Indira Gandhi Delhi Technical University For Women

(Established by Govt. of Delhi vide Act 09 of 2012) Kashmere Gate, Delhi – 110006

Department of Computer Science and Engineering

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

First Year (Common courses for all B.Tech Programme)

		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**		**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/	Basic Electrical Engineering/	3-0-2	4	**OEC**

	BMA-110	Engineering Mechanics			
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**	

B.Tech.(CSE)

Third Semester (Second Year)

S.No.	Course 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.	DEC- 3xx	Departmental Elective Course-1	3-1-0/ 3-0-2	4	DEC
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.	BCS- 308	Multimedia Technologies	**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	**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	

In case, a student opts for Research Paper for BIT-451, she will be required to publish at least one Research paper in a reputed SCOPUS/SCI/SCIE indexed journal, in order to get the grade.

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**	**Credits**
Departmental Elective Course-1	BCS - 303	Theory of Computation	3-1-0
	BCS- 305	Human Computer Interaction	3-1-0
	BCS- 307	Advanced Computer Architecture	3-1-0
Departmental Elective	BIT- 304	Cloud Computing	3-1-0

Course-2			
	BIT - 310	Internet of Things	3-1-0
	BCS - 314	Computer Graphics	3-0-2
Departmental Elective Course-3	BCS- 403	Evolutionary Computing	3-1-0
	BCS- 405	Knowledge Engineering	3-1-0
	BEC- 407	Digital Image Processing	3-1-0
Departmental Elective Course-4	BIT- 417	E-commerce	3-1-0
	BIT- 419	Cyber Security and Forensics	3-1-0
	BCS- 407	Intelligent Data & Information Retrieval	3-1-0
Departmental Elective Course-5	BCS- 404	Parallel Programming and Parallel Algorithms	3-1-0
	BCS- 406	Natural Language Processing	3-1-0
	BCS- 408	Process of Software Project Development	3-1-0
Departmental Elective Course-6	BCS- 410	Quantum Computing	3-1-0
	BCS- 412	Computational Optimization Techniques	3-1-0
	BCS- 414	Introduction to Signals & Systems	3-1-0

B.TECH CSE First Semester Syllabus

PROGRAMMING IN C LANGUAGE	
Course Code: BCS- 101 Contact Hours: L-3 T-0 P- 2 Course Category: OEC	Credits: 4 Semester: 1

Introduction: This course briefs about basic introduction to computers and its corresponding concepts in benefit of students coming from non-computer background. Apart from this, programming concepts are also discussed in this course using C programming language.

Course Objective:

- To provide an understanding of basic computer architecture including Number System. Discussion of computer history and overview of operating systems.
- To impart adequate knowledge on the need and concept of algorithms and programming.
- Develop, execute and document computerized solution for various problems using the features of C language.
- To enable effective usage of arrays, structures, functions, pointers and to implement the concepts of file organization.

Pre-requisite: None

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

- Explain the fundamentals of computers and programming.
- Apply problem solving skills in programming.
- Learn logic development
- Develop and run computer programs in C language

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

Contents

UNIT-I: Introduction to Computer system and Basics Programming fundamentals	10 Hours
Introduction to computer systems, ALU, registers, memory. Concepts of the finite storage, bits bytes, kilo, mega and gigabytes. Idea of program execution at micro level. **Introduction to system software:** operating systems, compilers, assemblers, interpreter and multi-user environments. Concept of flow chart and algorithms, algorithms to programs. Logic development for solving problems, development of flow chart and algorithms	
UNIT-II: Programming using C	10 Hours
Concept of variables, program statements and function calls from the library (Printf for	

example), C data types: int, char, float etc., C expressions, arithmetic operation, relational and logic operations, C assignment statements, extension of assignment of the operations. C primitive input output using getchar and putchar, exposure to scanf and printf functions, C Statements, conditional executing using if, else , switch case, goto and break statements.	
UNIT-III: Concept of Sub-programming	10 Hours
Concept of loops in C using for, while and do-while. **Arrays:** single and two--dimensional arrays, initializers, array parameters, example of iterative programs using arrays and use in matrix computations. Functions, parameters and return values, standard library functions.	
UNIT-IV: Pointers, Strings and Structure	12 Hours
Pointers, relationship between arrays and pointers, Call by reference. Array of pointers, passing arrays as arguments. **Character strings:** processing strings using loops, and string library functions **Structure and Unions:** structure concepts, structures as parameters, arrays of structures.	
Text Books	
1	Mastering C, 2nd Edition, K R Venugopal,Sudeep R Prasad, McGraw Hill Education, 2017
2	Let Us C, 13th Edition, Yashavant Kanetkar, BPB Publications, ISBN:978-8183331630, 2013.
3	Fundamentals of Computers, 6th Edition, V Rajaraman, PHI Learning, 2014.
Reference Books	
1	Programming in ANSI C, 6th Edition, McGraw Hill Education (India) Private Limited E Balagurusamy, ISBN:978-1259004612, 2012.
2	The C Programming Language, B W Kernighan, Dennis Ritchie, 2nd Edition, 2015.
3	The Complete Reference C, Herbert Schildt, Tata McGraw Hill, 4th Edition, 2017.

B.Tech CSE Third Semester Syllabus

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 Computer Science & Engineering. It deals with all aspects of Data structures like static and dynamic data structure. How to choose a particular data structure for any specific problem.,

Course Objective:

- To study different kinds of data structures with their respective applications.
- To learn applications of data structures
- To apply data structures in various programs
- Learn to use data structures for different programs

Pre-requisite: Fundamentals of Programming

Course Outcome:

- Knowledge of different kinds of data structures with their respective applications.
- Devise data structures for programs
- Differentiate between static and dynamic data structures
- Develop programs using different types of data structures

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

Contents

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, Insertion Sort, 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 and Sahni, "Fundamentals of Data structures", Galgotia publications, 1983
2	Tannenbaum, "Data Structures", PHI, 2007(Fifth Impression)
3	An introduction to data structures and application by Jean Paul Tremblay & Pal G. Sorenson (McGraw Hill).
Reference Books	
1	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI, 2009(Fourth Impression)
2	Seymour Lipschutz Saucham's series , data Structures, Mc, Graw Hill Publication, 2018
3.	Nitin Upadhaya, Data Structures using C, S K Kataria Publicatrions, 2015

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 Objective:

- 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
- Learn concepts of discrete mathematics

Pre-requisite: Nil

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

- distinguish between the notion of discrete and continuous mathematical structures
- Become Familiar with application of induction and other proof techniques towards problem solving
- Understand concepts of discrete structures
- Will learn use of discrete structures in program development

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

Contents

UNIT-I	10 Hrs
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 Hrs

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 diagonal argument and the power set theorem, Schröder-Bernstein theorem.

UNIT III	12 Hrs

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 Hrs

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.
2	C L Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw-Hill.
3	Bernard Kolman, Robert C Busby, and Sharon Cutler Ross, Discrete Mathematical Structures, fifth edition, Prentice-Hall of India.

Reference Books

1	Ralph P Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education Asia.
2	Norman L Biggs, Discrete Mathematics, Oxford University Press.
3	J P Tremblay and R Manohar, Discrete mathematical structures with applications to Computer Science, Tata McGraw-Hill.

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 of 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 studying this course, the students will be able:

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

Pedagogy:

Lecture delivery via discussions, whiteboard, slideshows, online learning material. Lab-work with exercises on SQL

Contents

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	11 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 Definition in SQL, View and Queries in SQL, Specifying Constraints and Indexes in SQL, Practicing SQL commands	
UNIT-III	11 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	Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw Hill, 6^{th} Ed
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3^{rd} Ed., 2003
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

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

Introduction:

Software engineering is the branch of computer science that creates practical, cost-effective solutions to computing and information processing problems, preferentially by applying scientific knowledge, developing software systems in the service of mankind. This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools. The course will combine a strong technical focus with a capstone project providing the opportunity to practice engineering knowledge, skills, and practices in a realistic development

Course Objective:

1. Study the current software engineering techniques and examines the software life-cycle, including software specification, design implementation, testing and maintenance.
2. Present software engineering methodologies for the development of Quality, cost-effective, schedule adhered software.
3. Develop an understanding of ethical and professional issues related to Software Project Delivery.

Pre-requisite: Nil

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

- Understand various phases of software development lifecycle
- Analyze the requirements systematically and develop the model using standard tools and methodologies
- Apply key aspects of software engineering processes for the development of a complex software system
- Develop a quality software project through effective team-building, planning, scheduling and risk assessment
- Keep abreast of current trends in the area of software engineering

Pedagogy

Lectures, ppt, Online Material, NPTEL, Assignments, Quiz. Lab will be based on a case study with complete software development life cycle.

Contents

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 involve 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 Behavioural & Non-Behavioural Requirements, SRS Components & various User's 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	K.K.Aggarwal, Yogesh Singh: Software Engineering, New Age International Ltd, 3rd Ed. 2008.
2	Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing, 2010.
Reference Books	
1	R.S. Pressman, Software Engineering – A Practitioner's Approach, 8th Edition, McGraw Hill, 2019.
2	Ian Sommerville, Software Engineering, 10th Edition, Pearson, 2017.

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:

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

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

Content

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

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) helps.

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

- Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
- Learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
- Solve system of linear equations numerically using direct and iterative methods.
- Understand how to approximate the functions using interpolating polynomials.
- 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.

Content

UNIT-I	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.
2	Sastry S., Introductory Methods of Numerical Analysis, 5th Edition, Prentice Hall India Learning Private Limited; 2012.
3	Conte, S.D and Carl D. Boor, Elementry Numerical Analysis: An Algorithmic approach, SIAM-Society for Industrial and Applied Mathematics, 2017.
4	Grewal, B. S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, 2012.

Reference Books

1	Gerald C.F and Wheatley P.O., Applied Numerical Analysis, 8thEdition, Pearson Education, 2011.
2	Chappra S.C., Numerical Methods for Engineers, 7th Edition, McGraw-Hill Higher Education, 2014.

ANALOG AND DIGITAL ELECTRONICS	
Course Code: BEC - 209 Contact Hours: L-3 T-1 P-0 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:

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

Pedagogy: Class room teaching, problem solving approach, practical based learning, tutorials

Contents

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.
2	Millman and Halkias, "Electronic Devices and Circuits" TMH, 4th Edition, 2015.
3	Salivahanan, Suresh Kumar, Vallavaraj, "Electronic Devices and Circuits" TMH, 4th Edition, 2016.

Reference Books

1	Balbir Kumar and S. B. Jain, "Electronic Devices and Circuits" PHI, 2nd Edition 2014.
2	R.P. Jain, "Modern Digital Electronics", TMH, 4th Edtion, 2010
3	Roy Choudhury and Jain, "Linear Integrated Circuits", New Age Publishers, 4th

	Edition, 2017.

ENGINEERING MEASUREMENT AND METROLOGY	
Course Code: BMA-213 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 standardising the methods

Course Objectives: The objectives of this course are

- 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 methods.
- 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

- Understand Measurement Process and various techniques
- Understand sensors and Transducers
- Understand measurement instrument capabilities
- Understand Statically control techniques
- 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.

Contents

UNIT I	11 Hours
Introduction: Introduction to measurement and measuring instruments 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 gauges and 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..
2.	T.G. Beckwith, R.D. Maragoni and J.H Lienhard, "Mechanical Measurements",

	Addison- Wesley, 1999.
Reference Books	
1.	R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi,2010
2.	I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi,2011
3.	F.W. Galyer& C.R. Shotbolt, "Metrology for Engineers", ELBS edition, 2009

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:

- Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.
- Understand the theory and architecture of central processing unit.
- Analyse some of the design issues in terms of speed, technology, cost, performance.
- Learn the concepts of pipelining and interrupt handling.

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

Content

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 Microoperations	
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 Hour
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.
2	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5 th Edition, McGraw Hill.
3.	Martin S, Computer Organization, PHI publication, 2012

Reference Books	
1	William Stallings, “Computer Organization and Architecture”, 6th Edition, Pearson/PHI.
2	John L. Hennessy and David A. Patterson, “Computer Architecture a quantitative approach”, 4th Edition.
3	A. Anandkumar, “Fundamentals of digital circuits”, 4th edition, PHI, 2016.

Suggestive List of Experiments

1. Verify the truth tables of AND, OR, NOT, NAND, NOR, XOR, and XNOR GATES.
2. Verify that NAND and NOR gates are universal gates.
3. Design a Half adder circuit and verify its truth table.
4. Design a Half subtractor circuit and verify its truth table.
5. Design a full adder circuit using half adders and verify its truth table.
6. Design a full subtractor circuit using half subtractor and verify its truth able.
7. Design a 2-bit binary incrementor using half adder circuit.
8. Design and implement a 3: 8 Decoder.
9. Design and implement a 4 X 1 Multiplexer.
10. Design and implement SR flip flop.
11. Design and implement D flip flop.
12. Design and implement JK flip flop.
13. Design and implement T flip flop.
14. Design and implement Master Slave flip flop.

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 Objective:

- 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-requisite: Data structures

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

- Assess and analyse the performance of algorithmic efficiency.
- Choose the most relevant and apt algorithm design approaches for problems solving.
- Understand the working of dynamic programming and determining computational complexity of the algorithms that influence the performance of programs.
- Learn designing of algorithms for different purposes.

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

Contents

UNIT-I	**10 Hours**
Introduction: 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: Polynomialtime 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.
2	E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," 2nd Ed., Universities Press.
3	P. H. Dave, H. B. Dave, "Design and Analysis of Algorithms", 2nd Ed., Pearson Education.
Reference Books	
1	Design and Analysis of Algorithms, S. Sridhar, Oxford Univ. Press.
2	Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education, 2008.
3	Foundations of Algorithms, R. Neapolitan and K. Naimipour, 4th edition, Jones and Bartlett Student 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 modern 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 Objective :

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

Pre-requisite: Analysis of algorithms, algorithm design techniques, programming knowledge in C, C++ or JAVA.

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

- Analyze the structure of OS and basic architectural components involved in OS design.
- Analyze and design the applications to run in parallel either using process or thread models of different OS.
- Analyze the various device and resource management techniques for timesharing and distributed systems.
- Understand the mutual exclusion, deadlock detection concepts in OS.
- Interpret the mechanisms adopted for file sharing in distributed applications.

Pedagogy

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

course instructor will demonstrate and explain about the applications of Operating Systems techniques with real-time examples.

Contents

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, Cooperating Processes, 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, Shared Devices, 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

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++11 language standard/ Python with numerous examples demonstrating the benefits of C++11/Python.In the end some basics of Java will be covered

Course Objective:

- To learn object-oriented programming (OOP) principles
- To get a flavour of modular programming

Pre-requisite: Basics of C Programming

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

- To learn basic programming in C++/Python and Java
- To develop OOP solutions to problems demonstrating usage of control structures, modularity, I/O and other standard language constructs

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.

Contents

UNIT-I	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, polymorphism), 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.
2	Martin C. Brown, "Python: The Complete Reference", 4th Edition, McGraw Hill, 2018
Reference Books	
1	Mark Lutz, "Learning Python" 3rd Edition, O'Reilly Media, 5th Ed. 2017
2	Bjarne Stroustrup , "The C++ Programming Language", Pearson, 4th Ed, 2009

NANO STRUCTURES AND MATERIALS IN ENGINEERING	
Course Code: BAS-202 Contact Hours: L-3 T-1 P-0 Course Category: OEC	Credits: 4 Semester: 4

Introduction:

The last two decades have seen a tremendous amount of research on nanomaterials. What is Nanotechnology? The art of manipulating the materials at nanoscale and tailoring their properties for a wider scope of applications is nothing but Nanotechnology. The renowned physicist and Nobel prize winner, Richard Feynman once said that *"there is plenty of room at the bottom"* during a conference of the American Physical Society. His comments were truly remarkable and fit well in the context of nanotechnology. A substantial number of new nano materials such as nanowires, quantum dots, polymers and fibers etcare making their way onto the market and are entering in all shapes and forms in everyday life. Not a single day passes without a press reportingon progress in this area. The course is aimed to make students familiar with this area and learn some basics of the Nanotechnology.

Course Objectives:

- To develop an understanding of the fundamentals of Nanotechnology and various properties at nanoscale.
- To impart basic knowledge on various synthesis and fabrication techniques involved in Nanotechnology.
- To give a general introduction to different classes of nanomaterials and their potential applications.
- To make the learner familiarize with various characterization techniques of nanomaterials.

Prerequisites: Basic understanding of Applied Physics Course.

Course Outcomes: Upon completion of this course, the students should be able to:

- Understand basics of Nanotechnology and various size dependent phenomena's at nanoscale.
- Learn various synthesis and fabrication techniques of nanomaterials.
- Enhance knowledge of nanomaterials and their potential applications.
- Familiarize with various characterization techniques and their use in study of various properties nanomaterials.

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

Content

UNIT-I	10 Hours

BASICS AND SCALE OF NANOTECHNOLOGY

Introduction to nanoscale, Scientific revolution-nanotechnology, Classification of nanostructures-zero, one, two and three dimensional nanostructures (Quantum wire, Quantum well, Quantum dot), Size Dependency in Nanostructures-quantum size effects in nanostructures, Surface to volume ratio, Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic and magnetic).

UNIT-II	11 Hours

NANOSCALE FABRICATION TECHNIQUES

Top down and Bottom Up approaches,

Physical Methods: Ball Milling, Thermal Evaporation, DC/RF Magnetron Sputtering, Molecular Beam Epitaxy (MBE).

Chemical Methods: Chemical Reduction, Solgel Method and Sono chemical Routes, Chemical Vapor Deposition (CVD).

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL) Nanoimprint, Soft lithography patterning.

UNIT-III	10 Hours

NANOMATERIALS AND APPLICATIONS

Carbon based nano materials (CNTs, graphene), Metal based nano materials (nanogold, nanosilver and metal oxides), Nanocomposites, Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation – Medical applications of nanomaterials, Nanotoxicology challenges.

UNIT-IV	11 Hours

CHARACTERIZATION OF NANOSTRUCTURES

Structural Analysis: X-ray diffraction, SEM, FESEM, TEM, HRTEM, AFM, STM, Surface enhanced Raman spectroscopy (SERS), X-ray Photoelectron Spectroscopy (XPS), Auger electron spectroscopy (AES), Rutherford backscattering spectroscopy (RBS).

Optical Characterizations: UV-Vis, FTIR-Principals, Instrumentations and applications.

Text Books	
1	Pradeep T., "*A Textbook of Nanoscience and Nanotechnology*", 1st Edition, Tata McGraw Hill Education Pvt. Ltd., 2012.
2	Hari Singh Nalwa, "*Nanostructured Materials and Nanotechnology*", 1st Edition, Academic Press, 2002.
Reference Books	
1	Nabok A., "*Organic and Inorganic Nanostructures*", Artech House, 2005.
2	Dupas C., Houdy P., Lahmani M., *"Nanoscience: Nanotechnologies and Nanophysics*", Springer-Verlag Berlin Heidelberg, 2007.
3	Masaru Kuno, Introductory Nanoscience: Physical and Chemical Concepts, CRC Press Book, 1st Edition Publisher: Garland Science; 2011.

OPTICAL ENGINEERING	
Course Code: BAS-204 Contact Hours: L-2 T-1 P-2 Course Category: OEC	Credits: 4 Semester: 3

Introduction: Optics is used in almost wide field of sciences. The lens and mirror are taught at primary school level these days. Even basics like interference and diffraction have trickled down to school level though secondary classes. However the optics has advanced much beyond these. The picture of a mobile camera is competing with many of the popular DLSR. Optics and advanced leaps and bounds. This subject is a glimpse to these advances.

Course Objectives: The aim of this course is make a student well advanced optics and that too from an engineer perspective.

Pre-requisite: Applied Physics-1 and Applied Physics -2.

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

- Comprehend how the modern optical instruments work.
- Appreciate the importance of spectroscopy in the industry and medicine.

Pedagogy: Apart from class room teaching, the concept taught in the class will be reinforced with lab and simulations.

Content

UNIT-I	7 Hours
Frequency response of a diffraction-limited system under coherent and incoherent illumination, OTF-effects of aberration and apodization. Techniques for measurement of OTF, comparison of coherent and incoherent imaging. Diffraction by circular aperture, Gaussian beams. Image evaluation: Geometric OTF, its computation and measurement, Strehl ratio, spot diagram; definition of merit function Parabolic and Fresnel lens, Cooks Triplet and its derivatives; Double Gauss lens, Introduction to	

zoom lenses and aspherics.

UNIT-II	7 Hours

Optical Components: Mirrors, prisms, gratings and filters; Sources, detectors and their characteristics.

Optical Instruments: Infrared instrumentation, imaging, near-field imaging techniques; Satellite cameras, Laser Doppler velocimetry Bio-medical applications of lasers, Laser tweezers and applications, Shack Hartmann Sensor and Moire, and Talbot interferometry for measurement of optical performance parameters of the optical elements.

Eye and vision: Visual system, sensitivity, acuity; Radiometry and Photometry: Radiometric quantities and their measurements, Photometric quantities, Radiation from a surface; Brightness and luminous intensity distribution; Optical detectors; Detector characteristics, Noise considerations, single & multi-element detectors, CCDs.

UNIT-III	7 HOUR

Holography: Basics of holography, in-line and off-axis holography; transmission and reflection holograms, Amplitude and phase holograms, Recording materials. Thick and thin holograms.

Lasers: fiber lasers, gas lasers, Pulsed lasers: ns, ps, and fs lasers, excimer-, dye-, X-ray and free-electron lasers; Semiconductor lasers: DH, QW, QCL, VCSEL, DFB and DBR lasers.

UNIT IV	7 HOUR

Spectroscopy : Laser spectroscopy, Spectroscopic instrumentation, Fourier transform spectroscopy;

Microscopy: phase contrast microscopy and other simple applications; Confocal Microscope.

Other Miscellaneous Topics: Adaptive optics; Wavefront sensing and correction, reconstruction.

Text Books

1	J. W. Goodman, Introduction to Fourier Optics, 2nd Edition, Mc Graw Hill, 1996.
2	P. Hariharan, Optical Holography Principles, techniques and applications, 2nd Edition, Cambridge University Press, 1996.
3	D. Malacara, Optical Shop Testing, 3rd Edition, Wiley,2007
4	E. Hecht, Optics, 4th Edition, Pierson, 2002.

Reference Books

1.	A. K. Ghatak, Optics, 5th Edition, Mc Graw Hill, 2014.
2	B. K. Johnson, Optics and Optical instruments, Dover Publications, 1967.
3	F. A. Jenkins and H. E. White, Fundamentals of Optics, 4th Edition, McGraw Hill, 2001.
4	B. K. Johnson, Optics and Optical instruments, Dovers Publications Inc., 1960.

PRACTICAL CONTENT

Introduction: Optical Engineering Lab acquaints the students is a synchronization of theory with experiments.

Course Objectives:

- The aim of this course is to make the students learn Coherent and Incoherent imaging, Optical Transfer function and spectroscopy.

Pre-requisites: Applied Physics-1 and Applied Physics -2.

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

- Learn to work on a variety of instruments to be used later on.
- Young graduates gains knowledge of interdisciplinary branches of the industry.

Pedagogy: Hands on experience on laboratory equipment's and software with self-explanatory lab manuals.

Evaluation Scheme:

Continuous Assessment Practical (CAP)	10marks
End Term Internal Practical (ETIP)	15marks

List of Experiments (Minimum Eight experiments to be performed)

1. Determination of point spread function of an optical system.
2. Determination of noise of a CCD camera.
3. Determination of spatial aberrations of an optical system.
4. Measurement of diffraction of a single slit and plotting of its intensity profile.
5. Measurement of diffraction of a circular aperture and plotting of its two dimensional intensity profile.
6. Experimental generation of a Gaussian beam.
7. Calculation of wave-front aberrations using Shack-Hartmann wavefront sensor.
8. Determination and comparison of field of view of different cameras.
9. Determination of intensity and wavelength using a CCD camera.
10. Determination of transmission and reflection spectrum of various filters.
11. Determination of radiation spectrum of various light sources.
12. Determination of numerical aperture of a microscope.

Study the various characteristics of a compound confocal phase contrast microscope

OPTIMIZATION TECHNIQUES	
Course Code: BAS-206 Contact Hours: L-3 T-1 P-0 Course Category: OEC	Credits: 4 Semester: 4

Introduction: Having a sound foundation of applied Mathematics; students are well equipped to apply them in various fields including Optimization Techniques which provides a logical and systematic approach for decision making.

Course Objective:

- To formulate mathematical models and to understand solution methods for real life optimal decision problems.
- To emphasize the basic study of linear programming problem, Integer programming problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using PERT and CPM.

Prerequisite: A basic course in calculus and matrices.

Course Outcomes: Upon Completion of this course, the students would be able to:

- Have a strong foundation of formulating and solving linear programming problems.
- Formulate and find optimal solution(s) of transportation and assignment problems
- Analyze Project Management problems and their solutions using PERT and CPM
- Solve two person zero-sum games

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

Content

UNIT-I	12 Hours

Linear spaces, Subspaces, Basis and dimension,Formulation of linear programming (LP), convex set, Graphical method, LP in standard form, Solution of LP by simplex method, Big – M Method, Two Phase Method, Exceptional cases in LP.	
UNIT-II	10 Hours
Revised Simplex Method, Karmarkar's Interior Point Algorithm, Sensitivity analysis, Duality theory, Dual simplex method, Integer Programming: Branch and bound technique.	
UNIT-III	10 Hours
Transportation and Assignment Problem : Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems and their optimal solutions, Transhipment, Travelling Salesman Problem	
UNIT-IV	10 Hours
Project Management: Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing. Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by linear programming.	
Text Books	
1	Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, 1st Edition, Affiliated East West Press 1976.
2	Kambo N. S., Mathematical Programming Techniques, East-West Press Pvt. Ltd., 2008.
3	Chandra S., Jayadeva, Aparna Mehra, Numerical Optimization with Applications, Narosa Publishing House, 2009.
Reference Books	
1	Gilbert Strang, Linear Algebra and its Applications, 4th Edition, Cenage Learning, 2010.
2	Taha H.A., Operations Research-An Introduction, PHI, 2007.
3	Pant J. C., Introduction to optimization: Operations Research, Jain Brothers 2004.
4	Bazaarra Mokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons, 1990.
5	Ravindran, A., Phillips, D.T. and Solberg, J.J., "Operations Research: Principles and Practice", John Wiley and Sons, NY, 2nd Edition, 1987.

OPERATIONS MANAGEMENT	
Course Code: BMA-211	Credits: 4
Contact Hours: L-3 T-1 P-0	Semester: 3
Course Category: OEC	

Introduction: This course provides a general introduction to operations management. Operations management is the design and control of business processes, that is, the recurring activities of a firm. Along with finance and marketing, operations is one of the three primary functions of a firm. At the risk of being simplistic, one may say that marketing generates the demand, finance provides the capital, and operations produces the product or delivers the service. More generally, operations spans the entire organization: COOs are in charge of R&D, design/engineering, production operations, marketing, sales, support and service.

Course Objectives: This course considers the operations from a managerial perspective .

- To explain the performance measures of operations viz. productivity, quality and effectiveness.
- Deliver important concepts such as location decision, facility layout, forecasting, production scheduling, inventory management, replacement analysis are discussed.
- Provide a fair understanding of the role of a Production / Operations Manager in business processes.
- 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 -

- Understand Productivity, efficiency and effectiveness, principles of management and organization structure;
- Understand business environment and importance of production function;
- Techniques to enhance value addition by method study;

- Be able to plan and control production;
- Manage inventory and be able to take replacement decisions;
- 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.

Contents:

UNIT I	11 Hours
Introduction –Introduction to productivity, Multi Factor productivity, Principles of management, Organization structure. **Capacity Planning, Plant Location and Plant Layout** – Introduction, need for selecting a suitable location, Location Factors, Quantitative Method, Principles of Plant layout, Types of Layout – Product, Process, Fixes Position, Cellular Layout.	
UNIT II	11 Hours
Demand Forecasting-Need for demand forecasting, Techniques of forecasting, Time series analysis, Least Square Method, Moving Average, Exponential Method and Qualitative Techniques. Method Study- Introduction, Objectives Steps, Micromotion Study, Cycle graph and chrono cycle graph, Therbligs and SIMO charts. Work Study – Objectives, Different Techniques, Standard Time, Allowances, Time study Numerical, Performance Rating, Work sampling. Process and Product Life Cycle, Material Requirement Planning – Introduction, MRP objectives, Functions served by MRP Production Planning and Control, Supply chain and Logistics Management, Production Scheduling.	
UNIT III	10 Hours

Inventory Management - Introduction, Reasons for Holding Inventories, Relevant Costs of Inventories, EOQ models, Quantity Discount Models, Safety Stock, Inventory control system, Selective Control of Inventory ABC analysis, VED analysis. Production Cost Concepts – Introduction, Cost of Production, Classification and analysis of Cost, break even analysis, Make and Buy.	
UNIT IV	10 Hours
Industrial Maintenance – Concepts of Maintenance, Organisation for Maintenance department, Types of Maintenance-Preventive, Breakdown and Corrective Maintenance, Failure Analysis, Maintenance Performance, Replacement policies of machines.	
Text Books	
1.	Martinich, J.S., Production and Operations Management: An Applied Modern Approach", John Wiley and Sons, New Delhi, 2008.
2.	Richard B. Chase, Nicholas J.A., Jacobs, F.R., "Production and Operation Management", Tata McGraw Hill, New Delhi, 1998.
3.	Ravi Shankar, "Industrial Engineering and Management", Galgotia Publications.
Reference Books	
1.	Paneerselvam, R., "Production and Operations Management", Prentice Hall India, 2012.
2	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai & Sons, 1985.

ELEMENTS OF INFORMATION THEORY	
Course Code:BEC-210 **Contact Hours:**L-3 T-1 P-0 **Course Category:** OEC	**Credits:** 4 **Semester:** 4

Introduction: Information theory deals with the study and solving the problems of communication or transmission of signals over channels. It is an essential component to decide upon the coding technique to be used for a particular application and measurement of the channel capacity. The concepts of information theory are widely used in research.

Course Objective:

- To introduce the principles and applications of information theory.
- To understand how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies.
- To calculate the capacity of a communication channel, with and without noise.
- To introduce coding schemes, including error correcting codes.
- To study efficient coding of audio-visual information, data compression.

Pre-requisite: Advanced courses of analog and digital communication**.**

Course Outcome: At the end of the course students should be able to

- Analyse the information content of a random variable from its probability distribution
- Understand and relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities
- Understand channel capacities and properties using Shannon's Theorems
- Evaluate efficient codes for data on imperfect communication channels

Pedagogy: Classroom teaching is supported by hand-outs, PowerPoint slides, assignments and notes.

Contents

UNIT-I	12 Hours
Information theory: Information rate, Entropy, Joint and conditional entropies, Kraft McMillan inequality, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit, Source coding theorem, Shannon-Fano coding.	
UNIT-II	**10 Hours**

Huffman coding, Extended Huffman coding, Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Channel, Linear Predictive coding, Introduction to Audio coding, Perceptual coding, Masking Techniques, Introduction to Speech Coding, Channel Vocoder.	
UNIT-III	**10 Hours**
Error control coding, Block codes-Definitions and Principles, Hamming weight, Hamming distance, Minimum distance decoding, Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation.	
UNIT IV	**10 Hours**
Convolution codes, Code tree, Trellis, State diagram, Error control coding, Turbo coding - Principle of Turbo coding, Video Compression - Principles I,B,P frames, Motion Estimation, Motion Compensation.	
Text Books	
1	R Bose, "Information Theory, Coding and Cryptography," McGraw hill Education, 3rd Edition, 2016.
2	Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson Education Asia, 4th Edition, 2009.
3	K. Sayood, "Introduction to Data Compression," Elsevier, 5th Edition, 2017.
Reference Books	
1	S Gravano, "Introduction to Error Control Codes," Oxford University Press, 2007.
2	Amitabha Bhattacharya, "Digital Communication," Tata McGraw Hill,1st Edition, 2017.
3	Cover and Thomas, "Elements of Information Theory," Wiley Series in Telecommunication and Signal Processing, 2nd Edition, 2006.

DISASTER MANAGEMENT	
Course Code: HMC-202 Contact Hours: L-1 T-0 P-2 Course Category: HMC	Credits: 2 Semester: 4

Introduction - Natural and technological hazards affect the everyday life as well as long-term development plans. For many decades the prevailing approach in dealing with disasters was focus on response and recovery, however lately pre-disaster actions to minimize the disaster risks are getting importance. The course introduces Disaster Management, focusing on natural disasters.

Course Objective:

- To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences
- To ensure knowledge, skills and abilities to analyse potential effects of disasters and the strategies and methods for disaster reduction

Pre-requisite: None

Course Outcomes

- Capacity to integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels
- Capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects, minimise risk, prepared community and develop capacities to mitigate disasters.
- Capacity to work at the time of need, support community. To understand theoretically and practically different step of disaster management and relate their interconnections, with psychosocial, livelihood, logistics and Public Health aspects of the disasters

Pedagogy: Classroom teaching, Practical, demonstrations and field work.

Content

UNIT-I	4 Hours
Concepts and definitions of disaster - hazard, vulnerability, resilience, risks, rehabilitation, reconstruction, search and rescue before, during and after disasters. Disaster Profile of India – Mega Disasters of India and Lessons Learnt.	
UNIT-II	10 Hours
Categories of disasters -Natural disasters – earthquake, cyclone, landslide, flood, tsunami, heat waves, cold waves, avalanches, Man-made disasters – fire, urban fire, forest fire, Chemical, biological, radiological and nuclear disasters, armed conflict and civil strife**,** oil and Gas leakage, Transport disasters Factors affecting Vulnerabilities, impact of Development projects such as dams, high rise constructions etc.	
UNIT-III	6 Hours
Geo-informatics in Disaster Management (RS, GIS, GPS and RS), Disaster Communication System (Early Warning and Its Dissemination), Use of ICT, mobile technology, alarms etc, Application of Drone.	
UNIT IV	8 Hours
Disaster Management Act 2005, Disaster Management National Policy, Disaster Management cycle, Role of Government (local, state and national), Non-Government, Inter-Governmental and UN Agencies.	
Practical Component	
Demonstration of Cardiopulmonary Resuscitation (CPR) Demonstration of • Search and Rescue Operations • Earthquake Evacuation Drill Demonstration of Fire Drill	
Text Books	
1	Alexander David, Introduction in Confronting Catastrophe, Oxford University Press, 2000.
2	Kapur, Anu& others, Disasters in India Studies of grim reality, Rawat Publishers, Jaipur, 2005.
3	MuktaGirdhar, Natural Disasters, Amy publication, Dariyaganj, New Delhi, 2019.
Reference Books	
1	Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social

	Sciences Working Paper No. 8, 2008.
2	Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.

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