

School of Computer Applications
Bachelor of Computer Applications
Evaluation Scheme (w. e. f. Academic Session 2019-20)

SEMESTER I									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
F	BCA3101	Computer Fundamentals	3	1	0	40	60	100	4
C	BCA3102	Digital Electronics	3	1	0	40	60	100	4
C	BCA3103	Programming Concepts Using 'C'	3	1	0	40	60	100	4
C	BCA3104	Mathematics	3	1	0	40	60	100	4
C	BHS3101	Technical Communication	3	1	0	40	60	100	4
Practical									
C	BCA3151	Digital Electronics Lab	0	0	4	40	60	100	2
C	BCA3152	'C' Programming Lab	0	0	4	40	60	100	2
	GP3101	General Proficiency	-	-	-	100	-	100	1
Total			15	5	8	-		800	25

SEMESTER II									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
C	BCA3201	Basics of Data Structures Using 'C'	3	1	0	40	60	100	4
C	BCA3202	Basics of Operating System	3	1	0	40	60	100	4
C	BCA3203	Basics of System Analysis & Design	3	1	0	40	60	100	4
C	BCA3204	Data Communication & Computer Network	3	1	0	40	60	100	4
C	BCA3205	Basics of Computer Organization & Architecture	3	1	0	40	60	100	4
Practical									
C	BCA3251	Basics of Data Structures Using 'C' Lab	0	0	4	40	60	100	2
C	BCA3252	Basics of Computer Organization Lab	0	0	4	40	60	100	2
	GP3201	General Proficiency	-	-	-	100	-	100	1
Total			15	5	8	-		800	25

SEMESTER III									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
C	BCA3301	Basics of Design & Analysis of Algorithm	3	1	0	40	60	100	4
C	BCA3302	Data Base Management Systems	3	1	0	40	60	100	4
C	BCA3303	Object Oriented Programming Using Java	3	1	0	40	60	100	4
C	BAS3304	Environmental Studies	2	0	0	40	60	100	2
C	BCA3305	Discrete Mathematics & Graph Theory	3	1	0	40	60	100	4
Practical									
C	BCA3351	Data Base Management Systems Lab	0	0	4	40	60	100	2
C	BCA3352	Object Oriented Programming Using Java Lab	0	0	4	40	60	100	2
	GP3301	General Proficiency	-	-	-	100	-	100	1
Total			14	4	8	-		800	23

SEMESTER IV									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
C	BCA3401	Basics of Python Programming	3	1	0	40	60	100	4
C	BCA3402	Numerical & Statistical Techniques	3	1	0	40	60	100	4
C	BCA3403	Basics of .NET Framework & C#	3	1	0	40	60	100	4
C	BCA3404	Data Warehousing & Data Mining	3	1	0	40	60	100	4
C	BCA3405	Computer Graphics	3	1	0	40	60	100	4
Practical									
C	BCA3451	Basics of Python Programming Lab	0	0	4	40	60	100	2
C	BCA3452	Basics of .NET Framework & C# Lab	0	0	4	40	60	100	2
	GP3401	General Proficiency	-	-	-	100	-	100	1
Total			15	5	8	-		800	25

SEMESTER V									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
C	BCA3501	Web Application Development Using Open Source System	3	1	0	40	60	100	4
C	BCA3502	Mobile Application Development	3	1	0	40	60	100	4
GE		Generic Elective	3	1	0	40	60	100	4
C	BCA3504	Software Engineering	3	1	0	40	60	100	4
OE		Open Elective	3	1	0	40	60	100	4
Practical									
C	BCA3551	Web Application Development Using Open Source System Lab	0	0	4	40	60	100	2
C	BCA3552	Mobile Application Development Lab	0	0	4	40	60	100	2
	GP3501	General Proficiency	-	-	-	100	-	100	1
Total			15	5	8	-		800	25

SEMESTER VI									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
Theory									
C	BCA3601	Management Information System	3	1	0	40	60	100	4
C	BCA3602	Advance Computer Technologies	3	1	0	40	60	100	4
Practical									
C	BCA3651	Project Training	-	-	-	220	280	500	16
	GP3601	General Proficiency	-	-	-	100	-	100	1
Total								800	25

Legends:

- L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
Basic Sciences	4		4	4			12	8.17
Humanities	4		2				6	4.06
Social Sciences								
Professional Subject - Core	16	24	16	20	16	8	100	67.5
Professional Subject – Generic Elective					4		4	2.70
Professional Subject – Open Elective					4		4	2.70
GP	1	1	1	1	1	1	6	4.06
Project Work, Seminar and/or Internship in Industry or elsewhere						16	16	10.81
Total	25	25	23	25	25	25	148	100

Discipline wise Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
F	4						4	2.7
C	20	24	22	24	16	24	130	87.48
GE					4		4	2.7
OE					4		4	2.7
GP	1	1	1	1	1	1	6	4.06
Total	25	25	23	25	25	25	148	100

Category of Courses:

- F Foundation Course
- C Core Course
- GE Generic Elective
- OE Open Elective

Generic Elective Subjects List

1. BCA3511: Fundamental of E Commerce
2. BCA3512: Basics of Software Project management
3. BCA3513: Green Computing
4. BCA3514: Basics of E- Governance

Open Elective Subjects List

1. OE31101: Environmental Issues of IT & e-Waste Management
2. OE31102: Digital Governance

I Semester

BCA3101: Computer Fundamentals

Course Objective:

1. The subject provides the fundamental concepts of computer science and information technology.
2. Subject introduces computer hardware, computer networks, DBMS and operating system.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the basics of computer science and information technology.
2. Learn History of computers, Computer Peripherals, Storage Devices, Computer Security Systems, Computer Viruses and Computer Networking etc.
3. Understand how to use Internet technology and their various applications.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Computers: Introduction to computer, Basics of computers and its operation, History of computer, Capabilities and limitations of computers, Types of computers; Hardware: CPU(Architecture & Related Technology) and Microprocessors; Storage Devices: Primary & Secondary; Auxiliary Storage Devices; Cache Memory; Memory Hierarchy; Buffering and Spooling; Software: Types of software; System Software: Control, Development, Management; Input devices: Keyboard, Mouse, Joystick, Stylus, Tablet, Touchpad, Touch Screen, Data Gloves, Camera Scanner, Microphones, Barcode reader, OCR, OMR, MICR; Output Devices: Display; CRT Plasma, LCD, LED, Printers and Plotters, projectors, Speaker, VR Head; Booting and POST.	8 Hours	1
II	Operating System: Operating System: Types of Operating System, Function of Operating System, MS-DOS, MS-Windows and Unix; Process Management(Job Scheduling), Memory Management, File Management, I/O Management, Security; Introduction to Programming Languages, Language Processing: Translator, Assembler, Compiler, Interpreter, Cross Compiler; Introduction to data storage; Virus & Anti-Virus.	8 Hours	1

III	Computer Networks & Internet: Data communication: Signaling & Transmission; Network Devices: HUB, Switch, Router, Gateways; Types of network; Topology; Transmission Mode & Media; Switching Techniques, Internet and protocol, Internet services, OSI reference model; TCP/IP Reference Model.	8 Hours	1
IV	Introduction to Modern Technologies: Open source Software; Mobile Application Development, Data Science & Analysis; Artificial Intelligence; Soft Computing; Cloud Computing; IOT; Digital Marketing.	8 Hours	1

Suggested Readings:

1. E. Balagurusamy, "Fundamentals of Computers", McGraw Hill Education.
2. Peter Norton's., "Introduction to Computers", McGraw Hill Education.
3. Raja Raman .V, "Fundamentals of Computers", PHI Publications, 3rd Edition, 2004.

BCA3102: Digital Electronics

Course Objective:

1. Provide a better understanding of Computer Organization, its designing & implementation.
2. Provide the understanding and uses of flip flops.
3. To enable student to implement synchronous state machine using flip flops.

Learning Outcome: On completion of this course students will be able to:

1. Understand the concept of logic family in order to build digital circuits and the obsolescence curve associated to a given logic family.
2. Simplify or minimize logic functions with up to 5 input variables by means of Karnaugh maps.
3. Use digital timing diagrams to specify a combinational circuits' behavior or to verify its operation.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Number System & Boolean Algebra: Number System: Binary, Octal, Decimal, Hexadecimal; Conversion of Number System; Binary Arithmetic & Complement, Binary Codes: Weighted & Non Weighted, Gray Code, Excess-3 Code. Error Detection Codes: Hamming Code; Boolean Function; Boolean Postulates; De-Morgan's Theorem; Boolean Expressions: Sum of Product, Product of Sum, Minimization of Boolean Expressions using K-Map; Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR; Implementations of Logic Functions using Gates; NAND- NOR Implementations; Multilevel gate Implementations.	8 Hours	1
II	Combinational Circuits: Adders & Subtractors: Half Adder, Full Adder, Binary Adder, Half Subtractor, Full Subtractor, Adder Subtractor; Magnitude Comparator: Two Bit Magnitude Comparator, Three Bit Magnitude Comparator; Multiplexer & De-Multiplexer: 4*1 Multiplexer, 8*1 Multiplexer; Decoder & Encoder; Parity Checker & Generator; Code Converter.	8 Hours	1
III	Sequential Circuit: Introduction to Flip Flops: SR, JK, T, D, Master Slave Flip Flops; Conversion of Flip Flops; Characteristic Table & Equation; Edge Triggering & Level Triggering; Excitation Table; State Diagram; State Table; State Reduction; Design of Sequential Circuits.	8 Hours	1
IV	Registers: Introduction of Registers; Classification of Registers; Register with Parallel Load; Shift Registers; Bidirectional Shift Register with Parallel Load. Counters: Introduction of Counter; Asynchronous/Ripple Counters; Synchronous Counters; BCD Counter; 4-bit Binary Counter with Parallel Load; Design of Synchronous Counters; Ring Counter; Johnson Counter.	8 Hours	1

Suggested Readings:

1. V. Rajaraman, "Fundamental of Computers", PHI Publications, 3rd Edition, 2004.
2. P. K. Sinha , "Fundamental of Computers",BPB Publications
3. M. Mano, "Digital Logic and Computer Design", 2nd Edition, PHI.
4. R. P. Jain, "Modern Digital Electronics", Tata Mc Graw Hill, 2003.
5. P. Raja, "Switching Theory", Fourth Edition, Umesh Publication.

BCA3103: Programming Concepts Using 'C'

Course Objective:

1. To provide the basic fundamental knowledge about various concepts of programming.
2. Clear understanding of the basic terminology required for programming.

Learning Outcome: On completion of this course students will be able to:

1. Understand various constructs of the C Language along with proper syntax.
2. Understand various header Files.
3. Develop programs on various topics.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction: Evolution of Programming Languages; Programming Approaches: Top-down Approach, Bottom-up Approach; Algorithm; Flowchart; Source Code; Object Code; Executable File; Introduction to C: Data Types: Primitive Data types, Derived Data types, User-Defined Data Types; Operators: Different Types of Operators, Precedence of Operators, Expression and Statements; Token: Variables, Constants, Literals, Identifiers, Keyword, Escape Sequence; Types of Conversion: Typecasting, Conversion; Decision Control Statements: IF, IF-ELSE, Nested IF, IF-ELSE ladder, Switch-case; Iterative statements: FOR loop, WHILE loop, DO-WHILE loop; Jump Statements: Break, Continue.	8 Hours	1
II	Array: Declaration of an Array, Initialization of Array, Types of Array: Single Dimension Array, Two-Dimensional Array; Address Calculation of an Element in Array; Insertion and Deletion in an Array; Searching: Linear Search, Binary Search; Sorting: Bubble Sort, Selection Sort, Insertion Sort; Character Array and Strings: Reading, writing, String Handling Functions: strcat(), strcmp(), strcpy(), strlen().	8 Hours	1
III	Functions & Pointers: User-Defined Functions; Function Declaration; Types of Arguments: Actual Arguments, Formal Arguments; Function Definition; Methods to Call a Function: Call by Value, Call by Reference; Passing Arrays as Parameters; Storage Classes; Pointers: Declaration of Pointer Variables; Pointer Arithmetic; Pointers and Arrays, Pointer and Character Strings, Array of Pointers, Pointers as Function Arguments; Structures; Unions; Array of Structures; Array of Union; Pointers and Structures; Enumerations.	8 Hours	1
IV	File Handling: Opening a File, Closing a File, File-Opening Modes, Reading from and Writing to a File, Copying Content of an Existing File to another, File Handling Library Functions; Command Line Arguments; Preprocessor Directives; Header Files: stdio.h, conio.h, math.h, stdlib.h, setjmp.h, signal.h, time.h, stdarg.h, graphics.h.	8 Hours	1

Suggested Readings:

1. E.Balagurusamy, "Programming in ANSI C", TMH Publications.
2. Reema Thareja, "Programming in C", OXFORD University Press.
3. Peter Norton's, "Introduction to Computers", TMH Publications
4. Kernighan, Ritchie, "The C Programming Language", PHI Publications
5. Yashwant Kanitakar, "Let us C", BPB Publications

BCA3104: Mathematics I

Course Objective:

1. To understand the basic concepts of mathematics.
2. To get the knowledge about the matrices, determinants and limits.
3. To study the basics of differential and integral calculus.

Learning Outcome: On completion of this course students will be able to:

1. Evaluate derivatives for complexly constructed elementary functions.
2. Evaluate definite and indefinite integrals.
3. Evaluate limits using algebraic, geometric, analytic techniques.
4. Demonstrate proficiency in calculus.
5. Evaluate matrices and Determinants.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Determinants: Definition, Minors, Cofactors, Properties of Determinants. Matrices: Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint, Inverse, Cramer's Rule, Rank of Matrix Dependence of Vectors, Eigen Vectors of a Matrix, Caley-Hamilton Theorem.	8 Hours	1
II	Differential Calculus: Successive Differentiation, Leibnitz's theorem, Taylor's Series, Maclaurin's series, Rolle's theorem, Mean value theorem, Maxima and Minima, Point of Inflexion; Tangent and Normals of simple curve Partial Differentiation, Definition and examples of Curvature, Asymptotes, Tracing of Curves.	8 Hours	1
III	Integral Calculus: Integral as Limit of Sum, Definite Integrals, Multiple Integrals, Quadrature, Rectification, Volume and Surface of Revolution.	8 Hours	1
IV	Differential Equations, Solutions with separation variable, homogenous equation, Linear equation, reducible to variable separable, reducible to homogenous and first order linear differential equation with constant coefficient.	8 Hours	1

Suggested Readings:

1. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company, 9th Revised Edition, 2001
2. Shanti Narayan, "Integral Calculus", S. Chand & Company
3. Shanti Narayan, "Differential Calculus", S.Chand & Company

BCA3151: Digital Electronics Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of Gates.2. State & Prove De Morgan's Law.3. Verification of Expressions using Gates.4. Verification of various gates (NOT, OR, AND, Ex-OR, Ex-NOR) using universal gates. (NAND & NOR).5. Implementation of Adders & Subtractors.6. Implementation of Code Converters.7. Implementation of Parity Checker & Generators.8. Implementation of Parity Magnitude Comparator.9. Design and Implementation of Combinational Circuits.	1
II	<ol style="list-style-type: none">1. Proving of Characteristic table of different Flip Flops.2. Prove the Conversion Logic of various Flip Flops.3. Design & Prove the State Table and State Diagram of various flip flop input functions.4. Design of sequential Circuit using different Flip Flops.5. Design of various counters using various Flip Flops.6. Design the sequential circuit using a 2-bit register and combinational gates.7. Design and Implementation of BCD Counters.8. Design and Implementation of Ripple Counter.9. Construct the Johnson Counter.	1

BCA3152: 'C' Programming Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of Fundamental Data Types.2. Implementation of Fundamental Operators.3. Implementation of Conditional Program such as if, switch etc.4. Implementation of Basic Control Constructs such as for loop, while loop, do while loop.5. Implementation of Functions.	1
II	<ol style="list-style-type: none">1. Implementation of Advance Control Constructs such as Arrays & structures etc.2. Implementation of Pointers.3. Implementation of Pointers as Function Arguments.4. Implementation of File.5. Implementation of Command Line arguments.	1

II Semester

BCA3201: Basics of Data Structures Using 'C'

Course Objective:

1. The objective of this course is to make the student learn fundamental data structures algorithms.
2. The course describes and implements algorithms such as stacks, queues, linked lists, trees, searching techniques, sorting techniques, hashing techniques and graphs.
3. Comprehend alternative implementations using the differing logical relationships and appreciate the significance of choosing a particular logical relationship for implementation within real-world setting.
4. Demonstrate the ability to plan, design, execute and document sophisticated technical programs to handle various sorts of data structures.
5. Be familiar with the use of data structures as the foundational base for computer solutions to problems.
6. Become introduced to and investigate the differing logical relationships among various data items.

Learning Outcome: Having successfully completed this course, the student will be able to:

1. Apply advance C programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for particular problems.
2. Design and implement abstract data types such as linked list, stack, queue and tree by using C as the programming language using static or dynamic implementations.
3. Analyse, evaluate and choose appropriate abstract data types and algorithms to solve particular problems.
4. Design and implement C programs that apply abstract data types.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Data Structures: Classification of Data Structure, Operations on Data Structure, Dynamic Memory Allocation, Types of Case Analysis. Arrays: Address Calculation, Application of arrays, Limitation of Array, Application of Arrays, Array as Parameters, Sparse Matrices.	8 Hours	1
II	Continuous Implementation (Stack): Array Representation, Operations on Stacks: Push & Pop, Applications of stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Recursive Definition and Processes, Principles of Recursion, Tower of Hanoi Problem, Recursion Vs. Iteration Continuous Implementation (Queue): Array representation and implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty Queue, Circular Queue, Dequeue and Priority Queue.	8 Hours	

III	Non Continuous Implementation: Link Lists: Linear List concept, List v/s Array, Linked List Terminology, Representation of Linked List in Memory, Types of Linked List, Single Linked List, Doubly Linked List, Single Circular Linked list, Circular Doubly Linked List, Operations on Link List: Create List Insert node (empty list, beginning, middle, end), Delete node (first, general case), Traversing node, Searching node, Print list, Count Nodes, Sort Lists.	8 Hours	1
IV	Trees: Introduction to Tree & its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (Inorder, Preorder, Postorder), Tree Expression, Binary Search Tree, Insertion and Deletion in BST. Graph Terminology. Sorting & Searching Techniques: Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Sequential Search, Binary Search.	8 Hours	1

Suggested Readings:

1. Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C and C++", Pearson Education Asia, 2nd Edition, 2002.
2. Ellis Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi.
3. S. Lipschutz, "Data structures", Mc-Graw-Hill International Editions, 1986.
4. Jean-Paul Tremblay, Paul. G. Soresan, "An Introduction to Data Structures with Applications", Tata Mc-Graw-Hill International Editions, 2nd edition 1984.
5. A. Michael Berman, "Data Structures via C++", Oxford University Press, 2002.
6. M. Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2nd Edition, 2002.

BCA3202: Basics of Operating System

Course Objective:

1. To provide a good understanding of the underlying concepts of operating systems.

Learning Outcome: Upon successful completion of the course the student will:

1. Understand the principles and techniques used to implement processes and threads as well as the different algorithms for process scheduling.
2. Understand the mechanisms used for process synchronization & handling deadlock.
3. Understand the concept of memory management and virtual memory.
4. Understand the file system structure and storage management.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction and Process Management: Operating System: System Components, System Calls and its types, System Programs; Types of Operating System; Operating System Structure: Simple Structure, Layered Approach, Microkernels, Exokernels; Virtual machine; Introduction to Process: Process States, Process Control Block; Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Scheduling Objectives, Scheduling Criteria; Scheduling Algorithms: First Come First Serve, Shortest Job First, Round Robin, Priority; Multiple- Processor Scheduling; Real-Time Scheduling; Multilevel Feedback Queue Scheduling; Threads.	8 Hours	1
II	Process Synchronization and Deadlocks: Critical-Section Problem; Peterson's Solution; Semaphore: Usage of Semaphore; Classical Problems of Synchronization: Producer Consumer, Readers-Writer, Dining Philosophers; Deadlock System Model; Deadlock Characterization: Necessary Condition, Resource-Allocation graph; Deadlock Handling Methods: Deadlock Prevention, Deadlock Avoidance Mechanisms: Resource Allocation graph Algorithm, Banker's Algorithm, Deadlock Detection and Recovery.	8 Hours	1

III	Memory Management: Memory Management Strategies: Address Binding, Logical and Physical Address Space, Dynamic Linking; Swapping; Contiguous and Non-Contiguous Memory Allocation; Paging; Segmentation; Virtual Memory Management Concept; Demand Paging; Page Replacement Policies: Basic Page Replacement, FIFO Page Replacement, LRU Page Replacement, Optimal Page Replacement, Counting Based Page Replacement; Allocation of Frames: Minimum Number of Frames, Allocation Algorithm, Global Versus Local Allocation; Thrashing: Cause of Thrashing, Working Set Model.	8 Hours	1
IV	Storage Management: File Concept: File Attribute, File Operations, File Types, File Structure; File Access Method: Sequential Method, Direct Access Method; Directory Structure; File System Implementation: File System Structure, Allocation Methods, Free space Management; Secondary Storage Structure: Disk Structure, Disk Scheduling Algorithms, Disk Management.	8 Hours	1

Suggested Readings:

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", Addison-Wesley.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall.
3. Milan Milankovic, "Operating Systems, Concepts and Design", TMH.
4. William Stallings, "Operating Systems: Internal and Design Principles", PHI.
5. D M Dhamdhare, "Operating System- a Concept based Approach", McGraw Hill Education.

BCA3203: Basics of System Analysis & Design

Course Objective:

1. To presents a comprehensive introduction to the system analysis and design skill in information management.
2. To provide the students with the skills to identify business problems which may be solved by technology based solutions and develop design which form the basis for implementing systems as well as a strong foundation in systems analysis and design concepts, methodologies, techniques and tools.
3. This also include waterfall model (system development life cycle), system analysis and Design Technique (Process Modeling (DFDs), Logical Modeling (decision tree, decision table, structured English).

Learning Outcomes: On completion of this course students will be able to:

1. Describe the different phases of systems development life cycle.
2. Describe the different fact-finding techniques in system analysis and design.
3. Explain different methodologies of analysis and design of information systems.
4. Describe the concepts and theories of systems approach.
5. Design appropriate information systems.
6. Manage the development of systems based on system specifications.
7. Manage implementation and maintenance of information systems.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	Overview of Systems Concepts: Introduction to System Concept: Characteristics of the system, Elements of a System, Types of Systems, Physical and Abstract System, Open and Closed System, Formal and Informal System; Types of Information System, Needs of Information Systems, Qualities of Information System; Software Development Life Cycle (SDLC); Role and Attributes of System Analyst.	8 Hours	1
II	System Analysis: Fact Finding Technique (Information gathering tools): Review of Literature, On-Site observation, Interviews and Questionnaires; The Tools of Structured Analysis: Data Flow Diagram, Components of a DFD, Zero Level DFD, DFD Transformation and Decomposition, Context Diagram, Leveling a DFD; Data Dictionary, Structured English, Decision Tree, Decision Table, Feasibility Study: Economic Feasibility (Cost & Benefit Analysis), Organizational Feasibility, Technical Feasibility, Behavioral Feasibility study, Steps in Feasibility study.	8 Hours	1

III	System Design: Process of Design: Logical and Physical Design, Structured Design, Functional Decomposition. Form Design, Classification of Forms, Requirement of Form Design, Input Design, Output Design.	8 Hours	1
IV	System Testing And Quality Assurance: System Testing, Types of System Tests, Quality Assurance, Quality factors specifications, Levels of Quality Assurance. Audit Trail; Software Maintenance. Hardware and Software Selection Procedure	8 Hours	1

Suggested Readings:

1. Elias Awad, "Systems Analysis and Design", Galgotia Publications.
2. V. Rajaraman, "Analysis & Design of Information System", PHI.
3. Hussain & Hussain, "Information Systems Analysis, Design and Implementation", McGraw Hill

BCA3204: Data Communication & Computer Networks

Course Objective:

1. To introduce basic elements of communication system.
2. Techniques, channels and devices used to transmit data between distant locations.
3. To introduce the functions of different layers.
4. Understand different protocols and network components.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Describe and analyze the hardware, software, components of a network.
2. Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
3. Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
4. Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Data Communications: Basic Data Communication System: Data, Signaling and Transmission System; Synchronous and Asynchronous Transmission; Transmission modes: Serial and Parallel; Simplex, Half Duplex and Full Duplex Transmission; Transmission media: Guided and Unguided , Wired and Wireless; Transmission Impairment and issues in wired and wireless communication; Bandwidth Band and Channel Capacity: Nyquist Capacity Formula, Shannon Capacity Formula; Modulation; Multiplexing: SDM, FDM, TDM, WDM; Switching; PSTN & ISDN: Narrowband and Broadband; Frequency Spectrum and Type of Data Communication System: Satellite and Terrestrial; Infrared and Optical Communication.	8 Hours	1
II	Introduction to Computer Network: Definition; Goals and Application of Computer Network; Types of Network: Based on Architecture (Point to point, Multipoint), Based on Topology (Bus, Star, Ring, Mesh, Tree, Hybrid), Based on Size Technology and Ownership (PAN, LAN, MAN, WAN), Based on Computing (Centralized, Distributed and Collaborative), Based on Connection Management (Connection-Oriented and Connectionless Communication); Introduction to Internet, Intranet, Extranet, VPNS. Network Architecture: Network Architecture: Monolithic v/s Layered Approach; Design Issues of Layered approach; Services, Interfaces, Standards and Protocols; Protocol Hierarchies; ISO-OSI Reference Model and TCP/IP Model ; Concept of Subnet & Host-to-Host Communication; Intermediate Devices: Repeaters and Regenerators, Hub, Switch, Router, Gateway. Subnet Communication: Physical Layer: Design Issues, Services provided to the Upper Layer, Physical Layer Protocols: Analog (RS232) & Digital(X.21); Data Link Layer: Design Issues; Services Provided to Upper Layer: Framing, Error	8 Hours	1

	Control, Flow Control, Link Management, Acknowledgement; Logical Link Control(LLC) Sub-layer and Protocols (BISYNC , HDLC); MAC Sub-layer: Static and Dynamic Channel Allocation; MAC Protocols: Unrestricted Simplex Protocol, Stop-and-wait Protocol, Sliding Window Protocols, Pure and Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA		
III	Subnet Communication: LAN Protocols: IEEE 802.3, 802.11, 802.15, 802.16; Frame Relay; Cell Relay and ATM Network Layer: Design Issues; Services provided to the Upper Layer: Routing, Congestion Control, Quality of Service, Internetworking; Routing Algorithms: Centralized and Distributed Routings; IP Addressing: IPV4 & IPV6, ICMP, IPSec, Firewalls. Host-to-Host Communication: Transport Layer: Design Issues , Services provided to the Upper Layer; Connection Management, Multiplexing, Segmentation and Reassembly Host-to-Host Flow Control, Acknowledge and Error Control; Transport Protocol: Connection-oriented TCP and Connection-less UDP, Secure Transport layer through SSL	8 Hours	1
IV	Host-to-Host Communication (Contd.): Session Layer: Design Issues, Services provided to the Upper Layer; Logical Session Management, Quality of Service, Token Management; Synchronization; Event Management; Exception Handling. Presentation Layer: Design Issues, Services provided to the Upper Layer; Data Presentation, Compression and Encryption; Data Compression: Text, Image, Audio and Video; Cryptography; Symmetric and Asymmetric Encryption; Private Key and Public Key Encryption; DES, AES and RSA Algorithms; Digital Signature; Message Digest; Application Layer Protocols: Design Issues, Services provided to the Upper Layer: HTTP, HTTPS, Internet Browser, FTP, Telnet, DNS, Email System (POP, IMAP, SMTP, MIME), SNMP	8 Hours	1

Suggested Readings:

1. W. Stallings, "Data and Computer Communication", Pearson Education.
2. A. S. Tanenbaum, "Computer Network", 4th, Edition, Pearson Education.
3. Forouzan, "Data Communication and Networking", 2nd Edition, Tata McGraw Hill.
4. W. Stallings, "Computer Network with Internet Protocols", Pearson Education.
5. Eugene Blanchard "Introduction to Networking and Data Communications".
6. J. Martin "Computer Network and Distributed Data Processing", PHI.

BCA3205: Basics of Computer Organization and Architecture

Course Objective:

1. To provide a good understanding of the underlying concepts of Computer organization.
2. Explain Computer performance measurement methods.
3. Student should learn how to quantitatively evaluate different designs and organizations.
4. Student should be able to articulate design issues in the development of processor or other components that satisfy design requirements.

Learning Outcome: Upon successful completion of the course the student will:

1. Describe software and hardware interaction layers in computer architecture.
2. Describe various machine language instructions.
3. Be familiar with the terminology and basic principles of Computer organization systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Register Transfer and Micro-operation: Register Transfer Language: Register Transfer, Bus and Memory Transfer; Micro operations: Arithmetic, Logical, Shift Micro-operations; Arithmetic logic shift unit; Timing and control; Instruction codes; Computer instructions; Machine language instructions. Basic Computer Organizations and Design: Instruction Cycle; Memory Reference Instructions; Register Reference Instructions; Input-Output Instructions; Design of Accumulator Logic Shift Unit; Instructions Format.	8 Hours	1
II	Central Processing Unit: Accumulator based organization; General register organization; Stack organization; Addressing modes; RISC vs. CISC; Hard wired & micro programmed control Unit. I/O Organizations: Introduction to system buses; Input/ output interface; Interrupt and Interrupt handling: S/W Interrupt, Daisy Chaining, Priority Interrupt; Device Polling; Serial Vs Parallel communications; Synchronous Data Transfer; Synchronous Data Transfer methods: Strobe Control, handshaking; Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O; DMA: DMA Controller, DMA Transfer.	8 Hours	1
III	Memory organization: Memory hierarchy, Main Memory: RAM Chips, ROM Chips; Concept of address space & Memory Space; Address Mapping; Auxiliary Memory; Cache memory; Mapping Techniques: Direct mapping, Associative mapping, Set associative mapping; Associative memory.	8 Hours	1

IV	Microprocessor & Concept of Parallel Processing: Introduction to 8085 microprocessor with instruction set and programming concepts; Uniprocessor System; Multiprocessor System; Pipelining Vs Parallelism; Flynn's and Fang's Classification; Introduction to multithreading; multi-core processors and shared memory microprocessor.	8 Hours	1
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Suggested Readings:

1. M. Morris Mano, "Digital Logic & Computer Design", PHI
2. R. P. Jain, "Modern Digital Electronics", TMH
3. M. Morris Mano, "Computer System Architecture", PHI
4. B. Ram, "Computer Fundamental Architecture & Organization", NewAge
5. William Stalling, "Computer Organization & Architecture", Pearson Education Asia
6. V. Carl Hamacher, "Computer Organization", TMH
7. B. Ram, "Fundamentals of Microprocessor & Microcomputers", NewAge

BCA3251: Basics of Data Structures Using 'C' Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of Arrays (Single & Double Dimension).2. Implementation of String.3. Implementation of Recursive Procedures.4. Array implementation of Stack.5. Array implementation of Queue.6. Array implementation of Circular Queue.7. Array implementation of Linked List.8. Implementation of Stack using dynamic memory allocation.9. Implementation of Queue using dynamic memory allocation.10. Implementation of Circular Queue using dynamic memory allocation.11. Implementation of Linked List using dynamic memory allocation.	1
II	<ol style="list-style-type: none">1. Implementation of Binary tree.2. Implementation of Linear Search.3. Implementation of Binary Search.4. Implementation of Bubble sort.5. Implementation of Merge sort.6. Implementation of Insertion sort7. Implementation of Selection sort.8. Implementation of Quick sort.	1

BCA3252: Basics of Computer Organization Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Study Architecture of 8085 and familiarization with its Software mnemonics of Microprocessor 8085.2. Write a program using 8085 & verify for :<ol style="list-style-type: none">A. Addition of two 8-bit numbers.B. Addition of two 16-bit numbers (with carry).3. Write a program using 8085 & verify for :<ol style="list-style-type: none">A. Subtraction of two 8-bit numbers. (display of borrow)B. Subtraction of two 16-bit numbers. (display of borrow)4. Write a program using 8086 for arranging an array of numbers in descending order & verify.5. Write a program using 8085 for finding First and second6. Complement of an 8-bit number.7. Write a program using 8085 for finding first and second Complement of 16-bit number.8. Write a program using 8085 for left shift 8-bit number by 2.9. Write a program using 8085 for left shift 16-bit number by 2.	1
II	<ol style="list-style-type: none">1. Write a Program using 8085 for masking 8-bit number.2. Write a program using 8085 for. Largest and Smallest number in an array.3. Write a program using 8085 to find table of any number.4. Write a program using 8085 to Sum of elements in an array.5. Write a program using 8085 for Sorting in Ascending and Descending Order of 8-bit number.	1

BCA3301: Basics of Design & Analysis of Algorithm

Course Objective:

1. To know the importance of studying the complexity of a given algorithm.
2. To study various algorithmic design techniques.
3. To utilize data structures and/or algorithmic design techniques in solving new problems.
4. To know and understand basic computability concepts and the complexity classes P, NP, and NP-Complete.
5. To study some techniques for solving hard problems.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
2. Apply the algorithms and design techniques to solve problems.
3. Analyze the complexities of various problems in different domains.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Basic Concepts of Algorithms: Definition of algorithm; Characteristic of algorithm; Pseudo Codes & Time Complexity of Basic Control Structures; Time and Space Complexity of Insertion Sort; Selection Sort; Heap Sort ; Bubble Sort; Asymptotic Notations (Growth of Functions).	8 Hours	1
II	Divide and conquer: Binary Search, Maximum & Minimum, Merge Sort, Quick Sort, Strassen's matrix multiplication; Greedy Method: General method, Knapsack Problem, Travelling Salesman problem, Job Sequencing with deadline, Optimal Storage on tapes, Huffman Codes, An Activity Selection Problem.	8 Hours	1
III	Dynamic Programming: Assembly Line Scheduling, Matrix Chain Multiplications, Longest Common Subsequence; Backtracking: General method, N Queens Problem, Sum of subsets, Hamiltonian Circuit Problem.	8 Hours	1
IV	Branch & Bound: Introduction, Live Node, Dead Node and Bounding Functions, Travelling Salesman Problem, Knapsack Problem, Assignment Problem; Analysis of Graph Algorithms: Elementary Graph Algorithms, Multistage Graphs, Minimum Spanning Trees: Kruskal's & Prim's Algorithm, Single Source Shortest Path: Dijkstra's & Bellman Ford, All Pairs Shortest Path: Warshal Algorithm, Maximum Flow: Ford Fulkerson Algorithm	8 Hours	1

Suggested Readings:

1. Thomas H. Cormen, "Introduction to Algorithms", PHI.
2. Horowitz & Sahani, "Fundamental of Algorithms", Galgotia.
3. Aho, "Design & Analysis of Computer Algorithms", Pearson.
4. Johnsonbaugh, "Algorithms", Pearson.
5. Bressard "Fundamental of Algorithm", PHI.
6. Jon Kleinberg and Eva Tardos "Algorithm Design", Pearson Education, 2006.

BCA3302: Data Base Management Systems

Course Objective:

1. To present the fundamental concepts of Database Management.
2. To develop skill of Database Design, Database Languages and Database-System Implementation with respect to Relational Database Management System.
3. To develop the concepts of Transaction Processing System, Concurrency control and Recovery procedures in database.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the basic concepts of the database and data models.
2. Design a database using ER diagrams and map ER into Relations and normalize the Relations.
3. Develop a simple database applications using normalization.
4. Acquire the knowledge about different special purpose databases and to critique how they differ from traditional database systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Database System Concepts, Database Users, and Architecture: Introduction to Database System with example, Introduction to Traditional File Oriented System, Characteristics of the Database Approach, Components of Database System, Database Users, Advantages and disadvantages of Using a DBMS, Structure of DBMS, Database Schemas and Instances, DBMS Architecture (ANSI/SPARC), Data Independence, Database Languages and Interfaces, Classification of Database Management Systems.	8 Hours	1
II	Data Modeling & Relational Database Management System: Data Modeling Using the Entity-Relationship Model: Entity Types, Entity Sets, Attributes, and Keys, Relationships, Relationship Types, Rules, and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, and Design Issues. The Relational Data Model, Relational Constraints, and the Relational Algebra: Relational Model Concepts, Codd's Rules for relational algebra, Relational Database Schemas, Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra.	8 Hours	1

III	<p>SQL and Database Design Theory and Methodology</p> <p>Structured Query Language- The Relational Database Standard: Data Definition, Constraints, and Schema Changes in SQL, Types of SQL Commands, SQL Operators and their Procedure, Insert, Delete, and Update Operations and Dealing with Constraint Violations, Queries and Sub Queries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views (Virtual Tables) in SQL.</p> <p>Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Armstrong Rules, Closure of Attributes, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.</p>	8 Hours	1
IV	<p>Transaction Processing, Concurrency Control and Distributed Database: Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Recoverability in Transaction, Concurrency Control Techniques, Locking Techniques for Concurrency Control, Concurrency Control Based on. Timestamp Ordering, Introduction to Distributed Database.</p>	8 Hours	1

Suggested Readings:

1. Date C. J.—An Introduction to Data Base System, Addison Wesley.
2. Korth, Silbertz, Sudarshan —Data Base Concepts, McGraw-Hill.
3. Elmasri, Navathe —Fundamentals Of Data Base Systems, Addison Wesley.
4. Bipin C. Desai —An introduction to Data Base Systems, Galgotia Publication.
5. Ramakrishnan, Gehrke —Data Base Management System, McGraw-Hill.
6. Connolly & Begg —Database Systems: A Practical Approach to Design, Implementation and Management, Pearson Education.
7. R. S. Deshpande --SQL/PL SQL for Oracle.
8. Ivan Bayross -- SQL, PL/SQL: The Programming Language Of Oracle

BCA3303: Object Oriented Programing using Java

Course Objective:

1. To introduce the fundamental concepts of Object Oriented Programing.
2. To develop the strong knowledge of core Java programming.
3. To impart foundation and develop skills of Web Development through Java Programming.

Learning Outcome: Students who have successfully completed this course will have full understanding of the following concepts:

1. This subject will help to improve the analytical skills of object oriented programming.
2. Overall development of problem solving and critical analysis
3. Develop the understanding of java technology.
4. To develop the skills of core java programming.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Java: Introducing Object-Oriented Programming, Evolution of Java; Comparing Java with C++;History; Java Features: Byte Code and Java Virtual Machine; Structure of Java Program; Compiling and Interpreting Applications; Java Tokens; Java Character set; Keywords and Identifiers, Primitive Data types Declarations, Non-Primitive data types; Operators and Expressions; Implicit and Explicit Type Conversions: The Cast Operator; Control Statements; Array and String: Single and Multidimensional Array, String class, String Handling: String Buffer class, Operations on string, Command line argument, Use of Wrapper Class. Class, Object, Object reference, Constructor, Constructor Overloading, Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize() method, Access control, modifiers, Nested class, Inner class, Anonymous inner class, Abstract class.	8 Hours	1

II	<p>Classes, Objects and Methods: Data Hiding; Introduction to Class, Object, Object reference, Object Oriented Concepts: Abstraction and Encapsulation, Access Controls; Inheritance and Interface: Use of Inheritance, Inheriting Data members and Methods, constructor in inheritance, Multilevel Inheritance– method overriding Handle multilevel constructors– super keyword, Stop Inheritance-Final keywords, Creation and Implementation of an interface, Interface reference, instance of operator, Interface inheritance, Dynamic method dispatch ,Understanding of Java Object Class, Comparison between Abstract Class and interface Polymorphism: Methods in Java; Access Modifiers; Constructor Overloading, Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize() method, Understanding of System.out.println – statements.</p>	8 Hours	1
III	<p>Packages: Defining Packages, The import Statement, Package Scope, CLASSPATH and Import; Vectors class; Exception Handling: Exceptions Overview, Types of Errors, Types of Exceptions, Try, Catch and Finally Block, Defining and Throwing Exceptions; Multithreading in java: Thread and its States, Creating thread form Thread class, Creating Thread from Runnable Interface, Thread control Priorities; daemon threads. Enumerations, auto boxing, annotations, generics. IO Programming: Introduction to Stream, Byte Stream, Character stream, Readers and Writers, File Class, File Input Stream, File Output Stream, Input Stream Reader, Output Stream Writer, File Reader, File Writer, Buffered Reader; Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Introduction to AWT: AWT controls, Layout managers.The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups. Choices, lists panels – scrollpane, dialogs, menubar, graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.</p>	8 Hours	1
IV	<p>Java Swing, Hierarchy of Java Swing classes, Methods used in Java Swing Applet Basics: Types of an Applet, The Applet Class, Applet Life Cycle, Applet Tag and Adding Applet to HTML File, Passing Parameters and Running The Applet;JavaServlets:Introduction,HTTPServletBasics,TheServletLifecycle,RetrievingInformation, Sending HTML Information, Session Tracking, Database Connectivity. Java Server Pages: Introducing Java Server Pages, JSP Overview, Setting Up the JSP Environment, GeneratingDynamicContent,UsingCustomTagLibrariesandtheJSPStandard Tag Library, Processing Input and Output</p>	8 Hours	1

Suggested Readings:

1. H. Schildt, "The Complete Reference JAVA", Seventh Edition Mc Graw Hill
2. Balagurusamy E, "Programming in JAVA", Second Edition TMH
3. Dr.C Muthu,"Programming with JAVA, Second Edition McGraw-Hill
4. CISTems School of computing Jaipur,"Internet: An Introduction"
5. R.Krishnamurthy and S.Prabhu,"Internet and Java Programming", New Age Publications
6. Udit Agrawal,"Internet and Java Programming", Dhanpat Rai & Co

BAS3304: Environmental Studies

Note: The Syllabus of Environmental Studies will be approved by the Board of Studies of School of Applied Sciences

BCA3305: Discrete Mathematics & Graph Theory

Course Objective:

1. Students should be able to distinguish between the notion of discrete and continuous mathematical structures.
2. Students should be able to understand the basic concepts of set theory.
3. Students should be able to apply fundamental counting algorithms to solve applied problems in the area of computer science.
4. Students should be able to prove mathematical statements by means of inductive reasoning.
5. Students should be able to understand the principle of recursion and apply it to the study of sequences and sets.

Learning Outcomes: On completion of this course students will be able to:

1. Verify the correctness of an argument using propositional and predicate logic and truth tables.
2. Demonstrate the ability to solve problems using counting techniques and combinatorics.
3. Solve problems of recurrence relations and generating functions.
4. Use graphs and trees as tools to visualize and simplify network related problems.
5. Perform operations on discrete structures such as sets, functions, relations, and sequences.
6. Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases and mathematical induction.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Discrete Numeric Function and Recurrence Relation: Numeric Function; Generating Function; Recurrence Relation: Linear Recurrence Relation with Constant Coefficients, Homogeneous and Particular Solution, Total Solution, Solution by Method of Generating Function.	8 Hours	1
II	Counting Techniques & Probability: Basics of Counting; Sum and Product rules; Pigeonholes Principle; Combinations and Permutations: Generalized Permutations and Combinations; Probability: Some Basic Concepts, Types of Events, Probability of an Event, Conditional Probability.	8 Hours	1
III	Fundamentals of Logics: Introduction, Proposition, First order Logic, Logical Operation, Truth Values, Compound Proposition, Tautologies, Contradiction, Logical Equivalences, De- Morgan's laws, Duality, Predicates, Universal and Existential Quantifiers.	8 Hours	1
IV	Graph: Simple Graph, Multi Graph, Graph Terminology, Bipartite, Regular and Planar Graph, Directed Graph, Euler Graphs, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number, Weighted Graphs, Shortest Path in Weighted Graphs. Tree: Trivial and Non-Trivial Tree, Rooted Tree, Distance and Centers in a Tree, Path Length in Rooted Tree,	8 Hours	1

	Spanning Tree, Minimal Spanning Tree, Kruskal's and Prim's Algorithms.		
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Suggested Readings:

1. J. P. Tremblay and R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", TMH, New Delhi, 2000.
2. Kolman, Busby and Ross "Discrete Mathematical Structures" PHI/Pearson., 6th Ed., 2009.
3. Kenneth H. Rosen, "Discrete Mathematics & Applications", TMH, 6th Ed., 2007.
4. C. L. Liu, "Elements of Discrete Mathematics", McGraw Hill Book Company, 2nd Ed., 1985.
5. Narsingh Deo, "Graph Theory", PHI, 24th Indian Print, 2003.

BCA3351: Data Base Management Systems Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Use of DDL for creating objects (Table, Database).2. Use of DML for performing retrieval operations.3. Use of DCL for specifying constraints on tables.4. Use of commands for aS Changes in SQL.5. Use of Aggregate Functions.6. Use of Different Operators in SQL.7. Use of String Functions.	1
II	<ol style="list-style-type: none">1. Grouping of Records.2. Ordering of Records.3. Creating and Performing various operations on Views.4. Performing Subqueries.5. Performing queries for Union & intersection, difference, Cartesian product and division.6. Performing queries for various Joins.	1

BCA3352 Object Oriented Programming Using Java Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of Fundamental Data Types & Testing and Debugging of Programs.2. Implementation of Basic Control Constructs such as loops etc3. Implementation of Advance Control Constructs such as Arrays etc.4. Implementation of classes & objects5. Implementation of Methods in Java.6. Implementation of Type Conversions.7. Implementation of constructors.8. Implementation of Inheritance.9. Implementation of Interface.10. Implementation of Polymorphism.11. Implementation of String Handling.12. Implementation of Access Specifiers.13. Implementation of super keywords14. Implementation of Structure (Linked list)	1
II	<ol style="list-style-type: none">1. Implementation of Abstract Class, Interfaces & Packages.2. Handling of Multiple Threads.3. Implementation of Exception Handling.4. Implementation of Input Output Streams.5. Implementation of connection of Database in console based programs6. Implementation of Applets for display of Images, Texts and Animations etc.7. Use of AWT controls8. Implementation of Event Handling9. Use of Layout Manager for creating different applications.10. Implementation of MySQL Database connection in Java Frame.11. Implementation of My Access(Excel Sheet) Database connection in Java Frame.	1

BCA3401: Basics of Python Programming

Course Objectives:

1. Appreciate the basic and advanced features of core language.
2. Handle and control system/OS level features.
3. Design and implement basic applications with database connectivity.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Acquire programming skills in core Python.
2. Develop the skill of designing Graphical user Interfaces in Python
3. Develop the ability to write database applications in Python

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Python, Variables, Expressions and Statements: Introduction to Python: Interactive mode and script mode, difference b/w python 3 and python, Keywords, Statement, Indentation and Comment, Structuring Python Programs, scripting, Expressions and Values, Variables, Input and output, operators and operator precedence, conditional statement, Loops and Control Statements (continue, break and pass), Multiple line statements, Printing Information, Getting Information from the Keyboard.	8 Hours	1
II	Conditional and Looping Construct, Functions: if - else statement and nested if – else while, for, use of range function in for, Nested loops, break, continue, pass statement, Use of compound expression in conditional constructs, Built-In Function, invoking built in functions, Module(Importing entire module or selected objects using from statement), Functions from math, random, time & date module, User Define Function: Defining, invoking functions, passing parameters (default parameter values, keyword arguments), Scope of variables, void functions and functions returning values.	8 Hours	1
III	Strings: Introduction to String, Working with Text: Creating Strings of Characters, Using Special Characters in Strings, Creating a Multiline String, String functions concepts & their use, String operators: +, *, in, not in, range, slice [n:m], String built in functions & methods: len, capitalize, find, isalnum, isalpha, isdigit, lower, islower, isupper, upper, lstrip, rstrip, isspace, istitle, partition, replace, join, split, count, decode, encode, swap case, Strings constants.	8 Hours	1
	Lists, Tuples, Sets, Dictionaries: Concept of mutable lists, creating, initializing and accessing the elements of list, List operations (Concatenation, Repetition, Membership, list		

IV	slices), List comprehensions, List functions & methods: len, insert, append, extend, sort, remove, reverse, pop, Immutable concept, creating, initializing and accessing the elements in a tuple; Tuple functions: cmp(), len(), max(), min(), tuple(), Concept of Sets , creating, initializing and accessing the elements of sets, Concept of key-value pair, creating, initializing and accessing the elements in a dictionary, Traversing, appending, updating and deleting elements.	8 Hours	1
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Suggested Readings:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning, ISBN: 978-1111822705.
2. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
3. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey , Jeffrey Elkner, 2015
4. David Beazley , Brian K. Jones “Python Cookbook”, 3rd Edition. O’Reilly Publications
5. Jake VanderPlas “Python Data Science Handbook” O’Reilly Publications
6. David Beazley, “Python Essential Reference (4th Edition) “ Addison Wesley
7. Vernon L. Ceder,” The Quick Python Book, Second Edition”, Manning Publications
8. Brett Slatkin ,”Effective Python”
9. Learning Python By Mark Lutz,O’Reilly Publication
10. Programming with python, A users Book, Michael Dawson, Cengage Learning
11. Python Essential Reference, David Beazley, Third Edition

BCA3402: Numerical & Statistical Techniques

Course Objective:

1. To implement computational problems on machine.
2. To offer sound knowledge on statistical tools.
3. To compute the relevant statistical measures for different types of data.
4. To analyze the statistical data based on experiments.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. To apply statistical distributions for real life problems.
2. To draw valid inferences based on the analysis of statistical data.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Errors and Floating Point Numbers: Errors in numerical computation: Sources of Errors, Types of Errors; Representation of Floating point numbers: Arithmetic operations on Floating Point numbers, Normalization of Floating Point numbers, Pitfalls of Floating Point representation. Solution of Non Linear equations: Zero's of Single transcendental equations and zero's of polynomial: Bisection Method, Iteration or Successive Approximation Method, Regula-Falsi or False Position Method, Newton Rapson Method; Rate of Convergence of iterative Methods.	8 Hours	1
II	Solutions of Simultaneous Linear equations: Solution of System of Linear equation using Direct Method and pivoting: Gauss Elimination Method, Gauss Jordan Method, Matrix Inversion Method, ILL Conditioned System of Equations; Solution of System of Linear equation using Iterative Method: Gauss Jacobi iterative method, Gauss Seidel iterative method. Interpolation and Approximations: Finite Difference; Difference Tables; Polynomial Interpolation for equal intervals: Newton's Forward and Backward, Central Difference Formulas: Gauss Forward and Backward Formulas, Sterling's and Bessel's Formula; Polynomial Interpolation for Unequal intervals: Lagrange's Interpolation Formula, Newton divided difference Formula.	8 Hours	1
III	Numerical Differentiation and Integration: Numerical Differentiation of Polynomial Interpolation: Newton's Formulae, Central Difference Formulae; Numerical Integration: Trapezoidal Rule, Simpson's Rule. Solution of Ordinary Differential Equation: Introduction and Methods of Ordinary Differential Equation: Picard's Method, Euler's Method, Runge-kutta Method.	8 Hours	1

IV	<p>Curve Fitting: Curve Fitting using Method of Least Squares: Fitting of Straight Line, Fitting of Polynomial, Fitting of Exponential Curves etc.</p> <p>Statistics: Introduction, Review of Basic Statistics; Different Frequency Chart: Histogram, Frequency Curve, Pi-Chart etc.; Measurement of Central Tendency: Mean, Median, Mode; Measures of dispersion: Absolute Measure of Dispersion: Range, Inter Quartile Range; Relative Measure of Dispersion: Mean Deviation, Standard Deviation.</p>	8 Hours	1
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Suggested Readings:

1. Shastri S.S., “Numerical Analysis”, PHI.
2. Balaguruswami E, “Numerical Methods”, TMH Publications.
3. Gupta S.P., “Statistical Methods”, Sultan and Sons.
4. Rajaraman V., “Computer Oriented Numerical Methods”, PHI.
5. Kandasamy P. “Numerical Methods”, S. Chand Publications.

BCA 3403: Basics of .Net Framework & C#

Course Objective:

1. To present the fundamental concepts of Windows Desktop and Website development through Microsoft Technologies.
2. To impart solid foundation and develop the skill of Web Development through C# Programming.
3. To develop the concepts of static and dynamic Web Pages and make the students familiar with Client Server
4. Technology, Distributed Applications and Web Services.

Learning Outcome: Students who have successfully completed this course will have full understanding of the following concepts:

1. Develop the understanding of .Net technology.
2. Develop the skills in ASP.NET with C# Programming.
3. Understand the Microsoft Database Connectivity.
4. Will be able to understand the Static and Dynamic web pages.
5. Will be able to understand about Distributed applications.
6. Will be able to develop a light to medium weight website

Course Contents:

Module	Course Topics	Total Hours	Credits
I	.Net Framework: Introduction and Origin of .Net technology, Framework Components, Common Language Runtime(CLR) and FCL, Managed and Unmanaged Code, Common Type System (CTS) & Common Language Specification (CLS), Microsoft Intermediate Language (MSIL) and Metadata, Just-In-Time Compilation (JIT), Garbage Collection, Base Classes and Ms.Net Namespaces.	8 Hours	1
II	C# Basics: Introduction and Evolution of C#, Types, Identifiers, Variables, Constants, Literals, Type Conversion and Casting, Operators, Data Structures in C#: Enum, Arrays, ArrayList, Strings; Control Statements and Looping: If Statement, Switch Statement, For Loop, While Loop, Do While Loop, For each Loop; Object and Classes: Properties(Read, Write), Indexers, Inheritance (Multilevel and Hierarchical), Polymorphism (Operational and Inclusion), Operator Overloading, Interfaces, Delegates and Events, Boxing and Unboxing.	8 Hours	1
III	C# Libraries and .Net Advance Features: Input output (Streams Classes), Multithreading, Managing Consol I/O Operations, .NET Assemblies: Type of Assemblies, GAC (Global Assembly Cache), Global ASAX Files, State management: Session Object, Hidden Fields, View State, Cookies, Cross page posting; Web Configuration and Machine Configuration Files.	8 Hours	1

IV	Windows and Website Development: Windows Forms (A Skeletal Form Based Windows Program, Handling Messages, Adding a Menu and introduction and usage of various Windows Form Controls), Debugging, Exceptions and Error Handling, ASP.NET Web Form Controls (User controls and Server Controls) Web Services (UDDI, DISCO, WSDL), ADO.NET(Architecture, Difference between Dataset and Data Reader, Connection and Command Object, Distributed applications, Globalization and Localization, Authentication and Authorizations, XML in .NET.	8 Hours	1
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Suggested Readings:

1. Balagurusamy —Programming with c# —, Tata McGraw Hill Publication.
2. ASP.NET 3.0 Black Book II, Dreamtech Press.
3. Beginning ASP.NET3.0 II, WROX Publication.
4. Stephen C. Perry, Atul Kahae, Stephen Walther, Joseph Mayo, —Essential of .NET and Related Technologies with a focus on C#, XML, ASP.net and ADO.netl, Pearson, 2nd Edition.

BCA3404: Data Warehousing & Data Mining

Course Objective:

1. Understand the architecture of Data warehouse and its organization.
2. Introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors.
3. Describing and demonstrating basic data mining algorithms, methods, and tools.
4. Identifying business applications of data mining.
5. Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Define what knowledge discovery and data mining are; define the concept, structure and major issues of data warehousing.
2. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
3. Select and apply proper data mining algorithms to build analytical applications.
4. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques.

Course Content:

Module	Course Topics	Total Hours	Credits
I	Introduction: Data Mining Definition, Steps In Data Mining, Architecture Of Data Mining System, Types Of Data For Data Mining: Relational Databases, Data Warehouses, Transactional Databases, Adverse Data Information System And Advance Applications, Classification Of Data Mining Systems, Data Mining Task Primitives, Integration Of A Data Mining System With A Data Base Or Data Warehouse System, Major Issues In Data Mining, Approaches to Build A Data Warehouse, Building A Data Warehouse, Metadata & Its Types.	8 Hours	1
II	Data Preprocessing: Need of data preprocessing, descriptive Data Summarization: Measuring the crystal Tendency, Measuring the Dispersion of data, Graphic Display of Basic Descriptive Data Summaries, Data cleaning, Data Integration and transformation, Data Reduction. Data Warehouse and OLAP Technology: Data warehouse, differences between operational Database systems and Data warehouses, Multidimensional data model. A three- tier data warehouse architecture.	8 Hours	1

III	Mining Frequent Patterns: Basic concepts Frequent Item set mining method: the Apriori Algorithm, Generating Association Rules from frequent item sets. FP-Growth Algorithm: FP Tree Representation. Frequent item set Generation in FP- Growth Algorithm.	8 Hours	1
IV	Classification: General Approach to solving classification problems, Classification by decision Tree Induction: Attribute selection measure, Tree pruning, Bayesian Classification: Bayes' Theorem Rule based classification, Nearest neighbor classifier. Evaluating the performance of a classifier: Holdout Method, Random sub sampling, cross-validation.	8 Hours	1

Suggested Readings:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques" Elsevier.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", PHI
3. Max Bramer, "Principles of Data Mining", Springer

BCA3405: Computer Graphics

Course Objective:

1. This course is designed to provide a comprehensive introduction to computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. It provides a goal oriented approach to discuss the fundamental principles of computer graphics, the underlying mathematics and the algorithmic aspects of the computerized image synthesis process.

Learning Outcome: Upon successful completion of the course the student will:

1. Be able to discuss and implement the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
2. Be able to discuss future trends in computer graphics and quickly learn future computer graphics concepts.
3. Know and be able to select among models for lighting/shading and surfaces.

Module	Course Topics	Total Hours	Credits
I	Overview of Graphics Systems, Graphics Primitives and Scan Conversion: Classification, Characteristics, Components of Computer Graphics, Applications of Computer Graphics, Hardware devices for Computer Graphics Video Display Devices, Refresh CRT(Cathode Ray Tube),Raster Scan Displays, Random Scan Displays, Color CRT Monitors, Direct View storage Tubes (DVST),Flat Panel Displays, Raster Scan and Random Scan Systems, Display File & Buffer, Vector & Bitmapped Images, Scan Conversion, Line Drawing Algorithms, Circle Drawing Algorithms, Text Mode & Graphics Mode, Aliasing and Anti-Aliasing.	8 Hours	1
II	2D-Transformations & Segments: Geometric Transformations, Basic Transformations about origin, Translation; Scaling, Rotation, Reflection, Shearing, Combined Transformations, Scaling about an arbitrary point, Rotation about an arbitrary point, Reflection about an arbitrary Line, Segments , Segment Table, Functions for Segmenting the Display File, Default Error Conditions, Visibility.	8 Hours	1
III	Polygons, Windowing & Clipping: Inside and outside Tests of Polygon, Even-odd Method, Winding Number Method, Polygon Filling, 4-Connected & 8-Connected Pixel Concept, Filling Algorithms, Boundary Fill Algorithm, Flood Fill Algorithm, Edge-Fill Algorithm, Fence Fill Algorithm, Viewing Transformation, Window to View Port Transformation, Clipping, Point Clipping, Line Clipping, Cohen Sutherland Algorithm, Mid-point Subdivision Algorithm, Polygon Clipping, The Sutherland-Hodgman Algorithm, Weiler-Atherton Algorithm.	8 Hours	1

IV	Multimedia System: Introduction to Multimedia System, Applications of Multimedia, Multimedia Hardware & Software, Multimedia Building Blocks, Audio, Image, Video, Text & Animation, Multimedia Standards, MIDI, JPEG, MPEG, MHEG, Multimedia File Formats.	8 Hours	1
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Suggested Readings:

1. D.Hearn & M. Pauline Baker, "Computer Graphics C Version", Pearson Education.
2. Steven Harrington, "Computer Graphics: A Programming Approach", TMH.
3. Rogers, "Procedural Elements for Computer Graphics", TMH.
4. Rogers D., Adams .J, "Mathematical Elements of Computer Graphics", TMH.
5. Plastock & Kelly, "Computer Graphics; Schaum Series; McGraw Hill

BCA3451: Basics of Python Programming Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Installing and configuring Anaconda on windows, Linux or mac.2. Introduction to Jupyter lab, Variables, keywords , basics operation, Taking input in jupyter , console Taking multiple inputs from user, operators implementation3. Python Input Methods for Competitive Programming, Python Output using print() function Python end parameter in print(),if, else, if elif ladder implementation4. Special keyword - in and is, for loop, range function, and examples use of enumerate, zip function in loops else with for.	1
II	<ol style="list-style-type: none">5. Using strings, single quoted/double quoted/triple quoted Strings, string functions - split, trim, join, format, replace, count, find, index, rjust, ljust, center, upper, lower6. Practical implementation of list, creation and traversal, list functions - append, insert, extend, remove, pop, clear, sort, count, index, copy7. Practical implementation of tuples, creation and traversal, Practical implementation of Set, creation and traversal, set functions - add, update, remove, clear, pop, union, intersection, difference, disjoint, subset, superset8. Practical implementation of Dictionary, creation and traversal, dictionary function - get, update, keys, items, values	1

BCA3452: Basics of .NET Framework & C# Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of Decision Making and Branching Statements on Console Applications.2. Implementation Iterative Statements on Console Applications.3. Implementation of Arrays and Array List on Console Applications.4. Implementation of Boxing and Unboxing on Console Applications.5. Implementation of Strings on Console Applications.6. Implementation of Inheritance and Polymorphism on Console Applications.7. Implementation of Interfaces on Console Applications.8. Implementation of Properties and Indexers on Console Applications.9. Construct the C# console application to implement the Operator Overloading.10. Implementation of Delegates and Events on Console Applications.	1
II	<ol style="list-style-type: none">1. Implementation of Multithreading in C#2. Implementation of private assemblies in .NET Applications.3. Implementation of shared assemblies in .NET Applications.4. Implementation of Server Side Controls in asp.net.5. Implementation of Database Connectivity in asp.Net6. Implementation of various Data Rendering Controls in asp.Net.7. Implementing of Web Services in asp.Net Applications.	1

BCA3501: Web Application Development Using Open Source System

Course Objective:

1. To focus on the process of Web Development.
2. To build sound concepts of several languages used in Web Technology.
3. To create a dynamic, interactive website quickly, confidently and successfully.

Learning Outcome: Students who have successfully completed this course will have understanding of the following concepts:

1. Gradually build a static website using HTML, DHTML and CSS.
2. Move this skill upward by creating some degree of user interactivity using JavaScript.
3. Server side data processing by creating pages using server side technologies like JSP.
4. Will have an idea of Open Source Technologies.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Open Source System and HTML: Introduction to Open sources : Need of Open Sources, Advantages of Open Sources, Application of Open Sources; Examples of Various Open source operating systems ,Open Source Database ,Open Source Programming Languages; Various Open Source HTML Editors; Comparison Chart between different Free and Open Source HTML Editors. Introduction to HTML5: HTML tags and its attributes; Text Formatting tags; Marquee tag, Block and inline elements; Various types of Lists: Ordered, Unordered, Definition lists; Table tags; Methods to Create Tables, Attributes of table tag, Colspan and Rowspan; Frame tags and its Attributes; Formtag: Creation of Forms, Textbox, Radio Button, Hidden, etc; Image, Anchor Tag; Links to External Documents: Inter-page and Intra-page linking.	8 Hours	1
II	DHTML and CSS: Dynamic HTML; Features of DHTML ;CSS (Cascading Style Sheet): Font Attributes, Color and Background Attributes Text Attributes, Border, Margin related Attributes, List Attributes; Types of Style Sheet-Inline, External and Embedded; CSSP (Cascading Style Sheet Positioning); Document Object Model; JSSS (JavaScript assisted Style Sheet); Browser objects; DHTML Events.	8 Hours	1

<p style="text-align: center;">III</p>	<p>Java Script: Introduction to Javascript: Advantages of Javascript, Difference between Javascript and Jscript; Basic Programming Techniques: Data Types and Literal, Creating Variables and Javascript Array; Operators and Expressions in javascript: Arithmetic Operators, Logical Operators, Comparison Operators, String Operators, Conditional Operators; Javascript Programming Constructs: Conditional checking, Loops;</p> <p>Functions in Javascript: Built in Functions and User Defined Functions; Dialog Boxes: Alert Dialog Box, Confirm Dialog Box, Prompt Dialog Box; Javascript Document Object Model (DOM): Object hierarchy in DOM, Event Handling; Form Object: Form Object's Methods and Properties, Text Element, Button Element, etc; Other Built in Objects in Javascript, String, Math and Date Object; Writing Client Side Validations from HTML Form Elements.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>
<p style="text-align: center;">IV</p>	<p>Server Side Technology using JSP: Introduction to open source web servers and its examples; Introduction to JSP; Advantages of JSP; JSP Features; JSP Architecture; JSP Life Cycle; JSP Tags; Implicit objects in JSP: Request, Response, Out, Session, etc; Using HTML forms with JSP; Introduction to AJAX: AJAX Advantages and Disadvantages.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>

Suggested Readings:

1. Xavier, C, "Web Technology and Design", New Age International Publications.
2. Bayross Ivan,"HTML, DHTML. JavaScript, and PHP", BPB Publications, 4thEdition, 2001.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
4. Ramesh Bangia, "Internet and Web Design", New Age International.
5. Bhave, "Programming with Java", Pearson Education.
6. Ullman, "PHP for the Web: Visual Quick Start Guide", Pearson Education.
7. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, "Professional Ajax, 2nd Edition", Wrox.
8. James Lee, Brent Ware, "Open Source Web Development with LAMP", Pearson Education.
9. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2001.

BCA3502: Mobile Application Development

Course Objectives:

1. The capabilities and limitations of mobile platforms that affect application development and deployment
2. The technology and business trends impacting mobile application development
3. The characterization and architecture of mobile applications
4. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability

Learning Outcome

1. Model and manage mobile application development using a range of methods.
2. Advantages and limitations of development frameworks.
3. Designing and develop mobile applications using a chosen application development framework
4. Develop enterprise-level mobile solutions.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Android Development: Overview: Overview of the Android Operating System Development tools, Deploying application packages, Step-by-step application development Android version: Platform version: Android 10.0, 5.0 Lollipop, 4.4 Kit-Kat, Framework API level: SDK compatibility, each platform version has an API level; NDK API level: API level for native headers	8 Hours	1
II	Tools for application development: Android SDK: Provides the Java framework classes, Compiles to java byte code, Class framework is updated with every OS release Android NDK: C/C++ tool chain for compiling to machine code, Android platform tools, adb (android debug bridge): runs and debugs apps from your dev machine. Android developer tools: Eclipse plug-in for Android, Android studio (doesn't yet fully support all NDK features) Application packages: .apk files: compressed files, class byte code, resources (icons, sounds, etc.), Binary native files; All .apks are signed: Default development key is created by SDK, When updating an application, signature are checked.	8 Hours	1

<p style="text-align: center;">III</p>	<p>Installing an application, Android Menu, Adaptor, Layout Manager, View: From your local computer using adb; AndroidManifest.xml: Package Name / version, Required SDK and target, SDK Application/Activities, Permissions; Android Activity: Provides user interaction: http://developer.android.com/reference/android/app/Activity.html, Callbacks for life-cycle management: onCreate(), onResume(), onPause(); An application can have multiple activities: Needs one launcher activity, Use onCreate() to create UI; Android Menu: Option Menu, Context Menu, Popup Menu; Adaptor: Array, Array list, Base adaptor; Layout Manager: Relative layout, Linear layout, Table layout, Grid layout, Frame layout, Constraint layout; Views: Grid view, Web view, Scroll view, Search view, Table view, Dynamic view.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>
<p style="text-align: center;">IV</p>	<p>Android service, Data Storage, Content Provider, Android Notification, Multimedia, Speech API, Telephone API, Location API: Android service: API, Android started service, Android bound service, Android service life cycle, Android service example; Data Storage: Shared preferences, Internal storage, External storage; Content Provider: Content provider fundamental, Contact content provider, Other built-in content Provider, Creating custom content provider, Understanding content URI, Content Resolver, Sharing Information from custom content provider; Android Notification: Notification API, Creating notification builder, Setting notification properties, Attaching actions, Issuing notification, Notification compat.Builder class, Android Notification class; Multimedia: Wallpaper, Live wallpaper, Multimedia API, Playing audio, Creating audio, Playing video, Alarm manager, Gallery; Speech API: Text to speech API, Text to Speech example, Managing speed and pitch; Telephone API: Telephone manager, Get call state, Call state Broadcast receiver, Simple caller Talker, Making phone call, Sending mails, sms; Location API: Location API fundamental, Example of android: Location API, Working with Google API.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>

Suggested Readings:

1. Pradeep Kothari, “Android Application Development (With KitKat support)” Black Book, Dreamtech Press
2. Barry Burd, “Android Application Development (All-In-One for Dummies)”, Second Edition, John Wiley & Sons

BCA3511: Fundamental of E Commerce

Course Objective: In this course, students will study

1. The fundamentals of the business and economic motivations for e-Commerce as well as the needs and desires of individuals.
2. The underlying computation, information and communication environments that encompass and enable e-Commerce transactions.
3. The evolving role of new highly portable, place-aware, always-with-your personal devices in e-Commerce, i.e., M-commerce.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Understand the nature and trends in e-Commerce and Mobile commerce.
2. Recognize the business impact and potential of e-Commerce.
3. Explain the technologies required to make e-Commerce viable.
4. Discuss the current drivers and inhibitors facing the business world in adopting and using e-Commerce.
5. Explain the economic consequences of e-Commerce.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction of E-Commerce: Introduction to Electronic Commerce: E-commerce, Traditional Commerce vs. E-commerce, Advantages and Disadvantages of E-commerce, Impact of E-commerce, Classification of E-commerce, Applications of E-commerce, Limitations of E-commerce, Electronic Commerce Business Models: Native Content based Model, Transplanted Content Model, Native Transaction Model, Transplanted Transaction Models.	8 Hours	1
II	E-Commerce Framework and Business Security: Architectural Framework of Electronic Commerce: Network Infrastructure, Information Distribution Technology, Networked Multimedia Content Publishing Technology, Security and Encryption, Payment Services, Business Service Infrastructure, Public Policy and Legal Infrastructure, Securing the Business on Internet: Vulnerability of Information on Internet: Security Policy, Procedures and Practices, Site Security, Protecting the Network, Firewalls.	8 Hours	1
III	Electronic Commerce Network Security & Payment System: Securing Network Transaction: Transaction Security, Cryptology, Digital Signatures, Electronic Mail Security, and Security Protocols for Web Commerce, Electronic Payment System. Introduction to Payment Systems: Online Payment Systems, Pre-Paid Electronic Payment Systems, Postpaid	8 Hours	1

IV	Mobile Commerce: Introduction and Applications: Mobile Commerce, Benefits of Mobile Commerce, Impediments in Mobile Commerce, Mobile Commerce Payment Systems, Mobile Commerce Applications, Case Study: Future of Ecommerce in India, Flipkart: Journey of E- Commerce Start-Up	8 Hours	1
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Suggested Readings:

1. Bharat Bhaskar, "Electronic Commerce: Framework, Technologies & Applications", TMH
2. Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison-Wesley
3. Bajaj and Nag, "E-Commerce: The Cutting Edge of Business", Tata McGraw Hill
4. P. Loshin, John Vacca, "Electronic Commerce", Firewall Media, New Delhi
5. P. T. Joseph, "E-Commerce: An Indian Perspective", PHI Learning Pvt. Ltd.

BCA3512: Basics of Software Project Management

Course Objective:

1. To present fundamentals of project management.
2. To cover software project management processes and techniques especially relevant to those likely to participate in or manage software projects.

Learning Outcome: Students who have successfully completed this course will have full understanding of the following concepts:

1. Develop the understanding of Software Project Management.
2. Develop the Software quality assurance and testing tools.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction and Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.	8 Hours	1
II	Project Organization and Scheduling: Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.	8 Hours	1
III	Project Monitoring and Control: Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.	8 Hours	1

IV	Software Quality Assurance and Testing: Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model (CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process, Case Study: Project Management in e-Governance	8 Hours	1
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Suggested Readings:

1. Kathy Schwalbe, "Information Technology Project Management", 4th ed., THOMSON Course Technology, 2007.
2. Bob Hughes and Mike Cottrell, "Software Project Management", 4th ed., Tata McGraw-Hill
3. Ramesh, Gopaldaswamy, "Managing Global Projects ", Tata McGraw Hill, 2001.
4. Royce," Software Project Theory", Pearson Education, 1999.
5. Pankaj Jalote "Software Project Management in Practice", Pearson Education, 2000.
6. S.A. Kelkar, "Software Project Management: A Concise Study", 2nd ed., Prentice Hall.
7. Liffingwell, "Managing Software Requirements: A Use Case Approach", Pearson Education.
8. Tom Gilb, "Principles of Software Engineering Management", Addison Wesley, 1988.

BCA3513: Green Computing

Course Objective:

1. The objective of this course is to provide students with an understanding of the role of ICTs and their impact on the global carbon footprint, This includes how to estimate the carbon footprint of the ICT operations of an organization and access ways to reduce the carbon footprint by changes to policies for procurement of ICT, changes to ICT operations and revising business processes.
2. To study about existing green computing strategies, fundamental challenges in achieving green operations of computing units and directions to solve some of them.
3. This course empowers students to reduce the energy use, waste, and other environmental impacts of Information Technology (IT) systems while reducing life cycle costs, thereby improving competitive advantage. Students learn how to measure computer power usage, minimize power usage, procure sustainable hardware, design green data centers, recycle computer equipment, configure computers to minimize power, use virtualization to reduce the number of servers, and other green technologies.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Assess enterprise-wide and personal computing and computing related energy consumption.
2. Acquire expertise for improving the energy efficiency of personal computers by reducing the power consumption requirements.
3. Choose the best sustainable hardware for their applications.
4. Evaluate the regulatory and governance issues surrounding IT.
5. Recognize the necessity for long-term sustainability in IT.
6. Formulate plans for reducing IT heating and cooling requirements.
7. Execute a virtualization plan.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Politics, Science and Business of Sustainability: The Basics of Green Computing: The Energy Problem, Types of IT Energy Wastes, Reducing Energy Waste, Problem of E-waste; Legal Mandates for Green IT: Regulations in the United States, Regulations in India, Waste Electrical and Electronic Equipment (WEEE).	8 Hours	1
II	Technical Strategy and Planning–Emerging Technology Monitoring: Energy Usage: Energy Problems (Power Supplies), Monitoring Energy Usage, Reducing Energy Usage, Low Power Computers and Components; Cooling: Cooling Costs, Reducing Cooling Costs; Energy Saving Initiatives: The Challenges of Energy Efficiencies, Energy Star, 80Plus Program, Electronic Product	8 Hours	1

	Environmental Assessment Tool (EPEAT); Document Management: The Problem with Paper, Reducing Paper Usage, Electronic Document Management.		
III	IT Asset Disposal (E-Waste Management): WEEE – The scale of the problem; Materials Used in Manufacturing Electrical and Electronic Products; Legislative Influences on Electronic Recycling: Producer Responsibility Legislation, The WEEE Directive, The RoHS Directive; Treatment Option for WEEE; Logistics of WEEE; Barriers to Recycling of WEEE.	8 Hours	1
IV	Business/IS Strategy and Planning: Virtualization: Basics of Virtualization, Types of Virtualization; Improving Data Centre Energy Efficiency: Energy Consumption, Power Requirement of Equipment, Power Requirement for Cooling the Equipment's; Green IT Department: The First Step – 5S, The Seven Wastes, Drawing a Process map.	8 Hours	1

Suggested Readings:

1. Toby J. Velete, Anthony T. Velete, Robert Elsenpeter - Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line; McGraw-Hill.
2. Lawrence Webber, Michale Wallace - Green Tech: How to plan and Implement Sustainable IT Solutions; AMACOM (American Management Association)
3. R E Hester, R M Harrison – Electronic Waste Management; RSC Publishing
4. John Lamb - The Greening of IT: How Companies Can Make a Difference for the Environment; IBM Press
5. Marty Poniatowski - Foundation of Green IT; Prentice Hall
6. Bhuvan Unhelkar - Green IT Strategies and Applications; CRC Press
7. Carl H. Speshock - Empowering Green Initiatives with IT; John Wiley & Sons, Inc.
8. Bill Tomlinson - Greening through IT; The MIT Press

BCA3514: Basics of E- Governance

Course Objective:

1. Generating human resources with the right skills, knowledge, and aptitude and leadership qualities for effective implementation of e-Governance Projects.
2. To study about e-Governance models and its characteristics.
3. Conceptualization of ideas and development of service delivery models for improving the quality of service to citizen.
4. To make aware students about scope of e-Governance in the State through various sectors and services.

Learning Outcomes

On completion of this course students will be able to:

1. Understand and critique the various roles attributable to government.
2. Explore current understandings of the relationship between public services and the rights, entitlements and responsibilities of citizens, clients and stakeholders.
3. Use terms such as 'good governance', 'accountability' and 'consultation' with a critical understanding of their meaning.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Overview of E-Governance and its Models: Introduction to E-Governance: Needs of E-Governance, Issues in E-Governance applications and Digital Divide; Evolution of E-Governance, its scope and content; Present global trends of growth in E-Governance; Evolution in E-Governance and Maturity Models: Five Maturity Levels; Characteristics of Maturity Levels; Key areas; Towards Good Governance through E-Governance Models.	8 Hours	1
II	E-Governance Infrastructure, Strategies: E-readiness: Digital System Infrastructure, Legal Infrastructural Preparedness, Institutional Infrastructural Preparedness, Human Infrastructural Preparedness, Technological Infrastructural Preparedness; Evolutionary Stages in E-Governance.	8 Hours	1
III	Applications of Data Mining in E-Governance: Introduction of Data warehousing and Data mining in E-Governance; National Data Warehouses: Census Data, Prices of Essential Commodities; Other areas for Data Warehousing and Data Mining: Agriculture, Rural Development, Health, Planning, Education, Commerce and Trade, Other Sectors.	8 Hours	1

IV	<p>Case Studies of E-Governance in Indian perspective</p> <ul style="list-style-type: none"> • NICNET-Role of Nationwide Networking in E-Governance • Smart Nagarpalika-Computerization of Urban Local Bodies (Municipalities) • Ekal Seva Kendra • Aadhar • E-Suvidha • Bhulekh 	8 Hours	1
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Suggested Readings:

1. C.S.R. Prabhu, "E-Governance: Concepts and Case Studies", Prentice-Hall of India Private Limited, 2004.
2. N. Gopalsamy, "Information Technology & e-Governance", New Age Publication, First Edition 2009.
3. Backus, Michael, "E-Governance in Developing Countries", IICD Research Brief, No. 1, March 2001.
4. Subhash Bhatnagar, "Unlocking E-Government Potential: Concepts, Cases and Practical Insights", SAGE Publications India Pvt. Ltd.

BCA3504: Software Engineering

Course Objective:

1. To present the fundamental concepts of Software Engineering.
2. To make the students aware regarding the importance of various phases in Software Development.
3. To make the students learn about the various methods to deal with different stages of SDLC.
4. The subject also deals the topics like CASE Tools and SPM.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Develop the understanding of Development Life Cycle.
2. Preparation of SRS, High Level, Low Level Design and Test Cases.
3. Aware about the various types of project management activities.
4. Know how to ensure quality during software development life cycle.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Software Engineering Models: Introduction to Software Engineering; Introduction to Software; Types of software; Scope and necessity of Software Engineering; Software Components and Software Characteristics; Software Life Cycle Models: Classical Water Fall Model, Iterative Water Fall Model, Prototype Model, Evolutionary Model, Spiral Model; Comparison of different Life Cycle Models.	8 Hours	1
II	Software Requirement Analysis and Project Planning: Requirements Analysis; Feasibility Study: Software Requirements Specification (SRS), Characteristics of SRS, Components of SRS; IEEE Standards for SRS; Project Planning; Software Cost Estimation: Basic COCOMO model, Intermediate COCOMO model, Complete COCOMO model.	8 Hours	1
III	Software Analysis & Design: Characteristics of good software design; Cohesion and Coupling; Software design approaches; Function-Oriented Software design: Structured Analysis, Data Flow Diagrams, Structured Design; Object-Oriented Software design: Key concepts of Object-Oriented Software design, Object-Oriented Vs. Function-Oriented Software design, Graphical Representation of Object-Oriented design.	8 Hours	1

IV	<p>Coding, Testing and Maintenance: Introduction to Software Coding: Coding Standards and Guidelines, Code Walk-through, Code Inspections;</p> <p>Software Testing: Unit Testing; Black Box Testing; White Box Testing; Integration Testing; System Testing; User Acceptance Testing; Roll out of Software & Deployment Issues; Software Maintenance; Need for Maintenance; Types of Software Maintenance: Corrective Maintenance, Adaptive Maintenance, Perfective Maintenance, Preventive Maintenance. Software Quality Assurance (SQA); Software Reliability & Reliability Models.</p>	8 Hours	1
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Suggested Readings:

1. R. S. Pressman, "Software Engineering: A Practitioners Approach", McGraw Hill.
2. Rajib Mall, "Fundamentals of Software Engineering", PHI Publication.
3. Pankaj Jalote, "Software Engineering", Wiley.
4. Carlo Ghezzi, M. Jarayeri, D. Manodrioli, "Fundamentals of Software Engineering", PHI Publication.
5. Ian Somerville, "Software Engineering", Addison Wesley.
6. Kassem Saleh, "Software Engineering", Cengage Learning.

Open Elective

BCA3551: Web Application Development Using Open Source System Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Implementation of various tags in Open Source System HTML editors2. Implementation of List Tags in HTML.3. Implementation of Table Tag in HTML.4. Implementation of Frame Tag in HTML.5. Implementation of Form Tags in HTML.6. Implementation of CSS (Inline, External and Embedded) in DHTML.7. Implementation of Class Concept in DHTML.8. Implementation of DHTML Events.	1
II	<ol style="list-style-type: none">1. Implementation of basic variables in JavaScript.2. Implementation of User Defined Functions in JavaScript.3. Implementation of inbuilt functions in JavaScript.4. Implementation of Form validation in JavaScript.5. Implementation of Basic Features of JSP.6. Implementation of Various Events and methods of Request and Response Object in JSP.7. Implementation of Database Access through HTML Forms in JSP.8. Implementation of JAVA API in JSP.9. Using LAMP Stack for web applications10. Using Tomcat Server for Servlets and JSPs	1

BCA3552: Mobile Application Development Lab

Module	Course Topics	Credits
I	<ol style="list-style-type: none">1. Develop an application that uses GUI components, Font and Colours2. Develop an application that uses Layout Managers and event listeners.3. Develop a native calculator application.4. Write a mobile application that creates alarm clock.5. Write an application that draws basic graphical primitives on the screen.6. Develop an application that makes use of databases.7. Develop an application that makes use of Notification Manager	1
II	<ol style="list-style-type: none">1. Implement an application that uses Multi-threading2. Develop a native application that uses GPS location information3. Implement an application that writes data to the SD card.4. Implement an application that creates an alert upon receiving a message5. Write a mobile application that makes use of RSS feed6. Develop a mobile application to send an email.7. Develop a Mobile application for simple needs (Mini Project)	1

BCA3601: Management Information System

Course Objective:

1. To understand the concept if Information Systems.
2. To learn the terminology used in the field of IT and how IT principles can apply to businesses.
3. To understand the types of Information Systems e.g., e-commerce, Enterprise Resource Planning (ERP), Decision Support Systems (DSS), Artificial Intelligence (AI) and Expert Systems (ES), SCM, CRM etc.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Understand basic information system concepts as applied to business operations and management.
2. Identify the major components of a computer system, including hardware, software, operating systems and operating environments as they apply to information systems.
3. Understand how to utilize large-scale computer applications systems to assist with business management and operations.

Course Contents:

Module	Course Topics	Total	Credits
I	An Overview of Information System: Information System Concepts: Introduction, Data vs. Information, The Characteristics of Valuable Information, The Value of Information, Types of Information; System and Modeling Concepts: System Components and Concepts, System Performance and Standards, System Variables and Parameters; Elements of Information System, Types of Information System: Manual and Computerized Information System, Computer-Based Information System; Information System Classification: Operations Support Systems, Management Support Systems.	8 Hours	1
II	Concepts of Management & Organization Theory and IS Technology: Levels of management; Hierarchy of management activity; Different types of decisions; Information requirements by level of management; Types of Computer-Based Information System: Office Automation System (OAS), Transaction Processing System (TPS), Management Information System(MIS), Decision Support System (DSS), Executive Information System (EIS), Artificial Intelligence and Expert Systems Information System Technology & Implementation The Evolution of Information System Technology; Computer Hardware (Input, Processing, Storage & Output H/W); Computer Software (System Software, Application Software);	8 Hours	1

	Horizontal Market Application Software; Vertical Market Application Software; Custom- Developed Application Software		
III	Management and Decision Support System: An Overview of Management Information Systems: Inputs & Output to a Management Information System, Characteristics of a Management Information System; Functional Aspects of the MIS: Financial Management Information Systems, Manufacturing Management Information Systems, Marketing Management Information Systems, Human Resource Management Information Systems, An Overview of Decision Support Systems: Characteristics of a Decision Support System, Capabilities of a Decision Support System, A Comparison of DSS and MIS; Components of a Decision Support System: The Database	8 Hours	1
IV	Business Applications of Information System: Introduction to Electronic Commerce: Business-to-Business (B2B) E-Commerce, Business-to-Consumer (B2C) E-Commerce, Consumer-to-Consumer (C2C), E-Commerce; E-Commerce Challenges; Electronic Commerce Applications; Business Application Tools: Enterprise Resource Planning, Advantages and Disadvantages of ERP Systems, Production and Supply Chain Management, Procurement Management, Customer Relationship Management and Sales Ordering.	8 Hours	1

Suggested Readings:

1. Ralph M. Stair & George W. Reynolds - Principles of Information System: A Managerial Approach; Course Technology
2. Laudon and Laudon - Management Information Systems; Pearson Education.
3. Jawadekar - Management Information Systems; Tata McGraw-Hill.
4. Davis and Olson, "Management Information Systems; Tata McGraw-Hill.
5. O'Brien - Management Information Systems; Tata McGraw-Hill.
6. D. P. Goel - Management Information System; Macmillan

BCA3602: Advance Computer Technologies

Course Objective:

1. To present fundamentals of advance technologies.
2. To cover advanced aspects of computing processes and techniques especially relevant to those likely to participate in or manage vast amount of data.

Learning Outcome: Students who have successfully completed this course will have full understanding of the following concepts:

1. Develop the understanding of Data Science and its stream uses.
2. Develop the understanding of data compilation.
3. Understanding of latest technologies which is revolting computer world.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction of Data Science : History of Data Science ,involvement of Data Science, Era of Data Science, Business Intelligence vs Data Science, Life cycle of Data Science, Tools of Data Science Data Extraction, Wrangling & Exploration, Data Analysis Pipeline, Types of Data: Raw and Processed Data, Data Wrangling, Exploratory Data Analysis Visualization of Data: Introduction to Visualization. Human Perception and Information Processing, Data types: Graphical perception (the ability of viewers to interpret visual (graphical) encodings of information and thereby decode information in graphs, Color for information display, Color management systems, Picture visualization and fruition Data Transformation into sources of knowledge through visual representation, Requirements and heuristics for high-quality visualizations, Charts and standard views: relevance and appropriateness, Advanced and innovative tools for data visualization and advanced quantitative analysis, The evaluation of the quality of visualizations and info graphics.	8 Hours	1
II	Introduction of Big Data Analytics: Evolution of Big data- Best Practices for Big data Analytics- Big data characteristics - Big Data Use Cases- Characteristics of Big Data Applications- Big Data Modelling- Hadoop Eco system. An Overview of Clustering- K-means clustering- Use Cases - Determining the Number of Clusters- Classification- Decision Trees- Decision Tree Algorithms- Evaluating a Decision Tree- Decision Trees in R- Bayes Theorem- Naive Bayes Classifier	8 Hours	1

<p style="text-align: center;">III</p>	<p>Hadoop: Data Storage File System Abstraction Big Data and Distributed File Systems Hadoop Distributed File System (HDFS) HDFS Architecture, Architectural assumptions and goals. Data is stored and read in HDFS, Namenodes and Data nodes Blocks, Data Replication, Fault Tolerance, Data Integrity Namespaces, and Federation in Hadoop 2.0, High Availability in Hadoop 2.0, Security and Encryption, HDFS Interfaces: Filesystem API, FSShell, WebHDFS, Fuse etc. Data Processing: MapReduce, The fundamentals: map () and reduce(), Data Locality Architecture of the MapReduce framework. Data Integration: Integrating Hadoop into your existing enterprise, Introduction to Sqoop.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>
<p style="text-align: center;">IV</p>	<p>Introduction of Blockchain Technology: Introduction – block chain history, basics, architectures, Types of block chain, Base technologies – dockers, docker compose, and data structures, hashes, micro-services. Bitcoins– Fundamentals, aspects of bitcoins, properties of bitcoins, bitcoin transactions, bitcoin P2P networks, block generation at bitcoins, consensus algorithms. Blockchain hyper ledger– Fabric architecture, implementation, networking, fabric transactions, demonstration, smart contracts. Applications– block chain applications, e governance, smart cities, smart industries, anomaly detections, use cases, trends on block chains, server less blocks, scalability issues, block chain on clouds.</p>	<p style="text-align: center;">8 Hours</p>	<p style="text-align: center;">1</p>

Suggested Readings:

1. Foundations of Data Science by Avrim Blum, John Hopcroft, and Ravindran Kannan.
2. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
3. Tom White , Hadoop: The Definitive Guide, 4th edition O'Reily Publications, 2015
4. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
5. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
6. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
7. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich "Recommender Systems: An Introduction", Cambridge University Press, 2010.
8. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
9. The Definitive Guide by Tom White.
10. MapReduce Design Patterns (Building Effective Algorithms & Analytics for Hadoop) by Donald Miner & Adam Shook
11. Professional Hadoop Solutions by Boris Lublinksy, Kevin Smith, and Alexey Yakubovich.
Web links: <https://cloudthat.in/course/processing-bigdata-with-apache-hadoop/>
12. Kevin Werbach, The Blockchain and the new architecture of Trust, MIT Press, 2018.

OE31101: Environmental Issues of IT & e-Waste Management

Course Objective:

1. The objective of this course is to provide students with an understanding of the role of ICTs and their impact on the global carbon footprint, This includes how to estimate the carbon footprint of the ICT operations of an organization and access ways to reduce the carbon footprint by changes to policies for procurement of ICT, changes to ICT operations and revising business processes.
2. To study about existing green computing strategies, fundamental challenges in achieving green operations of computing units and directions to solve some of them.
3. This course empowers students to reduce the energy use, waste, and other environmental impacts of Information Technology (IT) systems while reducing life cycle costs, thereby improving competitive advantage. Students learn how to measure computer power usage, minimize power usage, procure sustainable hardware, design green data centers, recycle computer equipment, configure computers to minimize power, use virtualization to reduce the number of servers, and other green technologies.

Learning Outcome: After successful completion of this course, the students would be able to:

1. Assess enterprise-wide and personal computing and computing related energy consumption.
2. Acquire expertise for improving the energy efficiency of personal computers by reducing the power consumption requirements.
3. Choose the best sustainable hardware for their applications.
4. Evaluate the regulatory and governance issues surrounding IT.
5. Recognize the necessity for long-term sustainability in IT.
6. Formulate plans for reducing IT heating and cooling requirements.
7. Execute a virtualization plan.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Politics, Science and Business of Sustainability: The Basics of Green Computing: The Energy Problem, Types of IT Energy Wastes, Reducing Energy Waste, Problem of E-waste; Legal Mandates for Green IT: Regulations in the United States, Regulations in India, Waste Electrical and Electronic Equipment (WEEE).	8 Hours	1
II	Technical Strategy and Planning–Emerging Technology Monitoring: Energy Usage: Energy Problems (Power Supplies), Monitoring Energy Usage, Reducing Energy Usage, Low Power Computers and Components; Cooling: Cooling Costs, Reducing Cooling Costs; Energy Saving Initiatives: The Challenges of Energy Efficiencies, Energy Star, 80Plus Program, Electronic Product	8 Hours	1

	Environmental Assessment Tool (EPEAT); Document Management: The Problem with Paper, Reducing Paper Usage, Electronic Document Management.		
III	IT Asset Disposal (E-Waste Management): WEEE – The scale of the problem; Materials Used in Manufacturing Electrical and Electronic Products; Legislative Influences on Electronic Recycling: Producer Responsibility Legislation, The WEEE Directive, The RoHS Directive; Treatment Option for WEEE; Logistics of WEEE; Barriers to Recycling of WEEE.	8 Hours	1
IV	Business/IS Strategy and Planning: Virtualization: Basics of Virtualization, Types of Virtualization; Improving Data Centre Energy Efficiency: Energy Consumption, Power Requirement of Equipment, Power Requirement for Cooling the Equipment's; Green IT Department: The First Step – 5S, The Seven Wastes, Drawing a Process map.	8 Hours	1

Suggested Readings:

1. Toby J. Velete, Anthony T. Velete, Robert Elsenpeter - Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line; McGraw-Hill.
2. Lawrence Webber, Michale Wallace - Green Tech: How to plan and Implement Sustainable IT Solutions; AMACOM (American Management Association)
3. R E Hester, R M Harrison – Electronic Waste Management; RSC Publishing
4. John Lamb - The Greening of IT: How Companies Can Make a Difference for the Environment; IBM Press
5. Marty Poniatowski - Foundation of Green IT; Prentice Hall
6. Bhuvan Unhelkar - Green IT Strategies and Applications; CRC Press
7. Carl H. Speshock - Empowering Green Initiatives with IT; John Wiley & Sons, Inc.
8. Bill Tomlinson - Greening through IT; The MIT Press

OE31102: Digital Governance

Course Objective:

1. Generating human resources with the right skills, knowledge, and aptitude and leadership qualities for effective implementation of e-Governance Projects.
2. To study about e-Governance models and its characteristics.
3. Conceptualization of ideas and development of service delivery models for improving the quality of service to citizen.
4. To make aware students about scope of e-Governance in the State through various sectors and services.

Learning Outcomes On completion of this course students will be able to:

1. Understand and critique the various roles attributable to government.
2. Explore current understandings of the relationship between public services and the rights, entitlements and responsibilities of citizens, clients and stakeholders.
3. Use terms such as 'good governance', 'accountability' and 'consultation' with a Critical understanding of their meaning.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Overview of E-Governance and its Models: Introduction to E-Governance: Needs of E-Governance, Issues in E-Governance applications and Digital Divide; Evolution of E-Governance, its scope and content; Present global trends of growth in E-Governance; Evolution in E-Governance and Maturity Models: Five Maturity Levels; Characteristics of Maturity Levels; Key areas; Towards Good Governance through E-Governance Models.	8 Hours	1
II	E-Governance Infrastructure, Strategies: E-readiness: Digital System Infrastructure, Legal Infrastructural Preparedness, Institutional Infrastructural Preparedness, Human Infrastructural Preparedness, Technological Infrastructural Preparedness; Evolutionary Stages in E-Governance;	8 Hours	1
III	Applications of Data Mining in E-Governance: Introduction of Data warehousing and Data mining in E-Governance; National Data Warehouses: Census Data, Prices of Essential Commodities; Other areas for Data Warehousing and Data Mining: Agriculture, Rural Development, Health, Planning, Education, Commerce and Trade, Other Sectors.	8 Hours	1

IV	<p>Case Studies of E-Governance in Indian perspective</p> <p>NICNET-Role of Nationwide Networking in E-Governance</p> <ul style="list-style-type: none"> • Smart Nagarpalika-Computerization of Urban Local Bodies (Municipalities) • Ekal Seva Kendra • Aadhar • E-Suvidha • Bhulekh 	8 Hours	1
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Suggested Readings:

1. C.S.R. Prabhu, "E-Governance: Concepts and Case Studies", Prentice-Hall of India Private Limited, 2004.
2. N. Gopalsamy, "Information Technology & e-Governance", New Age Publication, First Edition 2009.
3. Backus, Michael, "e-Governance in Developing Countries", IICD Research Brief, No. 1, March 2001.
4. Subhash Bhatnagar, "Unlocking E-Government Potential: Concepts, Cases and Practices