Indira Gandhi Delhi Technical University for Women

(Established by Govt. of Delhi vide Act 09 of 2012)

Kashmere Gate, Delhi–110006

Scheme of Examination

&

Detailed Syllabus

(w.e.f. Academic Year 2019-2020 onwards)

for

Bachelor of Technology
(Computer Science and Engineering)

Department of Computer Science and Engineering

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES

PSO1: Understanding of theoretical foundations and computing at different levels of abstraction including circuits and computer architecture, operating systems, algorithms, and applications.

PSO2: Ability to adapt established models, techniques, algorithms, data structures, etc. for efficiently solving new problems.

PSO3: Ability to design, implement, and evaluate computer-based system or application to meet the desired needs using modern tools and methodologies.

PROGRAM SPECIFIC OBJECTIVES

PEO1: Be highly competent engineers specializing in the area of Software and other information technologies in support of software related industry.

PEO2: Solve real world problems by applying technological knowledge ethically that will benefit organizations and society at large.

PEO3: Adapt to changing trends in software and related technologies, and become lifelong learners.

Course Structure for B.Tech CSE Program
(Under CBCS Scheme, starting from academic year 2019-2020)

First Year (Common courses for all B.Tech Program)
First Semester

S.No.	Code	Subject	L-T-P	Credits	Category
1.	BAS- 101	Applied Mathematics-I	3-1-0	4	**BAS**
2.	BAS- 103	Applied Physics-I	2-1-2	4	**BAS**
3.	BAS- 105	Applied Chemistry	2-1-2	4	**BAS**
4.	BMA-110/ BEC-110	Engineering Mechanics/ Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA-120/ BMA-130	Workshop Practice/Engineering Graphics	0-1-2	2	**OEC**
6.	HMC- 110/ BCS- 110	Humanities and Social Science/ Programming in C Language	3-1-0/ 3-0-2	4	**HMC/ OEC**
		Total		**22**	

Second Semester

S.No	Code	Subject	L-T-P	Credits	Category
1	BAS- 102	Applied Mathematics-II	3-1-0	4	**BAS**
2.	BAS- 104	Applied Physics-II	2-1-2	4	**BAS**
3.	BAS- 106	Environmental Science	2-1-2	4	**BAS**
4.	BEC- 110/ BMA-110	Basic Electrical Engineering/ Engineering Mechanics	3-0-2	4	**OEC**
5.	BMA-130/ BMA-120	Engineering Graphics/ Workshop Practice	0-1-2	2	**OEC**
6.	BCS- 110/ HMC- 110	Programming in C language / Humanities and Social Science	3-0-2/ 3-1-0	4	**HMC/ OEC**
		Total		**22**	

Third Semester (Second Year)

S.No	Code	Subject	L-T-P	Credits	Category
1.	BCS- 201	Data Structures	3-0-2	4	**DCC**
2.	BCS- 203	Discrete Structures	3-1-0	4	**DCC**
3.	BIT- 201	Database Management Systems	3-0-2	4	**DCC**
4.	BIT- 203	Software Engineering	3-0-2	4	**DCC**
5.	GEC- 201	Generic Open Elective-I*	0-2-0 / 0-0-4 / 2-0-0	2	**GEC**
6.	BCS- 253	Industrial Training/ Internship	-	1	**DCC**
7.	BAS-201 BAS- 203 BEC- 209 BMA- 211	Material Science and Engineering Numerical Methods Analog and Digital Electronics Engineering Measurement and Metrology	3-0-2 / 3-1-0 / 3-0-2/ 3-1-0	4	OEC
		Total		23	

Fourth Semester (Second Year)

S.No	Course Code	Subject	L-T-P	Credits	Category
1.	BCS- 202	Computer Organization and Architecture	3-0-2	4	DCC
2.	BCS- 204	Design and Analysis of Algorithms	3-0-2	4	DCC
3.	BIT- 202	Operating Systems	3-0-2	4	DCC
4.	BIT- 204	Object Oriented Programming	3-0-2	4	DCC
5.	BAS- 202 BAS - 204 BAS- 206 BMA- 210 BEC- 210	Nano Structures & Materials in Engineering. Optical Engineering Optimization Techniques Operations Management Elements of Information Theory	3-1-0 3-1-0 3-1-0 3-1-0 3-1-0	4	OEC
6.	HMC-202	Disaster Management	1-0-2	2	HMC
		Total		22	

Fifth Semester (Third Year)

S.No	Course Code	Subject	L-T-P	Credits	Category
1.	BIT- 301	Data Communication and Computer Networks	3-0-2	4	DCC
2.	BCS- 301	Artificial Intelligence	3-0-2	4	DCC
3.	BAS- 301	Modelling and Simulation	3-0-2	4	BAS
4.	BCS-303	Theory of Computation	3-1-0	4	DCC
5.	HMC- 301	Professional Ethics and Human Values	3-0-0	3	HMC
6.	BCS- 353	Industrial Training/Internship	-	1	DCC
7.	GEC- 301	Generic Open Elective-II*	0-2-0 / 0-0-4 / 2-0-0	2	GEC
		Total		22	

Sixth Semester (Third Year)

S.No.	Course Code	Subject	L-T-P	Credits	Category
1.	BCS- 302	Wireless Networks	**3-0-2**	4	**DCC**
2.	BCS- 304	Microprocessor and Interfacing	**3-0-2**	4	**DCC**
3.	BCS- 306	Compiler Design	**3-0-2**	4	**DCC**
4.	DEC- 3xx	Departmental Elective Course-1	**3-1-0/ 3-0-2**	4	**DCC**
5.	DEC- 3xx	Departmental Elective Course-2	**3-1-0/ 3-0-2**	4	**DEC**
6.	HMC- 302 HMC- 304 HMC- 306 HMC- 308	Principles of Management Marketing Management Financial Management Human Resource Management Resource Management	**2-0-0** **2-0-0** **2-0-0** **2-0-0**	2	**HMC**
		Total		22	

Seventh Semester (Fourth Year)

S.No.	Course Code	Subject	L-T-P	Credits	Category
1.	BIT-401	Mobile Computing	**3-0-2**	4	**DCC**
2.	BCS 401	Machine Learning	**3-0-2**	4	**DCC**
3.	DEC-4xx	Departmental Elective Course-3	**3-1-0 3-0-2**	4	**DEC**
4.	DEC–4xx	Departmental Elective Course-4	**3-1-0/ 3-0-2**	4	**DEC**
5.	BCS-451	Minor Project	**0-0-8**	4	**DCC**
6.	BCS-453	Industrial Training/Internship	**-**	1	**DCC**
		Total		21	

Eighth Semester (Fourth Year)

S.No.	Course Code	Subject	L-T-P	Credits	Category
1.	BCS-402	Embedded System Design	**3-0-2**	4	**DCC**
2.	DEC-4xx	Departmental Elective Course-5	**3-0-2**	4	**DEC**
3.	DEC-4xx	Departmental Elective Course-6	**3-1-0**	4	**DEC**
4.	BCS-450	Major Project	**0-0-16**	8	**DCC**
5.	GEC-402	Generic Open Elective-III*	**0-2-0 0-0-4 2-0-0**	2	**GEC**
		Total		22	

*The Exam/Evaluation methodology will be decided from time to time by concerned HOD

List of Departmental Elective Courses

Category	Course Code	Subject	L-T-P	Credits
Departmental Elective Course-1	BCS – 308	Multimedia Technologies	3-0-2	4
	BCS- 310	Human Computer Interaction	3-1-0	4
	BCS- 312	Advanced Computer Architecture	3-1-0	4
Departmental Elective Course-2	BIT- 304	Cloud Computing	3-1-0	4
	BIT – 310	Internet of Things	3-1-0	4
	BCS – 314	Computer Graphics	3-0-2	4
Departmental Elective Course-3	BCS- 403	Evolutionary Computing	3-1-0	4
	BCS- 405	Knowledge Engineering	3-1-0	4
	BEC- 407	Digital Image Processing	3-1-0	4
Departmental Elective Course-4	BIT- 417	E-commerce	3-1-0	4
	BIT- 419	Cyber Security and Forensics	3-1-0	4
	BCS- 407	Intelligent Data & Information Retrieval	3-1-0	4
Departmental Elective Course-3	BCS- 403	Evolutionary Computing	3-1-0	4
	BCS- 405	Knowledge Engineering	3-1-0	4
	BEC- 407	Digital Image Processing	3-1-0	4
Departmental Elective Course-4	BIT- 417	E-commerce	3-1-0	4
	BIT- 419	Cyber Security and Forensics	3-1-0	4
	BCS- 407	Intelligent Data & Information Retrieval	3-1-0	4
Departmental Elective Course-5	BCS- 404	Parallel Programming and Parallel Algorithms	3-1-0	4
	BCS- 406	Natural Language Processing	3-1-0	4
	BCS- 408	Software Project Management	3-1-0	4
Departmental Elective Course-6	BCS- 410	Quantum Computing	3-1-0	4
	BCS- 412	Computational Optimization Techniques	3-1-0	4
	BIT- 408	Neural Networks & Deep Learning	3-0-2	4

Data Structures	
Course Code: BCS-201 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction:

This course introduces about data structures and their useful applications in Information Technology. It deals with all aspects of Data structures like static and dynamic data structure and how to choose a particular data structure for any specific problem.

Course Objectives:

- To impart the basic concepts of data structures and algorithms
- To understand concepts about searching and sorting techniques
- To Understand basic concepts about stacks, queues, lists, trees and graphs
- To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

Pre-requisite: Fundamentals of Programming

Course Outcomes: After completion of the course, the students will be able:

CO1: To explain the concept of time and space complexity of the algorithm.
CO2: To understand the use of fundamental data structures and algorithm appropriately to solve a number of computational problems.
CO3: To apply various algorithms to solve the problems of searching and of data.
CO4: To design programs using a variety of data structures such as stacks, queues, hash tables binary trees, search trees, heaps, graphs, and B-trees.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations, and quizzes. Students would be encouraged to develop an understanding of the subject. The use of ICT and web-based sources will be adopted.

UNIT-I	10 Hours
Introduction: Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to abstract data types, design, implementation and applications. Introduction to List data structure. **Arrays and Strings:** Representation of Arrays in Memory: one dimensional, two dimensional and Multidimensional, Accessing of elements of array, performing operations like Insertion, Deletion and Searching. Sorting elements of arrays. Strings and String Operations.	
UNIT-II	**10 Hours**
Stacks and Queues: Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks, Applications of Stacks: recursion, Polish expression and their compilation conversion of infix expression to prefix and postfix expression, Operations of Queues, Representations of Queues Applications of Queues, Priority queues. **Linked Lists:** Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list and Doubly linked list and their Applications. Stacks and Queues as linked list.	
UNIT-III	**12 Hours**
Trees: Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees, Extended binary trees. General trees, AVL trees, Threaded trees, B- trees. **Searching and Sorting:** Linear Search, Binary search, Interpolation Search, InsertionSort, Quick sort, Merge sort, Heap sort, sorting on different keys, External sorting.	
UNIT-IV	**10 Hours**
Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs and their Transversal, Spanning trees, shortest path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths. **File Structure:** File Organization, Indexing & Hashing, Hash Functions, Collision Resolution Techniques.	

Text Books	
1	Horowitz, Sahni, and Anreson, "Fundamentals of Data structures in C", Universities Press, 2008 / Latest Edition.
2	Tannenbaum, "Data Structures", Pearson Education India, Latest Edition, 2007
3	Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2004/ Latest Edition.
Reference Books	
1	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI, 2009/Latest Edition.
2	Seymour Lipschutz Saucham's series, "Data Structures", Mc-Graw Hill Publication, 2018/Latest Edition.

Database Management Systems	
Course Code: BIT-201 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction:

Database Management System (DBMS) is used for creating and managing the databases. The main aim of a DBMS is to supply a way to store-up and retrieve the desired database information as per the application requirement, which is both convenient and efficient.

Course Objectives:

- To introduce the concepts of database management systems
- To design relational databases by applying normalization techniques to normalize the database
- Strong practice in SQL programming through a variety of database problems.
- Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Pre-requisites: Basic concepts of set theory

Course Outcomes: After completion of the course, the students will be able:

CO1: To have a high-level understanding of major DBMS components and their function.
CO2: To model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
CO3: To write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS
CO4: To understand the concept of Transaction, concurrency, and Query processing.

Pedagogy:

The class will be taught using theory **sessions** with strong conceptual knowledge which includes board teaching and presentations/slides, flipped classes, discussions, case studies etc. Along with classroom teaching, students will also be given assignments regarding the topics covered. Hands-on sessions on SQL will be conducted during the lab sessions.

UNIT-I	10 Hours
Overview of Concepts and Conceptual Database Design: Database Administrator and Database Users, Characteristics of the Database, Database Systems, Concepts and Architecture, Data Models, Schemes & Instances, DBMS Architecture & Data Independence, Database Languages & Interfaces, Overview of Hierarchical, Network & Relational Data Base Management Systems, Data Modeling using Entity-Relationship Model, Strong and Weak Entity Sets, Generalization, Specialization, and Aggregation.	
UNIT-II	**10 Hours**
Relational Model, Languages & Systems: Relational Model Concepts, Relational Model Constraints, Translating your ER Model into Relational Model, Relational Algebra, Relational Calculus (Tuple Calculus) SQL: A Relational Database Language, Data Definiton in SQL, View and Queries in SQL, Specifying Constraints and Indexes in SQL, Practicing SQL commands.	
UNIT-III	**12 Hours**
Relational Data Base Design: Functional Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF), Lossless Join and Dependency Preserving Decomposition, Multivalued Dependency, Join dependency. Transaction Management: Transaction Concept and State, Implementation of Atomicity and Durability, Serializability, Recoverability, Implementation of Isolation	
UNIT-IV	**10 Hours**
Concurrency Control: Lock-Based Protocols, Timestamp-based Protocols, Deadlock Handling, Recovery System, Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery. Query Processing: Query Processing Overview, Measures of Query Cost. Framework of Distributed Data Base Management Systems, Introduction to Enhanced Databases: Multimedia Databases, Object Oriented Databases, Mobile Databases.	

Text Books

1	Elmasri Ramez and Navathe Shamkant, Fundamentals of Database System, Pearson, 6th Ed. (June 2017)
2	Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3rd Ed., 2003/Latest Edition.
3	Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw Hill, 6th Ed//Latest Edition.

Reference Books

1	Ceri and Pelagatti, Distributed Databases: Principles & Systems, McGraw-Hill, 2017.
2	Conolly & Begg. Database Management Systems, Pearson Education Asia, 5th Edition, 2010

Discrete Structures	
Course Code: BCS-203 Contact Hours: L-3 T-1 P-0 Course Category: DCC	Credits: 4 Semester: 3

Introduction: The discrete structures subject introduces Propositional logic, Sets, Relations, and Functions, Algebraic structures, Graphs and Trees required for building mathematical foundation of computer science.

Course Objectives:

- To introduce and understand the fundamental notions in discrete mathematics.
- To understand basic concept of an algorithm and its application in combinatorial Mathematics.
- To introduce the basic properties of graphs and trees and model simple applications.
- To learn concepts of discrete mathematics.

Pre-requisites: Basic concepts of set theory.

Course Outcomes: After completion of the course, the students will be able:

CO1: To convert a logic sentence in terms of predicates, quantifiers, and logical connectives and its validation.
CO2: Able to use logical notations to define and reason about fundamental mathematical concepts such as sets relations, functions and combinatorics.
CO3: Able to use logical notations to define and reason about fundamental mathematical concepts of abstract algebra.
CO4: Apply algorithms and use of graphs and trees as tools to analyse and simplify Problems

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations, and quizzes. Students would be encouraged to develop an understanding of the subject. The use of ICT and web-based sources will be adopted.

UNIT-I	10 Hours
Propositional logic: Syntax, semantics, valid, satisfiable and unsatisfiable formulas, Mathematical reasoning, propositions, negation disjunction and conjunction, implication and equivalence, truth tables, predicates quantifiers, natural deduction, rules of Inference **Methods of proofs:** Forward proof, proof by contradiction, contra positive proofs, proof of necessity and sufficiency.	
UNIT-II	**10 Hours**
Sets, relations and functions: Operations on sets, relations, binary relations, partial ordering relations, equivalence relations and partitions, Partial orderings, Posets, Linear and well-ordered sets, principles of mathematical induction. Functions, mappings, injection and surjections, composition of functions, inverse functions, special functions; Peono postulates; pigeonhole principle; recursive function theory. **Size of a set:** Finite and infinite sets, countable and uncountable sets, Cantor's diagonalargument and the power set theorem, Schröder-Bernstein theorem.	
UNIT III	**12 Hours**
Algebraic structures and Morphisms: Algebraic structures with one binary operation - semigroups, monoids and groups, subgroups and their properties, congruence relation and quotient structures. Free and cyclic monoids and groups, permutation groups, substructures, normal subgroups. Algebraic structures with two binary operations - rings, integral domains and fields. Boolean algebra and Boolean ring.	
UNIT IV	**10 Hours**
Graphs and trees: Terminology, Graphs and their basic properties - degree, path, cycle, subgraphs, isomorphism, Eulerian and Hamiltonian walks, Graph coloring, planar graphs, directed graphs, trees terminology, tree traversals, spanning trees.	

Text Books	
1	Kenneth H Rosen (Editor-in-chief), Handbook of Discrete and Combinatorial Mathematics, CRC Press, 2000/Latest Edition.
2	C L Liu, Elements of Discrete Mathematics, McGraw-Hill/Latest Edition.
3	Bernard Kolman, Robert C Busby, and Sharon Cutler Ross, Discrete Mathematical Structures, Prentice-Hall of India/Latest Edition.
Reference Books	
1	Ralph P Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education Asia/Latest Edition.
2	Norman L Biggs, Discrete Mathematics, Oxford University Press/Latest Edition.
3	J P Tremblay and R Manohar, Discrete mathematical structures with applications to Computer Science, McGraw-Hill/Latest Edition.

Software Engineering	
Course Code: BIT-203 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction:

This course introduces students to the different software development lifecycle (SDLC) phases used in developing, delivering, and maintaining software products. Students will also acquire basic software development skills and understand common terminology used in the software engineering profession. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of software development projects.

Course Objectives:

- To introduce the concepts of software engineering, software processes and its models.
- To understand the software requirements analysis, transform the requirements using DFD, create software requirement specification document and validation of the software requirements.
- To understand fundamentals of software design, software quality and software maintenance.
- To understand the project planning process, size and cost estimation techniques further development of software.

Pre-requisites: Basic knowledge of Programming Languages.

Course Outcomes: After completion of the course, the students will be able:

CO1: To understand the concepts of Software engineering, Software process and its models.
CO2: To evaluate the Software Requirements, interpret and structure the requirements in Software required document.
CO3: To apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices, evaluate the quality and maintenance of the software through software testing.
CO4: To create the software project plan for size and cost estimation including risk analysis.

Pedagogy:

This course is structured around continuous progress. It will include a combination of lectures, and group activities focused on experiential learning, in-class discussions, regular assessments and case studies. The topics will be presented to students using real-world scenarios and problem-solving activities.

UNIT-I	10 Hours
Introduction: Introduction of Software (SW), Type of Software, SW Components: Process, People, Project, Product, Software crisis, Software Process Models: Details of People involved in each Process, SDLC methods/models: Build & Fix, Waterfall, Prototype (Evolutionary & Throw-away), Iterative, Incremental iterative, Spiral, RAD, Agile methodology.	
UNIT-II	**11 Hours**
Requirement Analysis & Specifications: Requirement Analysis, Requirement Specification, Approaches to Requirement analysis, Specifying Behavioral & Non-Behavioral Requirements, SRS Components & various Users of SRS. Introduction of Requirement Specification: Dataflow (DF) Diagram, Data dictionaries, Entity-Relationship (ER) diagram, Object Diagram etc., Requirement Validation.	
UNIT-III	**11 Hours**
Software Design and Testing: Design Architecture and Patterns, Modularity, Function oriented design, Object Oriented Design, Software Testing: Software Testing Strategy and Techniques, Functional testing, Structural testing, Debugging and testing tools, SW/HW reliability, Reliability concepts and models, Reliability allocation, Software Maintenance: Introduction to SW Maintenance and types, SW Maintenance models: Re-engineering & Forward Engineering.	
UNIT-IV	**10 Hours**
Software Project Planning: Role of Software Project Planning, Estimation method, Estimation of Effort & Schedule, Software Metrics: Introduction to Size metrics, Data structure metrics, information flow metrics, entropy-based measures, metric analysis. Basic COCOMO, Intermediate COCOMO, Detailed COCOMO, Quality Planning, Planning Parameter, Quality Defect Removal Cycle, Role of Risk Analysis.	

Text Books	
1	R.S.Pressman,"Software Engineering–A Practitioner's Approach", McGraw Hill, 8thEdition, 2019 / Latest Edition
2	K.K.Aggarwal, Y.Singh, "Software Engineering",NewAge International Ltd, 3rd Edition, 2008/ Latest Edition.
Reference Books	
1	I. Sommerville, "Software Engineering," Pearson, 10th Edition, 2017/ Latest Edition.
2	P. Jalote, "Software Engineering: A precise approach", Wiley Publications, Edition, 2010/ Latest Edition

Generic Open Elective Course	
Course Code: GEC-201 Contact Hours: L-0 T-0 P-4 L-0 T-2 P-0 L-2 T-0 P-0 Course Category: GEC	Credits: 2 Semester: 3

Introduction:

A Generic Elective (GE) course is an inter-disciplinary course provided to the students chosen generally from an unrelated discipline/subject and allowing them a chance at comprehensive education. GEs are introduced as part of the CBCS. The students can choose their preference from a pool of courses from various disciplines/subjects. Elective courses do much more than filling in the gaps to fulfill the high school graduation requirements. It gives a chance to explore new options, allowing students to study more about the subject they are passionate about, and enables them to 'test drive' new activities. They provide students with the necessary skills to improve creativity that they might not find in the classroom. The main purpose of the elective course is to seek exposure to a new discipline/subject and to provide the students with an alternative option for desired fields.

Course objectives:

- Students will have exposure to a new discipline/subject.
- Prepare students to look for inter-disciplinary research.
- Fulfill the limitation to pursue master's study in desired field.
- Help discover new things that never existed and might change the course of student's life.

Prerequisite: Basic knowledge of the selected domain of elective course

Course Outcomes: After completion of the elective course, the students will be able to:

CO1: Identify new discipline and learn new subject for future careers.

CO2: Apply their knowledge to understand and solve the real-life problems.

CO3: Analyze creative design process through the integration and application of diverse technical knowledge and expertise to address social issues.

CO4: Develop the habit of working independently to attain self-motivation, discipline, and confidence to achieve their goals.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching.

Industrial Training/Internship	
Course Code: BIT-253 Course Category: DCC	Credits: 1 Semester: 3

Course Objectives:

Students will carry on the industrial training/internship for at least six weeks in the summer break of previous academic session. The idea of the training is to make them capable of handling the implementation of their theoretical knowledge in the practical field. To facilitate the development of a holistic perspective among students towards life, industry experts teach advanced technologies. Through Industrial training, students get familiarize with the environment of an organization and a company. Students get a certificate which validates their skills and helps them in getting a job quickly. The assessment for the same will be done within the first two weeks of opening of academic session by the respective department.

Course Outcomes:

CO1: Understand the Organizational Structure of a company.

CO2: Develop work habits and attitudes necessary for job success (technical competence, professional attitude, organization skills etc.)

CO3: Develop written communication and technical report writing skills.

CO4: Develop an awareness for the need and applications of standards in the industry.

MATERIAL SCIENCE AND ENGINEERING	
Course Code: BAS-201 Contact Hours: L-3 T-1 P-0 Course Category: OEC	Credits: 4 Semester: 3

Introduction:

At the core of any technological advancement are the materials. Material Science and Engineering course give insight into importance of materials, their various classifications and physical properties. The course also provides an insight into various characterization techniques useful in studying the physical properties of materials.

Course Objectives:

- To provides an insight into the scope of Material Science and Engineering and classification of various Materials.
- To acquire basic understanding of the electronic, superconducting dielectric and magnetic properties of materials for technological applications.
- To familiarize with modern engineering materials and bio-materials in various applications.
- To develop an understanding of principles, working and applications of various material characterization techniques.

Pre-requisites: Basic understanding of Applied Physics Course.

Course Outcomes: After Studying this course, the students will be able to:

CO1: Understand scope and importance of materials in technological development.
CO2: Learn importance and utilization of various physical properties of materials in device applications.
CO3: Enhance the knowledge of latest advancements in field of materials, Modern Engineering and Biomaterials.
CO4: Learn the principles, working and applications of various material characterization techniques in studying the materials.

Pedagogy:

The class will be taught using theory **sessions** with strong conceptual knowledge which includes board teaching and presentations/slides, flipped classes, discussions, case studies etc.

UNIT-I	4 Hours
Introduction to materials: Importance of Material science and Engineering, Classification of Materials: Metallic, Ceramic, Polymeric, Electronic and Composite Materials.	
UNIT-II	16 Hours
PROPERTIES OF MATERIALS **Electronic Materials:** Fermi energy and Fermi–Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect. **Superconducting Materials:** Normal and High temperature superconductivity, Applications. **Dielectric Materials:** Polarization mechanisms in dielectrics, Frequency and temperature dependence of polarization mechanism, Piezoelectric properties. **Magnetic Materials:** Types of Magnetism: Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Ferrimagnetism, Classification of magnetic materials based on spin, Hard and soft magnetic materials, Spintronics (GMR).	
UNIT-III	10 Hours
MODERN ENGINEERING AND BIOMATERIALS **Photonic Materials:** LED – LCD – Photo conducting materials, Photo detectors, Photonic crystals and applications. **Smart materials:** – Shape memory alloys, Chromic materials (Thermo, Photo and Electro),Composite Materials. **Bio-materials:** Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials.	
UNIT-IV	10 Hours
MATERIALS CHARACTERIZATION **Structural Analysis:** X-ray diffraction, SEM, TEM, AFM- Principals, Instrumentations and applications. **Optical Characterizations:** UV-Vis, FTIR-Principals, Instrumentations and applications. **Thermal Analytical Techniques:** TGA, DTA, DSC-Principals, Instrumentations and applications.	

Text Books	
1	William D. Callister, Materials Science and Engineering: An Introduction, 8th Edition Edition, John Wiley & Sons, 2010/Latest Edition.
2	Sam Zhang, Lin Li, Ashok Kumar,"Materials Characterization Techniques", 1st Edition, CRC Press, 2008/Latest Edition.
3	T. Pradeep, "A Text Book of Nanoscience and Nanotechnology", Tata McGraw Hill, New Delhi, 2012/Latest Edition.
Reference Books	
1	Elements of X–ray Diffraction, B. D. Cullity, S.R. Stock, 3rdEdition, Pearson,2001/Latest Edition.
2	R. F. Egerton,Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM, 2nd Edition, Springer,2016/Latest Edition.

NUMERICAL METHODS	
Course Code: BAS-203 Contact Hours: L-3 T-1 P-0 Course Category: OEC	Credits: 4 Semester: 3

Introduction:

Numerical Methods give insight into problems we cannot otherwise solve. These methods provide us the way to solve problem when exact methods fails or unable to produce the desirable results

Course Objectives:

- To motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real life problems.
- To provide constructive methods for obtaining answers to such problem for which analytical methods fails to find solutions.

Pre-requisites: Calculus, Differential equations, some exposure to linear algebra (matrices)

Course Outcomes: After completion of this course, the students will be able to:

CO1: Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
CO2: Learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods
CO3: Solve system of linear equations numerically using direct and iterative methods.
CO4: Understand how to approximate the functions using interpolating polynomials.
CO5: Learn how to solve definite integrals and initial value problems numerically.

Pedagogy:

Apart from class room teaching, main focus is to enhance problem solving ability supported by weekly assignments and discussing individual's doubts.

UNIT 1	10 Hours
Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, -conditioning and stability. **Non-Linear Equations**: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.	
UNIT-II	**11 Hours**
Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.	
UNIT-III	**11 Hours**
Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations. Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss--Legendre quadrature formulae.	
UNIT-IV	**10 Hours**
Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge- Kutta methods (up to fourth-order), system of first-order differential equations.	

Text Books	
1	Jain M.K., Iyengar, S.R.K., and Jain, R.K. Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International Publication,2012/Latest Edition.
2	Sastry S., Introductory Methods of Numerical Analysis, 5th Edition, Prentice Hall India Learning Private Limited; 2012/Latest Edition.
3	Conte, S.D and Carl D. Boor, Elementry Numerical Analysis: An Algorithmic approach, SIAM-Society for Industrial and Applied Mathematics, 2017/Latest Edition.
4	Grewal, B. S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, 2012/Latest Edition.
Reference Books	
1	Gerald C.F and Wheatley P.O., Applied Numerical Analysis, 8thEdition, Pearson Education, 2011/Latest Edition.
2	Chappra S.C., Numerical Methods for Engineers, 7th Edition, McGraw-Hill Higher Education, 2014/Latest Edition.

ANALOG AND DIGITAL ELECTRONICS	
Course Code: BEC - 209 Contact Hours: L-3 T-0 P-2 Course Category: OEC	Credits: 4 Semester: 3

Introduction:

The course will introduce fundamental principles of analog and digital electronics. The course provides sufficient basic knowledge for the undergraduate to understand the design of diodes and transistor-based circuits, op-amps and their applications as well as the design of digital circuits.

Course Objective:

- Understand the design and analysis of various analog electronic circuits.
- Understand the fundamental concepts and techniques used in digital electronics.

Pre-requisite:

- Basic concept of circuit theory.
- Student should have the prior knowledge of semiconductor electronics.
- Basic concept of number system.

Course Outcome: After completion of the course, student will be able to:

CO1: Understand basic electronic devices such as diodes, BJT & FET transistors
CO2: Understand various applications of Op-Amp.
CO3: Analyse logic processes and implement logical operations using combinational logic Circuits.
CO4: Design sequential circuits.

Pedagogy:

Class room teaching, problem solving approach, practical based learning, tutorials.

UNIT-I	**12 Hours**
Semiconductor diodes, Characteristics and operation, Applications of p-n junction diode. **Bipolar Junction Transistor:** Construction and Operation, Common base (CB) configuration, Transistor amplifying action, Common emitter (CE) and Common collector (CC) configurations, definition of α and β, saturation, regions of operation of transistor, biasing methods.	
Amplifiers: CE, CC, CE amplifier circuits and their comparisons, RC coupled amplifier, Frequency response, Gain-bandwidth, and Darlington pair, Class B push pull amplifier. **Feedback:** Concept of negative & positive feedback and their relative advantages & disadvantages, Sinusoidal oscillators.	
UNIT-II	**10 Hours**
Field Effect Transistor: Introduction, JFET characteristics, Depletion & enhancement MOSFET, CMOS. Operational amplifier: Characteristics of ideal Op-Amp, Inverting & non-inverting amplifier, Differential amplifier, Adder & Subtractor, Integrator, Differentiator, Instrumentation amplifier, Schmitt trigger, Astable multivibrator	
UNIT-III	**10 Hours**
Digital electronics: Analog & digital signals, Logic gates, Boolean algebra. Standard representation of logical functions, K-map representation and simplification of logical functions, Don't care conditions, X-OR & X-NOR simplification of K-maps. **Combinational circuits:** Multiplexers, Demultiplexers, Decoders & Encoders, Adders & Subtractor, Code converters, Comparators, Decoder/drivers for display devices, A/D and D/A converters.	
UNIT-IV	**10 Hours**
Flip Flops: S-R, J-K, D & T Flip-flops, Excitation table of a flip-flop, Race around condition **Sequential circuits:** Shift registers, Ripple counter, Design of synchronous counters and Sequence detectors, Sequence generators	

Text Books	
1	Morris Mano, "Digital Design", PHI, 5th edition, 2013/Latest Edition.
2	Millman and Halkias, "Electronic Devices and Circuits" TMH, 4th Edition, 2015/Latest Edition.
3	Salivahanan, Suresh Kumar, Vallavaraj, "Electronic Devices and Circuits" TMH, 4th Edition, 2016/Latest Edition.
Reference Books	
1	Balbir Kumar and S. B. Jain, "Electronic Devices and Circuits" PHI, 2nd Edition 2014/Latest Edition.
2	R.P. Jain, "Modern Digital Electronics", TMH, 4th Edtion, 2010/Latest Edition.
3	Roy Choudhury and Jain, "Linear Integrated Circuits", New Age Publishers, 4th Edition, 2017/Latest Edition.

ENGINEERING MEASUREMENT AND METROLOGY	
Course Code: BMA-209 Contact Hours: L-3 T-0 P-2 Course Category: OEC	Credits: 4 Semester: 3

Introduction: This is a basic introductory course on measurement and metrology to be used in industry. A course on how to adopt and apply various methods of measurement. It enlightens the students about the various errors, calibration, sensors, accuracy of measurements thus to help in standardizing the methods.

Course Objectives:

- To enlighten the students on measurement process and why it is so important.
- The course aims to explain the students that in what best way to do measurement and develop standardization of measuring method.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-requisites: NIL

Course Outcomes: Having successfully completed this course, the student will be able to:

CO1: Understand Measurement Process and various techniques

CO2: Understand sensors and Transducer.

CO3: Understand measurement instrument capabilities

CO4: Understand Statically control techniques

CO5: The practical sessions will improve visualization of the concepts taught in theory.

Pedagogy:

Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

UNIT I	11 Hours
Introduction: Introduction to measurement and measuring instrument generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration concept of error, Types and sources of error, statistical analysis of errors. **Sensors and Transducers:** Types of sensors, types of transducers and their characteristics, Difference b/w Open loop and Closed loop measurement system, Signal conditioning unit, indicating unit, static characteristics i.e. accuracy, precision, sensitivity, resolution, linearity. **Measurement of flow:** Methods of flow measurement, hot wire anemometer, ultrasonic flow meter.	
UNIT II	11 Hours
Measurement of pressure: Elastic and indirect type pressure transducers. Measurement of very low pressures. **Strain measurement:** Types of strain gaugesand their working, temperature Compensation. **Measurement of force and torque:** Different types of load cells, elastic transducers, pneumatic and hydraulic systems. **Temperature measurement:** Thermocouples, pyrometers.	
UNIT III	10 Hours
Metrology and Inspection: Sources of error, Standards of linear measurement, line and end standards, Limit fits and tolerances, Interchangeability and standardization. **Length Standards:** Line standards, end standards, transfer from line standards to end standards, Numerical based on-line standards, slip gauges – its use and care, methods of building different heights using different sets of slip gauges. **Linear and angular measurements devices and systems Comparators:** Types of Gauges, Limit Gauge, Snap Gauge, Receiving Gauge, Taylor's Principle of Gauge Design.	
UNIT IV	10 Hours
Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile project autocollimator. **Interferometry:** principle and use of interferometer, optical flat. Measurement of screw threads and gears. **Surface texture:** quantitative evaluation of surface roughness and its measurement, Comparators, Feature inspection Form Tolerance Inspection. Tolerance Stack Analysis, CMM, working and features.	

Text Books	
1.	A.K. Tayal, "Instrumentation and Mechanical Measurement", Galgotia Publications Pvt. Ltd., 2003/Latest Edition.
2.	T.G. Beckwith, R.D. Maragoni and J.H Lienhard, "Mechanical Measurements", Addison-Wesley, 1999/Latest Edition.
Reference Books	
1.	R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi,2010/Latest Edition.
2.	I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi,2011/Latest Edition.
3.	F.W. Galyer& C.R. Shotbolt, "Metrology for Engineers", ELBS edition, 2009/Latest Edition.

B. Tech Fourth Semester Syllabus

Computer Organization & Architecture	
Course Code: BCS- 202 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction:

In order to achieve complete understandings of computer systems, it is always important to consider both hardware and software design of various computer components. In other words, every functionality of the computer has to be studied to increase the performance of the computer. Computer organization and architecture mainly focuses on various parts of the computer in order to reduce the execution time of the program, improve the performance of each part.

Course Objective:

- Understand the basics of computer organization: structure and operation of computers and their peripherals.
- Understand basic processing unit and organization of simple processor.
- Expose different ways of communicating with I/O devices and standard I/O interfaces.
- Understand concept of pipelining and other large computing system.

Pre-requisite: Fundamentals of computers and digital logic.

Course Outcome:

CO1: Ability to Demonstrate an understanding of the design of the functional units of a digital computer system.
CO2: Explain the instruction set, instruction formats and Addressing modes of CPU
CO3: Ability to Recognize and manipulate representations of numbers stored in digital computers and perform Basic arithmetic Operations.
CO4: Ability to analyze memory hierarchy and its impact on computer Cost/performance.

Pedagogy:

Classroom teaching which focuses on developing understanding of students to digest the concepts of subject with large number of examples.

UNIT-I	12 Hours
Digital Logic Circuit: Basic Logic functions, Synthesis of logic functions using basic and universal gates, Boolean Algebra Properties, Flip-Flops, Registers, Shift- Registers, Counters, Decoders, Multiplexers, Functional Unit of computer system. **Data Representation:** Data types, R & (R-1)'s Complements, Fixed-Point representation, Floating point representation. **Register Transfer and Micro operations:** Register transfer language, register transfer, Bus and Memory transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations	
UNIT-II	10 Hours
Basic Computer Organisation and Design: Instruction Codes, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt. **Micro programmed Control:** Control Memory. **Central Processing Unit:** Stack Organization, Instruction Formats, Addressing Modes, Program Control, Reduced Instruction Set Computer: RISC characteristics, CISC characteristics. Performance and Metrics.	
UNIT-III	10 Hours
Pipelining and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipelining, Instruction Pipelining, RISC Pipelining, Vector Processing, Array Processors. **Computer Arithmetic:** Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating- Point Arithmetic Operations.	
UNIT-IV	10 Hours
Input-Output Organization: Peripheral Devices, Input-Output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupt, Direct Memory Access. **Memory organization:** Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.	

Text Books	
1	M. Morris Mano, "Computer System Architecture", PHI, 3rd Edition, 2016/Latest Edition.
2	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw Hill, 5 th Edition, 2012/Latest Edition.
3	William Stallings, "Computer Organization and Architecture", PHI, 11th edition, 2021/Latest Edition.

Reference Books	
1.	John L. Hennessy and David A. Patterson, "Computer Architecture a quantitative approach", Elsevier, 6th Edition, 2019/Latest Edition.
2.	A. Anandkumar, "Fundamentals of digital circuits", PHI, 4th edition, 2016/Latest Edition.

OPERATING SYSTEMS	
Course Code: BIT-202 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction:

This course will aim at introducing classical internal algorithms and structures of modem operating systems including CPU scheduling, memory management, and device management. Topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity will be covered.

Course Objectives:

- To learn the fundamentals of Operating Systems & the mechanisms of OS to handle processes and their communication.
- To learn the mechanisms involved in memory management.
- To gain knowledge on OS architecture, mutual exclusion algorithms, deadlock detection algorithms etc.

Pre-requisite: Basic programming knowledge in C or C++.

Course Outcome: After studying this course, students will be able:

CO1: To understand various types of OS, basic concepts, various functions of different OS, process management & CPU scheduling.

CO2: To compare and contrast various memory management schemes like paging, segmentation and to apply different deadlock handling algorithms

CO3: To implement different disk scheduling algorithms, to apply and use various process synchronization techniques and device management strategies.

CO4: To analyse management of I/O and different file handling & directory implementation schemes OS.

Pedagogy:

The class will be taught using theory and tutorial-based methods which include board teaching and presentations/slides, discussions, brainstorming, case studies etc. Along with classroom teaching, students will also be given assignments regarding the topics covered.

UNIT-I	11 Hours
Introduction: Introduction to Operating System, **Types of O.S:** Simple Batch, Multi- programmed Batched, Time-Sharing, Personal-computer, Parallel, Distributed, Real-Time,Mobile **Operating-System Structures:** Layered Architecture, System Calls, System Programs,System Structure, Virtual Machine **Processes:** Process Concept, Process Scheduling, Operations on Processes, CooperatingProcesses, Inter-process Communication, Threads, Multithreaded Programming. **CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling	
UNIT-II	**11 Hours**
Process Synchronization: Background, Critical-Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions,Monitors. **Memory Management:** Background, Logical versus Physical Address space, Swapping, Contiguous allocation, Fragmentation, Paging, Segmentation, Segmentation with Paging. **Virtual Memory:** Demand Paging, Page Replacement, Page-replacement Algorithms,Performance of Demand Paging, Allocation of Frames, thrashing. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	
UNIT-III	**10 Hours**
Device Management: Techniques for Device Management, Dedicated Devices, SharedDevices, Virtual Devices **Secondary-Storage Structure:** Disk Structure, Disk Scheduling, Disk Management,Swap-Space Management, Disk Reliability, Stable-Storage Implementation	
UNIT-IV	**10 Hours**
Information Management: Introduction, Simple File System, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File System **File-System Interface:** File Concept, Access Methods, Directory Structure, Protection, and Consistency Semantics. **File-System Implementation**: File-System Structure, Allocation Methods, Free-Space Management, Directory Implementation, Efficiency and Performance, Recovery.	

Text Books	
1	Silberschatz and Galvin, “Operating System Concepts”, John Wiley, 9th Ed., 2016.
2	R. C. Joshi, “Operating Systems”, Wiley Dreamtech, 2008.
3	Deitel, Deitel and Choffnes, “Operating Systems”, Pearson, 3rd Edition, 2003
Reference Books	
1	Tannenbaum, “Operating Systems”, PHI, 5th Ed., 2000.
2	Madnick E. and Donovan J., “Operating Systems”, Tata McGraw Hill, 2017.
3	Flynn McHoes, “Operating System”, Cengage Learning, 6th edition, 2013.
4	Sibsankar Halder and Alex A. Arvind, “Operating System”, Pearson, 2009

DESIGN AND ANALYSIS OF ALGORITHMS	
Course Code: BCS-204 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction:

This course deals with teaching different methodologies of designing algorithms. There are certain standard approaches of analyzing the algorithms. This course deals with all aspects of these analysis. It teaches the concepts of Dynamic programming, different approaches of algorithm design like Greedy approach etc.

Course Objectives:

- Introduction, learning and analysis of performances of algorithmic efficiency of approaches such as searching, sorting etc.
- Introduction, learning and analysis of greedy paradigms.
- Introduction, learning and analysis of dynamic programming and back tracking.
- Introduction, learning and analysis of computational complexity and branch & bound.

Pre-requisites: Data structures.

Course Outcomes: After completion of the course, the students will be able to:

CO1: Understand asymptotic complexities of the algorithms and design algorithms using Divide and apply different deadlock handling algorithms.

CO2: Understand and apply greedy and dynamic programming approaches for designing algorithms.

CO3: Understand, analyse and implement various graph algorithms and the backtracking approach of algorithm design.

CO4: Understand and implement different string-matching algorithms and NP-Complete problems.

Pedagogy:

Classroom teaching which focuses on developing understanding of students to digest the concepts of subject with large number of examples.

UNIT-I	10 Hours
Algorithm definition and specification, analysis of algorithmic efficiency of algorithms Review of growth of function, space complexity, time complexity, Recurrences: Substitution method, Iteration method, Master method, Divide and Conquer Approach: merge Sort, quick sort, shell sort, heap sort, Simultaneous Max and Min Problem, Strassen's algorithm for matrix multiplications.	
UNIT-II	**10 Hours**
Greedy Algorithms: Elements of Greedy strategy, knapsack problem, job sequencing with deadlines, minimum spanning trees, Activity selection problem, Huffman Codes. **Dynamic Programming:** Elements of Dynamic Programming, Matrix Chain Multiplication, longest common subsequence and optimal binary search trees problems.	
UNIT-III	**12 Hours**
Graph Algorithms: DFS, BFS, Topological Sort, Strongly Connected Components, Kruskal's and Prim's algorithm for MST, Dijkstra's and Bellman Fort Algorithm, All pair shortest paths Algorithm. **Back Tracking:** General method, n-queen's problem, Branch and Bound: General Method, 0/1 knapsack.	
UNIT-IV	**10 Hours**
String matching: Naïve String-Matching algorithm, Rabin-Karp Algorithm, String Matching with finite automata, The Knuth-Morris Pratt algorithm. NP-Complete Problem: Polynomial time verification, NP-Completeness and Reducibility, NP-Completeness Proof, NP-Complete problems.	

Text Books	
1	T .H .Cormen, C .E .Leiserson, R .L .Rivest, "Introduction to Algorithms", 3rd Ed., PHI/Latest Edition.
2	E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," 2nd Ed., Universities Press/Latest Edition.
3	P. H. Dave, H. B. Dave, "Design and Analysis of Algorithms", 2nd Ed., Pearson Education/Latest Edition.
Reference Books	
1	Design and Analysis of Algorithms, S. Sridhar, Oxford Univ. Press/Latest Edition.
2	Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education, 2008./Latest Edition.
3	Foundations of Algorithms, R. Neapolitan and K. Naimipour, 4th edition, Jones and Bartlett Student edition/Latest Edition.

OBJECT ORIENTED PROGRAMMING	
Course Code: BIT-204 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction:

This course provides in-depth coverage of object-oriented programming principles and techniques. Topics include classes, objects, overloading, data abstraction, information hiding, encapsulation, inheritance, polymorphism, file processing, templates, exceptions, container classes etc. The course material embraces the C++ language standard/ Python with numerous examples demonstrating the benefits of C++/Python. In the end some basics of Java will be covered.

Course Objectives:

- To learn the syntax and semantics of the C++/java/python programming language.
- To understand object-oriented programming concepts, and apply them in solving problem
- To understand and design efficient programming.
- To demonstrate skills in writing programs using Java programming.

Pre-requisite: Basics of Programming language**.**

Course Outcomes: After completion of the course, the students will be able to:

CO1: Understand fundamentals syntax and their use to develop Object Oriented
CO2: Java/Python program to express proficiency and improve effective programming skills
CO3: Understand commonly used operations for file system, exception handling and create namespace solutions.
CO4: Implement Java based program and make effective use of Tools

Pedagogy:

Emphasis on lab sessions where students will be given programming assignments to code in C++/Python/Java based on topics learnt in previous lectures.

UNIT-1	10 Hours
Need for Object Oriented Programming, Comparison of Programming paradigms, Characteristics of Object-Oriented Programming Languages, Introduction to Object Oriented concepts (classes, objects, encapsulation, inheritance, data hiding, abstraction, polymorp hism), Fundamentals Data Types & Literals Variables, Arrays, Operators, Control of Flow in OOP, Compilation and Execution of Process , Reference vs. Pointer variable, Classes and Objects: class declaration, Role of private, public and protected access specifiers, Memory organization of class, inline function, friend function, static members , constructor and destructors, instantiation of objects, default parameter value, object types, garbage collection, dynamic memory allocation, new and delete operator	
UNIT-II	**11 Hours**
Polymorphism: Function overloading, Constructor overloading, Compile time polymorphism, Overloading Rules, Operator Overloading (Unary and Binary) as member function/friend function. Inheritance, Types of Inheritance, Use of protected access specifier, Virtual base class, Ambiguity resolution using scope resolution operator and Virtual base class, Overriding inheritance methods, Constructors and Destructor in derived classes, Runtime polymorphism, Pointer to objects, Virtual Functions (concept of virtual table), pure virtual functions, Abstract Class.	
UNIT-III	**11 Hours**
Managing Input / Output, Concept of streams, console I/O – formatted and unformatted, Manipulators, File I/O – Predefined classes, file opening & closing, file manipulation, read & write operations, sequential and random file access, **Exception Handling**: Basic mechanism, Throwing, Catching and Re-throwing. **Namespace**: Basic concept, role of scope resolution operator and using keyword, Introduction to Java- Overview and characteristics of Java, Data types, Organization of the Java Virtual Machine, Compilation and Execution Process in java	
UNIT-IV	**10 Hours**
Java Classes: String and String Buffer classes, Wrapper classes, using super keyword, Multilevel hierarchy abstract and final classes, Object class, Packages and interfaces, Access protection, Exception Handling: Fundamentals exception types, uncaught exceptions, throw, throws, final, built in exception, creating your own exceptions, Multithreaded Programming: Fundamentals, Java thread model: priorities, synchronization, thread classes, Runnable interface, inter thread Communication, suspending, resuming and stopping threads.	
Text Books	
1	Herbert Schildt , "Java: The Complete Reference", 11th Edition, McGraw Hill, 2018/Latest Edition.
2	Martin C. Brown, "Python: The Complete Reference", 4th Edition, McGraw Hill, 2018 /Latest Edition.
Reference Books	
1	Mark Lutz, "Learning Python" 3rd Edition, O'Reilly Media, 5th Ed. 2017 /Latest Edition.
2	Bjarne Stroustrup , "The C++ Programming Language", Pearson, 4th Ed, 2009/Latest Edition.

B. Tech Fifth Semester Syllabus

Data Communication and Computer Networks	
Course Code: BIT 301 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 5

Introduction: Data communications refers to the transmission of digital data between two or more computers, whereas, a computer network or data network is a telecommunication network that allows computers to exchange data. The physical connection between networked computing devices is established using either wired or wireless media. The best-known computer network is the Internet.

Course Objective:

- Explain basic concepts of OSI Reference model, services and role of each layer of OSI model and TCP/IP , network devices and transmission media, analog and digital transmission.
- To apply channel allocation, framing, error and flow control techniques. Describe functions of the network layer that is logical addressing , subnetting and routing mechanism.
- To explain the different transport layer functions that are port-addressing, connection management, error control and flow control mechanism.
- To study different protocols used in the application layer and various advanced protocols like SNMP, SIP and WIRESHARK.

Pre-requisite: Basic knowledge of networking.

Course Outcome: Upon successful completion of this course, students will be able to:
CO1 Describe the fundamental concepts and layered architecture of computer networking.
CO2 Explain the basic concepts of link layer properties to detect error and develop the solution for error control and flow control. Design, calculate, and apply subnet masks and addresses to fulfill networking requirements. Also, compare various routing protocols.
CO3 Comprehend the duties of transport layer and congestion control techniques.
CO4 Illustrate the features and operations of various application layer protocols such as DNS, HTTP, FTP, e-mail protocols and other applications; and focus on network security issues to secure communication towards society.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction: Goals and Applications of Networks, Layering Concept, OSI Reference Model, TCP/IP Protocol Suite, Networks Topology, Physical Layer: Signals, Digital Transmission – Analog to Digital & Digital to Digital, Analog Transmission – Digital to Analog & Analog to Analog, Multiplexing – FDM & TDM, Media – Guided and Unguided, switching – Packet based & Circuit based, Shannon Capacity; Network Topologies, Connecting Devices.	
UNIT II	**10 hours**
Data Link Layer: Addressing, Error Detection & Correction, Checksum & CRC; Medium Access – ALOHA, CSMA, CSMA/CD & CA; Protocols – Ethernet, ARP & RARP; Switching Techniques. Network Layer: Need for internetworking, IP Addressing, Subnetting, Super-netting, Basic Routing (or Forwarding) Mechanism; IPv4 frame format and functions; Key features of IPv6, ICMP, IGMP, Routing protocols – RIP, OSPF & BGP and algorithms – Distance Vector and Link State. Linux Network Commands: arp, route, ifconfig, netstat, traceroute, ping.	
UNIT III	**10 hours**
Transport Layer: Port Addresses; ARQ - Simple, Stop and Wait, Go Back-N, Selective Repeat; UDP – Services & Applications; TCP – header format, connection setup & termination, state transition diagram, flow control, error control, Congestion Control: causes for congestion, effects of congestion, various open-loop and close-loop congestion control techniques: The leaky bucket algorithm, The token bucket algorithm	
UNIT IV	**10 hours**
Application Layer: Web & HTTP, FTP, Email, Telnet, DNS, RPC. Network Security Basic Concepts: Cryptographic Protocols, PGP, IPSEC, SSL, SSH, Firewalls, IDS, IPS. Advanced Protocols: SNMP, RTP, SIP, BitTorrent.	
Text Books	
1	B. Forouzan, “Data Communications and Networking”, McGraw Hill Education, 5th Edition 2017/ Latest Edition.
2	A. S. Tanenbaum and D. J. Wetherall, “Computer Networks”, Pearson Education India, 5th Edition 2013/ Latest Edition.
Reference Books	
1	L. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Elsevier, 2011/ Latest Edition.
2	W. Stallings, “Data and Computer Communications”, 5th Edition, Pearson, 2014/Latest Ed.
3	V. Pallapamanvi, “Data Communications and Computer Networks”, 2nd Edition, Prentice Hall, 2014/Latest Edition.
4	K. James, “Computer Networking: A Top-down Approach”, 6th Edition, Pearson, 2017/Latest Edition.

Artificial Intelligence	
Course Code: BCS 301 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 5

Introduction: This course is an introduction to the basic Knowledge representation, problem solving and learning methods of artificial intelligence. After learning this course, the student should be able to understand the basic concepts of problem solving and learning in intelligent system engineering.

Course Objectives:

- To Introduce the basic concepts of artificial intelligence, problem solving, knowledge representation and reasoning.
- To introduce the basic concepts of handling uncertainty
- To help the students to applications of AI in different fields

Pre-requisite: Discrete Mathematics, Programming Concepts.

Course Outcome: Upon successful completion of this course, students will be able to:

CO1 To understand the fundamentals of Artificial Intelligence, intelligent agents and the basics of problem solving.

CO2 To apply predicate logic for knowledge representation and to study about the various text extraction and word embedding models.

CO3 To handle uncertaininty of data and study the various concepts of soft computing like fuzzy logic, Neural networks etc.

CO4 To study and design the architecture of expert systems and understand the various real world applications of AI

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction to AI: Introduction to AI: Brief introduction about Intelligent agents and Problem Solving. Turing Test. Uninformed Search Strategies, Informed Search Strategies, Heuristics. Solving problems by searching, BFS, DFS, Issues in design of Intelligent Search Algorithms	
UNIT II	**10 hours**
Knowledge Representation: Knowledge Representation using predicate logic, Rule Based Systems, Ontology, WordNet and Concept Net as Knowledge representation tools. Programming with Java/Python. Text Preprocessing: Stemming, Lemmatization, Tokenization, Feature Extraction - BoW Model, TF-IDF. Word Embeddings - Word2Vec, GloVe.	
UNIT III	**12 hours**
Decision Making in Uncertainty: Handling Uncertainty, Probabilistic Reasoning, Fuzzy Logic, Learning by induction, Introduction to Neural Network Genetic Algorithms basics. Rough Sets. Case Studies of Applications of Uncertainty	
UNIT IV	**10 hours**
Real World Applications of AI: Real World Applications of AI: Expert System Architecture, Case Studies: MYCIN, Applications in NLP, Medical Sciences, Agriculture, Education, Social Network Analysis, Information Retrieval from Search Engines and Metasearch Engines, IoT Applications & Big Data Analytics Applications. Ethics in AI: Model Transparency (Interpretability and Explainable AI), Discrimination & Fairness Studies.	

Text Books

1. S.J. Russell and P. Norvig, "Artificial Intelligence- A Modern Approach", Pearson 3rd Edition, 2010/Latest Edition.
2. P.H. Winston, "Artificial Intelligence", Pearson Education, 3rd Edition, 2002/ Latest Edition.

Reference Books

1. E. Rich and K. Knight, "Artificial Intelligence", McGraw Hill Education; 3rd Edition 2017, Latest Edition.
2. N.J. Nilsson, "Principles of Artificial Intelligence", Narosa Publ. House, 2002/ Latest Edition.
3. L. Luger,"Artificial Intelligence : Structures and Strategies for Complex Problem Solving", Pearson Education, 5th Edition 2008/ Latest Edition.
4. E. Kumar, "Artificial Intelligence", Dreamtech Press, 2020/ Latest Edition.

Modeling and Simulation	
Course Code: BAS 301 **Contact Hours**: L-3 T-0 P-2 **Course Category**: BAS	Credits: 4 Semester: 5

Introduction: Modeling and simulation are the indispensable tools that allow us to analyze the systems efficiently. They help us to analyze the behavior of the system before the system is actually built. Due to the advancement in this field, they have now become popular in all disciplines of engineering and sciences. The course will provide groundwork to the engineers to understand the underlying basis of modeling and simulation techniques.

Course Objectives: The objective of this course is to impart a basic understanding of system and their modeling. Students will be introduced to mathematical modeling and their applications with simulation techniques. Also, the use of MATLAB/R/Mathematica will help the students to simulate the various mathematical models.

Pre-requisite: None

Course Outcomes: Having successfully completed this course, the student will be able to

CO1 Understand the procedure of modeling of various systems using appropriate modeling techniques.

CO2 Learn about various models such as Monte Carlo simulation models, queuing models, and mathematical models.

CO3 Formulate and solve the mathematical models for the systems.

CO4 Write the simulation code in MATLAB/R/Mathematica for gaining quick and useful insights into real-world systems.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Concept of system and environment: Classification of Systems; Need of System Modeling; Modeling Methods for Complex Systems; Classification of Models: Physical vs. Abstract Model, Mathematical vs. Descriptive Model, Static vs. Dynamic Model, Steady State vs. Transient Model, Open vs. Feedback Model, Deterministic vs. Stochastic Models, Continuous vs. Discrete Models; Steps in the Modeling process; Mathematical Modeling: Concept, Importance, Advantages and Limitations.	
UNIT II	**10 hours**
Introduction to Simulation: Need and Advantages; Mathematical Modeling and Approaches to Simulation; Discrete system simulation: Monte Carlo method, Random Number Generation. Applications of Modeling and Simulation; Numerical Methods for Simulation: Trapezoidal and Tangent Formulae, Simpson's Rule, One-Step Euler's Method, Runge–Kutta Methods of Integration, Runge–Kutta Fourth-Order Method; Errors during Simulation with Numerical Methods.	
UNIT III	**12 hours**
Difference equations: Introduction to Discrete Models; Linear Models: Population Model Involving Growth, Drug Delivery Problem, Linear Prey-Predator Problem; Introduction to Continuous Models; Mathematical Model of Influenza Infection (within host), Epidemic Models (SI, SIR, SIRS), Numerical solution of the models.	
UNIT IV	**10 hours**
Fitting a Mathematical Function to Data: Fitting of Linear Model, Linear Model with Multiple Predictors, Non Linear Model Estimation. Queuing Theory: Introduction, notation and assumption. Simulation of queuing system, Simulation of a single server queue.	

Text Books	
1	Chaturvedi, K. Devendra., "Modeling and Simulation of Systems using MATLAB and Simulink", CRC press, 2017.
2	Gordon, Steven I., and B. Guilfoos, "Introduction to Modeling and Simulation with MATLAB® and Python", CRC Press, 2017.
Reference Books	
1	Kapur, J. Narain. "Mathematical modeling". New Age International, 1988.
2	Barnes, Belinda & Fulford, R. Glenn,"Mathematical Modelling with Case Studies, Using Maple and MATLAB" (3rd ed.). CRC Press, Taylor & Francis Group, 2015.
3	Velten, K. Mathematical Modeling and Simulation: Introduction for Scientists and Engineers. John Wiley & Sons, 2009.
4	Banerjee, Sandip, "Mathematical Modeling: Models, Analysis and Applications", CRC Press, 2014.

Theory of Computation	
Course Code: BCS 303 **Contact Hours**: L-3 T-1 P-0 **Course Category**: DEC	Credits:4 Semester:5

Introduction: The study of automata and the theory of computation deal with the concepts of working of automatic machine and processing of input formal language data. This subject provides an important background material to students involved in understanding the basic functionalities of automata theory.

Course Objective:

- To introduce concepts in Automata theory and theory of computation
- To introduce different formal language classes and their relationships
- To introduce grammars and recognizers for different formal languages

Pre-requisite: Basic concepts of mathematics

Course Outcome: Upon successful completion of this course, students will be able to:

CO1 To Understand properties of formal languages, automata, their equivalence, conversion techniques, concept of Context Free Grammars, and Pushdown Automata.
CO2 Understanding of the key results in algorithmic complexity, computability and solvability of problems.
CO3 To Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO4 Analyze the finite automata and regular expressions for accepting the language

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	11 hours
Introduction to Theory of Computation: Definitions: Languages, Grammar, Automata, Applications of Theory of Computation, Finite Automata: DFA, NDFA, Equivalence of DFA and NDFA, DFA Minimization Regular Languages, Regular Grammars, Properties of Regular Languages, Pumping Lemma	
UNIT II	**10 hours**
Context Free Language: Introduction, Parsing and Ambiguity, Pushdown Automata (PDA), Non Deterministic PDA, Context Free Grammar, Chomsky Normal Form, Greibach Normal Form, Parse Tree representation of Derivation Tree , Equivalence of PDA and CFGs , Properties of Context Free Grammars	
UNIT III	**11 hours**
Pumping Lemmas: Pumping Lemma for context free languages, Pumping lemma for linear languages. Turing Machine: Definition, TM as language acceptors, TM as transducers, Hierarchy of Formal Languages and Automata, Chomsky Hierarchy, Context Sensitive Languages and LBA, Unrestricted Grammars	
UNIT IV	**10 hours**
Turing machine Models and complexity: Some NP Problems, Complexity classes P and NP, Unsolvable Problem, Halting problem, Finite State Transducers: Introduction, Mealy Machines**,** Moore Machines, Mealy and Moore Equivalence, Limitations of Finite State transducer	

Text Books	
1	P. Linz "An Introduction to Formal Languages and Automata", Narosa Publishers, 2010
2	J. Ullman, J. Hopcroft "Introduction to Automata Theory, Languages and Computation", Pearson Education India; 3rd edition (2008)
Reference Books	
1	M. Sipser "Introduction to the Theory of Computation", Cengage; 3rd edition (2014)
2	C.K. Nagpal "Formal Languages and Automata Theory", Oxford University Press (2015)

Professional Ethics and Human Values	
Course Code: HMC 301 **Contact Hours**: L-3 T-0 P-0 **Course Category**: HMC	Credits: 3 Semester: 5

Introduction: Values and Ethics are very relevant in today's environment of conflicts and stress in every profession, with obligations to be met by one person in many directions. A formal study will certainly improve one's ability and judgment and refine one's behavior, decisions, and actions in performing the duty to the family, organization, and to the society.

Course Objectives: To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way. To inculcate Ethics and Human Values into the young minds and develop moral responsibility and mould them as best professional which will create ethical vision and achieve harmony in life.

Pre-requisite: High school level moral studies

Course Outcomes: After completion of the course, the students should be able to:
CO1 Develop the capability of shaping themselves into outstanding personalities, through a value-based life.
CO2 Students turn themselves into champions of their lives.
CO3 Students take things positively, convert everything into happiness and contribute for the happiness of others.
CO4 Students become potential sources for contributing to the development of the society around them and institutions / organizations they work in.
CO5 Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I	10 hours
Human Values: Morals, Values and Ethics, Integrity, Work Ethic, Respect for Others, Living Peacefully, Caring, Sharing, Honesty, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Character, Spirituality. Indian values (on the conceptual framework of Vedas): Purusharth, Niskama karma, Religion and Human Values, Towards a World Religion, Ethical Living and Harmony in Life.	
UNIT II	**11 hours**
Profession and Professionalism, Ethical Theories: Kohlberg's Theory, Gilligan's Theory, Feminist Consequentialism, Moral Dilemmas, Types of Enquiry, Uses of Ethical Theories, Engineering Profession, Engineering Professionals- Training, Skill Set, Life Skills, Engineering Ethics: Making Senses and Issues, Ethical Obligations of Engineers, Ethical Codes for Engineers.	
UNIT III	**10 hours**
Engineering as a Social Experimentation, Safety Responsibility and Rights: Engineering as experimentation, Engineers as responsible Experimenters, Concept of Safety and Risk, Engineer's Responsibility for Safety, Risk – Benefit Analysis, Case Studies: The challenger case study, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy. Disaster Management, Professional Rights, Employee Rights, Intellectual Property Rights (IPRs), Human Rights and Human Responsibilities. Major Ethical Issues.	
UNIT IV	**11 hours**
Ethics and Global Issues: Ethics in Global Scenario, Multinational corporations, Environmental ethics, computer ethics, Business Ethics. Corporate Social responsibility, Weapons Development, Research Ethics.	

Text Books	
1	M. Govindarajan., S. Natarajan., V. S. Senthil Kumar., "Engineering Ethics", Prentice Hall, New Delhi, 2004.
2	R. Subramaniam, "Professional Ethics", Oxford University Press, New Delhi, 2013.
3	M. Martin and R. Schinzinger, "Ethics in engineering", McGraw-Hill, New York 1996.
4	R. R. Gaur, R. Sangal, G.P. Bagaria, "A Foundation Course in Human values and Professional Ethics", Excel Books Pvt. Ltd, New Delhi 2009.
Reference Books	
1	B. P. Banerjee, "Foundation of Ethics and Management", Excel Books, 2005.
2	Fleddermann, Charles D., "Engineering Ethics", Pearson Education. 2004.
3	Harris, E. Charles, Protchard, Michael S. And Rabins, Michael, J., Wadsworth, "Engineering Ethics- Concepts and Cases", Thompson Learning, 2000
4	Boatright, John R., "Ethics and the Conduct of Business", Pearson Edu. N. Delhi, 2003.

BTech 6th semester Syllabus

Wireless Networks	
Course Code: BCS 302 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 6

Introduction: This course is about teaching of the fundamental concepts of wireless networks and has a basic knowledge of the different types of ad-hoc networks and underlying protocols. Course will provide the understanding of the architecture of wireless networks for its various application setups.

Course Objective:

- To introduce the basics of wireless networks
- To make them familiar to the challenges involved in wireless networks with respect to wired networks.
- To introduce various types of wireless networks, i.e cellular networks, Bluetooth, Ad hoc networks, wireless mesh networks and wireless sensor networks.

Pre-requisite: Students should have basic knowledge of wireless communication and computer networks.

Course Outcome: Upon successful completion of this course, students will be able to:
CO1 Understand the underlying technologies of wireless networks.
CO2 Understand of the existing wireless protocols for MAC layer, Network layer and transport layer.
CO3 Understand the concepts of ad hoc networks and the design / performance issues in wireless local area networks and wide area networks.
CO4 Understand the function of the node architecture and use of sensors for various applications.
CO5 Understand the implementation strategies of distributed computing and wireless network protocols.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	12 hours
Introduction: Introduction to wireless networks, Ad-hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - Indoor and outdoor models. **MAC Protocols:** design issues, goals and classification. Contention based protocols, IEEE Standards: 802.11, 802.15.	
UNIT II	**10 hours**
Network Protocols: Routing Protocols: Design issues, Proactive Vs reactive routing protocols, Unicast routing protocols, Multicast routing protocols, hybrid routing protocols, Energy aware routing protocols, Hierarchical Routing protocols **Transport Layer:** Issues in designing Transport Layer, Transport layer classification, Ad-hoc transport protocols.	
UNIT III	**10 hours**
Wireless Mesh Networks: Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing, Heterogeneous Mesh Networks, Vehicular Mesh Networks	
UNIT IV	**10 hours**
Wireless Sensor Networks: Introduction, Sensor Network architecture, Data Dissemination, Data Gathering, Location discovery, Quality of Sensor Networks, Sensor Network Platforms and Tools, Energy Efficient Approaches	

Text Books	
1	C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architectures and Protocols, 2nd edition, Pearson Education, 2004.
2	Holger Karl & Andreas Willig, " Protocols and Architectures for Wireless Sensor Networks", John Wiley, Student Edition (Indian), 2016.
Reference Books	
1	Perkins, Charles, "Ad hoc networking", 1st Edition, Pearson Education India, 2008.
2	R. Hekmat, "Ad-hoc Networks: Fundamental Properties and Network Topologies", Springer, 1st Edition, 2006
3	C. K.Toh, "Adhoc Mobile Wireless Networks", Pearson Education; 1st edition, 2015.
4	W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley, 2010.

Microprocessor and Interfacing	
Course Code: BCS 304 **Contact Hours:** L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 6

Introduction: This course provides the complete description of architecture and instruction set of microprocessors. It also deals with assembly language programming and concept of Interfacing with various I/O devices and microprocessors. It covers all concepts of microprocessors for the development of real time solutions. This course also helps to understand the difference between 8086 and other advanced microprocessors.

Course Objective:

- Ability to Demonstrate an understanding of the design of the functional units of a microprocessor.
- Explain the instruction set, instruction formats, Addressing modes of the microprocessor and ability to Recognize and manipulate representations of numbers stored in the microprocessor and perform Basic Arithmetic Operations.
- Ability to analyze memory hierarchy and its impact on computer Cost/performance.
- Understanding and interfacing communication modules with a processor for various real time applications.

Pre-requisite: Computer Organisation

Pre-requisite: Basic electronics

Course Outcome: Upon successful completion of this course, students will be able to:
CO1 Understand the basic concepts of microprocessors
CO2 Understand the instruction set of 8086.
CO3 Apply the knowledge of assembly language to solve various problems.
CO4 Grasp an understanding of various peripheral device interfaces with 8086.
CO5 Design and implement various interfaces in real life different applications

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction and architecture: Introduction to microprocessors, classification, basic architecture and its applications. History of microprocessors, Brief Introduction to 8085 Microprocessor, , 8086 architecture, BIU and EU, Register Organization, Pin diagram, Memory Segmentation	
UNIT-II	**12 Hours**
Assembly Language Programming of 8086: Instruction set of 8086, Instruction execution time, Timing Diagram, fetch cycle, execution cycle. Instruction format, Addressing modes, Instruction Types (data transfer instruction, arithmetic instructions, branch instruction, NOP & HLT instructions, flag manipulation instruction, logical instruction, shift and rotate instruction, String instructions), Assembler directions and operators.	
UNIT-III	**10 Hours**
Introduction to Multiprogramming: System Bus Structure ,Multiprocessor configurations, Coprocessor, Closely coupled and loosely Coupled configurations, Introduction to advanced processors, 80186, 80286, 80386 **Interfacing:** Memory interfacing to 8086, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine. Interfacing Interrupt Controller 8259	
UNIT-IV	**10 Hours**
Interfacing with advanced devices: I/O Interface: 8255 PPI various modes of operation and interfacing to 8086. Communication Interface: Serial data transfer schemes. 8251 USART architecture and interfacing, DMA , Interfacing DMA Controller 8257 to 8086.	
Text Books	
1	A.K. Ray and K.M. Bhurchandi, “Advanced Microprocessors and Peripherals “, McGraw Hill Education; 3rd edition (2017)
2	Douglas V Hall, SSSP Rao, “Microprocessor and Interfacing”, McGraw Hill Education; 3rd edition (2017)
3	Y.C. Liu and A. Gibson, “Microcomputer systems-The 8086 / 8088 Family”,Pearson Education India; 2nd edition (2015)
Reference Books	
1	Barry B. Brey, “The Intel Microprocessor, Architecture, Programming and Interfacing “ , Pearson Education India; 8th edition (2008)
2	Kenneth J Ayala, “The 8086 Microprocessor: Programming & Interfacing the PC” , Cengage Learning; 1st edition (2007)
3	B. Ram, ‘Fundamentals of Microprocessors and Microcomputers’, Dhanpat Rai Publications. latest edition, 2012

Compiler Design	
Course Code: BCS 306 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 6

Introduction: This course provides the complete description about inner working of a compiler. This course focuses mainly on the design of compilers and optimization techniques. It also includes the design of Compiler writing tools. This course also aims to convey the language specifications, use of regular expressions and context free grammars behind the design of compiler.

Course Objective:

- To Introduce the concepts of language translation and compiler design
- To impart the knowledge of practical skills necessary for constructing a compiler

Pre-requisite: Programming in C

Course Outcome: Upon successful completion of this course, students will be able to:

- Understand the concepts and different phases of compilation with compile time error handling.
- Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language.
- Compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.
- Design a compiler for a small subset of C language.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction to compilers – Analysis of the source program, Phases of a compiler, Grouping of phases, compiler writing tools– bootstrapping. Case study: MiniC (A small subset of C language) **Lexical Analysis-**The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Review of Finite Automata, Recognition of Tokens Case study: Lexical Analysis for MiniC **Syntax Analysis:** Review of Context-Free Grammars – Derivation trees and Parse Trees, Ambiguity.	
UNIT-II	**12 Hours**
Top-Down Parsing: Recursive Descent parsing, Predictive parsing, LL(1) Grammars. **Bottom-Up Parsing**: Shift Reduce parsing – Operator precedence parsing (Concepts only). LR parsing – Constructing SLR parsing tables, Constructing Canonical LR parsing tables and Constructing LALR parsing tables. Case study: Syntax analysis for MiniC	
UNIT-III	**10 Hours**
Syntax directed translation: Syntax directed definitions, Bottom- up evaluation of S- attributed definitions, L- attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes. **Type Checking**: Type systems, Specification of a simple type checker. **Run-Time Environments**: Source Language issues, Storage organization, Storage allocation strategies.	
UNIT-IV	**10 Hours**
Intermediate Code Generation (ICG): Intermediate languages – Graphical representations, Three Address code, Quadruples, Triples. Assignment statements, Boolean expressions. **Code Optimization**: Principal sources of optimization, Optimization of Basic blocks. **Code generation**: Issues in the design of a code generator. A simple code generator. Case study: MiniC Code Generator for the MiniC Architecture	
Text Books	
1	Aho A., M. S Lam, R. Sethi and D Ullman, "Compilers – Principles Techniques and Tools", Pearson Education India; 2nd edition (2013)
2	K. C. Louden, "Compiler Construction – Principles and Practice", Cengage Learning Indian Edition, 2006.
Reference Books	
1	A. I Hollub, Compiler Design in C, Pearson Education India; 1st edition (2015)
2	AW Appel, M Ginsburg, "Modern Compiler Implementation in C", Cambridge University Press, 2004.
3	K. Muneeswaran, "Compiler Design" ,Oxford University Press, Illustrated edition (2012)

Multimedia Technologies	
Course Code: BCS 308 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 6

Introduction: This course is an introduction to the technologies encompassing digital multimedia including images, videos, audios, web pages etc. that allow users to use and communicate with the multimedia over the internet. After learning this course, the student should be able to understand the basic concepts and technologies related to the multimedia, web, hardware and software programs needed to develop and deploy such computer based interactive multimedia applications.

Course Objective:

- To introduce the basic concepts of multimedia data representations and data compression
- To introduce multimedia architecture and databases
- To introduce the various multimedia applications.

Pre-requisite: Programming Concepts, Graphics.

Course Outcome: Upon successful completion of this course, students will be able to:

CO1 To understand the importance of multimedia objects for web application development

CO2 To understand and apply the compression techniques for various multimedia objects

CO3 To understand and study multimedia database systems and content-based information retrieval systems

CO4 To understand the various multimedia applications and latest trends

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction: Brief introduction about multimedia concepts. Multimedia objects. Text, graphics, sound, video, images, internet and web, world wide web, html, XML, Angular JS, CSS. Hardware and software requirements. Multimedia software tools, hardware. Concept of Non- Temporal and Temporal Media. Basic Characteristics of Non-Temporal Media, Hypertext and Hypermedia. Presentations, Synchronization, Events, Scripts and Interactivity.	
UNIT-II	**10 Hours**
Data representation and compression: Data representation, Basic concepts of Compression, basic compression techniques, video audio data compression techniques, image format. Huffman coding, Shannon Fano algorithm, Huffman algorithms, adaptive coding, arithmetic coding higher order modeling, finite context modeling, dictionary based compression, sliding window compression, LZ77, LZW compression, compression ratio loss less and lossy compression.	
UNIT-III	**10 Hours**
Multimedia system architecture & database: Introduction to Multimedia PC/Workstation Architecture, Characteristics of MMX instruction set, I/O systems: Overview of USB port and IEEE 1394 interface, Operating System Support for Multimedia, Multimedia Database Design, Content Based Information Retrieval: Text Retrieval, Image Retrieval, Video Retrieval, Overview of MPEG-7, and design of video-on-Demand Systems.	
UNIT-IV	**10 Hours**
Multimedia & its Applications: Speech (digital audio concepts, sampling variables, loss; loss less and silence compression), Images (multiple monitors, bitmaps, vector drawing, lossy graphic compression, JPEG compression, Zigzag coding), Multimedia network and QoS support, multimedia wireless networks, heterogeneous network, multimedia applications. Latest trends in multimedia and case study related to multimedia technologies.	
Text Books	
1	D. Hillman, "Multimedia Technology & Applications", Galgotia Publications. First edition 2008.
2	N. Chapman & J. Chapman, "Digital Multimedia", Wiley Pub. Third edition 2009.
Reference Books	
1	O. Marsh. "Multimedia Technology and Applications." Larsen and Keller Edu. 2017.
2	R. Agrawal, "Multimedia Systems", Excel Books. 2013.
3	D.P. Mukherjee, "Fundamentals of Computer Graphics and Multimedia", PHI 2004.
4	Z. Li & M. S. Drew. "Fundamentals of Multimedia." Prentice Hall India Learning Private Limited (2005)

Human Computer Interaction	
Course Code: BCS 310 **Contact Hours**: L-3 T-1 P-0 **Course Category**: DEC	Credits:4 Semester:5

Introduction: HCI is a multidisciplinary course focusing on design of computer technology interaction between humans particularly users, and computers. HCI has expanded and evolved and now covers several forms of information technology design.

Course Objective:

- To Impart knowledge and understanding about human cognition and human perspective with respect to computers.
- To Introduce User Interface and Graphical User Interface elements
- To introduce components and software tools for Human computer interaction.

Pre-requisite: Computer fundamentals

Course Outcome: Upon successful completion of this course, students will be able to:

CO1 To understand the importance of good user interface design and the difference between UI and GUIs

CO2 To understand and apply the design process of UIs

CO3 To understand and apply screen-based UI principles

CO4 To apply the UI design and interaction-based device components to UI designing

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I	10 Hours
Introduction: Importance of user interface, definition, importance of good design, Benefits of good design, A brief history on screen design. **Graphical User Interface:** Popularity of Graphics, the concept of direct manipulation, graphical system, characteristics, web user interface popularity, characteristics-principles of user interface.	
UNIT II	**11 Hours**
Design process: Human interaction with computers, importance of human characteristics, human considerations, human interaction speeds, understanding business junctions. Limitations and constraints of mobile and hand-held platforms and issues related to network, power, memory and UI responsiveness required with reference to other computing platforms.	
UNIT III	**11 Hours**
Screen Designing (UI Design): Design goals, screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis, presenting information simply and meaningfully, information retrieval on web, statistical graphics, technological consideration in interface design. **Windows:** Navigation schemes selection of window, selection of devices based and screen-based controls.	
UNIT IV	**10 Hours**
Components and Software Tools: Components: text and messages, Icons and increases, multimedia, colors, user problems. **Software tools:** Specification methods interface, building tools. **Interacting Devices:** Keyboard and function keys, touch screen technology, pointing devices, speech recognition digitization and generation, image and video displays (LED,LCD,HD displays), voice activated commands and its implementation	
Text Books	
1	W. O Galitz, "The essential guide to user interface design", Wiley, Third Edition, 2007.
2	B. Shneidermann, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition,Pearson Education ,2014.
Reference Books	
1	A. Dix, J. Fincay, G. Goryd, Abowd, R. Bealg, " Human Computer Interaction" , 3rdEdition, Pearson Education,2004.
2	Sharp ,Rogers, Preece, "Ineraction Design Beyond Human-Computer Interaction", 5th Edition, Wiley, 2019
3	D. Stone, C. Jarrett, M. Woodroffe, and S. Minocha, "User Interface Design and Evaluation(interactive technologies) , Morgan Kaufmann; Revised of "The Miracle of Col ed. edition (2005)

Advanced Computer Architecture	
Course Code: BCS 312 **Contact Hours**: L-3 T-1 P-0 **Course Category**: DEC	Credits: 4 Semester: 5

Introduction: This course provides the complete description about the advancements in Computer Architecture. After exploiting the full capacity of execution of uniprocessor system, the speed is enhanced with using multiprocessor and other concepts like pipelining. The algorithms also need to be parallelised for achieving highest speed. This course aims at teaching the complete concepts about the changes in bus system, memory, placements and interconnection of different processors etc.

Course Objective:

- To introduce different concepts for enhancing speed of computation
- To make students learn about different computer architectures.
- To introduce the concepts of parallel algorithms and parallel programming

Pre-requisite: A course on computer organisation, microprocessor, and computer architecture

Course Outcome: Upon successful completion of this course, students will be able to:
CO1 Understand the concept of parallel architecture and Analyse performance metrics
CO2 Understand the concept of pipelining for achieving higher speed.
CO3 Understand and Analyse different parallel architectures.
CO4 Understand the concepts of parallel algorithms and parallel programming

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	12 Hours
Introduction & Fundamentals: The concept of computer Architecture: Interpretation of concept of computer architecture at different level abstraction, Multi-level hierarchical frame work, description of computer architecture, Introduction to parallel processing: Basic concept, types of level of parallelism, classification of parallel architecture, Basic parallel techniques, relationship between language and parallel architecture. Principles of scalable performance: Performance Metrics and Measures, Speedup Performance Law, Scalability Analysis & approaches, Processor and memory hierarchy: Design Space of Processor, ISA, CISC & RISC, Memory Hierarchy Technology, Virtual Memory Technology	
UNIT II	**10 Hours**
Instruction Level Parallel Processor (Parallelism): Pipelined Processors: Basic concept, ILP: Basics, Exploiting ILP, Limits on ILP, design space of pipelines, performance of pipeline, reservation table, And DLX Case Study. VLIW architecture, Superscalar Processor: Super Scalar and super-pipeline Design, A case study of ARM 64-bit processor.	
UNIT III	**12 Hours**
Data parallel Architecture and MIMD architectures: SIMD Architecture: Design space, fine grain SIMD architecture, coarse grain SIMD architecture, Associative and Neural Architecture, Systolic Architecture, Vector Architectures: Wordlength, vectorization, pipelining, and vector instruction format**. Thread and Process Level Parallel Architecture (MIMD Architecture):** Multi-threaded Architecture: Design space, computational model, Data flow architecture, hybrid multi shared architecture Distributed memory MIMD, Architecture: Design space, interconnection networks, topology, fine grain system, medium grain system, coarse grain system, Cache Coherence and synchronisation Mechanism Shared memory MIMD Architecture.	
UNIT-IV	10 Hours
Parallel Algorithm and Programming: MPI: Basics of MPI Open MP: Open MP Implementation in 'C', Directives: Conditional Compilation, Internal Control Variables, Parallel Construct, Work Sharing Constructs, Combined Parallel Work-Sharing constructs, Master and Synchronisation Constructs POSIX thread: IEEE POSIX Threads: Creating and Exiting Threads, Simultaneous Execution of threads.	
Text Books	
1	D. Sima, T. Fountain , P. Karsuk , "Advanced Computer Architectures: A Design Space Approach", Pearson Education India; 1st edition, 2002.
2	K. Hwang , N. Jotwani , "Advance Computer Architecture : Parallelism, Scalability, Programmability", McGraw Hill Education; 3rdedition, 2017.
Reference Books	
1	Quinn, "Parallel Programming in C with MPI and Open MP", McGraw Hill Edu.; 1st Ed. 2017.
2	J. P. Hayes, "Computer Architecture and Organization", McGraw Hill Education; 3rd ed. 2017.

Cloud Computing	
Course Code: BIT 304 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DCC	Credits: 4 Semester: 6

Introduction: Cloud computing is a scalable services provider platform that provides on-demand and pay per use computing service for various types of shared pool of resources such as memory, servers, storage, networking, software, database, applications designing etc., with the help of internet. This course will introduce various aspects of cloud computing including fundamentals of cloud computing, load balancing techniques, security challenges, case studies and industrial applications of cloud computing. This will help students to use and explore the cloud computing platforms.

Course Objective:

- Learn the use Cloud Services and Cloud Deployment models.
- Understand the concept of virtualization in cloud computing.
- Gaining confidence in resource management and load balancing algorithms.
- To gain the confidence of security attacks and their provisions at various levels of cloud computing.

Pre-requisite: Basic understanding of Operating System, Internet, Parallel and Distributed Computing.

Course Outcome: Upon successful completion of this course, students will be able to:

CO1: To articulate key concepts of cloud computing and computing techniques, strength and limitations of cloud computing with possible application domains.

CO2: To identify the architecture and infrastructure of cloud computing including SaaS, PaaS, IaaS, public cloud, private cloud and hybrid cloud.

CO3: To interpret various data, scalability and cloud services to acquire efficient database for cloud storage.

CO4: To explain the core issues of cloud computing such as security, privacy and interoperability and deal with controlling mechanism for accessing sage cloud service.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Cloud Computing Fundamentals: Introduction of cloud computing, History of cloud computing, Trends in computing, Grid computing, Cluster computing, Distributed computing, Utility computing, Fog computing, NIST definition and characteristics of cloud computing, Cloud as green and smart, Cloud as IaaS, PaaS, SaaS, BPaaS and HaaS, SPI framework, SPI vs. traditional IT Model, Cloud deployment models, Benefits and challenges.	
UNIT II	**10 hours**
Virtualization and Cloud Architecture: Virtualization concept, Resource virtualization, Server virtualization, Storage virtualization and Network virtualization, Storage Network Design: Architecture of storage, Analysis and planning, Storage models, Cloud optimized storage, Virtual Box and Microsoft Hyper-V.	
UNIT III	**10 hours**
Cloud Security: Web services, Web 2.0, Web OS, Security challenges and preventive measures: Infrastructure layer, Network layer and Application layer of cloud computing architecture, Security models in cloud, Resource management in cloud computing, Static and dynamic load balancing in cloud computing, Identity access management and Trust in cloud computing, Thin client.	
UNIT IV	**10 hours**
Cloud providers and case studies: Amazon EC2, Amazon EC service level agreement and recent developments, GoGrid, Salesforce.com, Force.com, Google App Engine, Rackspace, Government of India Cloud, IBM cloud, Eucalyptus cloud, Analysis of Case Studies when deciding to adopt cloud computing architecture.	
Text Books	
1	B. Sosinsky, "Cloud Computing Bible", 1st Edition, Wiley-India, 2011/ Latest Edition.
3	Thomas Erl, Zaigam Mahmood, Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", 1st Edition, Pearson India, 2013/ Latest Edition.
Reference Material	
1	A. Shawish and M. Salama, "Cloud computing: paradigms and technologies." In Inter-cooperative collective intelligence: Techniques and applications, Springer, 2014/ Latest Edition.
2	M. Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", 1st Edition, Pearson Education India, 2008/ Latest Edition
3	https://swayam.gov.in/course/4413-cloud-computing
4	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs20/

Internet of Things	
Course Code: BIT 310 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DEC	Credits: 4 Semester: 6

Introduction: Internet of Things (IoT) is the next big idea in technology and has gained prominence with the ever-increasing connected devices, sensor systems and capability of computing resources. This course is designed to initiate the widest possible group of students to the field of IoT and will be comprehensive in its scope. This course supplies in-depth content that puts the theory into practice. The course will start with a basic introduction to IoT and take the students through an IoT solution case study.

Course Objective:

- Impart understanding of various building blocks and working of state-of-the-art IoT systems.
- Learn the basic issues, policy and challenges in the Internet and understand the cloud and internet environment.
- Design and program own IoT devices by using real IoT communication protocols.
- Analyze the data generated from the IoT devices.

Pre-requisite: Design and Analysis of Algorithms, Data Structures and Algorithms and Computer Networks

Course Outcome: After completion of this course, the students will be able to:
CO1 Develop smart IoT Applications using smart sensor devices and cloud systems.
CO2 Analyze the protocol Stack for IoT in order to address the issues related to heterogeneous devices and networks.
CO3 Design IoT system specific secure protocols.
CO4 Understand uses and risks related to IoT devices.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction: Definition, Functional requirements, Characteristics, Foundations, architectures, challenges and issues, Physical design of IoT, Logical design of IoT, Web 3.0 of IoT, IoT World Forum (IoTWF) and Alternative IoT models, IoT Communication Models, IoT in Global Context, Real world scenarios, Different Areas, Examples Trends in the Adaption of the IoT (Cloud Computing, Big Data Analytics, Concepts of Web of Things, Concept of Cloud of Things with emphasis on Mobile Cloud Computing, Smart Objects).	
UNIT II	**10 hours**
Components in IoT: Control Units, Sensors, Communication modules, Power Sources, Communication Technologies, RFID, Bluetooth, Zigbee, Wi-fi, RF links, Mobile Internet, Wired Communication**; IoT Protocol and Technology:** RFID, NFC, Wireless Networks, WSN, RTLS , GPS, Agents , Multi – Agent Systems, IoT Protocols: M2M, BacNet, ModBus, Bluetooth, Wi-Fi, ZigBee; **Web of Things (WoT):** WoT vs. IoT, Architecture; **Cloud of Things (CoT):** Grid/SOA and Cloud Computing, Standards, Cloud Providers and Systems, Architecture.	
UNIT III	**10 hours**
Data Analytics for IoT: Introduction, Machine Learning, Big Data Analytics Tools and Technology, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Apache Kafka, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study, **Tools for IoT**: Chef, Chef Case Studies, Puppet, Puppet Case Study – Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.	
UNIT IV	**10 hours**
Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Smart Homes, Ambient Assisted Living, Intelligent Transport, Other IoT application: Use-Case Examples; **Developing IoT solutions**: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi Implementation of IoT with Arduino and Raspberry, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.	
Text Books	
1	A. Bahga, V. Madisetti, "Internet of Things: A Hands-on Approach", 1st Edition, Universities Press, 2015/ Latest Edition.
2	R. Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education private limited, 2017/ Latest Edition.
Reference Material	
1	D. Uckelmann, M. Harrison, "Architecting the Internet of Things", 1st Ed., Springer, 2011/ Latest Edition.
2	O. Hersent, D. Boswarthick, O. Elloumi, "The Internet of Things – Key applications and Protocols", 2nd Edition, Wiley, 2012/ Latest Edition.

Computer Graphics	
Course Code: BCS 314 **Contact Hours**: L-3 T-0 P-2 **Course Category**: DEC	Credits: 4 Semester: 6

Introduction: The subject Computer Graphics introduces basic concepts of graphics, output primitives, transformations, projections, curve and surface generation methods and shading algorithms.

Course Objective:

- To introduce the basic concepts of computer graphics
- To introduce the concepts of 2D/3D transformations
- To introduce the concepts of curve generation and hidden surface detection.

Pre-requisite: Basic mathematics

Course Outcome: Upon successful completion of this course, students will be able to:
CO1 Understand basic concepts of computer graphics and its applications.
CO2 Use the 2D/3D transformation and projection concepts in various projects
CO3 Understand concepts of curve generation and hidden surface detection.
CO4 Develop various application of computer graphics

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction to computer graphics: Introduction, Application of computer graphics, Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors and Work Stations, Input Devices, Hard Copy Devices, Graphics Software. Colour Models: RGB, HSV etc. Output primitives: DDA Line drawing algorithm, Bresenham's Line Drawing Algorithm, Mid-point circle algorithm, Mid-point Ellipse algorithms, filling algorithms, boundary fill and flood fill algorithms, scanline filling.	
UNIT II	**11 hours**
Transformations: Basic 2D Transformations, Matrix representations & Homogeneous Coordinates, Matrix Representations for basic 2D and 3D transformations (Translation, Scaling, Rotation), Composite Transformations, reflection and shear transformations, affine transformation, transformations between coordinate systems. Two-dimensional viewing: The viewing Pipeline, Window to view port coordinate transformation, Clipping Operations: Point Clipping, Line Clipping (Cohen Sutherland and Liang-Barsky), Polygon Clipping, Sutherland-Hodgeman polygon clipping, Wailer-Atherton polygon clipping, curve clipping, Text clipping.	
UNIT III	**10 hours**
Curves and Surfaces: Representation of surfaces, polygon meshes, plane equations, parametric cubic curves, Hermite Curves, Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials, Conditions for smoothly joining curve segments, Bezier bi-cubic surface patch, B-Spline Curves, Cubic B-Spline curves using uniform knot vectors, Testing for first and second order continuities. Visible surface detection, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method. Scan Line Method, Depth Sorting Method, Area Subdivision Method.	
UNIT IV	**11 hours**
Three-Dimensional Concepts: 3D Transformations, Parallel Projection and Perspective Projection. Shading and Illumination Model: Shading, Illumination Model for diffused Reflection, Ambient light, Specular Reflection Model, Reflection Vector. Shading Models, Flat shading, Gourard Shading, Phong Model. Case studies:Design case studies to perform 2D rep resentations of lines and curves, perform 2D and 3D transformations on different objects.	
Text Books	
1	D. Hearn and M. P. Baker, "Computer Graphics C version", Pearson Education; 2nd ed. (2014)
2	Z. Xiang & R. Plastock "Computer Graphics", Schaum's Series, McGraw Hill Edu. 2nd Ed (2006)
Reference Books	
1	D. Rogers and J. Adams, "Mathematical Elements for Computer Graphics", McGraw Hill Education; 2nd edition (2017)
2	Foley, V. Dam, Feiner and Hughes, "Computer Graphics Principles & practice", Pearson Education India; 2nd edition (2002)

Principles of Management	
Course Code: HMC 302 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: To give a preview of basics of management to engineering students, this course discusses about the basic nature of management and describes the functions of management, the specific roles of contemporary management, different approaches to designing organizational structures. This will help the students to understand the role of personality, learning and emotions at work, discover and understand the concept of motivation, leadership, power and conflict, understand the foundations of group behavior and the framework for organizational change and development.

Course Objective:

- To acquaint the students with the fundamentals of managing business
- To make them understand individual and group behavior at workplace so as to improve the effectiveness of an organization.
- The course will use and focus on Indian experiences, approaches and cases.

Pre-requisite: Communication skills

Course Outcome: After completion of the course, the students should be able to:
CO1 Understand the nature of management and describe the functions of management·
CO2 Understanding the specific roles of contemporary management.
CO3 Develop understanding of different approaches to designing organizational structures.
CO4 Understand the role of personality, learning and emotions at work.
CO5 Discover and understand the concept of motivation, leadership, power and conflict.
CO6 Understand the foundations of group behavior and the framework for organizational change and development.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	7 hours
Introduction: Concept, Nature, Process and Significance of Management; Managerial levels, Development of Management Thought: Classical, Neo-Classical, Behavioral, Systems and Contingency Approaches.	
UNIT II	**7 hours**
Planning: Nature, Scope and Objectives of Planning; Types of plans; Planning Process; Organizing: Nature, Process and Significance; Principles of an Organization; Span of Control; Types of an Organization.	
UNIT III	**7 hours**
Staffing: Concept, Nature and Importance of Staffing. Motivating and Leading: Nature and Importance of Motivation; Types of Motivation; Leadership: Meaning and Importance; Traits of a leader.	
UNIT IV	**7 hours**
Controlling: Nature and Scope of Control; Types of Control; Control Process; Control Techniques– Traditional and Modern; Effective Control System.	

Text Books	
1	S.P. Robbins, "Fundamentals Management: Essentials Concepts Applications", Pearson Education, 2014.
2	Gilbert, J.A.F. Stoner and R.E. Freeman, "Management", Pearson Education, 2014. H. Koontz, "Essentials of Management", McGraw Hill Education, 2012.

Reference Books	
1	C. B. Gupta, "Management Concepts and Practices", Sultan
2	W. Ghillyer, "Management- A Real World Approach", McGraw Hill Education, 2010.
3	K. Mukherjee, "Principles of Management", McGraw Hill Education, 2012.

Marketing Management	
Course Code: HMC 304 **Contact Hours**: L-2 T-0 P-0 **Course Category**: HMC	Credits: 2 Semester: 6

Introduction: This course will build the basic concept of marketing and related concepts for the engineering students. It will provide an in-depth understanding to various elements of marketing mix for effective functioning of an organization. Students will learn some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Course Objective:

- To familiarize students with the marketing function in organizations.
- To equip the students with understanding of the Marketing Mix elements and sensitize them to certain emerging issues in Marketing.

Pre-requisite: Basic economics

Course Outcome: After completion of the course, the students should be able to
CO1 Understand the concept of marketing and related concepts.
CO2 An in-depth understanding to various elements marketing mix for effective functioning of an organization.
CO3 Learn some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	**7 hours**
Introduction to Marketing: Nature, Scope and Importance of Marketing, Basic concepts, Marketing Environment.	
UNIT II	**7 hours**
Product: Product Levels, Product Mix, Product Strategy, Product Development, Product Lifecycle and Product Mix Pricing Decisions.	
UNIT III	**7 hours**
Place: Meaning & importance, Types of Channels, Channels Strategies, Designing and Managing Marketing Channel.	
UNIT IV	**7 hours**
Promotion: Promotion Mix, Push vs. Pull Strategy; Promotional Objectives, Advertising-Meaning and Importance, Types, Media Decisions, Promotion Mix, Personal Selling-Nature, Importance and Process.	
Text Books	
1	P. Kotler, P.Y. Agnihotri and E.U. Haque, "Principles of Marketing- A South Asian Perspective", Pearson Education, 2012.
2	T. Ramaswamy and S. Namkumar, "Marketing Management Global Perspective: Indian Context", McMillan, Delhi, 2013.
Reference Books	
1	R. Saxena, "Marketing Management", McGraw Hill Education, 2012.
2	C.W. Lamb, J.F. Hair, C. McDaniel, D. Sharma, "MKTG: a South Asian Perspective with Coursemate", Cengage Learning, 2016.
3	R. Winer, "Marketing Management", Pearson Education, 2012.

Financial Management	
Course Code: HMC 306 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: Efficient Management of a business enterprise is closely linked with the efficient management of its finances. Accordingly, the objective of the course is to familiarize the engineering students with the basic fundamentals, principles and practices of financial decision-making in a business unit in the context of a changing, challenging and competitive global economic environment. The purpose of the course is to offer the students relevant, systematic, efficient and actual knowledge of financial management that can be applied in practice while making financial decisions and resolving financial problems.

Course Objective:

- To acquaint the students with the overall framework of financial decision-making in a business unit.
- To acquaint the students with the fundamentals of Financial Management
- To make them understand Decisions to be taken as a Finance Manager.
- The course will use and focus on Indian experiences, approaches and cases.

Pre-requisite: Basic economics

Course Outcome: Upon successful completion of the course, students will be able to:
CO1 Understand the overall role and importance of the finance function for decision-making.
CO2 Recommend whether and why a particular investment should be accepted or rejected by determining an appropriate investment criteria and projecting cash flows associated with corporate project evaluation.
CO3 Differentiate between the various sources of finance and their pros and cons.
CO4 Outline capital requirements for starting a business and management of working capital.
CO5 Analyse the complexities associated with management of cost of funds in the capital structure.
Apply the concepts of financial management to contemporary financial events.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	7 hours
Financial Management Definition, scope, objectives of Financial Management, Functions of a finance manager, Time value of money. Sources of Finance for different Organizations.	
UNIT II	**7 hours**
Capital Structure: Meaning of Capital Structure: Factors Determining Capital Structure. Cost of Capital: Concept, Importance and Classification.	
UNIT III	**7 hours**
Capital Budgeting: Concept, Importance and Appraisal Methods: Pay Back Period, Accounting, Rate of Return, Net Present Value Method (NPV), Profitability Index, and IRR. Capital Rationing.	
UNIT IV	**7 hours**
Working Capital Management: Operating cycle, Working Capital Estimation, Inventory Management: EOQ Problem.	
Text Books	
1	M.Y. Khan and P.K. Jain, "Financial Management", McGraw Hill Education, 8th Edition, 2018.
2	I. M. Pandey, "Financial Management", Vikas Publishing House, 2015.
Reference Books	
1	S. Kapil, "Financial Management", Pearson Education, 2012.
2	C. Prasanna, "Financial Management: Theory and Practice", McGraw Hill, 2017.
3	S.N. Maheshwari, "Financial Management: Principles and Practice", Sultan Chand, LN, 2019.

Human Resource Management	
Course Code: HMC 308 **Contact Hours**: L-2 T-0 P-0 **Course Category**: HMC	Credits: 2 Semester: 6

Introduction: This course focuses on issues and strategies required to select and develop manpower resources. The main objective of this course is to help the students to acquire and develop skill to design rational decisions in the discipline of human resource management.

Course Objective: The objective of this course is to make students familiar with the basic concepts of human resource management and people related issues.

- To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
- To help the students focus on and analyze the issues and strategies required to select and develop manpower resources.
- To develop relevant skills necessary for application in HR related issues.
- To enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

Pre-requisite: Soft skills

Course Outcome: After completion of the course, the students should be able to:
CO1 Develop an understanding of the concept of human resource management and to understand its relevance in organizations.
CO2 Develop necessary skill set for application of various HR issues.
CO3 Analyze the strategic issues and strategies required to select and develop manpower resources.
CO4 Integrate the knowledge of HR concepts to take correct business decisions.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	7 hours
Human Resource Management: Introduction to Concept and Functions of HRM, Role, Status and Competencies of HR Manager, HR Policies, Evolution of HRM. Emerging Challenges of Human Resource Management;	
UNIT II	**7 hours**
Human Resource Planning: Human Resource Planning- Quantitative and Qualitative dimensions; Recruitment – Concept and sources; (E-recruitment, recruitment process outsourcing etc.); Selection – Concept and process; test and interview; placement induction. Job analysis – job description and job specification.	
UNIT III	**7 hours**
Training and Development: Concept and Importance; Identifying Training and Development Needs; Designing Training Programs; Role Specific and Competency Based Training; Evaluating Training Effectiveness; Performance appraisal: nature and objectives; Modern Techniques of performance appraisal;	
UNIT IV	**7 hours**
Human Resource Development: Orientation Program; Requisite of an effective Program, Evaluation of Orientation Program. Strategic HRM: HRD audit, ethics and CSR	
Text Books	
1	G. Dessler. "A Framework for Human Resource Management", Pearson Education, 2017, 15th Edition.
2	D. A. Decenzo, S. P. Robbins, S. L. Verhulst, "Human Resource Management", Wiley India Private Limited, 2015.
Reference Books	
1	Bohlendar and Snell, "Principles of Human Resource Management", Cengage Learning, 2013.
2	B. Becker, M. Huselid, D. Ulrich, "The HR Scorecard", 1st edition, Harvard Business Review Press, 2001.

BTech 7th semester Syllabus

MOBILE COMPUTING	
Course Code: BIT 401 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 7

Introduction: Mobile Computing refers a technology that allows transmission of data, voice and video via a computer or any other wireless enabled device. It is free from having a connection with a fixed physical link. It facilitates the users to move from one physical location to another during communication.

Course Objective:

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks as well as systems issues for the design and implementation of mobile computing systems and applications.
- To understand the basic concepts of mobile communication and computing.
- To understand telecommunication systems and gain knowledge about different mobile platforms and application development.

Pre-requisite: Computer Networks

Course Outcome: Upon successful completion of this course, students will be able to:

CO1: Learn the basic concepts and applications of Mobile Computing and Cellular architecture;
CO2: Evaluate the effectiveness of the existing telecommunication systems such as GSM, GPRS, and UMTS;
CO3: Analyze the protocol suite for the wireless architecture (Mobile IP, Mobile TCP, and Wireless application protocols);
CO4: Explain the Bluetooth technology, and develop mobile applications for different domains.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Students would be encouraged to develop an understanding of the existing real-life issues and how they are solved. Emphasis would be given on assignments where students will be given numerical/ programming assignments based on topics studied in previous lectures. Course will have a blend of theory and practice for the benefit of students. Use of ICT, web-based sources as well as blackboard teaching will be adopted.

Unit 1

Introduction to Mobile Computing: History, Types, Benefits, Application, Evolution, Characteristics of Mobile computing, Security Concern regarding Mobile Computing, Different Propagation Modes, Wireless Architecture and its types. First-Generation Analog, Second-Generation TDMA, Second-Generation CDMA, Third-Generation Systems; **Cellular Concept:** Cellular Systems and Principals of Cellular Networks, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies, Distance to frequency reuse ratio; Electromagnetic Spectrum, **Antennas and Propagation**-Antennas, Propagation Modes, Line-of-Sight sionTransmis, Fading in the Mobile Environment, Signal Characteristics; Channel Capacity, Multiplexing, Spread Spectrum: DSSS & FHSS, CDMA.

Unit 2

Telecommunication Systems: GSM: Architecture, Channel allocation ,call routing, PLMN interface, GSM addresses and identifiers, network aspects, frequency allocation, authentication and security, Handoffs Technique; **GPRS:** network architecture, network operation, data services, Applications, Billing and charging; **UTRAN, UMTS**; **Mobile Networking**: Medium Access Protocol, Internet Protocol and Transport layer, Medium Access Control: Motivation for specialized MAC, Introduction to multiple Access techniques (MACA)

Unit 3

Mobile IP: Features of Mobile IP and its need, IP packet delivery, Key Mechanism in Mobile IP, Agent Discovery, Registration, Tunnelling and encapsulation, Reverse Tunnelling, Routing (DSDV,DSR), Route optimization, IP Handoff; **Mobile TCP:** Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission; **Wireless Application Protocol:** Introduction, Application, Architecture, Protocol Stack and Challenges.

Unit 4

Bluetooth: Introduction, User Scenario, Architecture, protocol stack; IP Mobility, Macro Mobility and Micro Mobility, Introduction to 4G and 5G; LTE, HIPERLAN, Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems, Software Development Kit: iOS, Android, BlackBerry, Windows Phone, M-Commerce, Structure, Mobile Payment System.

References

1. John H. Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2003.

2. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, Mobile Computing: Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.

3. Andreas F. Molisch, Wireless Communications, 2nd Edition, Wiley –India, 2006.

4. Raj Kamal, Mobile Computing, 3rd Edition, Oxford University Press, 2018.

5. Frank Adelstein, S.K.S. Gupta, Golden G. Richard III and Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill Professional

MACHINE LEARNING	
Course Code: BCS 401 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits:4 Semester:7

Introduction:
Machine learning (ML) is the science of getting computers to act without being explicitly programmed. Many researchers also think it is the best way to make progress towards human-level AI. This course provides a broad introduction to machine learning, data mining, and statistical pattern recognition.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of ML.
- To explain the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain)
- To be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Pre-requisites: Knowledge of programming, basic probability theory and statistics

Course Outcomes: After completion of the course, student will be able to:

CO1: Understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2: Understand the basic concepts of neural network model and design the same.
CO3: Understanding of the strengths and weaknesses of many popular machine learning algorithms.
CO4: Understanding the concepts of Unsupervised learning.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	12 Hours
Introduction to Machine Learning, Well Posed Problems, Machine Learning Process, designing a Learning System, Types of Machine Learning, Applications of Machine Learning, Feature Selection and Visualization, Testing ML Algorithms (Overfitting, Training, Testing, And Validation Sets, Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Datasets, Precision), Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Logistic regression. Case studies on Linear and logistic regression	
UNIT-II	**10 Hours**
The Brain and The Neuron, Neural Networks, The Perceptron, Linear Separability, The Multi-Layer Perceptron, Forward and Back-error propagation, The Curse of Dimensionality, Dimensionality Reduction, Principal Component Analysis. Case studies on Neural Networks	
UNIT-III	**10 Hours**
Learning With Decision Tree, ID3, CART, Ensemble Learning, Boosting, AdaBoost , Bagging, Random Forest. k-Nearest Neighbor Classification, Support Vector Machines, Naive Bayes classifiers, Case studies on various classifiers	
UNIT-IV	**10 Hours**
Unsupervised Learning, Clustering, K-Means Clustering, Hierarchical Clustering, Partitioning methods, Distribution based clustering, Density based clustering, fuzzy clustering, Evaluation Parameters for Unsupervised Learning. Case studies on various clustering techniques	
Text Books	
1	Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall/CRC; 2nd edition (8 October 2014)
2	Bishop, C.M., ,Pattern recognition and machine learning. Springer; 1st ed. 2006. Corr. 2nd printing 2011 edition (15 February 2010)
3	Tom Mitchell, Machine Learning, McGraw Hill Education; First edition (1 July 2017)
Reference Books	
1	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, Springer; 2nd ed. 2009, Corr. 9th printing 2017 edition (19 April 2017)
2	Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and techniques. Morgan Kaufmann; 3rd edition (2011)

Industrial Training/ Internship	
Course Code: BIT-353 **Contact Hours**: **Course Category**: DCC	Credits: 1 Semester: 5

Course Objectives: Students will carry on the industrial training for six weeks making them capable of handling the implementation of their theoretical knowledge in the practical field. To facilitate the development of a holistic perspective among students towards life, industry experts teach advanced technologies. Through Industrial training, students get familiarize with the environment of an organization and a company. Students get a certificate which validates their skills and helps them in getting a job quickly.

Course Outcome: After completion of the elective course, the students will be able to:
CO1 Apply theoretical concepts to practical implementation.
CO2 Develop solutions for real world problems.

General Elective Course	
Course Code: GEC-301 **Contact Hours**: **Course Category**: GEC	Credits: 2 Semester: 5

Introduction:

A Generic Elective (GE) course is an inter-disciplinary course provided to the students chosen generally from an unrelated discipline/subject and allowing them a chance at comprehensive education. Generic Electives (GE) are introduced as part of the CBCS. The students can choose their preference from a pool of papers from various disciplines/subjects. Elective courses do much more than filling in the gaps to fulfill the high school graduation requirements. It gives a chance to explore new options, allowing students to study more about the subject they are passionate about, and enables them to 'test drive' new activities. They provide students with the necessary skills to improve creativity that they might not find in the classroom. The main purpose of the Elective course is to seek exposure to a new discipline/subject and to provide the students with an alternative option for desired fields.

Course objective:

- Students will have exposure to a new discipline/subject.
- Prepare students to look for inter-disciplinary research.
- GE can fulfill the limitation to pursue master's study in desired field.
- Help discover new things that never existed and might change the course of student's life.

Pre-requisite: Basic knowledge of the selected domain of elective course

Course Outcome: After completion of the elective course, the students will be able to:

CO1 Investigate future careers.

CO2 Allow diligent students to improve their knowledge and area of weakness.

CO3 Help students build a strong resume that shows students willingness and curiosities to the officials and employers.

CO4 Electives take students into the real world that doesn't require academic papers or research. **CO5** They not only learn to work independently, but they attain self-motivation, discipline, and confidence to achieve their goals.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

BTech Eighth Semester Syllabus

EMBEDDED SYSTEM DESIGN	
Course Code: BCS 402 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 8

Introduction

This course aims at introducing the concepts and architecture of Embedded systems and to make the students capable of designing embedded systems. The course examines the contemporary issues and problems in the design and development, of contemporary real-time embedded systems

Course Objectives:

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.
- To understand the procedure of Processor selection for Embedded System.
- To visualize the role of Real time Operating System in Embedded System.

Pre-requisites: Microprocessor, Operating Systems

Course Outcomes: After completion of the course the students will be able to:

CO1: Understand the Design Process of Embedded Systems, Differentiate the role of their functional blocks and illustrate their selection process.

CO2: Understand the programming model of ARM processor and apply the programming concepts to solve problems.

CO3: Understand the architecture of Real Time Operating Systems (RTOS) and evaluate its role in an Embedded System.

CO4: Analyse the Intel architecture for Embedded system and Design /Develop various real-world applications using the concept of interfacing.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction to Embedded System Design: Definition, Classification of Embedded system and General-purpose computers, Embedded system design cycle, H/W-S/W Partitioning, Design and Integration, Selection Process, H/W-S/W Co-design, Memory organization, Interfacing, IDE Selection, Tool chain and Programming	
UNIT-II	**10 Hours**
Implementation Platforms and Its Programming: General Purpose and Domain Specific Processors, ASICs, Processor Selection for embedded systems and its issues, RISC and CISC architecture, ARMarchitecture (32-bit Cortex series), ARM programmer's model, ARM instruction set: Software interrupt (SWI) Interrupt Service Routines- Writing simple assembly language programs for ARM, 3-stage pipeline ARM organization Comparison between ARM and Atom processors.	
UNIT-III	**10 Hours**
RTOS based Embedded System Design: Basic concepts of Operating System, RTOS, RTOS kernel, Real Time Scheduling, Hard real time and Soft real time systems Interrupt Service Routines Interrupt routine in RTOS environment and handling of interrupt service calls, Watchdog timers-Flash memory, FreeRTOS.	
UNIT-IV	**10 Hours**
Embedded System Design Issues: Performance analysis and Optimization, speed, Power and Area Optimisation, System Reliability, Safety and Security Introduction to Reconfigurable platforms (SoC, FPGA), Host based debugging – Remote debugging, ROM emulators, In circuit emulators, Case studies of some applications of Embedded Systems.	
Text Books	
1	Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill,Second Edition Paperback – 1 2017
2	Embedded Systems Design: An Introduction to Processes, Tools, and Techniques by Arnold S. Berger, Elsevier India, 2010, Paperback.
3	ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, , Morgan Kaufman Publication, Elsevier First edition, 2004
Reference Books	
1	Embedded Systems- Architecture, Programming and Design ,Rajkamal, McGraw Hill Education 3rd Edition, 2017
2	Embedded System Design - Frank Vahid, Tony Givargis, JohnWiley, 2014
3	An Embedded Software Primer - David E. Simon, Pearson Education.,2002

EVOLUTIONARY COMPUTING	
Course Code: BCS - 403 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction:
This course introduces several computational methods that are based on principles of evolutionary biology.

Course Objectives:

- To study a thorough introduction to evolutionary computing (EC).
- To provide an understanding of the descriptions of popular evolutionary algorithm (EA) variants.
- To develop some familiarity with methodological issues and particular EC techniques.

Pre-requisites: Fundamentals of Algorithms.
Course Outcomes: After completion of the course the students will be able to gain:
CO1: Explain evolutionary computation techniques and methodologies set in the context of modern heuristic methods.
CO2: Apply various evolutionary computation methods and algorithms for particular classes of problems.
CO3: Develop evolutionary algorithms for real-world applications.
CO4: Use scientific research papers and present them in a seminar talk.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Evolutionary Computing: The Origins, The Main Evolutionary Computing Metaphor, Brief History. The Inspiration from Biology, Darwinian Evolution, Genetics. **Evolutionary Algorithm:** Components of Evolutionary Algorithms, An Evolutionary Cycle by Hand, Example Applications, The Operation of an Evolutionary Algorithm, Natural Versus Artificial Evolution, Evolutionary Computing, Global Optimisation, and Other Search Algorithms.	
UNIT-II	10 Hours
Representation, Mutation, and Recombination: Representation and the Roles of Variation Operators, Binary Representation, Integer Representation, Real-Valued or Floating-Point Representation, Permutation Representation, Tree Representation.	
UNIT-III	10 Hours
Popular Evolutionary Algorithm Variants: Genetic Algorithms, Evolution Strategies, Evolutionary Programming, Genetic Programming, Learning Classifier Systems, Differential Evolution, Particle Swarm Optimisation, Estimation of Distribution Algorithms.	
UNIT-IV	10 Hours
Swarm Optimization and Firefly Algorithm: Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.	
Text Books	
1	A.E. Eiben J.E. Smith, “Introduction to Evolutionary Computing”, Second Edition, Natural Computing Series, Springer, 2015.
2	Evolutionary Optimization Algorithms: Biologically-Inspired and Population-Based Approaches to Computer Intelligence, John Wiley & Sons, 2013.
3	Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
Reference Books	
1	Kenneth De Jong, Lawrence Fogel, Hans-Paul Schwefel, “Handbook of Evolutionary Computation”, CRC Press, 1997.
2	Xin-She Yang ,Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016.
3	Xin-She Yang, "Nature Inspired Optimization Algorithm, Elsevier First Edition 2014.
4	Yang ,Cui,XIao,Gandomi Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

KNOWLEDGE ENGINEERING	
Course Code: BCS 405 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction:
This course aims at introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of soft computing.
- To provide an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- To provide the mathematical background for carrying out the optimization associated with neural network learning.
- To develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Pre-requisites:
Artificial Intelligence, Data structures and algorithms, programming languages.
Course Outcomes: After completion of the course the students will be able to.

CO1: Understanding and applying the basics of knowledge extraction, engineering, and linking, making data suitable to machine querying and automated reasoning, typically on decentralized platforms such as the Web.
CO2: Explain the fundamental concepts and various learning algorithms of supervised, unsupervised and associative memory networks in Artificial Neural Networks.
CO3: Apply evolutionary algorithm such as Genetic algorithms for solving optimization, path finding problems, etc.
CO4: Design and implement new variant of existing Heuristic and Metaheuristic algorithms through demonstration project on real world problems.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10Hours
Introduction: Concept of Knowledge Engineering, Knowledge Economy, Knowledge Management vs Knowledge Engineering, Knowledge Engineering and Artificial Intelligence, Terminology related with Knowledge Engineering, Concept of Knowledge Reuse. Concept of Knowledgebase Intensive Systems and Development of elementary Knowledge Based System	
UNIT II	**10Hours**
Knowledge Acquisition and Knowledge Manipulation. Basic features of Knowledge Acquisition. Challenges in identification of Tacit Knowledge, Acquisition of Domain Knowledge, and Contextual Knowledge, Process of identification of explicit knowledge related to specific real world problems. Acquisition of static and dynamic knowledge. Concept of Knowledge Manipulation, Basic principles of Inferencing, Methods of inferencing, Forward chaining, Backward chaining, bidirectional chaining, Factors that decides the direction of inferencing, Drawing Conclusion using Inferencing.	
UNIT III	**10Hours**
Knowledge Management: Use and Reuse of Knowledge, Knowledge Management Overview, Knowledge Conversion, Knowledge Management Roles, Implications of Knowledge Management. **C**oncept of Expert System, Application Domain of Expert System	
UNIT IV	**10Hours**
Case study of Knowledge based systems, Study of systems that are dewsigned as expert systems, features, characteristics of expert systems, Case study of MYCIN, DENDRAL. Case study of Indian Govt. initiative led expert systems ArogyaSetu, UMANG .	
Text Books:	
1	James Martin, Problem Solving using Knowledge Engineering, PHI Publication, edition 4th 2017.
2	Ela Kumar, Knowledge Engineering, IK International Publication First Edition, 2017
3	Elias M.Awad, Hassan M.Ghaziri " Knowledge Management, PHI publication, Second Edition, 2011
Reference Books:	
1	Skyrme David " Knowledge Centric Problem Solving, Mc Graw Hill, publication 1st edition 2015.
2	Reich and Turing , " Artificial Intelligence", Mc Graw Hill, 3rd edition, 2016
3	M.Gahziri, Expert Systems Design, PHI publication, 1st edition , 2012,

KNOWLEDGE ENGINEERING	
Course Code: BCS 405 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction: The course will introduce fundamental principles of digital image processing. The course provides sufficient basic knowledge for the undergraduate to understand the design of digital image processing techniques such as image enhancement, restoration, segmentation, and morphological filtering.

Course Objective:

- Understand the design and analysis of various digital image processing techniques
- Understand the fundamental concepts and techniques used in digital image processing.

Pre-requisite:

Basics of engineering mathematics and signal and systems

Course Outcome: After completion of the course, student will be able to:

CO1: Understand basic image processing algorithms

CO2: Understand various applications of digital image processing

CO3: Design and analyze image enhancement, restoration, segmentation techniques for real time applications.

CO4: Apply the principles of digital image processing in developing some real world project.

Pedagogy: The teaching-learning of the course would be organized through lectures, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based sources as well as flipped class room teaching will be adopted.

UNIT-I	12 Hours
Introduction: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, Image Sensing and Acquisition, sampling and quantization, Basic Relationships between Pixels. **Image Enhancement**: Gray level transformation, Histogram Processing, Enhancement using arithmetic and logical operator, Spatial filtering, contrast intensification, smoothing and sharpening spatial filters, spatial filter enhancements.	
UNIT-II	**10 Hours**
Filtering in the Frequency domain: Introduction to Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Frequency domain filtering, correspondence between filtering in spatial and frequency domain, smoothing and sharpening frequency domain filters, Homomorphic filtering. **Image Restoration:** Basic Framework, Interactive Restoration, Image deformation and geometric transformations, Image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations, Restoration by Singular value Decomposition.	
UNIT-III	**10 Hours**
Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Introduction to different codings - Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, Symbol-based coding, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation, Introduction to Wavelet based Image Compression.	
UNIT-IV	**10 Hours**
Image Segmentation: Boundary detection-based techniques, Point, line detection, Edge detection, Edge linking, contour detection, local and regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation. **Morphological Image Processing:** Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, connected components, convex hull, thinning, thickening, skeletons, pruning, Erosion, Reconstruction by dilation & erosion.	

Text Books

1	Rafael C Gonzalez and Richard E Woods, "Digital Image Processing," Pearson Edu .3rd Ed., 2007.
2	Anil K Jain, "Fundamentals of Digital Image Processing," PHI, 1989.

Reference Books

1	B. Chanda and D. Dutta Majumder, "Digital Image Processing and Analysis," PHI, 2nd Ed. 2013.
2	Chris Solomon and Toby Breckon, "Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab," Wiley Blackwell, 1st Edition, 2010.

E-Commerce	
Course Code: BIT - 417 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction:

E-commerce is abbreviated for Electronic Commerce. Its function is the transference of financial and other commerce related information using Information Technology and Telecommunications. E-commerce helps to simplify the business processes and makes them faster and efficient. These business transactions occur either as business-to-business (B2B), business-to-consumer (B2C), consumer-to-consumer (C2C) or consumer-to-business (C2B). Benefits of e-commerce include its around-the-clock availability, the speed of access, the wide availability of goods and services for the consumer, easy accessibility and international reach.

Course Objectives:

- To understand the advantages and disadvantages of using e-commerce platforms.
- To learn various e-business strategies.
- To understand the various payment methods associated with e-commerce.
- To learn the concepts of security at various levels of e-commerce.

Prerequisite: Knowledge on the basics of Information Security, Networking

Course Outcome: Upon successful completion of this course, students will be able to:

CO1: Understand the basic concepts and principles of e-commerce.
CO2: Compare the advantages and disadvantages of using e-commerce platforms.
CO3: Understand various e-business strategies.
CO4: Identify security and privacy issues in e-commerce.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted

UNIT I	10 hours
Electronic Commerce Introduction: - Definition of E- Commerce, Electronic commerce and Physical Commerce, Architectural framework, Impact of E-commerce on business, different type of e-commerce, some e-commerce scenario, Economic potential of electronic commerce, Advantages and Disadvantages, Incentives for engaging in electronic commerce, forces behind E-Commerce.	
UNIT II	**10 hours**
E-business strategy: Introduction, Characteristics of e-Business, Business models, E-Business vs E-commerce, e-business Requirements, impacts of e-business, Strategic positioning, Levels of e-business strategies, Strategic planning process, Success factors for implementation of e-business strategies, CRM, MRP. ERP: Introduction, need of ERP, Modules of ERP.	
UNIT III	**10 hours**
Electronic Payment Methods: Overview, SET Protocol for credit card payment, E-cash, E-check, Micropayment system, Credit card, Magnetic strip card, Smart cards, Electronic Data Interchange, E-Commerce Law. Security Architecture, Encryption techniques, Symmetric & Asymmetric encryption, Digital Signatures, Virtual Private Network, IPsec, Threats, Firewalls.	
UNIT IV	**10 hours**
M-Commerce: Introduction, Attributes, customer and provider views, Architecture, Infrastructure of m-commerce, Requirement of the m-commerce, characteristics, Mobile Information device, Mobile Computing Applications, Mobile wallet, Mobile payments, Mobile portals, Pros and Cons of m-commerce, Secure Transaction Processes: Wireless Application Protocol, Bluetooth, The role of emerging wireless LANs and 3G/4G wireless networks.	
Reference Books	
1. R. Kalakota, A. Whinston, "Frontiers of Electronic Commerce", 2nd Edition/Latest edition, Addison Wesley, 1996.	
2. B. Mennecke and T. Strader, "Mobile Commerce: Technology, Theory and Applications", Idea Group, 2003/Latest edition3.	
3. D. Chaffey, "E-Business and E-Commerce Management", 3rd Edition/Latest edition, Pearson Education, 2009.	
4. H. Chan, "E-Commerce Fundamentals and application", 1st Edition/Latest edition, Wiley publication, 2001.	
5. Bajaj and Nag, "E-Commerce the cutting edge of Business", 2nd Edition/Latest edition, TMH, 2005.	
6. P. Loshin, J. Vacca, "Electronic commerce", 1st Edition/Latest edition, Firewall Media, 2005.	

CYBER SECURITY AND FORENSICS	
Course Code: BIT 419 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction:

Cyber Security and Forensics is the application of investigation and analysis techniques to gather and preserve evidence from a particular computing device in a way that is suitable for presentation in a court of law. This course provides for a broad introduction of cyber security and forensics concepts, industry best practices for information security and key security concepts that will protect an organization against fraud, data breaches and other vulnerabilities. It enables the students to gain in-depth knowledge in the field of Computer forensics & Cyber Crime.

Course Objectives:

- To maintain an appropriate level of awareness, knowledge and skill to allow students to minimize the occurrence and severity of information security incidents.
- To learn techniques used to detect, respond and prevent network intrusions.
- To identify and apply appropriate forensics tools to acquire, preserve and analyze system image.
- To protect information and information systems from unauthorized access, use, disclosure, disruption, modification or destruction in order to provide confidentiality, integrity and availability.
- Identify sources of evidentiary value in various evidence sources including network logs, network traffic, volatile data.

Pre-requisites:

Knowledge of Computer Networking, Linux, UNIX, Understanding of Web Application Architecture and HTTP/HTTPS communication.

Course Outcomes:

After completion of the course the students will be able to:

CO1: Understand the fundamentals of Cyber Security and comprehend the incident response process
CO2: Demonstrate the difference between data acquisition techniques
CO3: Apply forensic analysis tools to recover important evidence for identifying cyber-crime.
CO4: Apply investigation tools and techniques for analysis of data to identify evidence related to cyber-crime and use available digital forensics tools.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Students would be encouraged to develop an understanding of the existing real life cyber security issues and how they are solved. Emphasis would be given on assignments where students will be given numerical/ programming assignments based on topics studied in previous lectures.

UNIT-I	12 hrs
Cyber Security Concepts, Security Goals, Security Services, Types of Cybercrime, Cyber Attack Process, Sources of Security Threats, Vulnerabilities, Active/Passive, Malicious Software, Virus, Trojan, Worms, Spywares, Rootkit, Ransomware, Adware, Backdoor, Bots, Social Engineering, Phishing, Key logging, DoS attack, DDoS attack, Anonymity Networks, Proxy Servers, Surface, Deep and Dark Web;	
UNIT-II	**11 hrs**
Introduction to Incident Response Process, Computer Security Incident, Goals of Incident response, Who is involved in Incident response, Incidence Response Methodology, Pre Incident preparation, Detection of Incidents, Initial response, Formulate a response strategy, Investigate the incident, Reporting and Resolution	
UNIT-III	**10 hrs**
Computer Forensics Fundamentals, Data Acquisition of digital evidence from electronic media, Acquisition tools, Evidence collection and preservation, Windows Forensics, Live data collection from Windows systems, Live data Collection from Unix systems, Sources of Digital/Electronic Evidence, Computer Forensic Analysis and Validating Forensics Data,	
UNIT-IV	**10 hrs**
System Forensics, Network Forensics, Database Forensics, Malware forensics, Mobile Device Forensics, Google Forensics, Internet Forensics, Email Forensics, Messenger Analysis, Web Forensics, Current Computer Forensics Tools: Software/Hardware Tools. An Indian perspective on digital forensics: Indian IT act, Cyber laws.	
Text Books	
1. K Mandla, C. Prosise , Matt Pepe, " Incident Response and Computer Forensics", McGraw Hill, 2nd Edition, 2003	
2. Chad Steel, "Windows Forensics", Wiley India, 1st Edition, 2006	
3. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, Thomson Course Technology, 4th Edition, 2009	
Reference Books	
4. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Real Digital Forensics, Pearson Education, 1st Edition, 2005	
5. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi	

INTELLIGENT DATA AND INFORMATION RETRIEVAL	
Course Code: BCS 407 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 7

Introduction: Intelligent Data and Information Retrieval aims to focus on various concepts of artificial intelligence for organizing& fetching data in Intelligent manner and fetching the information from the internet databases like search Engines in an intelligent and optimized manner. The Subject will introduce various types Intelligent data organizations, data dependencies and Normal Forms and processing Techniques and also how to intelligently retrieve data from web sources so that the results of queries are exact and efficient.

Course Objective:

- To understand the concepts of intelligently organizing data and fetching data from queries.
- To understand various data dependencies and Normal Forms in Intelligent Databases
- To learn the different models for information storage and retrieval.
- To understand indexing and querying in information retrieval systems.
- To learn techniques for intelligently retrieving information from web search

Pre-requisite: Knowledge of basic databases and algorithms
Course Outcome: At the end of the course students will be

CO1: Understand the concepts of intelligently organizing data and fetching data from queries and types of Database models
CO2: Understand various data dependencies and Normal Forms in Intelligent Databases and deductive databases
CO3: Design and implement various information retrieval models and evaluate them using performance measures.
CO4: Learn and design techniques for intelligently retrieving information from web search and implement them in solving real world case studies.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10Hours
Introduction: Introduction to data and various database Models. Data v/s information. Fuzzy Databases- Type-1 and Type-2 Fuzzy Relational Databases. Difference between Type-1 Fuzzy and Type-2 Fuzzy Relational Database. Inherently Fuzzy Relational Databases. Fuzzy Functional Dependency and Fuzzy Multivalued Dependency.	
UNIT-II	10Hours
Fuzzy Normal Forms & Deductive Database- Fuzzy Key, Fuzzy Superkey, Fuzzy Foreign Key, Fuzzy First Normal Form, Fuzzy Second Normal Form, Fuzzy Third Normal Form, Fuzzy Boyce Codd Normal Forms, Effect of Fuzzy Normal Forms on Fuzzy Relation. Over-view of Deductive databases.	
UNIT-III	10Hours
Information Retrieval: Introduction of Information Retrieval. Comparison between databases and IR Systems. Information Retrieval Models- Boolean Model, Vector Space Model, Probabilistic Model, Fuzzy Model,Wrappers. **Evaluation Measures-** Precision, Recall and F-Score. Fuzzy Queries based development of Question Answering systems, Error detection and correction, Viterbi Algorithm , Implementation using Python.	
UNIT IV	10Hours
Web Search and Analysis: Web Search Algorithms : PageRank Algorithm, HITS algorithm. Web content Analysis, ontology based IR. Intelligent Web Agents. Query Expansion Algorithms, Fuzzy operators for Query Expansion. Case studies:-Development of MetaSearch Engine using intelligent operators like OWA, Implementation using Python.	
Text Books:	
1	Information Retrieval – Algorithms and Heuristics, David A. Grossman, Ophir Frieder, 2nd Edition, 2012, Springer, (Distributed by Universities Press)
2	An Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, , Cambridge University Press; Illustrated edition (7 July 2008)
Reference Books:	
1	Modern Information Retrieval Systems, Baeza-Yates , Ribeiro-Neto, Pearson Education India; second edition (23 December 2010)
2	Information Storage and Retrieval Systems, Gerald J Kowalski, Mark T Maybury, Springer; 2nd ed. 2002 edition (30 September 2000)
3	Mining the Web : Discovering Knowledge from Hypertext Data, Soumen Chakrabarti Morgan Kaufmann; 1st edition (16 October 2002)
4	Information Retrieval Systems: Theory and Implementation, Gerald J. Kowalski, Springer; 2nd edition (September 30, 2000)

PARALLEL PROGRAMMING AND PARALLEL ALGORITHMS	
Course Code: BCS - 404 Contact Hours: L- 3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 8

Introduction:

Parallel programming is ubiquitous in today's multi-core era and solves many real-world scientific problems. Massive parallelism entails significant hardware and software challenges. The course is structured so that the students understand challenges in efficient execution of parallel applications.

Course Objectives:

- Describe different parallel architectures, inter-connect networks, programming models, and algorithms for common operations such as matrix-vector multiplication.
- Given a parallel algorithm, analyze its time complexity as a function of the problem size and number of processors.
- Design a parallel algorithm, implement it using MPI, OpenMP, or a combination of MPI and OpenMP.

Pre-requisites:

Design and Analysis of Algorithms / Advanced Algorithms. Exposure to Operating Systems, Computer Architecture and Computer Networks are desirable.

Course Outcomes: After completion of the course the students will be able to

CO1: Understand the evolution of High-Performance Computing (HPC),

CO2: Understand, appreciate and apply parallel algorithms in problem Solving.

CO3: Gain hand-on experience with MPI and OpenMP for parallel programs development,

CO4: Master skills to measure the performance of parallel programs.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction to Parallel Programming and Parallel System Architectures: Needs for parallel computations. Challenges of parallel programming, Overview of parallel systems. Multiprocessors and multi-computers, Computer system classification, Clusters. **Modelling and Analysis of Parallel Computations:** speedup, efficiency, scalability, operation-operand graph, parallel method execution time, estimating the parallelization and computational load balancing.	
UNIT-II	**11 Hours**
Parallel Programming with MPI: Overview of the MPI standard. Point-to-point communication operations. Synchronous and asynchronous modes of data transmission, Collective operations. Derived data types, Logical topologies, Case studies: matrix solving partial differential equations. **Parallel Programming with OpenMP:** Overview of the OpenMP standard, Parallel regions, Computational load distributing among the threads. Shared and private data, Synchronization, OpenMP environment, Comparative consideration of various approaches to parallel programming for distributed and shared memory system.	
UNIT-III	**11 Hours**
Principles of Parallel Algorithm Design: Parallel program modelling, Development stages. **Parallel algorithms:** Matrix computations, Matrix vector multiplications, Solving the linear equations, Sorting, Solving the partial differential equations	
UNIT-IV	10 Hours
Parallel Program: Representation of the parallel program as a system of processes carried out in parallel, Programs for Mutual exclusion, Semaphores and monitors. **Modelling Parallel Programs:** Modelling the program state in the form of the "process-resource" graph. Model analysis:The detection and exclusion of deadlocks, Case studies: the "producer-consumer" problem, the "dining philosophers" problem etc.	

Text Books

1	Joseph F Jaja, An Introduction to Parallel Algorithms, Addison-Wesley, 1992.
2	Michael J Quinn, Parallel Programming in C with MPI and OpenMP, first edition, McGraw Hill, 2004/2003.
3	Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, second edition, Addison-Wesley/Pearson, 1994/2003.

Reference Books

1	Michael J Quinn, Parallel Computing: Theory and Practice, 2nd ed., McGraw Hill, 2002.
2	S. Lakshmivardhan and S.K. Dhall, "Analysis and design of parallel algorithm – arithmetic and matrix problems", McGraw Hill, 1990
3	Pacheco, P. (1996). Parallel Programming with MPI. - Morgan Kaufmann.
4	Chandra, R., Dagum, L., Kohr, D., Maydan, D., McDonald, J., and Melon, R. (2000). Parallel Programming in OpenMP. Morgan Kaufmann Publishers.

NATURAL LANGUAGE PROCESSING	
Course Code: BCS 406 Contact Hours: L- 3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 8

Introduction:
This course aims at teaching the basics about processing of Natural Languages. Natural language processing is the feature of 5th Generation Computer and is part of Artificial intelligence. It teaches about the different phases of natural language processing, methodologies, algorithms, data structures used for Natural Language Processing.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of Natural Language Processing.
- To provide an understanding of the basic phases of natural language processing like morphological analysis, syntactic analysis, semantic analysis, pragmatic analysis
- To teach algorithms and data structures etc for performing syntactic analysis, semantic analysis.
- To understand about grammars and their hierarchy.
- To teach about the latest tools of NLP like Word Net, concept of WSD, Hindi WORDNET etc.

Pre-requisites:
Artificial Intelligence, Data structures and algorithms, programming languages

Course Outcomes: After completion of the course the students will be able to
CO1: To provide an introduction to the basic principles, techniques, and applications of Natural Language Processing.
CO2: To provide an understanding of the basic phases of natural language processing like morphological analysis, syntactic analysis, semantic analysis, pragmatic analysis
CO3: To teach algorithms and data structures etc for performing syntactic analysis, semantic analysis.
CO4: To understand about grammars and their hierarchy.
CO5: To teach about the latest tools of NLP like Word Net, concept of WSD , Hindi WORDNET etc.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction: Basic concepts of Natural language Processing, evolution of NLP, issues and challenges in NLP, basic concepts of phases of natural language processing morphological analysis, syntactic analysis, semantic analysis, pragmatic analysis, tools and techniques used for performing these analysis, ambiguities, Types of ambiguities	
UNIT-II	11 Hours
Syntactic analysis: Concept of Grammars, Chomsky hierarchy of grammars, concept of parsing, top down parsing, bottom up parsing, bidirectional parsing, generating parse tree, data structures and algorithms used for parsing, tokenizer, Case study of parsers of NLP systems like ELIZA, LUNAR	
UNIT-III	11 Hours
Semantic Analysis: understanding meaning, CASE grammars, transformational grammars used for performing semantic analysis. Resolving ambiguities to generate correct meaning, Word Sense Disambiguation Case study of Toolkit of word sense disambiguation used in WORDNET.	
UNIT-IV	10 Hours
Software tools for Performing NLP: English WORDNET, components of WorldNet understanding NLTK tool for using wordnet, HINDI wordnet, Indian Govt initiative for language analysis and machine translation.	

Text Books

1	Allen,James, "Natural Language Understanding", Second Edition, Benjamin/ Cumming, 1995.
2	Jurafsky, Danand Martin, James," Speech and Language Processing", Second Edition,Pre ntice Hall,2008
3	Ela Kumar, " Natural Language Processing", IK international Publication, second edition 2014

Reference Books

1	Bharati Akshar, Chaitanya Vineet, Sangal, Rajeev, "Natural Language Processing: A Paninian Perspective", Prentice Hall India Learning Private Limited; EASTERN ECONOMY ed. edition , 1995
2	Philipp Koehn, Statistical Machine Translation, Cambridge University Press; 1st edition ,2009
3	U.S. Tiwari and Tanveer Siddiqui, Natural Language Processing and Information Retrieval, Oxford UniversityPress,2008.

SOFTWARE PROJECT MANAGEMENT	
Course Code: BCS 408 Contact Hours: L- 3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 8

Introduction:
This course aims at introducing the fundamental theory and concepts of project management and planning. It will help students to apply the conceptual knowledge of project management and map to the needs of industry and academia.

Course Objectives:
- To provide an introduction to the basic theory, concepts, methods and applications of software project management.
- To provide an understanding of software project management activities and tasks.
- To provide the background for understanding the organization, scheduling, quality and management of the software projects.
- To provide an understanding about the planning, tracking and monitoring of software project management processes.

Pre-requisites: Software engineering, programming languages.

Course Outcomes: After completion of the course the students will be able to
CO1: Explain the fundamental concepts and various methods related to software project management processes.
CO2: Apply and study about organization and project structures, management and software project management frameworks.
CO3: Apply and study about project scheduling, tracking, quality and management.
CO4: Apply software project management principles and blend it to the needs of academia and industry for various application domains.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction and Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.	
UNIT-II	11 Hours
Project Organization and Scheduling: Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, Monte Carlo Approach, CPM, Bar Charts: Milestone Charts, Gantt Charts.	
UNIT-III	11 Hours
Project Monitoring and Control: Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: 23 Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walk through, Code Reviews, Pair Programming. Types of Resources, Identifying Resource Requirements, Resource Scheduling.	
UNIT-IV	10 Hours
Software Quality Assurance and Testing: Testing Objectives& Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Clean room process. **Project Management and Project and Tools:** Software Configuration Management, Risk Management, Cost Benefit Analysis, Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.	
Text Books	
1	Software Project Management, Bob Hughes & Mike Cotterell, McGraw Hill Education; Sixth edition ,2017
2	Software Project Management in Practice, Pankaj Jalote, Addison-Wesley; 1st Ed ,2002
3	Software Project Management, Walker Royce, Pearson Education, 1998.
Reference Books	
1	Software Engineering Project Management, Richard H. Thayer & Edward Yourdon, Second edition, Wiley India, 2004.
2	Agile Project Management, Jim Highsmith, Pearson education, 2004.

QUANTUM COMPUTING	
Course Code: BCS - 410 Contact Hours: L-3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 8

Introduction:
This course aims at introducing the fundamental theory and concepts of quantum computation and its methods, in particular algebra, complex vector and quantum mechanics.

Course Objectives:

- To provide an introduction to the basic principles, algorithms, and applications of quantum computing.
- To provide an understanding of the basic areas of quantum computing including algebra of complex vector spaces, quantum information and cryptography and quantum mechanics.
- To provide the mathematical background for carrying out the optimization associated with quantum computation learning.
- To develop some familiarity with current research problems and research methods in quantum computing by working on a research or design project.

Pre-requisites:
Discrete mathematics, Data structures and algorithms, programming languages
Course Outcomes: After completion of the course the students will be able to
CO1: Learn the fundamentals of quantum computing and quantum mechanics;
CO2: Explain the basics of quantum circuits, quantum information, and cryptography;
CO3: Analyze existing quantum algorithms and evaluate their performance in different domains;
CO4: Design and analyze quantum algorithms incorporating noise and error correction.

Pedagogy:
The class will be taught using theory and tutorial-based methods. In addition to assigning some of the models and frameworks under case-based methods, the course instructor will demonstrate and explain about applications of quantum computing techniques with research orientation.

UNIT-I	10 Hours
Introduction to Quantum Computation: Classical deterministic systems, classical probabilistic systems, quantum systems, basic quantum theory. Quantum bits, Bloch sphere representation of a qubit, multiple qubits. **Background Mathematics and Physics**: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.	
UNIT-II	**11 Hours**
Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits, classical gates, quantum gates. **Quantum Information and Cryptography**: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem. Asymmetric and symmetric encryption, quantum key distribution.	
UNIT-III	**11 Hours**
Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Quantum circuits, reversibility of quantum circuits, power of quantum algorithms, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search, applications of quantum algorithms.	
UNIT-IV	**10 Hours**
Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation, Single-Qubit Errors, Quantum Operations and Krauss Operators, The Depolarization Channel, The Bit Flip and Phase Flip Channels, Amplitude Damping, Phase Damping.	

Text Books	
1	Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press, 2002.
2	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004.
3	Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000.
Reference Books	
1	Quantum Computation and Quantum Information. Michael A. Nielsen, Isaac L. Chuang. Cambridge University Press, Dec 9, 2010 - Science.
2	An Introduction to Quantum Computing. Phillip Kaye, Raymond Laflamme, Michele Mosca. Oxford University Press Inc., New York, 2007.
3	Quantum Computing: An Applied Approach. Jack D. Hidary. Springer; 1st ed. 2019 edition (20 September 2019).

Computational Optimization Techniques	
Course Code: BCS-412 Contact Hours: L- 3 T-1 P-0 Course Category: DEC	Credits: 4 Semester: 8

Introduction:
The aim of this course is to have some basic understanding of mathematical concepts of optimization and having skills necessary to solve and interpret optimization problems in engineering.

Course Objectives:
- To explain the basic mathematical concepts of optimization.
- To develop the modelling skills necessary to describe and formulate optimization problems.
- To conduct and interpret the post optimal and sensitivity analysis and explain the primal-dual relationship.
- To provide the skills necessary to solve and interpret optimization problems in engineering.

Pre-requisites: Exposure to relevant concepts at undergraduate level and instructor consent.
Course Outcomes: After completion of the course the students will be able

CO1: To explain the basic mathematical concepts of optimization.
CO2: To develop the modelling skills necessary to describe and formulate optimization problems.
CO3: To conduct and interpret the post optimal and sensitivity analysis and explain the primal dual relationship.
CO4: To provide the skills necessary to solve and interpret optimization problems in engineering.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Introduction: Engineering applications of optimization, statement of an optimization problem with example for minimum weight and optimum cost consideration, classification of optimization problems and techniques, Single variable optimization, multi-variable optimization with equality and inequality constraints and without constraints, Objective function, single objective function, multi objective function and optimality.	
UNIT-II	11 Hours
Linear Programming: Introduction, Techniques of linear programming: Simplex method, slack variable, revised simplex method: Duality in linear programming, decomposition principle, integer linear programming, Transportation problem, scheduling, applications to engineering design, real life application of optimization techniques.	
UNIT-III	11 Hours
Non Linear Programming: Introduction, Basic ideas of one- Dimensional optimization problem, unconstrained and constrained optimization problem-Lagrange's multiplier, quadratic programming-wolfe's method, direct search method, descent method, conjugate gradient method various search methods, Travelling salesperson problem, descent method, steepest descent method, two person zero sum game, Maximin-Minimax principle, engineering application of optimization techniques.	
UNIT-IV	10 Hours
Nature Inspired Optimization Algorithm: particle swarm optimization, ant colony optimization, simulated annealing, Tabu search, neural network-based optimization, fuzzy optimization technique, cuckoo search, bat algorithm, firefly algorithm, flower pollination algorithm, Bee algorithm.	

Text Books

1	S.S.Rao, Engineering Optimisation- Theory and Practice, Wiley; 5th edition (30 December 2019)
2	X in-She Yang , Nature-Inspired Optimization Algorithms, Academic Press Inc; 2nd edition (14 September 2020)

Reference Books

1	Kajla Basu, Samarjit Kar, Computational Optimization and Applications, Narosa Publishing House (30 January 2012)
2	Rajesh Kumar Arora , Optimization: Algorithms and Applications, Chapman and Hall/CRC; 1st edition (6 May 2015)
3	Deb K., Optimisation for Engineering Design-Algorithms and Example, Prentice Hall India Learning Private Limited; Second edition (1 January 2012)

Neural Networks And Deep Learning	
Course Code: BIT 408 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 8

Introduction:
Deep Learning has received a lot of attention over the past few years to solve a wide range of problems in Computer Vision and Natural Language Processing. Neural networks form the basis of deep learning. This course intends to cover fundamentals of neural networks, deep learning and application areas.

Course Objectives:

- To learn about the building blocks used in Deep Learning based solutions.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems
- To understand various optimization algorithms which are used for training such deep neural networks.

Pre-requisites:
Working knowledge of Linear Algebra, Probability Theory. It would be beneficial if the participants have done a course on Machine Learning

Course Outcomes:

CO1: To understand various deep learning algorithms and their applications to solve real world problems
CO2: To understand various optimization algorithms which are used for training deep neural networks.
CO3: To design CNN architectures for various computer vision tasks.
CO4: To apply deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

Pedagogy:
The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	7 Hours
Review of Linear Regression and Logistic Regression, Neural Networks, Feedforward & Backpropagation algorithm. Gradient Descent (GD), Batch GD, Stochastic GD, AdaGrad, RMSProp, Regularization, Learning Curves, Bias vs Variance, Early Stopping.	
UNIT-II	8 Hours
Image Classification, Convolutional Neural Networks (CNN), Operations - Convolution, Pooling, Stride, Padding, FC layer. Well known CNN architectures - AlexNet, VGG16, ResNet, InceptionNet. Object Recognition, One Shot Learning, Siamese Network, Face Recognition. Image data augmentation techniques.	
UNIT-III	7 Hours
Sequence Models. Recurrent Neural Networks, Backpropagation over time. LSTM, GRU. Language Models. Word Embeddings - Word2Vec, GloVe. Encoder Decoder Models, Attention Mechanism, Transformer, BERT. NLP data augmentation techniques.	
UNIT-IV	8 Hours
Autoencoders, Restricted Boltzmann Machines, Motivation for Sampling, Markov Chains, Training RBMs - Gibbs Sampling, Contrastive Divergence. Generative Adversarial Networks - GANs and applications. Explainability techniques.	
Text Books	
1 Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville http://www.deeplearningbook.org, 2016	
2 A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016	