

(The syllabus has been prepared in accordance with the NEP 2020 guidelines.)



SYLLABUS FOR BACHELOR OF TECHNOLOGY

DEPARTMENT OF INFORMATION TECHNOLOGY

**SCHOOL OF ENGINEERING AND TECHNOLOGY –
NAGALAND UNIVERSITY**

Course Structure

Course Category	Total Credits
Base courses	44
Core Courses	77
Elective Courses	15
Open Elective Courses	6
Projects	19
Internship	2
Total Credits	163

w.e.f. Academic Session 2025-2026

Semester 1 (Common to all the Branches)

Sl. No	Subject Code	Course Name	L	T	P	Credit
Theory						
1	BSH101	Physics	3	-	-	3
2	BSH102	Mathematics -I	3	1	-	4
3	BSH103	Basic Electrical Engineering	3	-	-	3
4	BSH104	Engineering Graphics and design	1	-	-	1
5	BSH105	Technical English	2	-	-	2
6	BSH106	Environmental Science	3	-	-	3
7	BSH107	IDEA lab Workshop	2	-	-	0
Practical						
1	BSH111	Physics Lab	-	-	2	1
2	BSH112	Engineering Graphics and design lab	-	-	4	2
3	BSH113	Design Thinking Lab	-	-	2	1
4	BSH114	Technical English Lab	-	-	2	1
5	BSH115	IDEA lab Workshop	-	-	4	0
			17	1	14	21

Semester 2 (Common to all the Branches)

Sl. No	Subject Code	Course Name	L	T	P	Credit
Theory						
1	BSH201	Chemistry	3	-	-	3
2	BSH202	Mathematics-II	3	1	-	4
3	BSH203	Programming for Problem solving	3	-	-	3
4	BSH204	Basic Electronics	3	-	-	3
5	BSH205	Manufacturing Practices	1	-	-	1
6	BSH206	Sports and Yoga	2	-	-	0
7	BSH207	Universal Human values-II: Understanding Harmony and Ethical Human Conduct	2	1	-	3
Practical						
1	BSH211	Chemistry Lab	-	-	2	1
2	BSH212	Programming for Problem solving lab	-	-	4	2
3	BSH213	Basic Electronics Lab	-	-	2	1
4	BSH214	Manufacturing Practices Lab	-	-	4	2
			17	2	12	23

Semester 3

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1	ECB303	Digital System Design	3	-	-	3
2	ITB301	Object Oriented Programming	3	-	-	3
3	ITB302	Computer Organization & Architecture	3	-	-	3
4	ITB303	Data Structures	3	-	-	3
5	BSH301	Mathematics-III	3	1	-	4
Total Credits (Theory)						16
PRACTICAL						
1	ITB311	Object Oriented Programming Lab	-	-	3	1.5
2	ITB312	Data Structures Lab	-	-	3	1.5
3	ECB312	Digital System Design Lab	-	-	3	1.5
Total Credits (Practical)						4.5
Total Credits						20.5

Semester 4

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1.	BSH401	Organizational Behaviour	3	-	-	3
2.	BSH402	Discrete Mathematics	3	1	-	4
3.	ITB401	Software Engineering	3	-	-	3
4.	ITB402	Algorithm Analysis and Design	3	-	-	3
5.	ITB403	Formal Language & Automata Theory	3	-		3
Total Credits (Theory)						16
PRACTICAL						
1	ITB411	Algorithm Analysis and Design Lab	-	-	3	1.5
2	ITB412	Software Engineering Lab	-	-	3	1.5
3	BSH412	Communication Skills Lab	-	-	3	1.5
Total Credits (Practical)						4.5
Total Credits						20.5

Semester 5

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1	ITB501	Operating system	3	-	-	3
2	ITB502	Computer Networks	3	-	-	3
3	ITB503	Database Management Systems	3	-	-	3
4	ITB504	Compiler Design	3	-	-	3
5	ITBEL*	Elective I	3	-		3
6	ITB520	Internship I	-	-	-	1
Total Credits (Theory)						16
PRACTICAL						
1.	ITB511	Database Management Systems Lab	-	-	3	1.5
2.	ITB512	Operating System Lab	-	-	3	1.5
3.	ITB513	Network Lab	-	-	3	1.5
Total Credits (Practical)						4.5
Total Credits						20.5

Semester 6

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1	ITB601	Industrial Economics & Principles of Management	3	-	-	3
2	ITB602	Web Technology	3	-	-	3
3	ITB603	Computer Graphics & Virtual Reality	3	-	-	3
4	ITBEL*	Elective II	3	-		3
5	ITBEL*	Elective III	3			3
6	ITB620	Internship II		-	-	1
Total Credits (Theory)						16
PRACTICAL						
1.	ITB612	Web Technology Lab	-	-	3	1.5
2.	ITB613	Computer Graphics & Virtual Reality Lab	-	-	3	1.5
3.	ITBPJ1	Project (Minor)	-	-	6	3
Total Credits (Practical)						6
Total Credits						22

Semester 7

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1.	ITB701	Machine Learning	3			3
2.	ITB702	Foundation of research	3	-	-	3
3.	ITBEL*	Elective IV	3	-	-	3
4.	ITBOE*	Open Elective I	3	-	-	3
Total Credits (Theory)						12
PRACTICAL						
1	ITBCQ1	Colloquium*	-	-	-	-
2	ITB711	Machine learning lab	-	-	3	1.5
3	ITBPJ2	Project (Major) #	-	-	12	6
Total Credits (Practical)						7.5
Total Credits						19.5

*The student will give presentation (Colloquium) on the summer/winter/industrial training/Internship (4 – 6 weeks) that She/ He underwent during the vacation period after 4th, 5th or 6th semester.

#The student will submit a synopsis for their Project at the beginning of the semester in a specified format which should be approved by the departmental committee. The student will also have to present the progress of their project through seminars and progress reports.

Semester 8

Sl. No	Subject Code	Course name	Contact Hours per week			Credits
			Lectures	Tutorials	Practical	
THEORY						
1	ITBEL*	Elective V	3	-	-	3
2	ITBOE*	Open Elective II	3	-	-	3
3	BSH801	Constitution of India (Mandatory Course)	-	-	-	-
Total Credits (Theory)						6
PRACTICAL						
1	ITBPJ3	Project (Major) **	-	-	20	10
Total Credits (Practical)						10
Total Credits						16

**The student will continue the project work carried over from the previous semester. The student will submit the final report/thesis of the project in the format specified by the School.

LIST OF ELECTIVE COURSES

Subject code	Course Name	Credits	Lectures	Tutorials	Practical
ITBEL1	Distributed Database	3	3	-	-
ITBEL2	Mobile Computing (SWAYAM)	3	3	-	-
ITBEL3	Cloud Computing (SWAYAM)				
ITBEL4	Advanced Computer Architecture	3	3	-	-
ITBEL5	Advanced python programming	3	3	-	-
ITBEL6	Statistical Modeling and Tools	3	3	-	-
ITBEL7	Mobile Application Development	3	3	-	-
ITBEL8	Network Protocols	3	3	-	-
ITBEL9	XML and Web Services	3	3	-	-
ITBEL10	Service Oriented Architecture	3	3	-	-
ITBEL11	System Analysis and Design	3	3	-	-
ITBEL12	Decision Support System	3	3	-	-
ITBEL13	Advanced Java Technology	3	3	-	-
ITBEL14	.Net Technology	3	3	-	-
ITBEL15	Natural Language Processing	3	3	-	-
ITBEL16	Distributed Computing	3	3	-	-
ITBEL17	Multimedia Technologies	3	3	-	-
ITBEL18	Mobile Communications	3	3	-	-
ITBEL19	Cryptography and Information Security				
ITBEL20	Software Quality Assurance	3	3	-	-
ITBEL21	Soft Computing	3	3	-	-
ITBEL22	Blockchain Architecture & Design	3	3	-	-
ITBEL23	Advanced Database Systems	3	3	-	-
ITBEL24	Data Science	3	3	-	-
ITBEL25	Environmental Studies and Green IT	3	3	-	-
ITBEL26	Bioinformatics	3	3	-	-
ITBEL27	Digital Image Processing	3	3	-	-
ITBEL28	Complex networks	3	3	-	-
ITBEL29	Graph Theory	3	3	-	-

LIST OF OPEN ELECTIVE COURSES

Subject code	Course Name	Credits	Lectures	Tutorials	Practical
ITBOE1	Artificial Intelligence	3	3	-	-
ITBOE2	Internet-of-Things	3	3	-	-
ITBOE3	Big Data Analytics	3	3	-	-
ITBOE4	E-Business (SWAYAM)	3	3	-	-
ITBOE5	Data Mining & Data Warehousing	3	3	-	-
ITBOE6	Embedded Systems	3	3	-	-

Note: The following courses will be offered through SWAYAM.

1. E-Business
2. Mobile Computing

3. Cloud Computing

DETAILED SYLLABUS

Note: The Course Outcomes (CO) to Programme Outcomes (PO) mapping used: (1-weak, 2-moderate, 3-strong)

Subject Code	Course name	Credits	Lectures	Tutorials	Practical	
ECB303	Digital System Design	3	2	1	-	
CO1 – Apply number systems, binary arithmetic, and error codes CO2 – Simplify Boolean functions and design combinational logic CO3 – Analyze logic families (TTL, CMOS) and electrical behavior CO4 – Design combinational and sequential circuits CO5 – Apply PLDs and memory devices in circuit design						
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO7
CO1	3	2				
CO2	3	3	2	2	2	
CO3	2	2			3	2
CO4	3	3	3	2	3	
CO5	3	2			3	

Unit I: Introduction to Digital System
Number systems, binary arithmetic and codes: positional number system; binary, octal and hexadecimal number systems; representation of signed numbers; binary arithmetic – addition, subtraction, multiplications and division; fixed and floating point numbers; binary coded decimal codes; Gray codes; error detection and correction codes-parity check codes and Hamming code.

Unit II: Boolean Algebra and Switching Functions
Boolean algebra; basic postulates and fundamental theorems of Boolean algebra; truth tables; basic logic operations and gate symbols; algebraic forms of switching functions-SOP and POS forms, minterms and maxterms; derivation of canonical forms; minterms and maxterms; simplification of switching functions- K-map and quine-McCluskey tabular minimization methods; synthesis of combinational logic circuits-NAND and NOR networks.

Unit III: Combinational Logic Modules
Decoders, encoders, multiplexers, de-multiplexers and their applications; three state devices and buses; code converter; binary adders: half adder and full adder, ripple carry adder, carry-lookahead adder; subtractors; multipliers; ALU; comparators; parity circuits; circuit timing-timing diagrams and specifications; combinational circuit design examples.

Unit IV: Sequential Logic Devices and Circuits
Latches; flip- flops; registers, shift-registers; counters ripple counters, synchronous counters, up-down counters, BCD counters, ring counters, timing diagrams and specifications; state machine models-synchronous state machines; state machine design

examples design examples; design using ASM charts; timing hazards and races; design and analysis of asynchronous sequential circuits: pulse mode and fundamental mode.

UNIT V: Logic Families and Programmable Logic Devices

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL, TTL, ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM, PROM, EPROM, EEPROM, EAPROM.

Textbooks:

1. Morris Mano, "Digital logic and computer design", 1e, Pearson Education India, 2016.
2. J. F. Wakerly, "Digital Design-principles and practices", 4e, Pearson Education, 2008.

References:

1. Meena K., "Principles of Digital electronics", 1e, Prentice Hall India learning Private Ltd., 2009.
2. M. D. Ercegovic, T. Lang and J.H. Moreno, "Introduction to Digital Systems", Wiley India, 2011.
3. Shamsheer S. Dhillon, "Fundamental of digital logic design and computer organization", 1e, Nation Press, 2021.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITB301	Object Oriented Programming	3	3	-	-

CO1: Explain the fundamental concepts of object-oriented programming and compare it with other programming paradigms.

CO2: Develop classes and objects in C++ using features like constructors, destructors, and dynamic memory allocation.

CO3: Demonstrate use of inheritance and polymorphism to enable code reusability and flexibility.

CO4: Apply file handling, exception handling, and use of STL components in C++ programming.

COs	PO1	PO2	PO3	PO4	PO5	PO6-PO12
CO1	3	2	1	-	1	-
CO2		3	3	2	2	-
CO3	3	3	3	2	2	-
CO4	3	2	3	2	3	-

Unit 1: Introduction

Introducing Object-Oriented Approach related to other paradigms (functional, data decomposition), Characteristics of Object –Oriented Languages. Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Review of C, Difference between C and C++, cin, cout, new, delete operators.

Unit 2: Classes and objects

Abstract data types, Objects & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, Copy Constructor, Static Class Data, Constant and Classes, C++ garbage collection, dynamic memory allocation.

Unit 3: Inheritance and Polymorphism

Inheritance, Types of Inheritance, Class hierarchy, derivation-public, private & protected, Aggregation, composition vs Classification hierarchies, polymorphism, Type of polymorphism- Compile time and runtime, Method polymorphism, polymorphism by parameter, Operator overloading, Parametric Polymorphism, Generic function – template function, function name overloading, Overriding inheritance methods.

Unit 4: File and Exception Handling

Persistent objects, Streams and files, Namespaces, Exception handling, Generic Classes. Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, vectors.

Text Books:

1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle "Object-Oriented Analysis and Design with Applications (3rd Edition)"
2. Bruce, Foundations of Object Oriented Languages, PHI
3. Jana, C++ & Object Oriented Programming, PHI
4. Rambaugh, James Michael, Blaha - "Object Oriented Modelling and Design" - Prentice Hall India/ Pearson Education.

Reference Books:

1. **Rajaram: Object Oriented Programming and C++, New Age International**
2. Olshevsky : Revolutionary guide to Object Oriented Programming using C++, Shroff / Wrox
Mahapatra: Introduction to System Dynamic Modelling, Universities Press.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITB302	Computer Organization & Architecture	3	3	-	-

CO1: Understand the basic parts of a computer system, including the CPU, memory, input-output devices, and how data and instructions are represented and processed.

CO2: Learn how CPU control units and memory systems work, and explore how data is transferred using different methods like interrupts and DMA.

CO3: Understand pipelining and parallel processing to improve computer performance and solve problems like pipeline hazards and memory access issues.

CO4: Learn about memory organization, including cache design, memory hierarchy, and techniques to improve memory performance.

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3											
CO2	3	2										
CO3			2	1								
CO4	3				1							

Unit 1:

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs. Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Unit 2:

Introduction to x86 architecture. CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions.

Unit 3:

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Unit 4:

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

Textbooks:

1. “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. “Computer Organization and Embedded Systems”, 6th Edition by Carl Hamacher,

McGraw Hill Higher Education.

Reference books:

1. “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. “Computer Organization and Architecture: Designing for Performance”, 10th Edition by William Stallings, Pearson Education.
3. “Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB303	Data Structures	4	3	1	-
CO1: Understand the basic concepts of data structures, recursion, and analyze algorithm complexities using Big-O notation. CO2: Apply abstract data types and implement linear data structures like arrays, stacks, queues, and various linked lists. CO3: Design and implement non-linear data structures such as trees and graphs and perform relevant operations and traversals. CO4: Analyze and implement different sorting algorithms and understand the use of advanced searching and indexing techniques.					
COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1
CO2	3	3	3	2	2
CO3	3	3	3	2	2
CO4	3	3	3	3	3
Unit 1: Basic concept of data structures, mathematical preliminaries-big oh notation, notion of space and time complexity, simple algorithms and illustration of their complexity, recursion. Unit 2: Abstract Data Types – Algorithm Notations - Basic data structures – Arrays – Lists – Singly linked lists – Doubly linked lists – Circular lists - Stacks and Queues – Applications of Stack and Queues Unit 3: Trees – Binary Trees – Binary tree representation and traversals – Threaded binary trees, Counting Binary Tree, AVL Trees – Binary tree representation of general trees – Application of trees: Set representation – Graph and its representations – Graph Traversals Unit 4: Insertion sort – Merge sort – Quick sort – Heap sort, Radix sort – Sorting with disks – K-way Merging – Sorting with Tapes – Polyphase Merge, Linear Search – Binary Search - Hash Tables – Overflow Handling – Cylinder Surface Indexing – Hash Index – B-Tree Indexing.					
Text books: 1. E. Horowitz and S. Sahani, “ Fundamentals of Data Structures”, Galgotia Book source Pvt. Ltd. 1999. 2. R.L.Kruse, B.P. Leung, C.L. Tondo, “ Data Structure and program design in C”, PHI, 2000. 3. Sartaj Sahni, “Data Structures, Algorithms, and Applications in C++”, Second Edition,					

McGraw Hill NY, Silicon Press, 2005.

Reference books:

1. Schaum's outline series, "Data Structure", TMH, 2002.
2. Y. Langsam et al., "Data Structures using C and C++", PHI, 1999.
3. Yashwantkanethkar, "Data Structure through C", BPB, 2005.
4. A.V. Aho, J. Hopcroft, J.D. Ullman, "Data Structures and Algorithms", Addison-Wesley.
5. Goodrich, Michael T., Roberto Tamassia, David Mount. "Data Structures and Algorithms in C++", Seventh Edition, Wiley Publishers, 2004.
6. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 3rd edition, Pearson Education India, 2007.
7. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
8. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, Prentice Hall of India, 2010.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
BSH301	Mathematics-III	4	3	1	-

CO1 - Analyze convergence of sequences and series, and apply power/Taylor series for function approximation.
 CO2 - Apply concepts of partial derivatives, gradients, curl, divergence, and optimization techniques.
 CO3 - Evaluate multiple integrals and apply Green's, Gauss's, and Stokes' theorems in vector calculus.
 CO4 - Solve first and second order differential equations and apply special functions to model systems.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO12
CO1	3	2				1
CO2	3	3				1
CO3	3	3				1
CO4	3	3				2

Unit 1:

Sequences and series: Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.

Unit 2:

Multivariable Calculus (Differentiation): Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 3:

Multivariable Calculus (Integration): Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes, orthogonal

curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Unit 4:

First and higher orders ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Text books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

Reference books:

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
6. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
7. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
8. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
9. G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.

BSH 401	Organizational Behaviour	3	3	-	-
---------	--------------------------	---	---	---	---

CO1 - Understand the foundational concepts of organizational behavior, including perception and learning, and apply them to real-world workplace scenarios.
CO2 - Analyze the impact of personality and attitudes on individual and group behavior within an organization.
CO3 - Examine the role of emotions, motivation, interpersonal dynamics, and leadership in influencing organizational performance.
CO4 - Evaluate organizational culture, structure, and change management processes in the context of sustainable and ethical business practices.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	2	2	1	2	2	3	1	2
CO2	2	3	2	1	1	3	1	3	3	3	2	2
CO3	2	2	3	2	2	2	2	3	3	3	2	3
CO4	2	2	3	2	2	3	3	3	2	3	3	3

Unit 1:
Introduction – defining organization, behavior and organizational behavior, assumptions of OB, principles of OB, levels of OB, scope of OB, OB and Human Resource Management, Applications of OB, Historical developments of OB, emerging concerns Perception and Learning – understanding perception, Basic elements of perception, Principles of perceptual selection, Perceptual grouping, Social Perception, Self-perception and identity, attribution of causality, Perceptual biases in social perception, Implications for human resource management, defining learning, classical and operant conditioning, learning in organizations

Unit 2:
Personality – Defining Personality, History of the concept, Key assumptions, biological and social determinants, Theories – Intrapsychic theory, social learning theory, self-theory, Trait and type theories, Related concepts (locus of control, dogmatism, authoritarianism, Machiavellianism), measuring personality.
Attitudes – Definition, Key elements of attitudes, Attitudes and related concepts (Values, opinion, belief and ideology), Characteristics of attitudes, Attitude formation, Attitude measurement, Changing attitudes, Attitudes at workplace (job satisfaction, work attitude and organizational commitment), Prejudice and discrimination at workspace.

Unit 3:
Emotions in workplace - Definition, Types of emotions, Related concepts (mood, temperament), Stress in workplace, General Adaptation Syndrome, Managing Stress, Psychosomatic disorders and stress, emotional labor and emotional contagion.
Motivation – Definition, Process of motivation, Types of motives, Motivators at workplace, Motivation theories (Process and Content theories) Interpersonal Dynamics – Definition, Psychological Contract, Trust and trust building, Prosocial behavior, Cooperation Vs Competition, Conflict management, Levels and types of conflict at workplace, Conflict management Styles, Managing Negotiations Power and Leadership - Defining Power, Sources of Power, Organizational politics, Leadership, Managers Vs Leaders, Trait and Type approach to leadership, Leadership style, Leadership Grid, Contingency Theories, Contemporary issues Team Dynamics – Groups and Teams, Types of Teams, Stages in group development, problems in team work (Free riding, social loafing, group think), Cross-cultural virtual teams.

Unit 4:

Organizational culture – Defining culture, levels of culture, cultural dimensions, high and low context cultures, Strong and weak organizational cultures, Expressions of organizational culture, Impact of culture on individuals, Organizational cultural change
 Organization Change – Change in Organizations, Nature of the change process, Types of change, Impact of change, Managing resistance to change, Organizational Development interventions
 Organizational Structure and Design – Basic dimensions of structure, Departmentalization, Organizational life cycle, Organizations as socio-technical systems, Organizational design and its impact on employees, Organizational boundary spanning

Textbooks:

1. Behaviour in Organizations by Jerald Greenberg and Robert A. Baron, PHI learning private Ltd, New Delhi (Ninth Edition).
2. Understanding Organizational Behaviour by Udai Pareek, Oxford University Press (Third Edition) ORGB by Nelson, Quick and Khandelwal, Cengage Learning New Delhi (second edition)..

References books:

1. Organizational Behavior by Stephen P. Robbins, Timothy A. Judge, and Neharika Vohra, Pearson Education, 2022(18th Edition,).
2. Organizational Behavior: An Evidence-Based Approach, by Fred Luthans, McGraw-Hill Education, 2021(13th Edition)

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
BSH402	Discrete Mathematics	4	3	1	-
CO1 - Apply set theory, functions, and number theory concepts such as mathematical induction and Euclidean algorithms to solve foundational problems in discrete mathematics.					
CO2 - Utilize logical reasoning, proof techniques, and basic combinatorics to analyze and construct valid mathematical arguments.					
CO3 - Understand and apply algebraic structures and Boolean algebra to model abstract systems and logical functions.					
CO4 - Analyze and solve problems involving graphs and trees, including shortest paths, coloring, and prefix codes, with real-world applications.					

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	1	1	2	1	3
CO2	3	3	2	2	2	1	1	2	1	2	1	3
CO3	3	3	2	2	3	1	1	2	1	2	1	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3

Unit 1:

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers. The Greatest Common Divisor: Euclidean Algorithm. The Fundamental

Theorem of Arithmetic.

Unit 2:

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Unit 3:

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

Unit 4:

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Textbooks:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

Reference books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
3. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson, Discrete Mathematics, Tata McGraw - Hill

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITB401	Software engineering	3	3	-	-
CO1: Understand software development life cycle models and apply project planning techniques such as size, cost, and risk estimation. CO2: Analyze and model software requirements using various structured and object-oriented techniques and document them effectively in an SRS. CO3: Apply design principles and architectural styles to develop high-level software design and user interfaces. CO4: Develop effective testing strategies, understand metrics for software quality, and manage software maintenance and configuration					
COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	3	2	2
CO3	3	2	3	2	2
CO4	3	3	3	3	3
Unit 1: Introduction : Software crisis, software processes & characteristics, software life cycle models, waterfall, prototype, evolutionary and spiral models. Software project planning : size estimation like lines of code & function count, cost estimation models, COCOMO, COCOMO-II, Putnam resource allocation model, risk management. Unit 2: Requirements Engineering: Requirements Engineering, Initiating the process, Eliciting Requirements, Building the Requirements Model, Negotiating, Validating requirements, Requirements Analysis, Scenario-Based Analysis, Requirements Modeling strategies, Flow-Oriented Modeling, Class based modeling, requirement analysis using DFD, Data dictionaries & ER diagrams, requirements documentation SRS, , nature of SRS, characteristics & organization of SRS. Unit 3: Design Process, Design Concepts, The Design Model: Data Design, Architectural, interface Design Elements, Architectural Design: Software Architecture, Architectural Styles, Architectural Design, User Interface Design: Rules, User Interface Analysis and Design, Applying Interface Design Steps, Issues, Web App Interface Design Principles Unit 4: Software testing: Testing process, design of test cases, functional testing: Boundary value analysis, equivalence class testing, decision table testing, cause effect graphing, structural testing, path testing, data flow and mutation testing, unit testing, integration and system testing, debugging, alpha & beta testing, testing tools & standards. Software metrics: software measurements: What & Why , token count , halstead software science measures, design metrics, data structure metrics, information flow metrics. Software reliability: importance, hardware reliability & software reliability, failure and faults, reliability models, basic model, logarithmic poisson model, software quality models, CMM & ISO 9001. Software maintenance: Management of maintenance, maintenance process, maintenance models, regression testing, reverse engineering, software re-engineering, configuration management, documentation.					
Textbooks: 1. K.K.Aggarwal & Yogesh Singh, “ Software engineering “, 2nd Ed. , New age					

international,2005.

2. R.S. Pressman, “ Software engineering- A practioner’s approach “, 5th Ed., Mcgraw Hill Int. Ed., 2001.

3. Pressman R., "Software Engineering, A Practitioners Approach", 7th Edition, Tata MCGraw Hill Publication, 2010, ISBN 978-007-126782-3

Reference books:

1. Stephen R. Schach, “ classical & object oriented software engineering “, IRWIN,TMH,1996.

2. James peter, W. Pedrycz, “ Software engineering : An engineering approach “, John Wiley & Sons, 2004.

3. I. Sommerville, “ Software engineering “, Addison Wesley, 2004.

4. K. Chandrasekhkar, “ Software engineering & quality assurance “,BPB,2005.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB402	Algorithm Analysis and Design	3	3	-	-

CO1: Understand the fundamental characteristics of algorithms and analyze their complexity using asymptotic notations and recurrence relations.

CO2: Apply various algorithmic strategies such as Brute-force, Greedy, Dynamic Programming, Backtracking, and Branch-and-Bound to solve computational problems.

CO3: Implement and analyze graph and tree algorithms for traversal, shortest paths, spanning trees, and network flows.

CO4: Differentiate between tractable and intractable problems, and understand NP-completeness, approximation, and randomized algorithms.

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1
CO2	3	3	3	2	2
CO3	3	3	3	2	2
CO4	3	3	2	3	2

Unit 1:

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

Unit 2:

Fundamental Algorithmic Strategies: Brute-Force, Greedy,Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.

Unit 3:

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

Unit 4:

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Textbooks:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

<i>Subject Code</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB403	3	3	-	-

	r											
	y											
CO1: Understand and analyze the foundational concepts of formal languages, grammars, and their classification within the Chomsky hierarchy. CO2: Apply the theory of regular expressions, finite automata (DFA and NFA), and their equivalence. CO3: Demonstrate the ability to design and analyze context-free grammars (CFG), nondeterministic pushdown automata (PDA), and context-sensitive grammars (CSG). CO4: Understand the operation and theory of Turing machines and apply the Church-Turing thesis.												
COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3			2							
CO 2	3		3	2	2							
CO 3	3	3		3	2							
CO 4	3	3		3	2							2
Unit 1: Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. Unit 2: Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata. Unit 3: Context-free languages and Context-sensitive languages: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs, Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Unit 4: Turing machines: The basic model for Turing machines (TM), Turingrecognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable												

problems about languages.

Text books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Reference books:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITB501	Operating System	3	3	-	-							
CO1: Understand the fundamental concepts and types of operating systems, their evolution, and their role in computing systems.												
CO2: Explain the concept of processes, process states, context switching, threads, and multithreading models.												
CO3: Analyze and compare different CPU scheduling algorithms including FCFS, SJF, RR, preemptive and non-preemptive strategies.												
CO4: Illustrate the working of multiprocessor and real-time scheduling algorithms such as RM and EDF.												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	3	2									
CO3	3	3	3	2	2							
CO4	3	2	3	2	2							1

Unit 1:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Unit 2:

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson’s Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC

Problems: Reader's & Writer Problem, Dining Philosopher Problem, Bounded Buffer problem. Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit 3:

Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

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

Unit 4: I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

Textbooks:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB502	Computer Networks	3	3	-	-
CO1: Understand the fundamental concepts of data communication, OSI model, and network topologies. CO2: Apply error detection and correction methods and evaluate data link layer protocols. CO3: Analyze addressing schemes, switching techniques, and routing mechanisms in the					

network layer.

CO4: Evaluate transport and application layer protocols and Quality of Service (QoS) techniques and demonstrate understanding of network security fundamentals and cryptography concepts.

COs	PO1	PO2	PO3	PO4	PO5	PO6–PO12 (optional)
CO1	3	-	-	1	-	-
CO2	3	3	-	-	-	-
CO3	3	3	3	-	-	-
CO4	3	2	-	3	3	-

Unit 1:

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

Unit 2:

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

Unit 3:

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

Unit 4:

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm. Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Textbooks:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Reference books:

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
---------------------	--------------------	----------------	-----------------	------------------	------------------

ITB503	Database Management Systems	3	3	-	-
--------	-----------------------------	---	---	---	---

CO1: Introduction to DBMS, data models, ER/EER models CO2: Relational data model, relational algebra, and queries CO3: Dependencies, normalization, and schema design CO4: Data storage, indexing, transactions, error recovery												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	-	-
CO4	3	3	3	-	3	2	-	-	-	-	-	-

Unit 1:
Introduction to database system, components of DBMS, DBMS architecture, three-schema architecture of a database, Data model, overview of hierarchical network and relational DBMS, ER-model, EER-model: specialization, generalization, aggregation

Unit 2:
Relational data model: concepts of relations, schema-instance distinction, keys, referential integrity and foreign keys. Relational algebra operators: selection, projection, cross product, various types of joins, division, example queries. Tuple relation calculus, domain relational calculus, converting the database specification in

Unit 3:
Dependencies and Normal forms: Importance of a good schema design, problems encounter with bad schema design, motivation for normal forms, functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF, and BCNF, decompositions and desirable properties of them, algorithm for 3NF and BCNF normalization, multi-valued dependencies and 4NF, join dependencies and definition 5NF.

Unit 4:
Data Storage and Indexes- file organizations, primary, secondary index structures, various index structures-hash based, dynamic hashing techniques, multi-level indexes, B+ trees, Transaction and Error recovery- concepts of transaction processing, ACID properties, concurrency control, locking based protocols for concurrency control, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

TEXT BOOKS:
1. Korth, Silberschatz, "Database system concepts", 4th Ed., TMH, 2003.
2. Steve Bobrowski, "Oracle 8 architecture", TMH,2000.
3. Raghu Ramakrishnan," Database Management System," WCB/McGraw Hill

REFERENCES:
1. C.J.Date, "An introduction to database systems", 7th Ed., Narosa publishing,2004.
2. Elmasri and Navathe, "Fundamentals of database systems", 4th Ed., A.Wesley, 2004.
3. J.D. Ullman, "Principles of database systems", 2nd Ed., Galgotia publications,1999.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB504	Compiler Design	3	3	-	-

CO1: Lexical Analysis (Scanner)
 CO2: Syntax Analysis (Parser)
 CO3: Semantic Analysis & Symbol Table
 CO4: Intermediate Code Generation & Optimization

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	3	-	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	-

Unit 1:

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

Syntax

Unit 2:

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

Unit 3:

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

Unit 4:

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

Textbooks:

1. Tremblay, et al., "The Theory and practice of compiler Writing", McGraw Hill, New York, 1985.
2. A. Holub, "Compiler Design in C", PHI, 2004.
3. Aho, Ullman & Ravi Sethi, "Principles of Compiler Design", Pearson Education, 2002.

Reference books:

1. Andrew L. Appel, "Modern Compiler Implementation in C", Delhi, Foundation Books, 2000.
2. Dick Grune et. Al., "Modern Compiler Design", Wiley Dreamtech, 2000.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITB601	Industrial Economics & Principles of Management	3	3	-	-							
CO1: Introduction to Economics CO2: Demand, Supply, Money and Banking CO3: Management Principles CO4: Human Behavior in Management												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	-	-	3	-	-	-	-	-	-
CO2	2	3	2	-	-	3	3	-	-	-	-	-
CO3	2	-	3	-	-	-	-	-	3	-	-	-
CO4	2	-	3	-	-	3	-	-	3	-	-	-
Unit 1: Introduction: Nature and Scope of economics, micro and macro economics; Problems in industrial economics; A framework of industrial economics. Unit 2: Demand and supply, elasticity concept, indifference curve analysis, consumer's equilibrium, marginal utility concept, pricing techniques, price effect, income effect, substitution effect. Money and Banking: Value and function of money, inflation, quantity theory of money, functions of banking system: commercial banking system and central banking system, business fluctuation. Unit 3: Management: Definition, nature and significance of management, evaluation of management thought, contribution of Max Weber and Taylor and Fayol. Different functions of management:-planning, organizing, staffing, directing and controlling. Unit 4: Human Behavior: Factors of human behavior, perception, learning and personality development, inter-personal relationship and group behavior.												
Text books:												

1. Dewett, KK, "Modern economic theory", s chand and co".
2. Luthers Fred, " Organisational Behaviour".

Reference Books:

1. Prashad L M, "Principles of management" .
2. W Stonier and DC Horgne, "A textbook of economic theory", Oxfordpublishing house pvt.Ltd.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB602	Web Technology	3	3	-	-
CO1: Understand the fundamentals of the internet, client-server architecture, communication protocols (TCP/IP, UDP), DNS, and HTTP operations.					
CO2: Develop structured and styled web pages using HTML, CSS, and JavaScript with dynamic and responsive features.					
CO3: Work with XML for data representation, transformation using XSL/XSLT, and perform XML-based client-side scripting using AJAX.					
CO4: Apply PHP for server-side scripting to create interactive, database-driven websites, Integrate PHP with MySQL to retrieve, manipulate, and display data; manage state using sessions and cookies.					

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	-	-	-	-
CO2	3	3	2	-	2	-	-	-	-	2	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-
CO4	3	2	3	2	2	-	-	-	1	2	-	1

Unit 1:
The Internet, Client-Server communication, TCP/IP, UDP, DNS, WWW. Hypertext Transfer Protocol – HTTP Request and Response Message, Browser and server functions, Uniform Resource Locator, Server Cache control.

Unit 2:
Markup languages – HTML and XHTML, HTML tags, Document Structure, headings, images, lists, tables, frames, forms, links, element attributes, event handlers. Cascading Style Sheets – syntax, importing CSS to HTML documents, CSS box model, Responsive layouts. JavaScript Fundamentals – Variables and Data Types, statements, operators, functions, objects, built-in objects, events and event handlers, strings, Arrays.

Unit 3:
Extensible Markup Language – Namespace, Document Type Definition, XML Schema, Document Object Model, creating XML documents, Javascript and XML:AJAX, DOM-based XML processing, Event oriented parsing:SAX, introduction to XSL, XPath, XSLT.

Unit 4:
Server side programming with PHP – Adding PHP to HTML, Syntax and Variables, Passing information between pages, Strings, Arrays, Functions, Numbers, Basic PHP

errors / problems. PHP/MySQL Functions, Displaying queries in tables, Building Forms from queries, String and Regular Expressions, Sessions, Cookies and HTTP, Type and Type Conversions.

TEXT BOOKS

1. Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education.
2. PHP : The Complete Reference By Steven Holzner, Tata McGrawHill.

REFERENCES:

1. Web Design The complete Reference, Thomas Powell, Tata McGrawHill.
2. HTML and XHTML The complete Reference, Thomas Powell, Tata McGrawHill.
3. www.w3schools.com for online reference

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB603	Computer Graphics & Virtual Reality	3	-	-	-

CO1: Understand the fundamental concepts of computer graphics, display devices, scan conversion, and curve generation.

CO2: Apply 2D and 3D geometric transformations, clipping algorithms, and object representation techniques.

CO3: Describe and analyze animation techniques, motion control methods, and the components of a virtual reality system.

CO4: Explore geometric, kinematic, physical, and behavioral modeling in virtual environments, Demonstrate programming knowledge using VRML and Java 3D for building and rendering 3D graphics and virtual worlds.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	2	-	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	2	-	1
CO3	3	3	3	2	3	-	-	-	-	-	-	1
CO4	3	3	3	2	3	-	-	-	-	-	-	1

Unit 1:

Introduction to Computer Graphics, Display devices, Bitmap and Vector based Graphics, Overview of coordinate system, scan conversion of: point, line using differential analyzer and Bresenham's algorithm, circle using midpoint approach. Curve Generation: Bezier and B-Spline curves. Introduction to fractals: generation procedure, classification, dimension and Koch Curve.

Unit 2:

Area Filling: Inside/Outside test, scanline polygon fill algorithm, Boundary fill and floor fill algorithm. Basic 2D transformations: Translation, Rotation, Scaling, Reflection, Shear – Homogeneous Matrix representation and composite transformation, Introduction to 2D viewing, viewing pipeline, view coordinate reference frame, window to viewport transformation, point clipping. Line clipping: Cohen Sutherland Algorithm, Liang Barsky

algorithms. Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton. Text Clipping. Three Dimensional Transformations: Translation, Scaling, Rotation and Composite. 3D object representation: Polygon surfaces, Tables, Meshes. 3D viewing pipeline, viewing transformation, Projections: Parallel (oblique and orthographic), Perspective (one point); visibility – Z-Buffer.

Unit 3:

Introduction to Animation, key frame animation, animation sequence, Motion control methods, morphing, mesh warping. Virtual Reality : Basic Concepts , Classical Components of VR System , Types of VR Systems, Three Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture. Interfaces, Graphical Display, Sound displays, and Haptic Feedback . Input Devices ,Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL rendering pipeline.Applications of Virtual Reality.

Unit 4:

Geometric Modeling: Virtual Object Shape, Object Visual Appearance. Kinematics Modeling: Object Position, Transformation Invariants, Object Hierarchies, Physical Modeling: Collision Detection, Surface Deformation, Force Computation. Behavior Modeling. Programming through VRML : Defining and Using Nodes and Shapes , VRML Browsers , Java 3D :Visual Object Definition by Shape 3D instances , Defining personal visual object class, Color Cube Class, Geometric – Utility Classes, Geometry Classes , Attributes.

Textbooks

1. Donald Hearn and M. Pauline Baker, “Computer Graphics”, Pearson Education.
2. R. K Maurya, “Computer Graphics with Virtual Reality”, Wiley India.

Reference Books:

1. Grigore Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley.
2. Steven Harrington, “Computer Graphics”, McGraw Hill.
3. Vince, “Virtual Reality Systems”, Pearson Education.
4. F.S. Hill , Stephen M. Kelley , “Computer Graphics using Open GL” Prentice Hall

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITB701	Machine Learning	3	3	-	-
<u>Unit I</u> Introduction: Definition of learning systems,Goals and applications of machine learning, Aspects of developing a learning system:- training data, concept representation, function approximation. UNIt 2: Supervised Learning (Regression/Classification): Basic methods:-Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes. Linear models: - Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: -Multi-class/Structured Outputs, Ranking. Unsupervised Learning: Clustering:- K-means/Kernel K-means,Dimensionality					

Reduction:- PCA and kernel PCA ,Matrix Factorization and Matrix Completion ,Generative Models (mixture models and latent factor models).

Unit 3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

Unit 4:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning. Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

Text books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

References books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITB702	Foundation of research	3	3	-	-							
CO1: Understand the fundamentals of research and its importance in engineering and technology. CO2: Develop critical skills to perform literature surveys, analyze data, and create models. CO3: Enhance communication skills and understand the ethical implications of research. CO4: Apply knowledge of experimental design and intellectual property in research projects.												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2

CO 1	3	3										1
CO 2		3		2	1							
CO 3								2	1	2		
CO 4			3			1	1					

Unit 1:
A group discussion on what is research; Overview of research;

Unit 2:
Literature survey , Experimental skills; Data analysis, Modelling skills;

Unit 3:
Technical writing; Technical Presentations; Creativity in Research, Group discussion on Ethics in Research

Unit 4:
Design of Experiments, Intellectual Property, Department specific research discussions

Text Books:

1. C. R. Kothari and Gaurav Garg, *Research Methodology: Methods and Techniques*, 4th Edition, New Age International Publishers, 2019.

Reference books

2. John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th Edition, Sage Publications, 2017.
3. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, 4th Edition, Sage Publications, 2014.
4. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 4th Edition, University of Chicago Press, 2016.

Course Code	Course name	Lectures	Tutorials	Practicals	Total Credits
BSH801	Constitution of India	-	0	0	0 (Non Credit)

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form

of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Textbooks:

1. Introduction of Constitution by Durga Das Basu
2. The Indian Constitution: Cornerstone of A Nation by Austin Granville

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBEL1	Distributed Database	3	3	-	-							
CO1: Distributed Databases Overview CO2: Designing Strategies for Distributed Databases CO3: Query Optimization and Distributed Transaction Management CO4: Transaction Concurrency Control and Database Administration												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	-	2	-	-	-	-	-	-	-
CO2	3	3	2	-	3	-	-	-	-	-	-	-

CO3	3	3	3	2	3	-	-	-	-	-	-	-
CO4	3	3	-	-	3	-	-	-	2	-	-	-

Unit 1:
Distributed Database Overview-Distributed Database management system DDBMS, Features of Distributed Vs Centralized databases, Why Distributed databases?, Principals and Concepts related to Distributed Databases-Review of Databases, Review of Computer Networks, Principals of Distributed Databases. Distributed Database Architecture-Reference Architecture for Distributed databases, Architectural model for DDBMS, Distributed DBMS architecture.

Unit 2:
Designing Strategies of Distributed Databases from the replication and Fragmentation Point of View-Types of Data Fragmentation, Distributed database alternative design strategies, Advantages and Disadvantages of Fragmentation and Replication, Distributed Query Design and Execution-Difference between centralized and Distributed query execution, Transforming global queries and fragment queries, Distributed grouping and aggregation functions used in Distributed query processing.

Unit 3:
Query Optimization in Distributed Database Environment-Framework for Query Optimization, General queries, Decomposition and Data Localization, Need for Query optimization, Distributed Query Design and Execution Strategies-Difference between centralized and Distributed query execution, Transforming global queries and fragment queries, Distributed grouping and aggregation functions used in Distributed query processing. Distributed Transaction Management-Introduction to Transaction Management, Atomicity and Concurrency control.

Unit 4:
Transaction Concurrency Control Techniques-Different techniques for concurrency control, Role of concurrency in the Integrity of the DDBMS, Distributed Database Administration-Catalog Management in distributed database, Authorization:Need and techniques,Catalog meaning and Need and Its role in DDBMS, Protection :Why and How in DDBMS Environment. DDBMS Object Management and Disaster Prevention, Recovery and Backup--Fundamental Object concepts and Object management, Architectural issues, Object management and Distributed Object storage, Object Query Processing.Database Recovery Models,BackupTypes, Backup Options,Backup Strategies, Restoring Databases, Database Snapshots.

Text Book:
1. Stefano Ceri, Giuseppe Pelagatti, *Distributed Database Principles & Systems.*, 5th ed.McGraw-Hill (2008).

Reference Books:
1. M. Tamer ozsu, Patrick valduriez, S. Sridhar, pearson, principles of distributed Database systems, 1th ed., Pearson, (2006).
2. Chris leiter, Dan Wood, Michael Cierkowski, Albert Boettger, Beginning microsoftsql Server 2008 administration, 1st ed., wiley (2009).

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL2	Mobile Computing	3	3	-	-
CO1 - Understand the architecture, services, and security features of GSM networks and					

the fundamentals of mobile computing.

CO2 - Analyze wireless MAC techniques and apply Mobile IP concepts for addressing mobility in network layer communication.

CO3 - Evaluate transport layer protocols for mobile environments and design data management strategies in mobile database systems.

CO4 - Analyze Mobile Ad hoc Networks (MANETs), routing protocols, and study the architecture of WAP and Bluetooth technologies.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	2	1	2	1	3
CO2	3	3	3	3	3	2	2	2	1	2	2	3
CO3	3	3	3	2	3	2	2	2	2	2	2	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3

Unit 1:

Introduction to Mobile Communications and Computing: Introduction to Mobile Computing, novel applications, limitations, and architecture. GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services.

Unit 2:

Wireless Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA. Spreading techniques.

Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations).

Unit 3:

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP. Transaction oriented TCP. Database Issues: Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation. Data Dissemination: Communications asymmetry, classification of new data delivery mechanisms, push based mechanisms, pull-based mechanisms.

Unit 4:

Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, routing and various routing algorithms, security in MANETs. Protocols and Tools: Wireless Application Protocol-WAP. (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking).

Text Books:

1. Jochen Schiller, Mobile Communications, Pearson Education.
2. Stojmenovic and Cacute, Handbook of Wireless Networks and Mobile Computing, Wiley.

Reference Books:

1. Reza Behravanfar, Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Cambridge University Press.
2. Frank Adelstein, Sandeep K.S Gupta, Golden Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, TMH.
5. Uwe Hansmann, Lothar Merk, Martin S, Nicklous, Thomas Stober, Principles of

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBEL3	Cloud Computing	3	3	-	-							
CO1: Understand the fundamental concepts and architecture of cloud computing.												
CO2: Explain service management and data handling techniques in cloud environments.												
CO3: Evaluate resource management strategies, security measures, and tools like cloud simulators.												
CO4: Analyze emerging research trends in cloud computing and fog computing.												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-		2
CO2	-	3	-	2	2	-	-	-	-	-		-
CO3	-	3	2	3	3	2	-	2	-	2		-
CO4	2	3	2	3	2	2	3	-	-	2		3

Unit 1:
Introduction to Cloud Computing, Cloud Computing Architecture

Unit 2:
Service Management in Cloud Computing, Data Management in Cloud Computing

Unit 3:
Resource Management in Cloud, Cloud Security, Open Source and Commercial Clouds, Cloud Simulator

Unit 4:
Research trend in Cloud Computing, Fog Computing

Text Books:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010

References Books:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
2. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India, 2010

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL4	Advanced Computer Architecture	3	3	-	-
CO1: Understand the basics of computer architecture, including performance metrics, benchmarking, and instruction set principles, to evaluate CPU designs. CO2: Apply pipelining and instruction-level parallelism (ILP) concepts to enhance CPU performance and address pipeline hazards. CO3: Analyze memory hierarchy design, including cache and virtual memory systems, to optimize performance and efficiency. CO4: Understand input/output systems and advanced architectures, such as DMA, RAID, and multi-core systems, to evaluate their impact on computing.					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	3	1	1								
CO3	3	3	1		1							
CO4	3	2		1	1							

Unit 1:
Introduction - What is computer architecture? CPU Performance metrics. Performance measurement. Benchmark programs, Quantitative Principles of Computer Design. Instruction Set Principles, Classifying Instruction Set Architectures, Memory Addressing, Type and Size of Operands, Operations in the Instruction Set, Instructions for Control Flow, Encoding an Instruction Set

Unit 2:
Pipelining - Speedup. Pipeline hazards , Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Forwarding, Branch prediction, Dynamic Scheduling, advanced techniques for Instruction Delivery and Speculation, Limitations of ILP.

Unit 3:
Memory Hierarchy Design, Eleven Advanced Optimizations of Cache Performance, Memory Technology and Optimizations. Cache memory- Locality of reference. Cache organization and access. Multilevel caches. Measuring and Improving Cache Performance. Cache coherence. Virtual memory- Hardware support for address translation, page fault handling. Translation look aside buffer.

Unit 4:
Input/Output- Hard disk. Flash memory. I/O Performance, Reliability Measures, and Benchmarks, I/O interfacing. Memory mapped I/O. Interrupt driven I/O. Direct memory access. Redundant arrays of inexpensive disks; Introduction to advanced topics- Multi-cores. Multi-processors. Clusters.

Text Books:

- David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware and Software Interface, Morgan Kaufmann Publishers, Fourth Edition.(2009)

Reference Books:

- John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann Publishers (2007)

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL5	Advanced python programming	3	3	-	-

CO1: Use the Spyder IDE for Python programming, including managing scripts, variables, and the coding environment.

CO2: Apply Python data types, advanced data structures, and sequence data types (like lists, tuples, dictionaries, sets, and arrays) for problem-solving.

CO3: Perform data analysis and visualization using NumPy, pandas, and other relevant libraries.

CO4: Develop Python programs using control structures, functions, and implement basic

machine learning concepts like regression and classification.												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			2							
CO2	3	2	1		1							
CO3	2	1	1	1	2							
CO4	3	2	1	1	2							
Unit 1: BASICS OF PYTHON SPYDER (TOOL):Introduction Spyder, Setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files, Variable creation, Arithmetic and logical operators, Data types and associated operations, Advanced Python Fundamentals: Advanced Data Structures. Unit 2: Sequence data types and associated operations: Strings, Lists, Arrays, Tuples, Dictionary, Sets, Range, NumPy:ndArray Unit 3: Pandas dataframe and dataframe related operations, Data visualization, Control structures, Functions Unit 4: CASE STUDY: Regression; Classification												
Text Books: 1. Introduction to linear algebra - by Gilbert Strang 2. Applied statistics and probability for engineers – by Douglas Montgomery References Books: 1. Mastering python for data science, Samir Madhavan												

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL6	Statistical Modeling and Tools	3	3	-	-
CO1: Understand and apply probability concepts and distributions to analyze statistical problems. CO2: Employ parametric methods for point and interval estimation and hypothesis testing in statistical data analysis. CO3: Analyze multivariate statistical problems using techniques like PCA, canonical correlations, and Hotelling's T^2 . CO4: Apply nonparametric methods and statistical tools like IBM-SPSS, R, and MATLAB to solve advanced statistical problems.					

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	2
CO2	3	3	2	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	2	-	-	-	-	2	-	3
CO4	2	3	3	3	3	2	2	-	-	2	-	3

Unit 1:

Review of Probability and Distributions: Rules for probability, random variables and their distributions, moments, special discrete and continuous distributions, laws of large numbers and central limit theorem, sampling distributions.

Unit 2:

Parametric Methods: Point estimation – unbiasedness, consistency, UMVUE, sufficiency and completeness, method of moments, maximum likelihood estimation and method of scoring. Bayes, minimax and admissible estimators. Interval estimation - confidence intervals for means, variances and proportions. Testing of Hypotheses - tests for parameters of normal populations and for proportions, goodness of fit test and its applications.

Unit 3:

Multivariate Analysis: Multivariate normal, Wishart and Hotelling's T^2 distributions and their applications in testing of hypotheses problems. Classification of observations, principal component analysis, canonical correlations and canonical variables.

Unit 4:

Nonparametric Methods: Empirical distribution function, asymptotic distributions of order statistics, single sample problems, problems of location, prediction intervals, Kolmogorov Smirnov one sample statistics, sign test, Wilcoxon signed rank statistics, two sample problems, Mann-Whitney-Wilcoxon tests, scale problems, Kolmogorov Smirnov two sample criterion, Hoeffding's U-statistics. **Statistical Tools:** IBM-SPSS, R, MATLAB.

Text books:

1. An Introduction to Probability and Statistics by V.K. Rohatgi & A.K. Md.E.Saleh.
2. Modern Mathematical Statistics by E.J. Dudewicz & S.N. Mishra

Reference Books:

1. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross
2. An Introduction to Multivariate Analysis by T. W. Anderson
3. Nonparametric Statistical Inference by J.D. Gibbons & S. Chakraborti

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
--------------	-------------	---------	----------	-----------	-----------

ITBEL7	Mobile Application Development	3	3	-	-							
CO1 - Understand the Android platform, development environment, and activity lifecycle for building mobile applications. CO2 - Design user interfaces and manage activity interaction using intents, layouts, and event listeners in Android and iOS environments. CO3 - Develop multimedia applications in Android using graphics APIs, media handling tools, and apply modern deployment practices. CO4 - Implement networking capabilities in Android apps using asynchronous tasks and HTTP connections.												
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	2	3
CO3	3	3	3	2	3	2	1	2	2	3	2	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3
Unit 1: The Android Platform: Introduction to the Android platform and the Android Studio IDE, Android components, Activities and their lifecycle. Unit 2: User Interface Design: Intents, Activity lifecycle, UI Design: Widgets and Layouts, UI Events, Event Listeners, XML & LOGS, Advanced Database & introduction to iOS Unit 3: Graphics Support in Android: Drawables, Basics of Material Design, 2D graphics: Canvas/Drawing using a view, Modern deployment & development practice. Multimedia in Android: Audio playback and MediaPlayer, SoundPool Unit 4: Networking support: Basics of networking in Android, AsyncTask, HttpURLConnection												
Text Books: 1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley 2. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design and Development, Prentice Hall, 2004.												
Reference Books: 1. Suzanne Ginsburg, Designing the iPhone User Experience: A User-Centered Approach to Sketching and Prototyping iPhone Apps, Addison-Wesley Professional, 2010. 2. Brian Fling, Mobile Design and Development, O'Reilly Media, Inc., 2009.												

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL8	Network Protocols	3	3	-	-
CO1 - Understand network communication architectures, IP addressing schemes, and foundational protocols such as ARP, RARP, and IGMP. CO2 - Analyze process-to-process communication mechanisms and transport layer protocols including UDP and TCP with congestion and flow control.					

CO3 - Evaluate client-server models, name resolution systems, and dynamic addressing using DNS, DHCP, and BOOTP.

CO4 - Develop and implement socket programming using TCP and UDP to create client-server applications.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	2	1	2	1	3
CO3	3	3	2	2	2	1	1	2	1	2	1	3
CO4	3	3	3	3	3	2	1	2	2	3	2	3

Unit 1:

Introduction: Network Communication Architecture and Protocols. IP Addressing, CIDR, Subnetting and Supernetting. Data gram, ARP, RARP, Message Protocol, Group Management Protocols.

Unit 2:

Process to process communication-User datagram –Checksum- UDP operation- uses of UDP – UDP design, TCP Services –Segment -Options- Checksum-Flow control- Error Control- TCP Timers- Connection-State Transition Diagram-Congestion Control-TCP operation- TCP Design.

Unit 3:

Client-server Model-Concurrency-Processes, BOOTP and DHCP, Name Space-Domain name Space-Distribution of Name space-DNS in the Internet-Resolution- DNS Messages- Types of Records- Compression-DDNS Encapsulation.

Unit 4:

Connections- Communication-Command Processing-File Transfer-User Interface-Anonymous FTP, Sockets-Byte ordering- Address Transformation-Byte manipulation Function-Information about Remote Host- Socket System Calls- Connectionless Iterative server- UDP Client/Server Programs- Connection oriented Concurrent Server – TCP Client/Server Programs.

Text Book

1. TCP/IP Protocol Suite. Behrouz A. Forouzan (TMH edition)

Reference Book:

1. Internetworking with TCP/IP. D. E. Comer (PHI publications).

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL9	XML and Web Services	3	3	-	-

CO1 - Understand XML structure, parsing, transformation, validation, and applications in publishing and data interchange.

CO2 - Explain and apply core web service technologies and architectures including RPC, SOAP, UDDI, and WSDL.

CO3 - Develop and deploy XML-based web services using frameworks like AXIS2 and handle SOAP messaging patterns.

CO4 - Analyze and implement web service deployment models, message processing, and client communication mechanisms.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------	------

CO1	3	3	2	2	3	1	1	2	1	2	1	3
CO2	3	3	3	2	3	1	1	2	1	2	2	3
CO3	3	3	3	3	3	1	1	2	2	3	2	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3

Unit 1:
XML Fundamentals: Basics – XML Tree – Syntax – XML Elements – Attributes – Validation – XML, Viewing – CSS – XSLT – XML Namespace – CDATA - XML Parser – DOM – XML to HTML – Applications, **XML Technology:** XML Essentials – Schema – XML Design Techniques – Security – Transformation – Query – XML Components – XML Processing – XML Publishing

Unit 2:
Web Services Fundamentals: RPC concepts – RMI Implementation – Concepts and Use of Web Services – Web Service Architecture - JAX-RPC – XML-RPC - Web Services Platform: SOAP – UDDI – WSDL – Simple Web Service Creation – Deployment

Unit 3:
Web Services Development and Deployment: XML Web Services Standards – AXIS2 Framework - SOAP Messages – Life Cycle of a Message – Message Exchange Patterns – Handling of SOAP Messages - AXIS2 Clients and Services – SOAP Messages with Attachments – Applications

Unit 4:
Deployment Platform Architectural Models: AXIS2 Requirements – Architecture – Information Model – XML Processing Model– SOAP Message Processing Model – Deployment Model – Client Communication with Web Services – Transports – Code Generation – Data Binding – Modules – Handlers – SOAP Faults

Textbooks:
1. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, “Web Services - Concepts, Architectures and Applications”, Springer Verlag, 2010.
2. Ron Schmelzer, “XML and Web Services Unleashed”, Sams, 2002.

References:
1. Frank. P. Coyle, XML, Web Services And The Data Revolution, Pearson Education, 2002.
2. Eric Newcomer, “Understanding Web Services: XML, WSDL, SOAP and UDDI”, Addison Wesley Professional, 2002.
3. David A. Chappell and Tyler Jewell, “Java Web services”, O'Reilly Media, Inc., 2002.
4. Anne Thomas Mannes, “Web Services: A Manger’s Guide”, Addison Wesley Professional, 2003.
5. <http://www.w3schools.com>
6. <http://www.w3.org>
7. <http://axis.apache.org/axis2/java/core/docs/toc.html>

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL10	Service Oriented Architecture	3	3	-	-

CO1 -Understand the fundamental principles, architecture, and characteristics of SOA and how it compares with traditional architectures.
CO2 -Apply web service technologies such as SOAP, WSDL, and orchestration layers within an SOA framework.

CO3 -Analyze and design SOA-based systems through service modeling, WSDL, and composition strategies.

CO4 -Demonstrate implementation of SOA using enterprise platforms like J2EE and .NET, including WS-* standards and related technologies.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	1	1	1	2	1	2
CO2	3	3	3	2	3	1	1	1	2	2	2	3
CO3	3	3	3	2	3	1	1	1	2	2	2	3
CO4	3	3	3	2	3	1	1	1	2	3	3	3

Unit 1:

SOA FUNDAMENTALS: Defining SOA, Roots of SOA, Characteristics of SOA, Concept of a service in SOA, Basic SOA architecture - Comparing SOA to client-server and distributed internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of service orientation.

Unit 2:

WEB SERVICES AND SOA: Web services – Service descriptions – Messaging with SOAP – Message exchange Patterns – Coordination – Atomic Transactions – Business activities – Orchestration – Choreography – Service layer abstraction – Application Service Layer – Business Service Layer – Orchestration Service Layer.

Unit 3:

SOA ANALYSIS AND DESIGN: Service oriented analysis – Business-centric SOA – Deriving business services- service modeling - Service Oriented Design – WSDL basics – SOAP basics – SOA composition guidelines – Entity-centric business service design – Application service design – Task centric business service design

Unit 4:

ENTERPRISE PLATFORMS AND SOA: SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAX-WS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC)- Web Services Interoperability Technologies (WSIT) - SOA support in .NET – Common Language Runtime - ASP.NET web forms – ASP.NET web services – Web Services Enhancements (WSE), WS-BPEL basics – WS-Coordination overview - WS-Choreography, WS-Policy, WSSecurity

Text books:

1. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.

Reference books:

1. Thomas Erl, “SOA Principles of Service Design “(The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005.
2. Newcomer, Lomow, “Understanding SOA with Web Services”, Pearson Education, 2005.
3. Sandeep Chatterjee, James Webber, “Developing Enterprise Web Services, An Architect’s Guide”, Pearson Education, 2005.
4. Dan Woods and Thomas Mattern, “Enterprise SOA Designing IT for Business Innovation” O’REILLY, First Edition, 2006.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL11	System Analysis and Design	3	3	-	-

CO1: Understand the fundamentals of systems, system types, roles of systems analysts, and the phases of the system development life cycle (SDLC).

CO2: Apply documentation standards and fact-gathering techniques for system planning and evaluate feasibility for proposed systems.

CO3: Design system models using tools such as DFD, ERD, flowcharts, and structured charts, and apply design principles for modular and distributed systems.

CO4: Analyze and evaluate systems for audit, security, disaster recovery, and apply object-oriented analysis/design with real-world case studies.

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	1	1
CO2	3	3	2	2	2
CO3	3	3	3	2	2
CO4	3	3	2	3	2

Unit 1:

Fundamentals of System: System definition and concepts- Characteristics and types of system, Manual and automated systems, Real-life Business sub-systems- Production, Marketing, Personal, Material, Finance, Systems models types of models- Systems environment and boundaries, Realtime and distributed systems, Basic principles of successful systems. Systems analyst and System Development cycle :Role and need of systems analyst ,Qualifications and responsibilities ,Systems Analyst as an agent of change, system, SDLC, Various phases of development :Analysis, Design, Development, Implementation, Maintenance.

Unit 2:

Systems documentation considerations and System Planning :Principles of systems documentation, Types of documentation and their importance, Enforcing documentation discipline in an organization .System Planning: Data and fact gathering techniques: Interviews, Group communication, Presentations, Site visits. Feasibility study and its importance, Types of feasibility reports, System, Selection, plan and proposal, Prototyping.

Unit 3:

Systems Design and modeling: Process modeling, Logical and physical design, Design representation, Systems flowcharts and structured charts , Data flow diagrams , Common diagramming conventions and guidelines using DFD and ERD diagrams. Data Modeling and systems analysis , Designing the internals: Program and Process design, Designing Distributed Systems .Classification of forms, Input/output forms design, User-interface design, Graphical interfaces. Modular and structured design-Module specifications ,Module coupling and cohesion , Top-down and bottom-up design .System Implementation and Maintenance: Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems quality Control and assurance, Maintenance activities and issues.

Unit 4:

System Audit and Security :Computer system as an expensive resource-Data and Strong media Procedures and norms for utilization of computer equipment, Audit of computer system usage, Audit trails, Types of threats to computer system and control measures-Threat to computer system and

control measures, Disaster recovery and contingency planning. Object Oriented Analysis and design: Introduction to Object Oriented Analysis and design life cycle, object modeling: Class Diagrams, Dynamic modeling: state diagram, sequence diagramming. Cost-Benefit and analysis and Case study: Tools and techniques of Cost-Benefit and analysis. Case study: Inventory Control, Railway Reservation System, University Management System, Hospital management System.

Text Book:

1. Elias M. Awad, System analysis and design

Reference Books:

1. Perry Edwards, System analysis and design, McGraw Hill international edition, 1993.
2. James A. Senn, *Analysis and design of information systems*, McGraw-Hill, 1989

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL12	Decision Support System	3	3	-	-

CO1: Understand the framework and process of decision-making, decision styles, and the role of Decision Support Systems (DSS) in aiding complex decisions.

CO2: Describe the architecture, components, and classifications of DSS, and evaluate its effectiveness in different contexts.

CO3: Apply modeling techniques in DSS using decision analysis, mathematical programming, simulations, and visual interactive modeling.

CO4: Analyze and apply Business Intelligence (BI) concepts, data warehousing, OLAP, data mining, and knowledge-based systems in decision-making scenarios.

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	1	1
CO2	3	3	2	2	2
CO3	3	3	3	2	3
CO4	3	3	3	3	3

Unit 1:

A Framework for Decision Support, The Concept of Decision Support Systems; Group Support Systems; Enterprise Information Systems. Decision-Making Systems: Introduction and Definitions; Systems; Models; Phases of the Decision Making Process; The Intelligence Phase; Decision-Making: The Design Phase; The Choice Phase; The Implementation Phase; How Decisions Are Supported; Personality Types, Gender, Human Cognition, and Decision Styles; The Decision-Makers

Unit 2:

Decision Support Systems: DSS Configurations; What Is a DSS?; Characteristics and Capabilities of DSS; Components of DSS; The Data Management Subsystem; The Model Management Subsystem; The User Interface (Dialog) Subsystem; The Knowledge-Based Management Subsystem; The User; DSS Hardware; DSS Classifications;

Unit 3:

Modeling and Analysis: MSS Modeling; Static and Dynamic Models; Certainty, Uncertainty, and Risk; Influence Diagrams; MSS Modeling with Spreadsheets; Decision Analysis of a Few Alternatives; The Structure of MSS Mathematical Models; Mathematical Programming Optimization; Multiple Goals, Sensitivity Analysis, What-If, and Goal Seeking; Problem-Solving Search Methods; Heuristic Programming; Simulation; Visual Interactive Modeling and Visual Interactive Simulation; Quantitative Software Packages; Model Base Management.

Unit 4:

Business Intelligence: Data Collection, Problems, and Quality; The Web/Internet and Commercial

Database Services; Database Management Systems in Decision Support Systems/ Business Intelligence; Database Organization and Structures; Data Warehousing; Data Marts; Business Intelligence/Business Analytics; Online Analytical Processing (OLAP); Data Mining; Data Visualization, Multidimensionality, and Real-Time Analytics; Geographic Information Systems; Business Intelligence and the Web: Web Intelligence/Web Analytics. Intelligent Decision Support Systems: Knowledge-Based Systems, Knowledge Acquisition, Representation, and Reasoning.

Text Book:

1. Decision Support Systems and Intelligent Systems, Seventh Edition, Efraim Turban, Jay E. Aronson, Richard V. McCarthy, Prentice-Hall of India, 2007

Reference Books:

1. Decision Support Systems, A Knowledge-Based Approach, Clyde W. Holsapple and Andrew B. Winston
2. Decision Support Systems For Business Intelligence by Vicki L. Sauter

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL13	Advanced Java Technology	3	3	-	-

CO1 - Apply core Java concepts including collections, multithreading, and networking to build efficient and concurrent applications.

CO2 - Develop and integrate JavaBeans and JDBC for enterprise applications involving databases and transaction management.

CO3 - Design and implement dynamic web applications using Servlets, JSP, cookies, sessions, and Remote Method Invocation.

CO4 - Understand and implement distributed systems using CORBA and develop Android-based mobile applications integrating Google Maps.

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	3	3	2	3	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	2	2	2	2	3
CO3	3	3	3	2	3	2	1	2	2	3	2	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3

Unit 1:

Collections: Collection Interfaces, Concrete Collections, The Collections Framework
Multithreading: Creating thread and running it, Multiple Thread acting on single object, Synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle of Thread, Networking: Internet Addressing, InetAddress, Factory Methods, Instance Methods, TCP/IP Client Sockets, URL, URL Connection, TCP/IP Server Sockets, Datagrams

Unit 2:

Enterprise Java Bean: Preparing a Class to be a JavaBean, Creating a JavaBean, JavaBean Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean, Java Database Connectivity (JDBC):Merging Data from Multiple Tables: Joining, Manipulating Databases with JDBC, Prepared Statements, Transaction Processing, Stored Procedures C:

Unit 3:

Servlets: Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resou

rces, Session Tracking, Cookies, Session Tracking with HttpSession, JavaServer Pages (JSP): Introduction, JavaServer Pages Overview, A First JavaServer Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries, Remote Method Invocation: Defining the Remote Interface, Implementing the Remote Interface, Compiling and Executing the Server and the Client

Unit 4:

Common Object Request Broker Architecture (CORBA): Technical/Architectural Overview, CORBAbasics, CORBA services, Introduction to android platform, Creating application template, adding activity, intent, services to application, using Google map API

Text Books:

1. “Advanced Java 2 Platform HOW TO PROGRAM” by H. M.Deitel, P. J. Deitel, S. E. Santry – Prentice Hall

Reference Books:

1. “Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional” by Antonio Goncalves – Apress publication

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL14	.Net Technology	3	3	-	-

CO1: Introduction to .NET Framework and Console Applications

CO2: C# Language Features, ADO.NET, and Windows Forms

CO3: ASP.NET, Web Forms, and State Management

CO4: Web Services, Advanced .NET Concepts

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	-	-	-	-	-	-
CO2	3	2	3	-	3	-	-	-	-	-	-	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	-

Unit 1:

Introduction to .NET Framework: NET framework, MSIL, CLR, CLS, CTS, Namespaces, Assemblies The Common Language Implementation, Assemblies, Garbage Collection, The End to DLL Hell - Managed Execution. The Basics and Console Applications in C#: Name Spaces - Constructor and Destructors, Function Overloading & Inheritance, Operator Overloading, Modifiers - Property and Indexers , Attributes & Reflection API, When to use Console Applications - Generating Console Output, Processing Console Input.

Unit 2:

C#.NET: Language Features and Creating .NET Projects, Namespaces Classes and Inheritance -, Namespaces Classes and Inheritance -, C, Exploring the Base Class Library -, Debugging and Error Handling -, Data Types -, Exploring Assemblies and Namespaces, String Manipulation ,Files and I/O ,Collections. ADO.NET: Benefits of ADO.NET, ADO.NET compared to classic ADO -, Datasets, Managed Providers -, Data Binding: Introducing Data Source Controls -, Reading and Write Data Using the SqlDataSource Control. Windows Forms and Controls in details: The Windows Forms Model, Creating Windows Forms Windows Forms Properties and Events, Windows Form Controls, Menus - Dialogs – ToolTips. Visual Inheritance in C#.NET: Apply Inheritance techniques to Forms,

Creating Base Forms, Programming Derived Forms. Mastering Windows Forms: Printing - Handling Multiple Events, GDI+, Creating Windows Forms Controls.

Unit 3:

ASP.NET: Introduction to ASP.NET, Working with Web and HTML Controls, Using Rich Server Controls, Login controls, Overview of ASP.NET Validation Controls, Using the Simple Validations, Using the Complex Validators Accessing Data using ADO.NET, Using the Complex Validators Accessing Data using ADO.NET, Configuration Overview. Themes and Master Pages: Creating a Consistent Web Site, ASP.NET 2.0 Themes - Master Pages, Displaying Data with the GridView Control Introducing the GridView Control, Filter Data in the GridView Control, Allow Users to Select from a DropDownList in the Grid, Add a Hyperlink to the Grid, Deleting a Row and Handling Errors. Managing State: Preserving State in Web Applications and Page-Level State, Using Cookies to Preserve State, ASP.NET Session State ,Storing Objects in Session State, Configuring Session State, Setting Up an Outof-Process State Server, Storing Session State in SQL Server, Using Cookieless Session IDs, Application State Using the DataList and Repeater Controls, Overview of List-Bound Controls, Creating a Repeater Control and DataList Control.

Unit 4:

Creating and Consuming Web Services: The Motivation for XML Web Services, Creating an XML Web Service with Visual Studio, Designing XML Web Services, Creating Web Service Consumers, Discovering Web Services Using UDDI. Advanced in .NET: Introduction to Windows Presentation Foundation (WPF), Window Communication Foundation and its Application.

Text Books:

1. Matthew Macdonald and Robert Standefer, ASP.NET Complete Reference. TMH.

Reference Books:

1. Christian Nagel, Professional C# .Net, Wrox Publication.
2. Vijay Mukhi, C# The Basics, BPB Publications.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL15	Natural Language Processing	3	3	-	-

CO1: Introduction to NLP and Text Representation

CO2: Linguistics Resources and Models in NLP

CO3: Part of Speech Tagging and Parsing

CO4: Semantics, Word Sense Disambiguation, and Applications

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	-	-	-	-	-	-
CO2	3	3	2	-	3	2	-	-	-	-	-	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-
CO4	3	3	3	-	3	-	2	-	-	-	-	-

Unit 1:

Introduction: Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.

Unit 2:

Linguistics resources: Introduction to corpus, elements in balanced corpus, TreeBank, PropBank,

WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF.

Unit 3:

Part Of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax. Parsing- Unification, probabilistic parsing, TreeBank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet.

Unit 4:

Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP- Spell-checking, Summarization.

Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.

Text Books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009.
2. James A.. Natural language Understanding 2e, Pearson Education, 1994.

References Books:

1. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000.
2. Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP, 2008.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBEL16	Distributed Computing	3	3	-	-							
CO1: Understand the fundamental concepts, challenges, and architectures of distributed systems, including synchronization techniques such as Lamport’s and vector clocks. CO2: Analyze distributed deadlock detection and resolution mechanisms, agreement protocols, and remote invocation techniques like Java RMI. CO3: Evaluate distributed transaction management techniques, including concurrency control, recovery methods, and distributed shared memory systems. CO4: Examine file system designs, naming services, and emerging distributed technologies such as NoSQL and Hadoop.												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	2

CO2	3	3	2	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	3	-	-	-	-	2	-	3
CO4	2	3	3	3	3	-	2	-	-	2	-	3

UNIT 1:

Introduction to Distributed Systems, trends and challenges in Distributed Systems, Resource sharing. Case Study – World Wide Web. System Architectures, middleware, absence of global clock, Lamport's & vector logical clocks, Causal ordering of messages, global state, termination detection. Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms.

UNIT 2:

Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms. Agreement Protocols: Introduction, System models, classification of Agreement Problem- Interactive consistency Problem, Applications of Agreement algorithms. Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study.

UNIT 3:

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

UNIT 4:

File service components, design issues, interfaces, implementation techniques, Sun Network File System – architecture and implementation, other distributed file systems – AFS, CODA. Name services – SNS name service model. Introduction to NoSQL, Hadoop.

TEXT BOOKS:

1. Distributed Systems – Concepts and Design. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair.
2. "Advanced Concepts in Operating Systems", by Mukesh Singhal & Niranjana G Shivaratri, Tata McGraw Hill.

Reference Books:

1. Tanenbaum S, "Distributed Operating Systems", Pearson Education .
2. P K Sinha, "Distributed System: Concepts and Design", PHI.
3. Distributed Systems – Principles and Paradigms. Andrew S. Tanenbaum and Maarten Van Steen.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL17	Multimedia Technologies	3	3	-	-

CO1 -Understand the basic concepts, components, and applications of multimedia, including different media types and data streams.

CO2 -Analyze image representation formats, audio/video digitization techniques, and multimedia authoring tools.

CO3 -Apply various compression algorithms for multimedia data including audio, image, and video.

CO4 -Evaluate multimedia communication systems, data transmission quality, and retrieval

techniques over digital networks.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	1	3
CO3	3	3	3	2	3	1	1	1	2	3	2	3
CO4	3	3	3	2	3	2	2	2	2	3	2	3

UNIT 1:

Introduction to Multimedia: Media and Data Streams; Sound/Audio, Images and Graphics, Video and Animation. Multimedia and Hypermedia, Applications of Multimedia.

UNIT 2:

Graphics and Image data representations, image data types, color lookup tables, image file formats : GIF, JPEG, PNG, TIFF, BMP. Multimedia authoring tools. Video signals: Component video, composite video, S-video. Analog videos, digital videos. Digitization of sound, MIDI: hardware aspects, MIDI messages, coding of audio.

UNIT 3:

Data Compression, Lossless data compression:variable length coding:Huffman,LZW coding, dictionary based coding, arithmetic, differential coding of images, lossless JPEG. Lossy Compression algorithm, image compression standards. Video compression based on motion compensation, H.261, H.263, basic audio compression.

UNIT 4:

Multimedia Communication Systems; Quality of multimedia data transmission, multimedia over IP and ATM networks, Media on demand, content based retrieval in digital libraries, multimedia databases.

TEXTBOOKS

1. Fundamentals of Multimedia, Ze-Nian Li and Mark S. Drew.
2. “Multimedia Computing Communications & Applications ” by Ralf Steinmetz, Klara Nahrstedt , , Pearson Education (2004)

Reference Books:

1. *Multimedia Systems*, By John E Koegal, Buford, IIBK. (1994)

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBEL18	Mobile Communications	3	3	-	-							
CO1 -Understand the evolution, architecture, and capacity optimization of cellular mobile communication systems.												
CO2 -Analyze radio wave propagation, small-scale fading, and digital modulation techniques used in wireless communication.												
CO3 -Evaluate and compare multiple access techniques and protocols for efficient wireless communication.												
CO4 -Understand the architecture, channel structure, and signal processing mechanisms in GSM and CDMA standards.												
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	3	2	2	2	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	1	3
CO3	3	3	3	2	3	1	1	1	2	2	2	3
CO4	3	3	3	2	3	2	1	1	2	2	2	3

UNIT 1:

Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Second Generation (2G) Cellular Networks, Third Generation (3G) Wireless Networks. The Cellular Concept: Frequency reuse, Channel Assignment Strategies, Interference and system capacity, Trunking and Grade of Service, Improving Coverage and capacity in Cellular systems (Cell Splitting, Sectoring, A Microcell Zone Concept)

UNIT 2:

Introduction to Radio Wave Propagation, Free space propagation model, Three Basic Propagation Mechanisms (reflection, diffraction, scattering), Outdoor Propagation models, Indoor propagation models, Small-Scale Multipath propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile multipath channels, Types of small scale fading, Flat Fading, Frequency Selective Fading, Fast Fading, Slow Fading. Linear Modulation Techniques (BPSK, DPSK, QPSK, Offset QPSK), Constant Envelope Modulation (BFSK, MSK, GMSK), Combined Linear and Constant Envelope Modulation Techniques (Minimum Shift Keying, Gaussian MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing), Spread Spectrum Modulation Techniques, Pseudo-Noise (PN) Sequence, Direct Sequence Spread Spectrum (DS-SS), Frequency Hopped Spread Spectrum (FH-SS), Performance of DS-SS and Performance of FH-SS.

UNIT 3:

Multiple Access Techniques: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Frequency Hopped Multiple Access (FHMA) and Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA), Packet Radio Protocols, Pure ALOHA, Slotted ALOHA, Capacity of Cellular Code Division Multiple Access and Space Division Multiple Access.

UNIT 4:

Global System for Mobile (GSM), GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM channels, GSM Traffic Channels and GSM Control Channels, Frame structure for GSM, Signal Processing in GSM, CDMA Digital Cellular Standard, Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel

TEXT BOOKS:

1. T S Rappaport, Wireless Communications, Pearson Education, India
2. Upen Dalal, Wireless Communication, Oxford University Press, 2010

REFERENCE BOOKS:

1. W C Y Lee, Mobile Communication Engineering – Theory and Applications; TMH
2. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2003.
3. William Stallings, “Wireless Communications and Networks”, Pearson Education, 2002.
4. T L Singhal, Wireless Communications, Tata McGraw Hill 2010.
5. V K Garg, Wireless Communication and Networking; Morgan Kaufman Publishers India; 2008

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL19	Cryptography and information security	3	3	-	-

CO1: Understand symmetric encryption algorithms and apply classical encryption techniques such as substitution, transposition, and modern block ciphers (DES, AES).

CO2: Explain the principles of asymmetric cryptography and analyze RSA, Diffie-Hellman, and key management techniques.

CO3: Illustrate various authentication mechanisms, digital signatures, and the working of standard authentication protocols.

CO4: Identify and evaluate email, IP, and web security mechanisms and understand system-level threats like viruses and intrusions, Analyze and assess modern security threats such as SQL injection, phishing, session hijacking, and propose suitable countermeasures.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2
CO3	3	3	3	2	3	2	-	-	2	2	-	2
CO4	3	3	3	3	3	2	2	-	2	2	2	3

UNIT 1:

Symmetric Ciphers: Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. Block Cipher Principles, Data Encryption Standard (DES): The Strength of DES, Differential and Linear Cryptanalysis. Triple DES, Advanced Encryption Standard (AES): AES Structure, AES Transformation Functions, AES Key Expansion.

UNIT 2:

Asymmetric Ciphers: Introduction to Number Theory: Prime numbers, Fermat's and Euler's Theorems, Testing for Primality. Principles Of Public-Key Cryptosystems: Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, Public-Key Cryptanalysis. The RSA Algorithm: Description of the Algorithm, Computational Aspects, The Security of RSA. Key Management, Diffie Hellman Key Exchange.

UNIT 3:

Authentication Methods and Protocols: Password based authentication, Token Based authentication, Biometric Authentication, Digital Certificates, X. 509 Directory Services, PKI, Needham Schroeder - Authentication Protocol, Single sign on, Kerberos Authentication Protocol, Message Authentication : Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures, Digital Signature Standards.

UNIT 4:

Network Security - Electronic Mail Security : Pretty Good Privacy. IP Security : Overview, IP Security Architecture, Authentication Header, Encapsulation Security Payload. Web Security : User Authentication and session management, Cookies, Secure HTTP, SQL Injection Techniques, Cross Site Scripting, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, Web Services Security. System Security- Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.

Text Books:

1. William Stallings, Cryptography and Network Security, Pearson Education/PHI.
2. Cryptography and Network Security by Behrouz A. Forouzan, TATA McGraw hill.

Reference Books:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in Public World, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, TMH.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL20	Software Quality Assurance	3	3	-	-

CO1: Understand the fundamentals of Software Quality Assurance (SQA), causes of software errors, and quality factors in various phases of software lifecycle.

CO2: Analyze and apply SQA systems, contract review processes, quality plans, and maintenance tools for software projects.

CO3: Explain and evaluate software quality infrastructure components such as training, certification, configuration management, and change control.

CO4: Assess and apply software quality metrics, standards, and project management responsibilities to ensure software quality in real-world scenarios

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	1	1
CO2	3	3	2	2	2
CO3	3	2	2	2	2
CO4	3	3	3	3	3

UNIT 1:

Introduction-Uniqueness of software quality assurance, Environment for which SQA methods are developed, Classification of the causes of software errors, SQA and software engineering, Product operation, revision, Transition software quality Factors.

UNIT 2:

Quality components-SQA system and architecture, Contract review process and stages, Implementation of contract review, Development plan and quality plan objectives, Elements of quality and development plan, Pre-maintenance software quality components, Maintenance software quality assurance tools.

UNIT 3:

Software Quality infrastructure components-Objectives of training and certifications and its process. Corrective and preventive actions and their process, Development of solutions and implementation, Software configuration, Its items and its management tasks and organization, Software change control.

UNIT 4:

Management components of software quality-Components of project progress control, Classification of software quality metric, Product and process metrics, Limitations of software metrics, Objectives of cost quality metrics, Classic and extended model of cost quality metrics. Standards, certification and assessment-ISO 90001 and ISO 9000-3, CMM and CMMI, Bootstrap Methodology, IEEE/EIA std 12207, IEEE Std 1012, Project management responsibilities for quality assurance

Text Book:

1. Daniel galin, Software Quality Assurance, 1st ed., Pearson Education.

Reference Books:

1. Milind Limaye, *Software Quality Assurance*, Tata McGraw-Hill.
2. G. Gordon Schulmeyer, *Handbook of Software Quality Assurance*, 4th ed.

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL21	Soft Computing	3	3	-	-

CO1 -Understand the fundamentals of soft computing, its components, and how it differs from hard computing, along with real-world applications.

CO2 -Apply genetic algorithms to solve optimization problems by implementing encoding, selection, crossover, and mutation techniques.

CO3 -Understand and apply neural network architectures and learning algorithms for pattern recognition and image processing.

CO4 -Analyze fuzzy systems, neuro-fuzzy models, and swarm intelligence techniques for intelligent decision-making and optimization.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	1	1	1	2	1	3
CO2	3	3	3	2	3	1	1	1	2	2	2	3
CO3	3	3	3	2	3	1	1	1	2	2	2	3
CO4	3	3	3	2	3	2	2	2	2	2	2	3

UNIT 1:

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

UNIT 2:

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

UNIT 3:

Neural Networks- Concept, biological neural system, Supervised learning- Perceptron learning, single 1 layer/multilayer perceptron, linear separability, hidden layers, back propagation algorithm, Radial Basis Function network; Unsupervised learning - Kohonen, SOM, Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.

UNIT 4:

Fuzzy systems - Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems. Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Text Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley. ISBN13: 9788126527410 (2011)
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.

Reference Books:

1. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL22	Blockchain Architecture & Design	3	3	-	-

CO1 -Understand the evolution, architecture, and consensus mechanisms of blockchain, including permissioned and permissionless models.

CO2 -Design and implement blockchain solutions using Hyperledger Fabric and its components including Chaincode and SDK tools.

CO3 -Analyze blockchain use cases in finance, supply chain, and scientific domains, focusing on security and privacy aspects.

CO4 -Explore current research challenges in blockchain, especially related to scalability and secure cryptographic protocols.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	2	2	1	2	1	3
CO2	3	3	3	2	3	1	2	2	2	2	2	3
CO3	3	3	3	2	3	2	2	2	2	3	2	3
CO4	3	3	2	3	3	2	2	2	2	3	2	3

UNIT 1:

Introduction to Blockchain, History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms. Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols. Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains.

UNIT 2:

Hyperledger Fabric I: Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation. Hyperledger Fabric II: Beyond Chaincode: fabric SDK and Front End, Hyperledger composer tool.

UNIT 3:

Use case I: Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance. Use case II: Blockchain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting, etc. Blockchain Cryptography, Privacy and Security on Blockchain. Blockchain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum etc.

UNIT 4:

Research aspects I: Scalability of Blockchain consensus protocols, Case Study – Various recent works on scalability. Research aspects II: Secure cryptographic protocols on Blockchain, Case Study – Secured Multi-party Computation.

Text Book:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos

Reference Books:

1. Hyperledger Fabric - <https://www.hyperledger.org/projects/fabric>
2. 4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBEL23	Advanced Database Systems	3	3	-	-

CO1: Review of Data Models

CO2: Query Processing and Concurrency Control

CO3: Recovery and Database Security

CO4: Distributed, Object-Oriented, Spatial Databases, and Blockchain

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									
CO2	3	3	2		2							
CO3	3	3			3							
CO4	3	3	3		3		2					

UNIT 1:

Review of ER/EER and other semantic data models; Network, Hierarchical and Relational Data Models.

UNIT 2:

Query Processing: Various Operations such as Join, Selection, sorting, expression evaluation, etc

Concurrency Control Mechanism: Protocols, Multiple Granularity, Multi-version schemes, Deadlock handling,

UNIT 3:

Recovery: Recovery and atomicity, various techniques, buffer management, Advanced Recovery Techniques. Database Security: Authentication, Various Access Control Mechanisms, etc

UNIT 4:

Distributed Databases: Distributed Query Processing, Transaction Model, deadlock handling, multi-database systems; Object Oriented Database: OO Data Model e.g. UML, OO DBMS architectures, Client-Server Approach, Query Processing, Object Relational Databases

Spatial Databases: Data Models, various representation schemes, architectures, Query Processing, Storage Structures; Image and Multimedia Databases, introduction to Blockchain technology.

Text Books:

1. Silberschatz and Korth, Database system concepts, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of database systems; Narosa Publishing Co.

Reference Books:

1. John G Hughes, Object Oriented Databases; Prentice Hall Int nl Series in Computer Science
2. Andleigh and Thakrar, Multimedia Systems Design, Prentice Hall PTR
3. R Raghuramakrishnan & J Gehrke, Database Management System

4. Alhir, UML: In A Nutshell, O Reilly

Subject Code		Course name		Credits		Lectures		Tutorials		Practical		
ITBEL24		Data Science		3		3		-		-		
CO1: Describe the benefits and use cases of data science and big data, and classify various data types.												
CO2: Apply statistical inference techniques and follow the data science process from problem definition to model building.												
CO3: Perform exploratory data analysis and apply basic machine learning algorithms for both supervised and unsupervised learning tasks.												
CO4: Analyze recommendation systems and apply dimensionality reduction techniques like PCA and SVD.												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			1							
CO2	3	3	1	1	1							
CO3	3	3	2	1	2							
CO4	2	2	2	1	2							
Unit 1: Benefits and uses of data science and big data, Facets of data: Structured data, Unstructured data, Natural language, Machine-generated data, Graph-based or network data, Audio, image, and video, Streaming data.												
Unit 2: Statistical Inference: Populations and samples, Statistical modeling, probability distributions, fitting a model. The data science process: Overview, Defining research goals, Cleansing, integrating, and transforming data, Building the models,												
Unit 3: Exploratory data analysis: Basic tools (plots, graphs and summary statistics), Data Visualization. Machine Learning: Introduction, Supervised learning, Unsupervised learning, semi supervised learning, Basic Machine Learning Algorithms: Linear Regression, Logistic Regression, Naïve Bayes classification, k-Nearest Neighbors (k-NN), k-means.												
Unit 4: Recommendation Engines: Introduction, Issues with Nearest Neighbors, The Dimensionality Problem, Singular Value Decomposition (SVD), Principal Component Analysis (PCA).												
Text Book: 1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali. "Introducing Data Science", Manning Publication												
Reference Books: 1. Cathy O'Neil and Rachel Schutt. "Doing Data Science, Straight Talk From The Frontline". O'Reilly. 2. Sinan Ozdemir, "Principles of Data Science", Packt.												

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL25	Environmental Studies and Green IT	3	3	-	-
CO1: Understand the scope, importance, and environmental impact of IT, and explain the concept of					

Green IT and e-waste management.

CO2: Explain the environmental footprint of devices and hardware through their lifecycle, and evaluate strategies for reuse, recycling, and disposal.

CO3: Describe the role of energy-efficient software practices and techniques for sustainable computing.

CO4: Analyze energy consumption in data storage systems and propose green storage strategies including RAID, hierarchical storage, and cloud-based systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1			1	2	2					1
CO2	1	1	1		2	1	2					1
CO3	1	1	2	1	2		1					1
CO4	1	2	2	1	2		1					1

Unit 1:

Definition, Scope and Importance of Environmental Studies, The need for Public Awareness, Environment and Its Components. Introduction to e-Waste Management, Green IT: An Overview: Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Enterprise Green IT Strategy.

Unit 2:

Green Devices and Hardware: Life Cycle of a Device or Hardware: Design, Manufacturing, Packaging and Transportation, Use. Reuse, Recycle and Dispose.

Unit 3:

Green Software: Processor Power States, Energy-Saving Software Techniques: Computational Efficiency, Data Efficiency, Context Awareness, Idle Efficiency.

Unit 4:

Green Data Storage: Storage Media Power Characteristics: Hard Disks, Magnetic Tapes, SSDs, System-Level Energy Management: RAID with Power Awareness, Hierarchical Storage Management, Cloud Storage.

Text Book:

1. Environmental Studies, Anindita Basak, Pearson

Reference Book:

1. Harnessing Green IT: Principles and Practices - by San Murugesan, G.R. Gangadharan, Wiley.
http://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL26	Bioinformatics	3	3	-	-

CO1 -Understand the fundamental concepts of molecular biology, chemical structure, and apply sequence alignment algorithms in bioinformatics.

CO2 -Analyze evolutionary relationships using substitution models and phylogenetic tree construction techniques.

CO3 -Evaluate genomic structures and predict gene and protein structures using bioinformatics approaches.

CO4 -Apply computational and experimental methods for protein structure prediction, proteomics, and drug discovery.

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	1	1	1	2	1	3
CO2	3	3	2	2	3	1	1	1	2	2	1	3
CO3	3	3	3	2	3	1	1	1	2	2	2	3

CO4	3	3	3	2	3	2	2	1	2	3	2	3	
Unit 1: Molecular Biology and Biological Chemistry: The Genetic Material, Gene structure and Information Content, Protein Structure and Function, The nature of Chemical bonds, Molecular Biology Tools, Genomic Information Content, Data Searches and Pairwise Alignments: Dot Plot, Simple Alignments, Gaps, Scoring Matrices, Needleman and Wunsch Algorithm, Global and local Alignments, Database searches, Multiple sequence Alignments, Unit 2: Substitution Patterns: Patterns of substitutions within Genes, Estimating Substitution numbers, Variations in evolutionary rates between Genes, Molecular clocks, evolution in Organelles. Distance based methods of Phylogenetics: History of Molecular Phylogenies, Phylogenetic trees, Distance matrix methods, Maximum likelihood approaches, Multiple sequence Alignments. Character Based methods of Phylogenetics: Parsimony, Inferred ancestral sequences, Strategies for Faster searches, Consensus trees, tree confidence, Comparison of Phylogenetic methods, Molecular Phylogenies. Unit 3: Genomics and Gene Recognition: Prokaryotic genomes, Prokaryotic gene structure, GCcontent Prokaryotic genomes, Prokaryotic gene density, Eukaryotic genomes, Eukaryotic gene structure, Open reading frames, GC-content Eukaryotic genomes, Gene expression, Transposition, Repetitive elements, Eukaryotic gene density, Protein and RNA structure prediction: Amino acids, Polypeptide composition, Secondary structure, Tertiary and quaternary structure, Unit 4: Algorithms for Modeling Protein Folding, Structure prediction, Predicting RNA secondary structures, Proteomics: from Genomes to Proteomes, Protein classification, Experimental techniques, Inhibitors and drug design, Ligand screening, X-ray crystal structures, NMR structures, Empirical methods and prediction techniques, Post-translational modification prediction.													
Text Books: 1. Dan E. Krane, Michael L. Raymer, "Fundamental Concepts of Bioinformatics", First Edition, 2003, Pearson Education, Inc. New Delhi. 2. Teresa Attwood, David Parry-Smith, "Introduction to Bioinformatics", 1999, Pearson Education, Inc. New Delhi. Reference Books: 1. Shuba Gopal, A. Haake, R. P. Jones, P. Tymann, "Bioinformatics: A Computing Perspective", First Edition, 2009, McGraw-Hill Education (India), New Delhi. 2. Yi-Ping P. Chen, "Bioinformatics Technologies", 2006, Springer India Pvt. Ltd., New Delhi. 3. Arthur Lesk, "Introduction to Bioinformatics", 2009, Oxford University Press, ISBN-13: 978-0199208043. 4. Bryan Bergeron, "Bioinformatics Computing", 2003, PHI Learning. New Delhi. - Zoe Lacroix, Terence Critchlow, "Bioinformatics: Managing Scientific data", 2009, Elsevier India Pvt. Ltd., New Delhi.													

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL27	Digital Image Processing	3	3	-	-
CO1 - Understand the fundamentals of digital image representation, perception, acquisition, sampling, quantization, and pixel relationships. CO2 - Apply image enhancement techniques using spatial and frequency domain filters, histogram processing, and transformation functions. CO3 - Analyze and implement image restoration techniques using various filtering methods and noise models. CO4 - Demonstrate the ability to perform image segmentation using edge detection, thresholding, and region-based methods including color processing.					

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		2							
CO2	3	3	3	2	3							1
CO3	3	3	3	2	3							
CO4	3	3	3	2	3							1

Unit 1:

Introduction: Digital Image representation, fundamental steps in image processing, Elements of digital image processing systems. Elements of Visual perception, A simple Model, Image Sensing and Acquisition, Image Sampling and quantization, some basic relationships between pixels.

Unit 2:

Image Transformation and enhancement: Some basic Intensity Transformation functions, Histogram Processing, Smoothing and Sharpening Spatial Filters, Smoothing and Sharpening using Frequency Domain Filters.

Unit 3:

Image Restoration: Degradation Model, Noise Models, Restoration in the presence of Noise – Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Inverse Filtering, Minimum Mean square error filter.

Unit 4:

Image Segmentation: Point Detection, Line Detection, Edge Detection, Thresholding, Region – Based Segmentation, Color Image Processing.

Textbooks:

1. Digital Image Processing - Rafael C Gonzalez - Addison Wesley

References:

1. Digital Image Processing - Richard E Woods - Addison Wesley
2. Fundamentals of Digital Image Processing - A.K Jain – PHI

Subject Code	Course name	Credits	Lectures	Tutorials	Practical
ITBEL28	Complex networks	3	3	-	-

CO1: Understand fundamental concepts in network science, including large-scale network properties, degree distributions, and small-world effects.

CO2: Analyze and apply various algorithms and models for community detection and random graph generation.

CO3: Evaluate different network growth models and simulate dynamic processes such as epidemics and information spread on networks.

CO4: Examine social network structures and interpret patterns such as homophily, cohesiveness, and information diffusion.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1							
CO2	3	2	1	1	2							1
CO3	3	2	2	2	2							1
CO4	3	1	1	1	1	2						1

Unit 1: Overview of Network science, Motivation, Large scale dynamic networks, Challenges of graph theory, Basic Concepts related to Networks: Small world effect, transitivity and clustering, degree distribution, scale free networks, maximum degree; network resilience; mixing patterns; degree correlations; community structures; network navigation Unit 2: Community Structure Analysis: Basic concepts of network communities, Modularity, various community finding approaches like Girvan-Newman Algorithm, Spectral Bisection Algorithm, Radicchi Edge Clustering Algorithm (for binary as well as weighted graphs), Wu-Hubermann Algorithm, and Random Walk based Algorithm, Louvain, InfoMap, Random Graphs Poisson random graphs, generalized random graphs, the configuration model, generating functions, power-law degree distribution, directed graph, bipartite graph, degree correlations Unit 3: Models of Network Growth: Price model, Barabasi & Albert model, other growth models, vertex copying models, Bipartite Network; Processes taking place on Networks: Percolation theory and network resilience, Epidemiological processes, Cascades and information spread Unit 4: Social Network, Homophily, Cohesiveness, Cliques, Clans, Clubs, Plex, Equivalence of ties, Ego-centric networks, Cascade formation and information diffusion in Social media. Text Books: 1. Networks: An Introduction, Oxford University Press, Oxford, 2010. 2. Evolution of Networks, Oxford University Press, Oxford, 2003. Reference Books: 1. The structure and function of complex networks, SIAM Review 45, 167-256, 2003. 2. Statistical mechanics of complex networks, Rev. Mod. Phys., 74(1), 2002.
--

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBEL29	Graph theory	3	3	-	-							
CO1: Understand the basic properties of graphs, including paths, circuits, Eulerian and Hamiltonian graphs.												
CO2: Apply matrix representations and graph algorithms to solve shortest path, matching, and routing problems.												
CO3: Analyze tree structures, spanning trees, planarity, and connectivity in graphs.												
CO4: Solve problems related to vertex and edge colouring and explain major colouring theorems.												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										
CO2	3	2	1	1	2							
CO3	3	2	1	1	1							
CO4	3	1	1		1							1
Unit 1: Introduction to graphs, Basic properties of graphs, Complete and bi-partite graphs, Isomorphism of graphs. Paths and circuits. Eulerian Graphs. Hamiltonian cycles												

Unit 2:

Matrix representation of graphs, Chordal graphs, Weighted graphs, Matchings in graphs, Hall's 'marriage' theorem and its application, Travelling salesman's problem & Chinese postman problem
Distances in graphs, Shortest path and Dijkstra's algorithm, Floyd – Warshall Algorithm, Bellman-Ford Algorithm

Unit 3:

Trees, Spanning tree in graphs, Minimum spanning tree algorithms, Kruskal's algorithm, Independence sets and covering in graphs, Planar graphs, Euler's formula, Cut vertices and Cut edges, Edge connectivity,

Unit 4:

Vertex Colouring of graphs, Edge Colouring of graphs, The four-colour and five-colour theorems

Text Books:

1. Narsingh Deo, "Graph Theory: With Application to Engineering and Computer Science", Prentice Hall of India, 2003
2. Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley, 1994.
3. Clark J. And Holton D.A, "A First Look at Graph Theory", Allied Publishers, 1995.

Reference books:

1. Mott J.L., Kandel A. And Baker T.P. "Discrete Mathematics for Computer Scientists and Mathematicians", Prentice Hall of India, 1996.
2. Liu C.L., "Elements of Discrete Mathematics", Mc Graw Hill, 1985.
3. Rosen K.H., "Discrete Mathematics and Its Applications", Mc Graw Hill, 2007.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBOE1	Artificial Intelligence	3	3	-	-							
CO1: Understand fundamental concepts of AI, types of agents, their environments, and basic problem-solving techniques like Tic-Tac-Toe.												
CO2: Apply uninformed search techniques such as BFS, DFS, and bidirectional search to classical AI problems.												
CO3: Implement heuristic and adversarial search strategies, including A*, hill climbing, genetic algorithms, and game-playing strategies like minimax and alpha-beta pruning.												
CO4: Explain knowledge representation approaches using logic, rules, and reasoning under uncertainty, and demonstrate planning techniques.												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1							
CO2	3	2	1	1	1							
CO3	3	2	2	1	1							
CO4	2	1	1	1	1							

UNIT 1: Introduction : Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. UNIT 2: Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. Search techniques: Solving problems by Searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. UNIT 3: Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening. UNIT 4: Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge. Probabilistic reasoning and planning.
Text Books: 1. Artificial Intelligence, Ritch & Knight, TMH 2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson 3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI 4. Poole, Computational Intelligence, OUP 5. Logic & Prolog Programming, Saroj Kaushik, New Age International 6. Expert Systems, Giarranto, VIKAS 7. Artificial Intelligence, Russel, Pearson Reference Books: 1. Char nick, “ Introduction to Artificial Intellegence”, Addison Welsey. 2. Expert System Programming”, PHI. 3. Lioyed, ” Foundation of logic Programming”, Springer Verlag.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBOE2	Internet of Things	3	3	-	-
CO1: Understand the role of the Internet of Things (IoT) in environmental parameter monitoring and its importance to human and ecological well-being. CO2: Identify and explain the working principles, characteristics, and modeling of various types of environmental sensors and their applications. CO3: Describe the architecture and fabrication techniques used in the development of smart sensors. CO4: Analyze interfacing circuits, evaluate challenges in sensor integration, and explore the scope of silicon technology and recent trends in smart sensors.					
COs	PO1	PO2	PO3	PO4	PO5

CO1	3	2	1	1	1
CO2	3	3	2	2	2
CO3	3	3	3	2	2
CO4	3	3	3	3	3

UNIT 1:

Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT.

UNIT 2:

Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc. Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors.

UNIT 3:

Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel.

UNIT 4:

Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor Recent trends in smart sensor for day to day life, evolving sensors and their architecture.

Text Book:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

Reference Book:

1. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>							
ITBOE3	Big Data Analytics	3	3	-	-							
CO1 - Understand fundamental concepts of descriptive and inferential statistics, hypothesis testing, and regression techniques.												
CO2 - Apply supervised machine learning techniques such as regression and classification using appropriate algorithms and frameworks.												
CO3 - Analyze models using bias-variance trade-off, validation techniques, and implement advanced models including SVM, ensemble methods, and neural networks.												
CO4 - Implement unsupervised learning techniques such as clustering and association rule mining; understand data creation strategies for analytics.												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2							1
CO2	3	3	3	3	3							1

	CO3	3	3	3	3	3							2
	CO4	3	3	3	2	3							2

UNIT 1:

Introduction to the course, Descriptive Statistics, Probability Distributions, Inferential Statistics through hypothesis tests, Permutation & Randomization Test, Regression, ANOVA(Analysis of Variance)

UNIT 2:

Machine Learning: Introduction and Concepts: Differentiating algorithmic and model based frameworks, Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification

UNIT 3:

Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines, Ensemble Methods: Random Forest, Neural Networks, Deep learning

UNIT 4:

Clustering, Associative Rule Mining, Challenges for big data analytics, Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning

Text books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010.

Reference books:

1. Mitchell, Tom M., Machine Learning, McGraw Hill, 2013.
2. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Introduction to *Data Mining*, Pearson, 2014.
3. Alpaydin, Ethem. Introduction to *machine learning* — 2nd ed, PHI, 2010.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBOE4	E-Business	3	3	-	-
CO1 - Understand the fundamentals of E-Business, including value chains, supply chains, and ERP integration.					
CO2 - Analyze and apply E-Business strategies to enable procurement, marketing, selling, and supply chain functions.					
CO3 - Explore and evaluate key technologies used in E-Business such as internet, security systems, EDI, IoT, and cloud computing.					
CO4 - Apply data-driven approaches in E-Business using web analytics, recommender systems, and customer behavior modeling for decision-making.					

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2							1
CO2	3	3	3	2	3							2

	CO3	3	3	3	2	3							2	
	CO4	3	3	3	3	3							3	

UNIT 1:
Introduction to E-Business, Making Functional Areas E-Business Enabled : Value chain and supply chain, inter and intra organizational business processes, ERP

UNIT 2:
Making Functional Areas E-Business Enabled : E-Procurement, Making Functional Areas E-Business Enabled : E-marketing, E-Selling, E-Supply Chain Management

UNIT 3:
Technologies for E-Business: Internet and Web based system, Security and payment systems, Supply chain integration technologies (EDI, RFID, Sensors, IoT, GPS, GIS), Technologies for E-Business: Supply chain integration technologies (Web services and cloud)

UNIT 4:
Decision Support in E-Business: Web analytics, Customer behavior modeling
Auctions, Recommender systems

Text Books:

1. Management Information Systems: Managing the Digital Firm, Laudon and Laudon, Pearson

Reference Books:

1. Scaling for E-Business, Menasce & Almeida, PHI
2. eBusiness & eCommerce – Managing the Digital Value Chain, Meier & Stormer, Springer

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBOE5	Data Mining & Data Warehousing	3	3	-	-

CO1: Understand the fundamentals of data mining and data warehousing, including data preprocessing and warehousing basics.

CO2: Apply various data mining techniques such as classification, clustering, and association rule mining.

CO3: Design and implement data warehousing systems, including schema design and integration with data mining techniques.

CO4: Analyze time-series data, conduct periodicity and trend analysis, and apply web mining techniques.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1	1							
CO2	3	2	1	1	1							
CO3	3	2	2	1	1							1
CO4	2	2	2	1	1							1

Unit 1:

Introduction to Data Mining and Data Warehousing: Data Mining Overview, Data Preprocessing, Data Warehousing Basics

Unit 2:

Data Mining Techniques: Classification Techniques-Decision Trees, Naïve Bayes Classifier, k-Nearest Neighbor (k-NN), Neural Networks; Clustering Techniques- k-Means, Hierarchical Clustering, Density-Based Clustering (DBSCAN); Association Rule Mining-Apriori Algorithm, FP-Growth Algorithm

Unit 3:

Data Warehouse Design and Implementation: Data Warehouse Design, Star Schema, Snowflake Schema, Fact and Dimension Tables, Implementation and Tools, Data Partitioning and Indexing, Integration with Data Mining Mining OLAP Cubes

Unit 4:

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis, Web Mining,.

Text Books:

1. Jiawei Han and Micheline Kamber, 'Data Mining: Concepts and Techniques, Morgan Kaufmann, India.

References books:

1. A K Pujari, 'Data Mining Techniques, University Press, India
2. Han, Manilla and Smyth, 'Principles of Data Mining', PHI, India.

<i>Subject Code</i>	<i>Course name</i>	<i>Credits</i>	<i>Lectures</i>	<i>Tutorials</i>	<i>Practical</i>
ITBOE6	Embedded Systems	3	3	-	-
CO1 - Understand the fundamentals of embedded systems design, including hardware components, microcontrollers, and development tools.					
CO2 - Analyze and implement inter-process communication and synchronization in embedded systems using RTOS concepts and scheduling models.					
CO3 - Evaluate various resource management and scheduling paradigms in embedded systems along with real-time performance constraints and OS-specific features.					
CO4 - Demonstrate the application of embedded programming languages, development methodologies, and co-design in real-world applications.					

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3							1
CO2	3	3	3	2	3							2

CO3	3	3	3	3	3							2	
CO4	3	3	3	3	3							3	

Unit 1:

Introduction to embedded systems design: Embedded system, Processor in the System, Microcontroller, Memory Devices, Embedded System Project Management, ESD and Co-design issues in System development Process, Design cycle in the development phase for an embedded system, Use of target system or its emulator and In-circuit emulator, Use of software tools for development of an ES.

Unit 2:

Inter-process Communication and Synchronization of Processes, Tasks and Threads, Problem of Sharing Data by Multiple Tasks, Real Time Operating Systems: OS Services, I/O Subsystems, Interrupt Routines in RTOS Environment, RTOS Task Scheduling model, Interrupt Latency and Response times of the tasks.

Unit 3:

Resource Management/Scheduling Paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX.

Unit 4:

Programming languages for embedded systems e.g., Handel-C and Esterel, system support for embedded systems, selected embedded system-based applications: process-control, robotics, etc. Software Development Methodology: Model based development, Statecharts, General language characteristics, MISRA C, Hardware/Software Co- design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test. Case studies, Controlling an Injection molding process, Flight simulator, digital call center handler, codec.

Text Book:

1. Raj Kamal, Embedded Systems, TMH, 2004.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.

Reference Books:

1. David E. Simon, An Embedded Software Primer, Pearson Education, 1999.
2. C.M. Krishna and Kang G, RTS: Real-Time Systems, Shin, McGraw-Hill, 1997.