasticity of Demand, Types of Elasticity of Demand, Measurement of Elasticity of Demand, Demand Forecasting, Law of Supply, Supply Function.

MODULE 4: Revenue, Production & Cost Analysis (4 Lectures)

Average, Marginal and Total Revenue, Revenue Function, Average, Marginal and Total Cost, Cost Function, Short and Long Run Cost Curves. Break Even Point, Managerial Uses of Cost Function, Cobb Douglas Production Function

MODULE 5 : Market Structure (4 Lectures)

Concept of Market, Price-Output Determination under Perfect Competition, Monopoly Market and Monopolistic Competition

MODULE 6 : Money, Banking and National Income (8 Lectures)

Definition of Money, Function of Money, Index Numbers, Construction of Index Numbers, value of Money, Causes of Inflation, Functions of Commercial and central bank, Central bank and its monetary policy, Money Market and Capital Market, Functions of Stock exchange, Concept of National Income, Measurement of National Income, Concept of Investment.

MODULE 7: Introduction to Environmental Economics (5 Lectures)

Concept of Environmental Economics, Cost -Benefit Analysis, Social Cost, Externalities, Concept of Pareto Equilibrium, Externality, Market Failure.

MODULE 8: Public Finance (3 Lectures)

Introduction to Public Finance, Concept of Budget, Types of Budget, Budget Receipts, Concept of Goods and services Tax (GST).

Textbooks/Reference Books:

1. Managerial Economics by V. Agarwal: Pearson Pvt. Limited, New Delhi.
2. Engineering Economics by Dr. A. Ahmed & G. Begum: Chandra prakash, Guwahati
3. Principles of Engineering Economics with Application by Dr. Z. A. Khan, A. N. Siddiquee, B. Kumar, M. H. Abidi: Cambridge University Press.
4. Public Finance and Public Policy by Dr. R. K Choudhury: Kalayani publishers
5. Quantitative Methods for Economics by R. Veerachamy: New Age International Publication Ltd.
6. Micro and Macro Economics by Dr. M. L. Seth: Educational Publishers, Agra -3
7. A Koutsoyiannis: Modern Microeconomics
8. Environmental Economics by R. N. Bhattacharya: Oxford Publication.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181511	**Database Management System Lab**	**0-0-4**	**2**

[The detailed manuals and other references should be provided at least one week in advance before each experiment - Students would only resolve doubts and carry out experiments in the labs]

LIST OF EXPERIMENTS:

1. Write statements for creation/alteration/view of relational database schema along with necessary integrity constraints. Insert tuples into the created tables.
2. Write SQL statements for selection, updation and deletion of data (students should be able to use features like selection, projection, joins, grouping, set theoretic operations, nested sub query, views etc.)
3. Write statements for creating and using stored procedures, functions and triggers.
4. Write statements for handling transactions and recovery.
5. Perform operations related with user management, access control and security.
6. Write a program to implement a B tree using any programming language of your choice.

Note: Database management systems like MySql, Oracle, PostgresSQL, SQL server, DB2 etc. can be used to perform the experiments.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181516	**Web Programming**	**0-1-4**	**3**

[The detailed manuals and other references should be provided at least one week in advance before each experiment - Students would only resolve doubts and carry out experiments in the labs. Students must carry out two experiments per lab]

Introduction to Web Development **(Tutorial)**: History of WWW, The HTTP protocol, how servers works, how clients (web browsers) work – including WebKit/WebCore/Blink browser engine, v8 JavaScript engine, etc.

WEB PROGRAMMING LABORATORY

1. **Create a skeleton HTML page**: Create a basic skeleton of HTML page with <head>, <body> , <title> and <meta> tags, Document relevant information using comments, Insert CSS and JavaScript using <style> and <script> tags, Insert CSS and JavaScript using external files

2. **Insert elements into the body of an HTML page**: Use elements like <p>, <h1> - <h6>, <b>, , <i> , , <del> , <ins> , <sub> , <sup> ,
 , <hr> , <pre> and for formatting, Insert images, videos and audio using <img> , <video> and <audio> elements, Insert hyperlinks using <a> element, Understand usage of HTML5 semantic elements like <article> , <section> , <nav> , <aside> , <header> , <footer> , <summary> , etc.

3. **Create lists and tables in a HTML page**: Create unordered, ordered and description lists, Create table using <table> , <tr> , <th> and <td>, Use colspan and rowspan attribute of table

4. **Create a HTML form to submit data to a server**: Create a form with different (text , password , email , tel , number , radio , checkbox , textarea , file) input fields, Set default value and placeholder in input fields, Understand required , validate , disabled , readonly , autofocus , min , max and step attributes of input field, Validation of input (e.g., phone number, email) using Regular Expressions and pattern attribute, Understand GET and POST methods, Understand the action attribute

5. **Process submitted form data using PHP**: Process GET and POST data and display processed output, save uploaded file into a directory in the server, send email message to notify user

6. **Style HTML elements using inline CSS**: Set background color and image of page, Set text color, text alignment, font, font size and formatting, Understand shape of elements using border, Manipulate space inside and outside elements using padding and margin, Shape elements using box-radius

7. **Select HTML elements for styling using CSS selectors**: Understand class and id attribute of HTML elements, Select elements for styling using class and id simple selectors, Select elements using pseudo selectors

8. **Position HTML elements on a page using CSS**: Set absolute, fixed and relative positions of Elements, Design a grid layout of a HTML page using CSS Grid Layout module

9. **Animate HTML elements on a page using CSS**: Set transition effect of elements, Set animation on elements using @keyframes

10. **Design a responsive page for multiple devices**: Use @media query to make HTML page change design based on screen resolution and orientation

11. **Manipulate HTML DOM using JavaScript**: Different ways to output data using JavaScript, Read values from form input elements, Change innerHTML of elements, Change style and attribute of elements

12. **Send AJAX request to a server and receive response using XML and JavaScript**: Send AJAX request from JavaScript and receive server response, Encode request and decode response using XML in JavaScript, Decode request and encode response unsung XML in PHP, Understand JSON data exchange formats

13. **Store persistent data using cookies, session and WebSQL**: Set cookie and session variables using JavaScript and PHP, Use a database on client browser using WebSQL

14. **Interface PHP with MySQL**: Insert data into a table in a MySQL database, Use prepared statements to protect against SQL injection, Select and display data from a table in a MySQL Database

15. **Object oriented programming using PHP**: Organize code into classes and objects, Use external PHP libraries

16. **Create a JSP servlet program to handle form data**: Understand JSP life cycle, Create JSP program on Tomcat, Apply exception handling in JSP to display error page

17. **Interface JSP servlet with database**: Understand usage of database middleware, Use JDBC to perform CURD operations on a database, Save data BLOB on database

18. **Deploy a full-stack web application**: Install Apache httpd on a virtual machine, Configure the Apache httpd server, Deploy a web application on a LAMP server, Understand load balancers

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
GUWAHATI

Course Structure and Syllabus
(From Academic Session 2018-19 onwards)

B.TECH
COMPUTER SCIENCE AND ENGINEERING

6TH SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure

(From Academic Session 2018-19 onwards)

B. Tech 6th Semester

Semester VI/ B.TECH/Computer Science and Engineering

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	CSE181601	Compiler Design	3	0	0	3	30	70
2	CSE181602	Computer Networks	3	0	0	3	30	70
3	CSE1816PE2*	Program Elective-2	3	0	0	3	30	70
4	CSE1816PE3*	Program Elective-3	3	0	0	3	30	70
5	CSE1816OE1*	Open Elective-1	3	0	0	3	30	70
6	HS181606	Accountancy	2	0	0	2	30	70
Practical								
1	CSE181611	Compiler Design Lab	0	0	2	1	15	35
2	CSE181612	Computer Networks Lab	0	0	2	1	15	35
3	CSE181621	Mini Project	0	0	6	3	50	100
TOTAL			**17**	**0**	**10**	**22**	**260**	**590**
Total Contact Hours per week: 27								
Total Credits: 22								

N.B. 4-6 weeks Mandatory Industry Internship need to be done in the 6th semester break and the report is to be submitted and evaluated in 7th semester

PROGRAMME ELECTIVE–2 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1816PE21	Data Mining
2	CSE1816PE22	Advanced Computer Architecture
3	CSE1816PE2*	Any other subject offered from time to time with the approval of the University

PROGRAMME ELECTIVE–3 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1816PE31	Image Processing
2	CSE1816PE32	Ad hoc and Sensor Networks
3	CSE1816PE33	Real Time Systems
4	CSE1816PE3*	Any other subject offered from time to time with the approval of the University

OPEN ELECTIVE–1 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1816OE11	Software Engineering
2	CSE1816OE12	Information Theory and Coding
3	CSE1816OE13	Fault Tolerant Computing
4	CSE1816OE1*	Any other subject offered from time to time with the approval of the University

Detail Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181601	**Compiler Design**	**3-0-0**	**3**

MODULE 1:
Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (LEX, flex)

MODULE 2:
Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (YACC, bison)

MODULE 3:
Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree, Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope

MODULE 4:
Intermediate Code Generation: Translation of different language features, different types of intermediate forms. Code Improvement (optimization): Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation Advanced topics

MODULE 5:
Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages

Textbooks/Reference Books:

1. Compilers: Principles, Techniques, and Tools, by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nd ed.), Addison-Wesley, 2007
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.
3. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
4. D. Brown, J. Levine, and T. Mason, LEX and YACC, O‟Reilly Media, 1992.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181602	**Computer Networks**	**3-0-0**	**3**

MODULE 1:
Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum

MODULE 2:
Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

MODULE 3:
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols

MODULE 4:
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm

MODULE 5:
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Textbooks/Reference Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816PE21	**Data Mining**	**3-0-0**	**3**

MODULE 1:
Introduction: Basic concepts of data mining, including motivation and definition; different types of data repositories; data mining functionalities; concept of interesting patterns; data mining tasks; current trends, major issues and ethics in data mining

MODULE 2:
Data: Types of data and data quality; Data Preprocessing: data cleaning, data integration and transformation, data reduction, discretization and concept hierarchy generation; Exploring Data: summary statistics, visualization, multidimensional data analysis

MODULE 3:
Association and Correlation Analysis: Basic concepts: frequent patterns, association rules - support and confidence; frequent item set generation – Apriori algorithm, FP-Growth algorithm; Rule generation, Applications of Association rules; Correlation analysis

MODULE 4:
Clustering Algorithms and Cluster Analysis: Concept of clustering, measures of similarity, Clustering algorithms: Partitioning methods - k-means and k-medoids, CLARANS, Hierarchical methods - agglomerative and divisive clustering, BIRCH, Density based methods - Subspace clustering, DBSCAN; Graph-based clustering - MST clustering; Cluster evaluation; Outlier detection and analysis

MODULE 5:
Classification: Binary Classification - Basic concepts, Bayes theorem and Naïve Bayes classifier, Association based classification, Rule based classifiers, nearest neighbor classifiers, Decision Trees, Random Forest; Perceptrons; Multi-category classification; Model Over fitting, Evaluation of classifier performance - cross validation, ROC curves

MODULE 6:
Applications: Text mining, Web data analysis, Recommender systems

Textbooks/Reference books:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson (2005), India
2. Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 3rd edition(2011)
3. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, MorganKaufmann, 3rd edition (2011)
4. T. Hastie, R. Tibshirani and J. H. Friedman, The Elements of Statistical Learning, Data Mining, Inference, andPrediction, Springer, 2nd Edition, 2009
5. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 1st edition, 2006

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816PE22	Advanced Computer Architecture	3-0-0	3

MODULE 1:
Review of Basic Organization and Architectural Techniques: RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level, Classification of parallel architectures

MODULE 2:
Instruction Level Parallelism: Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data, and control hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution, Review of modern processors, Pentium Processor: IA 32 and P6 micro architectures, ARM Processor

MODULE 3:
Memory Hierarchies, Basic concept of hierarchical memory organization, Main memories, Cache memory design and implementation, Virtual memory design and implementation, Secondary memory, technology, RAID

MODULE 4:
Peripheral Devices, Bus structures and standards, Synchronous and asynchronous buses, Types and uses of storage devices, Interfacing I/O to the rest of the system, Reliability and availability, I/O system design, Platform architecture

MODULE 5:
Thread Level Parallelism, Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multi core architecture, Review of modern multiprocessors

MODULE 6:
Process Level Parallelism: Distributed computers, Clusters, Grid Mainframe computers

Textbooks / References:
1. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann: 4th Edition
2. Kai Hwang , Advanced Computer Architecture, McGraw Hill
3. Sima D, Fountain T. and Kacsuk P., Advanced Computer Architectures: A design space approach, Pearson Education

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816PE31	Image Processing	3-0-0	3

MODULE 1: Introduction
Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization

MODULE 2: Spatial Domain Filtering
Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian

MODULE 3: Filtering in the Frequency Domain
Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering

MODULE 4: Image Restoration
Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections

MODULE 5: **Image Compression**
Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

MODULE 6: Wavelet based Image Compression
Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking

MODULE 7: Morphological Image Processing
Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion

MODULE 8: Image Segmentation
Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

Textbooks / References:

1. Digital Image Processing by Rafael C Gonzalez & Richard E Woods, 3rd Edition
2. Fundamentals of Digital Image Processing by Anil K Jain
3. Digital Image Processing by William K Pratt

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816PE32	**Ad hoc and Sensor Networks**	**3-0-0**	**3**

MODULE 1:
Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures, Applications of Ad Hoc and Sensor networks, Design Challenges in Ad hoc and Sensor Networks

MODULE 2:
MAC Protocols for Ad Hoc Wireless Networks: Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

MODULE 3:
Routing Protocols and Transport Layer in Ad Hoc Wireless Networks: Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc Wireless Networks

MODULE 4:
Wireless Sensor Networks (WSNs) And Mac Protocols: Single node architecture: hardware and software components of a sensor node – WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4 and Zigbee, underwater WSN

MODULE 5:
WSN Routing, Localization & QoS: Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues, security

Textbooks/Reference Books:

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall Professional Technical Reference, 2008

2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816PE33	**Real Time Systems**	**3-0-0**	**3**

MODULE 1:

Introduction: Real - Time System Characteristics, Basic Issues, Modeling Timing Constraints, basics of Real - Time Task Scheduling, Cyclic Scheduler, Event - Driven Scheduling, Rate Monotonic Scheduler, Deadline Monotonic Scheduling

MODULE 2:

Resource Sharing Among Real-Time Tasks, Highest Locker and Priority Ceiling Protocols, An Analysis of Priority Ceiling Protocol, Handling Task Dependencies, Real-Time Task Scheduling on Multiprocessors and Distributed Systems

MODULE 3:

Clock Synchronization in Distributed Real-Time Systems, Internal Clock Synchronization in Presence of Byzantine Clocks

MODULE 4:

Basic Issues in Real-Time Operating Systems, Unix and Windows as RTOS, Real - Time POSIX, Open Source and Commercial RTOS, Benchmarking Real - Time Computer & Operating Systems

MODULE 5:

Real - Time Communications, Real - Time Communication in a LAN, Real - Time Communication over Packet Switched Networks, Real - Time Databases

Textbooks/Reference Books:

1. Rajib Mall, "Real-Time Systems: Theory and Practice," Pearson, 2008.

2. Jane W. Liu, "Real-Time Systems" Pearson Education, 2001

3. Krishna and Shin, "Real-Time Systems," Tata McGraw Hill. 1999

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816OE11	Software Engineering	3-0-0	3

MODULE 1:

Software Process – Introduction – S/W Engineering Paradigm – life cycle models (waterfall, incremental, spiral, WINWIN spiral, evolutionary, prototyping) – system engineering – computer based system – life cycle process – development process

MODULE 2:

Software Requirements – Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modeling

MODULE 3 :

Design Concepts and Principles – modular design – design heuristic – S/W architecture – data design – architectural design – transform & transaction mapping – Introduction to SCM process – Software Configuration Items, Abstraction Architecture, pattern modularity, information hiding, design classes, refactoring etc., Design of web application, architectural design, component level design, user interface design

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MODULE 4:

Software Testing and Quality Management – Taxonomy of S/W testing – levels - black box testing – testing boundary conditions – structural testing — regression testing– S/W testing strategies – unit testing – integration testing – validation testing – system testing and debugging, Quality concepts, quality assurance, software reviews, statistical quality assurance.

MODULE 5 :

Software Project Management - S/W cost estimation – Function point models – COCOMO model – Delphi method – S/W challenges – S/W maintenance.

Textbooks/Reference Books:

1. R. S. Pressman, Software Engineering - A practitioners approach, III Edition, McGraw Hill International editions, 1992
2. Ian Sommerville, Software Engineering, Pearson Education Asia, VI Edition, 2000
3. PankajJalote, An Integrated Approach to software Engineering, Springer Verlag, 1997
4. James F. Peters and WitoldPedryez, Software Engineering – An Engineering Approach, John Wiley and Sons, New Delhi

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816OE12	Information Theory and Coding	3-0-0	3

MODULE 1:
Information theory: Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies, mutual information, information rate, chain rules, data-processing inequality, Fano's inequality, Asymptotic Equipartition Property Theorem, consequences of the AEP: data compression, high-probability sets and the typical set

MODULE 2:
Source coding – Encoding techniques, purpose of encoding, instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy, source coding theorem. construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, arithmetic coding, dictionary coding – LZ77, LZ78, LZW, ZIP coding, Channel coding, Channel coding theorem for discrete memoryless channels

MODULE 3:
Channel capacity, redundancy and efficiency of channels, discrete channels – symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel, Properties of Channel Capacity, Jointly Typical Sequences, Channel Coding Theorem, Fano's Inequality and the Converse to the Coding Theorem

MODULE 4:
Codes for error detection and correction – Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes, Cyclic codes – Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction

MODULE 5:
Convolutional codes – Encoding and State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes -Viterbi algorithm, Sequential decoding -Stack algorithm. Interleaving techniques – Block and convolutional interleaving, Coding and interleaving applied to CD digital audio system - CIRC encoding and decoding, interpolation and muting. ARQ – Types of ARQ, Performance of ARQ, Probability of error and throughput

Textbooks/Reference Books:

1. T. M. Cover, J. A. Thomas, Elements of Information Theory, Wiley
2. R. Togneri, C.J.S de Silva, Fundamentals of Information Theory and Coding Design, Taylor and Francis
3. R. J. McEliece, The Theory of Information and Coding, Cambridge University Press
4. R. Bose, Information Theory Coding and Cryptography, Tata McGraw Hill
5. William Ryan, Shu Lin, Channel Codes: Classical and Modern, Cambridge University Press

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1816OE13	**Fault Tolerant Computing**	**3-0-0**	**3**

MODULE 1:
Basic concepts and overview of the course Faults and their manifestations, Mathematical Reliability Modelling, Probability Basics; Reliability and Availability Modelling, Analysis using Markov Models, performance reliability trade-offs

MODULE 2:
Hardware Fault-Tolerance, Canonical and Resilient Structures; Reliability Evaluation Techniques and Models; Processor-level Fault Tolerance; Byzantine Failures and Agreements

MODULE 3:
Information Redundancy Error Detection/Correction Codes (Hamming, Parity, Checksum, Berger, Cyclic, Arithmetic); Encoding/Decoding circuits; Resilient Disk Systems (RAID)

MODULE 4:
Software Fault-Tolerance Single-Version Fault Tolerance; N-Version Programming; Recovery Approach; Exception and Conditional (Assert) Handling; Reliability Models

MODULE 5:
Fault-Tolerant Networks, Network Topologies and their Resilience; Fault-tolerant Routing

MODULE 6:
Fault-Tolerant System Design/Applications: Defect-tolerance in VLSI Designs; Fault Detection in Cryptographic Systems, Mobile computing and Mobile communication environment, Fault Tolerant Distributed Systems, Checkpointing in Distributed and Shared-memory Systems

Textbooks/Reference Books:

1. Israel Koren and C. Mani Krishna; Fault-Tolerant Systems; Morgan-Kaufman Publishers, 2007
2. Elena Dubrova; Fault-Tolerant Design; Springer, 2013
3. Michael R. Lyu; Handbook of Software Reliability Engineering; IEEE Computer Society Press (and McGraw-Hill), 1996
4. Martin L. Shooman; Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design; John Wiley & Sons Inc., 2002
5. Kishor S. Trivedi; Probability and Statistics with Reliability, Queuing and Computer Science Applications; John Wiley & Sons Inc., 2016

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181606	**Accountancy**	**2-0-0**	**2**

MODULE 1:
Concept and classification of Accounts, Transaction, Double Entry system of Book Keeping, Golden rules of Debit and Credit, Journal- Definition, advantages, Procedure of Journalising, Ledger, advantages, rules regarding Posting, Balancing of Ledger accounts, Trial Balance- Definition, objectives, procedure of preparation

MODULE 2:
Name of Subsidiary Books, Cash Book-definition, advantages, objectives, types of Cash Book, preparation of different types of cash books, Bank Reconciliation Statement, Regions of disagreement between Cash Book with Pass Book balance, preparation of Bank Reconciliation Statement

MODULE 3:
Final Account: Preparation of Trading Account, Profit and Loss Account with adjustments

MODULE 4:
Concept of Capital Expenditure and revenue Expenditure, Bad debts, Provision for Bad and Doubtful debts, Provision for discount on Debtors, Outstanding expenses, Prepaid expenses, Accrued Income

MODULE 5:
Introduction to Depreciation Accounting- Meaning, causes, factors, methods of charging depreciation etc.

Textbooks/Reference Books:

1. Theory and Practice of accountance- KR Das, KM Sinha, KS Pal Choudhury, Dr. A Rahman, PK Pujary
2. Book- Keeping & Accountancy- C Mohan Juneja, J R C Chawla, KK Sakseena
3. Double Entry Book- Keeping & Accountancy- JR Batliboi

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181611	**Compiler Design Lab**	**0-0-2**	**1**

LIST OF EXPERIMENTS

1. Write a program to recognize strings specified by a regular expression (use finite automaton)

2. Design and implement a predictive parser for a given grammar

3. Design and implement an LALR parser for a given grammar

4. Implement a lexical analyzer using lex/flex or any other lexical analyzer generator

5. Implement a parser using Yacc for a given grammar

6. Write a program to generate machine code for a given grammar

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181612	**Computer Networks Lab**	**0-0-2**	**1**

1. **Implementation of Elementary TCP Sockets** [Socket address structures – Byte ordering functions – Address conversion functions – Elementary TCP sockets – Socket – Connect – Bind – Listen – Accept – Read – Write – Close functions – Iterative server – Concurrent server]

2. **Implementation of Application Development TCP Echo Server** [TCP echo client –POSIX signal handling – Server with multiple clients – Boundary conditions– Server process crashes–Server host crashes – Server crashes and reboots – Server shutdown – I/O multiplexing – I/O models – Select function – Shutdown function – TCP echo server (with multiplexing) – Poll function – TCP echo client (with multiplexing)]

3. **Implementation of Socket Options, Elementary UDP SOC Sockets:** [Socket options – Getsocket and setsocket functions – Generic socket options – IP socket options – ICMP socket options – TCP socket options – Elementary UDP sockets – UDP echo server – UDP echo client – Multiplexing TCP and UDP sockets – Domain Name System – Gethostbyname function – IPV6 support in DNS – Gethostbyadr function – Getservbyname and etservbyport functions]

4. **Implementation of Advanced Sockets** [IPV4 and IPV6 interoperability – Threaded servers – Thread creation and termination– TCP echo server using threads – Mutexes – Condition variables – Raw sockets – Raw socket creation – Raw socket output – Raw socket input – Ping program – Trace route program]

5. **Implementation of Simple Network Management SNMP** [SNMP management information – Standard MIB‘s – SNMP V1 protocol and practical issues – Introduction to RMON, SNMP V2 and SNMP V3]

6. **Configuration of Layer 3 Switch and Router** [Modular field-replaceable Layer 3 switches & routers with integrated router, firewall and VPN functionalities, creating VLAN and checking]

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH

COMPUTER SCIENCE AND ENGINEERING

7th Semester

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure

(From Academic Session 2018-19 onwards)

B.Tech 7th Semester: Computer Science and Engineering

Semester VII/ B.TECH/CSE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	CSE1817PE4*	Program Elective-4	3	0	0	3	30	70
2	CSE1817OE2*	Open Elective-2	3	0	0	3	30	70
3	CSE1817OE3*	Open Elective-3	3	0	0	3	30	70
4	HS181704	Principles of Management	3	0	0	3	30	70
Practical								
1	CSE181722	Project-1	0	0	12	6	50	50
2	SI181721	Internship-III (SAI-Industry)	0	0	0	2	-	200
TOTAL			**12**	**0**	**12**	**20**	**170**	**530**
Total Contact Hours per week : 24								
Total Credit: 20								

Program Elective-4

Sl. No.	Subject Code	Subject
1	CSE1817PE41	Cloud Computing
2	CSE1817PE42	Computational Complexity
3	CSE1817PE43	Principles of Programming Languages
4	CSE1817PE4*	Any other subject offered from time to time with the approval of the University

Open Elective-2

Sl. No.	Code	Subject
1	CSE1817OE21	Machine Learning
2	CSE1817OE22	Human Computer Interaction
3	CSE1817OE23	Computer Vision and its Applications
4	CSE1817OE2*	Any other subject offered from time to time with the approval of the University

Open Elective-3

Sl No	Code	Subject
1	CSE1817OE31	Distributed Systems
2	CSE1817OE32	Computational Geometry
3	CSE1817OE33	Embedded Systems
4	CSE1817OE3*	Any other subject offered from time to time with the approval of the University

Detail Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817PE41	**Cloud Computing**	**3-0-0**	**3**

MODULE 1:
Introduction - Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IAAS, PAAS, SAAS; service oriented computing and cloud environment

MODULE 2:
Cloud Computing Technology - Client systems, Networks, server systems and security from services perspectives; accessing the cloud with platforms and applications; cloud storage

MODULE 3:
Working with Cloud- Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities Software as a Service –conceptual model and working Technologies and Trends in Service provisioning with clouds

MODULE 4:
Using Cloud Services- Cloud collaborative applications and services – technology, applications and case studies with calendars, schedulers and event management; cloud applications in project management

MODULE 5:
Case Studies-Microsoft Azure, Google App Engine and Open source clouds-Open-Nebula and Eucalyptus, Current trends and research

Textbooks/Reference Books:

1. Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH, 2010
2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817PE42	**Computational Complexity**	**3-0-0**	**3**

MODULE 1: Introduction: Turing machines, equivalence of reasonable models of computation, non-determinism, algorithms, decision versus optimization problems, reduction between problems.

MODULE 2: Time Complexity: The complexity classes P, NP, Co-NP and Exp, completeness for NP, Cook's theorem, some well-known NP-complete problems, classes FP, FNP, TFNP and FNP-Complete, approximation algorithms.

MODULE 3: Space Complexity: Classes PSPACE, NSPACE and PSPACE-complete, Savitch's theorem, logarithmic space, classes PolyL, L, NL, Co-NL and NL-complete.

MODULE 4: Intractability: Space and time hierarchy, EXPSPACE-completeness, alternating Turing machines and the polynomial hierarchy, relativization and oracle Turing Machines.

MODULE 5: Randomized Computation: Classes RP, ZPP, PP and BPP.

MODULE 6: Parallel Computation: Circuit complexity, classes NC and RNC, P-completeness.

MODULE 7: Cryptography: One-way functions, public-key cryptography, interactive protocols.

Textbooks/Reference Books:

1. Bernard M E Moret, The Theory of Computation, Addison-Wesley, 1998.
2. Christos H Papadimitriou, Computational complexity, Addison-Wesley, 1994.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing Company 1997.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817PE43	**Principles of Programming Languages**	**3-0-0**	**3**

MODULE 1: History and Need of Various types of Programming Languages, Types of PL, Characteristics of programming languages, Syntax, Semantics- various types of semantics, Pragmatics Analysis

MODULE 2: Concurrent Programming Languages: Concurrency structure for message passing, loosely coupled system, shared memory, PRAM, monitor, semaphore, Example: Java RMI, Parallel Java, Parallel C.

MODULE 3: Logic Programming: Predicate calculus- Logical operators, Propositional forms, Rules of inference, Logical equivalence, Quantification, Well-formed formula, PROLOG - Syntax, Lists, Operators and arithmetic, Control, i/o, data structures.

MODULE 4: Functional Programming: Lambda calculus- Lambda expressions, Variables, Substitutions, Arithmetic, Conditionals, Recursion, Lambda reduction, Type assignment, Polymorphism, Lambda calculus and computability

LISP - Control constructs, List processing, Files and i/o, Generic functions, Objects, Exceptions.

Textbooks/Reference Books:

1. Programming Languages: Concepts and Constructs by Ravi Sethi, Pearson Education.
2. Programming Language Concepts by Carlo Ghezzi and Mehdi Jazayeri, John Wiley & Sons.
3. Programming Languages: Paradigm and Practices by Doris Appleby and J. J. Vandekopple, McGraw Hill.
4. Concepts of Programming Languages by Robert W. Sebesta, Pearson Education.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE21	**Machine Learning**	**3-0-0**	**3**

MODULE 1: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

MODULE 2: Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation, Bias Variance Trade-off, Generalization errors, model selection, evaluation metrics

MODULE 3: Basic Probabilistic Modelling, Learning via Probabilistic Modelling, Probabilistic Models for Supervised Learning- Discriminative Approaches and Generative Approaches: Naïve Bayes, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM

MODULE 4: Neural Network: Perceptron, multilayer network, gradient descent and back propagation, Convolutional Neural Networks, Recurrent Neural Networks, Deep Unsupervised Learning, Dynamic memory networks

MODULE 5: Computational learning theory, PAC learning model, Linear Discriminant Analysis, Sample complexity, VC Dimension, Ensemble learning: Boosting and bagging, random forest, reinforcement learning

MODULE 6: k-means clustering, Gaussian mixture model and EM algorithm

Textbooks/Reference Books:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE22	**Human Computer Interaction**	**3-0-0**	**3**

MODULE 1: Introduction: The human, The computer, The interaction, Paradigms, Usability of Interactive Systems, Guidelines, Principles, and Theories

MODULE 2: Design Process: Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User support

MODULE 3: Models and Theories Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models, Task analysis, Dialogue notations and design, Models of the system, Modeling rich interaction

MODULE 4: Interaction Styles- Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration and Social Media Participation

MODULE 5: Design Issues- Quality of Service, Balancing Function and Fashion, User Documentation and Online Help, Information Search, Information Visualization

MODULE 6: Outside the Box- Group ware, Ubiquitous computing and augmented realities, Hypertext, multimedia, and the World Wide Web

Textbooks/Reference Books:

1. "Human Computer Interaction" by Alan Dix, Janet Finlay, ISBN: 9788131717035, Pearson Education (2004)
2. "Designing the User Interface - Strategies for Effective Human Computer Interaction", by Ben Shneiderman ISBN: 9788131732557, Pearson Education (2010).
3. Usability Engineering: Scenario-Based Development of Human-Computer Interaction, by Rosson, M. and Carroll, J. (2002)
4. The Essentials of Interaction Design, by Cooper, et al., Wiley Publishing (2007)
5. Usability Engineering, by Nielsen, J. Morgan Kaufmann, San Francisco, 1993. ISBN 0-12-518406-9
6. The Resonant Interface: HCI Foundations for Interaction Design, by Heim, S., Addison-Wesley. (2007)
7. Usability engineering: scenario-based development of human-computer interaction, By Rosson, M.B & Carroll, J.M., Morgan Kaufman. (2002)

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE23	**Computer Vision and its Applications**	**3-0-0**	**3**

MODULE 1: Introduction- Machine vision systems, optics and lenses, image sensors, human vision and Neuro-visual model, Imaging geometry - world co-ordinate system and camera coordinate system, co-ordinate transformations, projection geometry, camera model, camera calibration, radiometry. Open and manipulate images using NumPy.

MODULE 2: Introduction to Object Detection, template matching, concept of edge detection, edge linking, corner detection, Harris Corner detection, contour detection, feature matching, grid detection techniques using OpenCV and Python, introduction to face detection using OpenCV.

MODULE 3: Range measurement and recovering scene geometry: Binocular technique stereo pair, epi polar line and plane, stereo matching, photogrammetry, monocular technique -texture processing and shape from texture, depth from focusing and symmetry, different range finder (active) - laser range finder, light-stripe method.

MODULE 4: Introduction to object tracking, motion field, optical flow - smoothness, boundary conditions, discontinuities of optical flow, block-based method, pre-recursive method, Bayesian method, motion segmentation method, motion from points and lines, token tracking, stereo and motion tracking, use of Kalman filter, optical flow coding with OpenCV.

MODULE 5: Representation and analysis of polyhedral scene: understanding line drawings, gradient and dual space, generalized cylinder, volumetric representation, edge and junction labeling; labeling and recognition of scene objects; construction of model-base and visual learning, model-based recognition system - acronym, model-based recognition from sparse range data, 3D model based vision system, scene understanding, special systems for computer vision: visual information processing architecture, language and control, applications

Textbooks/Reference Books:

1. Computer Vision: A Modern Approach, by Forsyth / Ponce, Pearson Education India; 2nd edition, 2015
2. D. H. Ballard and C. M. Brown: Computer Vision, Prentice Hall, New York,1986.
3. R. M. Haralick, L. G. Shapiro: Computer and Robot Vision, Addison-Wesley Pub Co., 1992.
4. Hands-On Algorithms for Computer Vision: Amin Ahmadi Tazehkandi, Packt Publishing Limited, 2018
5. Programming Computer Vision with Python: Techniques and Libraries for Imaging and Retrieving Information, Jan Erik Solem, O′Reilly; 1st edition, 2012
6. Y. Shirai: Three-Dimensional Computer Vision, Springer-Verlag Berlin, 1988.
7. B. K. P. Horn: Robot Vision, MIT Press, Cambridge, 1986.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE31	**Distributed Systems**	**3-0-0**	**3**

MODULE 1: Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Issues in Distributes Operating Systems, Resource sharing and the Web Challenges.
System Models: Architectural models, Fundamental Models Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamppost's & vectors logical clocks, Causal ordering of messages, global state, termination detection, distributed Mutual Exclusion: classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token based algorithms, performance metric for distributed mutual exclusion algorithms.

MODULE 2: Distributed Deadlock Detection: system model, resource Vs. communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms, Agreement Protocols: Introduction, System models, classification of Agreement Problem-Interactive Consistency Problem, Applications of Agreement algorithms.

MODULE 3: Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study, message passing communication, group communication

MODULE 4: Distributed Transactions: Introduction, Flat and nested distributed transactions, Atomic commit protocols, concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery, distributed shared memory – Design and Implementation issues, consistency models, CORBA Case Study: CORBA RMI, CORBA services.

MODULE 5: File service components, design issues, interfaces, implementation techniques, Sun Network File System – architecture and implementation, other distributed file systems – AFS, CODA. Name services – SNS name service model.

MODULE 6: Load scheduling and balancing techniques

Textbooks/Reference Books:

1. Distributed System: Concepts and Design, by Coulouris, Dollimore, Kindberg, Pearson Education, 2006
2. Advanced Concepts in Operating Systems, by Mukesh Singhal & Niranjan G Shivaratri,Tata McGraw Hill, 2001
3. Tenenbaum, S., Distributed Operating Systems, Pearson Education, 2005
4. P K Sinha, Distributed System: Concepts and Design, PHI, 2004

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE32	**Computational Geometry**	**3-0-0**	**3**

MODULE 1: Introduction: historical perspective, geometric preliminaries

MODULE 2: Convex hulls algorithms in 2d and 3d, Gift Wrapping and Graham Scan, lower bounds, Divide-and-Conquer

MODULE 3: Triangulations: polygon triangulations, representations, point-set triangulations, The Flip Graph of the set of triangulations

MODULE 4: Voronoi diagrams: algorithms, closest pair problems. Delaunay triangulations: algorithms (divide-and-conquer, flip, incremental), duality of Voronoi diagrams, properties (min-max angle)

MODULE 5: Geometric searching: point-location, 2d linear programming with prune and search

Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems. Arrangements of lines: 2d arrangements, zone theorem, many-faces complexity, algorithms.

MODULE 6: Sweep techniques: plane sweep for segment intersections, Fortune s sweep for Voronoi diagrams, topological sweep for line arrangements

MODULE 7: Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets. Rectilinear geometry: intersection and union of rectangles, rectangle searching. Robust geometric computing. Applications of computational geometry

Textbooks/Reference Books:

1. Mark de Berg, Otfried Schwarzkopf, Marc van Kreveld and Mark Overmars, Computational Geometry: Algorithms and Applications, Springer.
2. F. P. Preparata and Michael I. Shamos, Computational Geometry: An Introduction, Springer.
3. Joseph O Rourke, Computational Geometry in C, Cambridge University Press.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1817OE33	**Embedded Systems**	**3-0-0**	**3**

MODULE1: Hardware Concepts -Application and characteristics of embedded systems, Overview of Processors and hardware units in an embedded system, General purpose processors, Microcontrollers, Application- Specific Circuits (ASICs), ASIP, FPGA, ARM-based System on a Chip (SoC), Network on Chip (NoC), levels of hardware modelling, Verilog/VHDL, Sensors, A/D-D/A converters, Actuators, Interfacing using RS-232,UART, USB, I2C, CAN bus, Flexray, SRAM and DRAM, Flash memory.

MODULE 2: Real-Time Operating Systems- Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Commercial Real-time operating systems: Time services, features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real- time operating systems, Microkernel based systems, benchmarking real-time systems.

MODULE 3: Embedded Application Development - UML 2.0, State charts, General language characteristics, Hardware/Software Co-design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.

Textbooks/Reference Books:

1. Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware /Software Introduction, John Wiley, 2001
2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, 1999
3. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication – 2002
4. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005
5. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007
6. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181704	Principles of Management	3-0-0	3

MODULE 1: Introduction

Definition and meaning of management, Characteristics of management, importance of management, functions of management-planning, organising, directing, staffing, coordination and controlling etc., principles of management, Difference between administration and management

MODULE 2: Financial Management

Definition and management of financial planning, importance and characteristics of sound financial plan, concepts of capital- fixed capital and working capital, source of finance, fund flow statement.

MODULE 3: Marginal costing

Definition and meaning of marginal costing, advantages, marginal cost equation, contribution, profit-volume ratio, break even analysis, margin of safety.

MODULE 4: Cost Accounting

Cost Accounting- Concept and benefit, elements of cost, preparation of cost sheet with adjustment of raw materials, work-in-progress and finished goods.

MODULE 5: Capitalisation

Definition and meaning of capitalisation, over and under capitalisation.

MODULE 6: Motivation

Introductory observation, definition of motivation, motivational technique, features of sound motivational system.

MODULE 7: Leadership

Concept of leadership, principles of leadership, functions of leadership, qualities of leadership, different styles of leadership**.**

Textbooks/Reference Books:

1. Principle of Business Management: RK Sharma, Shashi K.Gupta
2. Business Organisation and Management: SS Sarkar, RK Sharma, Shashi K.Gupta
3. Industrial Organisation and Management: SK Basu, KC Sahu, B Rajviv
4. Principles of Management by Dr. A. K. Bora: Chandra Prakash, Guwahati.
5. Management Accounting: RK Sharma, Shashi K Gupta
6. Cost Accounting: SP Jain, K I Narang

7. Cost Accounting, RSN Pillai, V Bhagawati
8. Principles of Management: RN Gupta
9. Principles of Management: RSN Pillai, S. Kala
10. Principles of Management: Dipak Kumar Bhattacharjee

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE181722	**Project-1**	**0-0-12**	**6**
GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME			

Course Code	Course Title	Hours per week L-T-P	Credit C
SI181721	**Internship-III (SAI - Industry)**	**0-0-0**	**2**
GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME			

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
GUWAHATI

Course Structure and Syllabus
(From Academic Session 2018-19 onwards)

B.TECH

COMPUTER SCIENCE AND ENGINEERING

8th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 8th Semester
Semester VIII/ B.TECH/CSE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	CSE1818PE5*	Program Elective-5	3	0	0	3	30	70
2	CSE1818PE6*	Program Elective-6	3	0	0	3	30	70
3	CSE1818OE4*	Open Elective-4	3	0	0	3	30	70
4	CSE1818OE5*	Open Elective-5	3	0	0	3	30	70
Practical								
1	CSE181822	Project-2	0	0	12	6	100	50
TOTAL			12	0	12	**18**	**220**	**330**
Total Contact Hours per week : 24								
Total Credit: 18								

PROGRAMME ELECTIVE – 5 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1818PE51	Cryptography and Network Security
2	CSE1818PE52	Speech and Natural Language Processing
3	CSE1818PE53	Parallel Computing
4	CSE1818PE5*	Any other subject offered from time to time with the approval of the University

PROGRAMME ELECTIVE – 6 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1818PE61	Big Data Analytics
2	CSE1818PE62	Computer Vision
3	CSE1818PE63	Neural Networks and Deep Learning
4	CSE1818PE6*	Any other subject offered from time to time with the approval of the University

OPEN ELECTIVE – 4 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1818OE41	Artificial Intelligence
2	CSE1818OE42	Quantum Computing
3	CSE1818OE43	Optimization Techniques in Machine Learning
4	CSE1818OE4*	Any other subject offered from time to time with the approval of the University

OPEN ELECTIVE – 5 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	CSE1818OE51	Internet of Things
2	CSE1818OE52	Computational Number Theory
3	CSE1818OE53	Electronic Design Automation
4	CSE1818OE54	Soft Computing
5	CSE1818OE5*	Any other subject offered from time to time with the approval of the University

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE51	**Cryptography and Network Security**	**3-0-0**	**3**

MODULE 1: Symmetric Ciphers - Overview: Services, Mechanisms and Attacks, The OSI Security Architecture, A Model of Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography, Block Cipher and the Data Encryption Standard: Simplified DES, Block Cipher Principles, the DES, the Strength of DES, Differential and Linear Cryptanalysis. Symmetric Ciphers: Triple DES, Blowfish. Confidentiality using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.

MODULE 2: Public Key Encryption, Digital Signatures - Number Theory, Prime Numbers Format's and Euler's Theorems, Testing for Primality, Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, the RSA Algorithms, Key Management, Diffie-Hellman Key Exchange.

MODULE 3: Authentication Protocols - Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols, Digital Signature Standards.

MODULE 4: Network Security - Authentication Applications: Kerberos, X.509 Directory Authentication Service. Electronic Mail Security: Pretty Good Privacy. IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulation Security Pay load, Web Security: Web Security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

MODULE 5: System Security- Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.

Text/Reference Books:

1. William Stallings, Cryptography and Network Security, 4th Edition, Pearson Education/PHI, 2006
2. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in PublicWorld, 2nd Edition, 2011, Pearson Education.
3. Atul Kahate, Cryptography and Network Security, TMH. (2003)

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE52	**Speech and Natural Language Processing**	**3-0-0**	**3**

MODULE 1: Phases in natural language processing, applications, Text representation in computers, encoding schemes, Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank,WordNet, VerbNet etc., Resource management with XML, Management of linguistic data with the help of GATE, NLTK.

MODULE 2: Regular expressions, text normalization, stemming, Morphology with Finite State Transducer, N-gram language models, smoothing, text categorization using Naïve Bayes

MODULE 3: Part of Speech tagging- Stochastic POS tagging, HMM, Viterbi algorithm, Handling of unknown words

MODULE 4: Parsing- probabilistic parsing, dependency parsing

MODULE 5: Information Extraction: named entity recognition, relation extraction, event extraction

MODULE 6: Semantics- Meaning representation, semantic analysis, lexical semantics, Word Sense Disambiguation

MODULE 7: Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure

MODULE 8: Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries

MODULE 9: Overview of machine translation, question answering, dialog systems and chatbots

Text/Reference Books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009
2. James A., Natural language Understanding 2e, Pearson Education, 1994
3. Bharati A., Sangal R., Chaitanya V., Natural language processing: a Paninian perspective, PHI, 2000
4. Siddiqui T., Tiwary U. S., Natural language processing and Information retrieval, OUP, 2008

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE53	**Parallel Computing**	**3-0-0**	**3**

MODULE 1: Introduction: Why parallel computing; Ubiquity of parallel hardware/multi-cores; Processes and threads; Programming models: shared memory and message passing; Speedup and efficiency; Amdahls Law

MODULE 2: Introduction to parallel hardware: multi-cores and multiprocessors; shared memory and message passing architectures; cache hierarchy and coherence; sequential consistency

MODULE 3: Shared memory parallel programming: Synchronization: Locks and barriers; Hardware primitives for efficient lock implementation; Lock algorithms; Relaxed consistency models; High-level language memory models (such Java and/or C++); Memory fences. Developing parallel programs with UNIX fork model: IPC with shared memory and message passing; UNIX semaphore and its all-or-none semantic, developing parallel programs with POSIX thread library: Thread creation; Thread join; Mutex; Condition variables, developing parallel programs with OpenMP directives: Parallel for; Parallel section; Static, dynamic, guided, and runtime scheduling, Critical sections and atomic operations, Barriers, Reduction

MODULE 4: Message passing programming: Distributed memory model, Introduction to message passing interface (MPI), Synchronization as Send/ Receive pair, Synchronous and asynchronous Send/Receive, Collective communication: Reduce, Broadcast, Data distribution, Scatter, Gather; MPI derived data types.

MODULE 5: Basic Parallel Algorithmic Techniques: Pointer Jumping, Divide-and-Conquer, Partitioning, Pipelining, Accelerated Cascading, Symmetry Breaking, Synchronization (Locked, Lock-free), Parallel Algorithms: Searching, Merging, Sorting, Prefix operations, matrix computation

MODULE 6: Introduction to GPU programming: GPU architecture, introduction to CUDA programming, Concept of SIMD and SIMT computation, thread blocks, Warps, global memory, shared memory, thread divergence in control transfer, introduction to PGAS programming paradigms, Transactional memory paradigm, speculative parallelization

Text/Reference Books:

1. Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011
2. M Herlihy and N Shavit, The Art of Multiprocessor Programming Morgan Kaufmann, 2008
3. JL Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Edition, Morgan Kaufmann India, 2006
4. DE Culler and JP Singh with A Gupta, Parallel Computer Architecture: A Hardware/Software Approach Morgan-Kaufmann, 1998
5. A Grama, A Gupta, G Karypis, and V Kumar, Introduction to Parallel Computing, 2nd Ed., Addison-Wesley, 2003
6. MJ Quinn, Parallel Computing: Theory and Practice, Tata McGraw Hill, 2002

7. DB Kirk and W-m W Hwu, Programming Massively Parallel Processors, Morgan Kaufmann, 2010
8. Parallel Programming in C with MPI and Open MP by M J Quinn
9. Introduction to Parallel Computing by Ananth Grama, George Karypis,Vipin Kumar, and Anshul Gupta
10. Programming Massively Parallel Processors by D.Kirk and W. Hwu

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE61	**Big Data Analytics**	**3-0-0**	**3**

MODULE 1: Introduction to Big Data, introduction to Enabling Technologies for Big Data, introduction to Big Data Platforms, introduction to Big Data Storage Platforms for Large Scale Data Storage, introduction to Big Data Streaming Platforms for Fast Data, Relationships and Representations, Graph Databases

MODULE 2: Introduction to Big Data Applications using machine learning

MODULE 3: Introduction to Spark, introduction of big data Machine learning with Spark, Language processing with Spark, Analysis of Streaming Data with Spark, Applications of Spark ML Library, Basic Neural Network and Tensor Flow

MODULE 4: Introduction to Big Data Applications: Graph Processing, Analysis of Images, Question Answer Systems, Page Rank like Search systems, Analysis of Streaming Data with Tensor Flow, VoltDB, Data Flow Engines and other memory databases

Text/Reference Books:

1. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014
2. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.
3. Chuck Lam, Hadoop in Action, December, 2010.
4. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.
5. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.
6. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE62	**Computer Vision**	**3-0-0**	**3**

MODULE 1: Introduction- Machine vision systems, optics and lenses, image sensors, human vision and Neuro-visual model; Marr's paradigm; Imaging geometry - world co-ordinate system and camera co-ordinate system, co-ordinate transformations, projection geometry, camera calibration, radiometry.

MODULE 2: Early processing and image filtering: Noise removal, region segmentation, concept of primal sketch, scale space, edge detection and localization, edge linking, Hough transform, corner and junction detection. Reflectance map and photometric stereo: Image brightness and radiometry, image formation and surface reflectance under different conditions, reflectance map and bidirectional reflectance distribution function, photometric stereo recovering albedo and surface orientation, shape from shading.

MODULE 3: Range measurement and recovering scene geometry: Binocular technique stereo pair, epipolar line and plane, Stereo matching, photogrammetry, monocular technique -texture processing and shape from texture, depth from focusing and symmetry, different range finder (active) - laser range finder, light-stripe method.

MODULE 4: Motion estimation: Motion field, optical flow - smoothness, boundary conditions, discontinuities of optical flow, block-based method, pre-recursive method, Bayesian method, Motion segmentation method, motion from points and lines, token tracking, stereo and motion tracking, use of Kalman filter, focus of expansion, structure from motion, motion compensated filtering and restoration, video compression, active and passive surveillance.

MODULE 5: Representation and analysis of polyhedral scene: understanding line drawings, gradient and dual space, generalized cylinder, volumetric representation, edge and junction labeling; labeling and recognition of scene objects; Construction of model-base and visual learning, model-based recognition system - Acronym, model based recognition from sparse
range data, 3D model based vision system, scene understanding. Special systems for computer vision: Visual information processing architecture, language and control, Applications

Text/Reference Books:

1. D. H. Ballard and C. M. Brown: Computer Vision, Prentice Hall, New York, 1986.
2. R. M. Haralick, L. G. Shapiro: Computer and Robot Vision, Addison-Wesley Pub Co, reading, Mass., 1992.
3. Y. Shirai: Three-Dimensional Computer Vision, Springer-Verlag Berlin, 1988.
4. B. K. P. Horn: Robot Vision, MIT Press, Cambridge, 1986.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818PE63	**Neural Networks and Deep Learning**	**3-0-0**	**3**

MODULE 1: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent: Momentum, Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam , Feed forward Neural Networks, Representation Power of Feed forward Neural Networks, Feed forward Neural Networks and Back propagation

MODULE 2: Principal Component Analysis and its interpretations, Singular Value Decomposition, Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

MODULE 3: Greedy Layer wise Pre-training, Better activation functions, better weight initialization methods, Batch Normalization

MODULE 4: Convolutional Neural Networks, CNN architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

MODULE 5: Encoder Decoder Models, Attention Mechanism, Attention over images

Text/Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, MIT Press. (2016)

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE41	**Artificial Intelligence**	**3-0-0**	**3**

MODULE 1: Scope of AI -Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.

MODULE 2: Problem solving - State space search; Production systems, search space control: depth-first, breadth-first search, heuristic search - Hill climbing, best-first search, tabu search, Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization, branch and Bound, A*, IDA*, divide and conquer approaches, beam stack search, Problem Reduction, Goal Trees, AO*, Rule Based Systems, Rete Net means-ends analysis

MODULE 3: Knowledge Representation- Predicate Logic: Unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: Forward reasoning: conflict resolution, backward reasoning, Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.

MODULE 4: Handling uncertainty and learning- non-Monotonic reasoning, probabilistic reasoning, use of certainty factors, fuzzy logic, Concept of learning, learning automation, learning by inductions, neural nets.

MODULE 5: Game Playing: Minimax Algorithm, Alpha-Beta Algorithm, SSS*.

MODULE 6: Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graph plan, Constraint Propagation.

Text/Reference Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
2. E. Rich and K. Knight, “Artificial intelligence”, TMH, 2nd ed., 1992
3. N.J. Nilsson, “Principles of AI”, Narosa Publishing House, 2000
4. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000
5. D.W. Patterson, “Introduction to AI and Expert Systems”, PHI, 1992
6. R.J. Schalkoff, “Artificial Intelligence - an Engineering Approach”, McGraw Hill International Edition, Singapore, 1992
7. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013
8. Eugene Charniak, Drew McDermott. Introduction to Artificial Intelligence, Addison Wesley, 1985

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE42	**Quantum Computing**	**3-0-0**	**3**

MODULE 1: Introduction to quantum computing, Quantum bits, Bloch sphere representation of a qubit, qubit measurement, multiple qubits, measuring multiple qubit systems, quantum systems evolution

MODULE 2: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

MODULE 3: single qubit gates, multiple qubit gates, design of quantum circuits

MODULE 4: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

MODULE 5: Classical computation on quantum computers, relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, quantum computer prototype, factoring and the RSA, factoring and period finding, quantum Fourier transform, Shor's algorithm, Grover search.

Text/Reference Books:

1. 1 Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press, 2002
2. 2 Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004
3. 3 Pittenger A. O., An Introduction to Quantum Computing Algorithms
4. P Kaye, R Laflamme and M Mosca , An Introduction to Quantum Computing

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE43	**Optimization Techniques in Machine Learning**	**3-0-0**	**3**

MODULE 1: Application of Continuous optimization in learning model parameters and application of discrete optimization in inference and auxiliary tasks such as feature selection, data subset selection, model compression

MODULE 2: Basics of Continuous Optimization, Convexity and non-smooth calculus tools, Gradient Descent, Projected/Proximal gradient descent, Sub Gradient Descent, Accelerated Gradient Descent (momentum), Newton & Quasi Newton, examples in data science

MODULE 3: Important standard classes such as linear and quadratic programming, semidefinite programming, second-order cone programming

MODULE 4: Fundamentals of discrete optimization, basic forms of combinatorial optimization, submodular functions and Applications in Machine Learning, Sub modularity and Convexity, Submodular Minimization, Submodular Maximization, Sub-gradient methods for non-differentiable functions

MODULE 5: Real world applications in feature selection, summarization and diversified search, structured prediction, data subset selection and model compression

Text/Reference Books:

1. Convex Optimization: Algorithms and Complexity by Sébastien Bubeck
2. Convex Optimization by Stephen Boyd and Lieven Vandenberghe
3. Convex Analysis by R. T. Rockafellar, Vol. 28 of Princeton Math. Series, Princeton Univ. Press, 1970
4. Linear Algebra and Its Applications by Gilbert Strang
5. Nonlinear Programming: 2nd Edition by Dimitri P. Bertsekas
6. Numerical Optimization by Nocedal, Jorge, Wright, Stephen
7. An Introduction to Optimization by E.K. P Chong and S.H.Zak
8. Introduction to Nonlinear Optimization - Theory, Algorithms and Applications by Amir Beck

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE51	**Internet of things**	**3-0-0**	**3**

MODULE 1: Introduction to IoT: Importance of IoT, applications and technologies, connecting terminologies and network configurations, Sensors and transducers, Actuators, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, UAV networks

MODULE 2: Interoperability in IoT, Introduction to Arduino Programming, integration of Sensors and Actuators with Arduino, introduction to Python programming, architecture and components of Raspberry Pi, implementation of IoT with Raspberry Pi

MODULE 3: Introduction to SDN, basic concepts and components of SDN, open flow protocol, APIs in SDN, SDN for IoT, wireless sensor networks and software defined WSNs

MODULE 4: Data Handling and Analytics, Cloud computing, Sensor-Cloud

MODULE 5: Fog Computing: Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

Text/Reference Books:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE52	**Computational Number Theory**	**3-0-0**	**3**

MODULE 1: Algorithms for integer arithmetic: Divisibility, GCD, modular arithmetic, modular exponentiation, Montgomery arithmetic, congruence, Chinese remainder theorem, Hensel lifting, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations.

MODULE 2: Representation of finite fields: Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials.

MODULE 3: Algorithms for polynomials: Root-finding and factorization, Lenstra-Lenstra-Lovasz algorithm, polynomials over finite fields.

MODULE 4: Elliptic curves: The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.

MODULE 5: Primality testing algorithms, Fermat test, Miller-Rabin test, Solovay-Strassen test, AKS test, Integer factoring algorithms: Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method.

MODULE 6: Computing discrete logarithms over finite fields: Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.

Text/Reference Books:

1. A. Das, Computational number theory, Chapman and Hall/CRC.
2. V. Shoup, A computational introduction to number theory and algebra, Cambridge University Press.
3. M. Mignotte, Mathematics for computer algebra, Springer-Verlag.
4. I. Niven, H. S. Zuckerman and H. L. Montgomery, An introduction to the theory of numbers, John Wiley.
5. J. von zur Gathen and J. Gerhard, Modern computer algebra, Cambridge University Press.
6. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press.
7. A. J. Menezes, editor, Applications of finite fields, Kluwer Academic Publishers.
8. J. H. Silverman and J. Tate, Rational points on elliptic curves, Springer International Edition.
9. D. R. Hankerson, A. J. Menezes and S. A. Vanstone, Guide to elliptic curve cryptography, Springer-Verlag.

10. A. Das and C. E. Veni Madhavan, Public-key cryptography: Theory and practice, Pearson Education Asia.
11. 11.H. Cohen, A course in computational algebraic number theory, Springer-Verlag

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE53	**Electronic Design Automation**	**3-0-0**	**3**

MODULE 1: VLSI design automation tools, an overview of the features of practical CAD tools, Modelsim, Leonardo spectrum, ISE 13.1i, Quartus II, VLSI backend tools

MODULE 2: Synthesis and simulation using HDLs: Logic synthesis using VERILOG and VHDL. Memory and FSM synthesis, Performance driven synthesis, Types of simulation. Static timing analysis. Formal verification, Switch level and transistor level simulation.

MODULE 3: Circuit simulation using Spice: Circuit description.AC, DC and transient analysis. Advanced spice commands and analysis, Models for diodes, transistors and OPAMP, Digital building blocks. A/D, D/A and sample and hold circuits, Design and analysis of mixed signal circuits.

MODULE 4: System Verilog: Introduction, Design hierarchy, Data types, Operators and language constructs, Functional coverage, Assertions, Interfaces and test bench structures.

MODULE 5: Mixed signal circuit modeling and analysis, concept of system on chip. introduction to Cypress Programmable System on Chip (PSoC), Structure of PSoC, PSoC Designer, PSoC Modules, Interconnects, memory management, global resources, and design examples.

Text/Reference Books:

1. M.J.S.Smith, “Application Specific Integrated Circuits”,Pearson, 2008.
2. M.H.Rashid, “Introduction to PSpice using OrCAD for circuits and electronics”, Pearson, 2004.
3. S.Sutherland, S. Davidmann, P. Flake, “System Verilog For Design”,(2/e), Springer,2006.
4. Z. Dr Mark, “Digital System Design with System Verilog “, Pearson, 2010.
5. Robert Ashby, “Designer's Guide to the Cypress PSoC, Newnes (An imprint of Elsevier)”, 2006
6. O.H. Bailey, “The Beginner's Guide to PSoC”, Express Timelines Industries Inc.

Course Code	Course Title	Hours per week L-T-P	Credit C
CSE1818OE54	**Soft Computing**	**3-0-0**	**3**

MODULE 1: Introduction - What is soft computing, Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing.

MODULE 2: Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

MODULE 3: Neural Networks- Concept, biological neural system, Evolution of neural network, McCulloch-Pitts neuron model, activation functions, feed forward networks, feedback networks, learning rules – Hebbian, Delta, Perceptron learning and Windrow-Hoff, winner-take-all.

MODULE 4: Supervised learning- Perceptron learning, single l layer/multilayer perceptron, linear separability, hidden layers, back propagation algorithm, Radial Basis Function network; Unsupervised learning - Kohonen, SOM, Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.

MODULE 5: Fuzzy systems - Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules& Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modeling.

MODULE 6: Swarm Intelligence- What is swarm intelligence, Various animal behavior which has been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Text/Reference Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley, ISBN13: 9788126527410 (2011)
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edition, 2003.
5. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
6. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

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