Choice Based Credit System

140 Credit (3-Year UG Hons.) MAKAUT Framework

B. Sc. in Digital Forensics

Course Curriculum Structure:

B.Sc. in Digital Forensic	
Course Duration	3 Years (6 Semester)
Course Credit	140

CBCS course structure & Credit Distribution & implementation planning at MAKAUT WB

Subject type	Abbreviation	Number of courses	Credit Point	Total Credit	Credit Distribution	Proposed MOOCs	Mode of delivery
Core Course	CC	14	6	84	(Theory 4+Prac 2) or (Theory 5 + Tutorial1)		Offline/ Blended
Discipline Specific Elective	DSE	4	6	24	(Theory 4+Prac 2) or Project Dissertation		Offline/ Blended
Generic Elective or Interdisciplinary	GE	4	6	24	(Theory 4+Prac 2) or (Theory 5+ Tutorial 1)	2/12	Offline/ Online
Ability Enhancement Course	AECC	2	2	4	Theory 2 No Prac or Tutorial	1/2	Online
Skill Enhancement course	SEC	2	2	4	Theory 2 No Prac or Tutorial	1/2	Online
		26		140		4/16	

Semester-wise distribution of courses:

Subject type	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
CC	C1, C2	C3, C4	C5, C6, C7	C8, C9, C10	C11, C12	C13, C14
DSE					DSE1, DSE2	DSE3, DSE4
GE	GE1	GE2	GE3	GE4		
AECC	AECC1	AECC2				
SEC			SEC1	SEC2		
	4 (20)	4 (20)	5 (26)	5 (26)	4 (24)	4 (24)

Core Course (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

Elective Course: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope, or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

B.Sc. in Digital Forensics

Program Outcomes or Graduate Attributes of B.Sc. Digital Forensics Program under MAKAUT:

Graduates will be able to demonstrate the following program outcomes:

PO1- Digital Forensic Knowledge: Apply the knowledge of computer systems, networking, data systems and digital forensic specializations to the solution of complex digital forensics problems.

PO2- Design/Development of Solutions: Identify, formulate, review and research design solutions for complex digital forensic and cyber security problems and design digital forensic lab and processes to meet the specified needs with appropriate consideration for the public and private data security and the cultural, societal and environmental considerations.

PO3- Digital Forensic Professional and Society: Create, select and apply techniques, resources and modern digital forensic and cyber security tools and techniques to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the digital forensic cases and professional cyber security service

PO4- Individual and teamwork: Apply ethical principles and commit to professional ethics and responsibilities and norms of the digital forensic and cyber security practice as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

PO5- Communication: Communicate effectively on complex digital forensic and cyber security activities with IT 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.

PO6- Lifelong Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

Program Outcomes (PO) Mapping:

PO #	Program Outcome	Mapped Course
1	Digital Forensics Knowledge	BDF101, BDF102, BDF201, BDF202, BDF301, BDF302, BDF303, BDF501, BDF502, BDF601, BDF602,
2	Digital Forensics Professional & Society	BDF204, BDF404,
3	Design/Development of Solutions	BDF401, BDF402, BDF403
4	Individual and Teamwork	BDF393
5	Communication	BDF104
6	Life-Long Learning	BDF301, BDF302, BDF303, BDF401, BDF403, BDF404, BDF501, BDF502, BDF601

<u>Core Course Subject Details:</u>

Year	Semester	CBCS Structure (Core Course Code)	Paper Code	Paper Name
First	I	CC1	BDF101	Fundamentals of Digital Systems
		CC2	BDF102	Introduction to Programming
	II	CC3	BDF201	Introduction to Digital Forensics & Cyber Laws
		CC4	BDF202	Data Structures and Algorithms
Second	III	CC5	BDF301	Computer Networks and Network Security
		CC6	BDF302	Cyber Security
		CC7	BDF303	Biometric Security
	IV	CC8	BDF401	Cryptography
		CC9	BDF402	Software Engineering
		CC10	BDF403	Image Processing and Pattern Recognition
Third	V	CC11	BDF501	Computer Forensics
		CC12	BDF502	Preserving and Recovering Digital Evidence
	VI	CC13	BDF601	Mobile Forensics and Wireless Security
		CC14	BDF602	Malware Analysis

I.   <u>Generic Elective Courses (Semester – I to Semester – IV)</u>

Semester	Paper Code	GE Code	GE Basket	Paper Name
I	BDF103	A	GE – 1	The Yoga Professional
		B		Indian History & Culture
		C		Cinema and Other Arts
		D		Health Education & Communication
II	BDF203	A	GE – 2	Basic Mathematics & Statistics
		B		Operations Research
		C		Probability & Statistics
		D		Mathematics for Computing
III	BDF304	A	GE – 3	Data Analytics
		B		Mathematics for Machine Learning
		C		IT Literacy
		D		Applied Cryptography
IV	BDF404	A	GE – 4	Entrepreneurship Theory & Practice
		B		Principles of Management
		C		Economics
		D		Accounting

*Students can earn the credits by choosing elective courses from GE basket

** Credits will be transferred as per the scheduled guidelines.

II. Skill Enhancement Courses: (Semester – III and IV)

Semester	Paper Code	SEC Code	SEC Basket	Paper Name
III	BDF305	A	SEC – 1	Operating Systems and System Software
		B		Operating Systems with Linux
		C		Programming for Problem Solving
		D		Introduction to Financial Technology
IV	BDF405	A	SEC – 2	Database Management Systems and Security
		B		e-Commerce security
		C		Web security
		D		Secure Software Design

* Students can earn the credits by choosing elective courses from SEC basket

** Credits will be transferred as per the scheduled guidelines.

III. Discipline Specific Elective: (Semester – V and Semester – VI)

Semester	Paper Code	DSE Code	DSE Basket	Paper Name
V	BDF503	A	DSE – 1	Computer Organization and Embedded Networking
		B		Linear Algebra and Natural Language Processing
		C		Security Testing
	BDF504	A	DSE – 2	Advanced Networking and IoT
		B		Cloud Architectures and Security
		C		Image Processing and Security
VI	BDF603	A	DSE –3	Data Warehousing and Data Mining
		B		Blockchain & Crypto Currency
		C		Mobile Ad-Hoc Network Security
	BDF604	A	DSE – 4	Crime and Society
		B		Economic Offences
		C		Course: Criminalistics

* Students can earn the credits by choosing elective courses from DSE basket

** Credits will be transferred as per the scheduled guidelines.

IV.   **Ability Enhancement Compulsory Course: (Semester – I and II)**

S. No.	CBCS Category	Course Code	Paper Name
1	AECC1	BDF104	English Communication
2	AECC2	BDF204	Environmental Science

B.Sc. in Digital Forensics Curriculum Structure

			Semester – I					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC1	BDF101	Fundamentals of Digital Systems	3	1	0	4	Offline
2	LAB – 1	BDF191	Fundamentals of Digital Systems Lab	0	0	4	2	Offline
3	CC2	BDF102	Introduction to Programming	3	1	0	4	Offline
4	LAB – 2	BDF192	Introduction to Programming Lab	0	0	4	2	Offline
5	GE-1	BDF103	Students will have to choose from the GE Basket	5	1	0	6	Offline / Online / Blended
6	AECC-1	BDF104	English Communication	2	0	0	2	Offline / Online
Total Credits of Semester – I				13	3	8	20	

			Semester – II					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC3	BDF201	Introduction to Digital Forensics & Cyber Laws	4	0	0	4	Offline
2	LAB – 1	BDF291	Introduction to Digital Forensics & Cyber Laws Lab	0	0	4	2	Offline
3	CC4	BDF202	Data Structures and Algorithms	4	0	0	4	Offline
4	LAB – 2	BDF292	Data Structures and Algorithms Lab	0	0	4	2	Offline
5	GE-1	BDF203	Students will have to choose from the GE Basket	5	1	0	6	Offline / Online / Blended
6	AECC-2	BDF204	Environmental Science	2	0	0	2	Offline / Online
Total Credits of Semester – II				13	3	8	20	

			Semester – III					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC5	BDF301	Computer Networks and Network Security	4	0	0	4	Offline
2	LAB – 1	BDF391	Computer Networks and Network Security Lab	0	0	4	2	Offline
3	CC6	BDF302	Cyber Security	3	1	0	4	Offline
4	LAB – 2	BDF392	Cyber Security Lab	0	0	4	2	Offline
5	CC7	BDF303	Biometric Security	5	1	0	6	Offline
6	GE-3	BDF304	Students will choose from the GE Basket	5	1	0	6	Offline / Online
7	SEC – 1	BDF305	Students will choose from the SEC Basket	2	0	0	2	Offline
Total Credits of Semester – III				18	4	8	26	

			Semester – IV					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC8	BDF401	Cryptography	4	0	0	4	Offline
2	LAB – 1	BDF491	Cryptography Lab	0	0	4	2	Offline
3	CC9	BDF402	Software Engineering	4	0	0	4	Offline
4	LAB – 2	BDF492	Software Engineering Lab	0	0	4	2	Offline
5	CC10	BDF403	Image Processing and Pattern Recognition	4	0	0	4	Offline
	CC10	BDF493	Image Processing and Pattern Recognition LAB	0	0	4	2	Offline
6	GE-3	BDF404	Students will choose from the GE Basket	5	1	0	6	Offline / Online
7	SEC – 2	BDF405	Students will choose from the SEC Basket	2	0	0	2	Blended
Total Credits of Semester – IV				18	4	8	26	

			Semester – V					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC11	BDF501	Computer Forensics	4	0	0	4	Offline
2	LAB – 1	BDF591	Computer Forensics Lab	0	0	4	2	Offline
3	CC12	BDF502	Preserving and Recovering Digital Evidence	4	0	0	4	Offline
4	LAB – 2	BDF592	Preserving and Recovering Digital Evidence Lab	0	0	4	2	Offline
5	DSE – 1	BDF503	Students will choose from the DSE Basket	5	1	0	6	Blended
6	DSE – 2	BDF504	Students will choose from the DSE Basket	3	0	0	3	Offline
7	DSE	BDF581	Project Work	0	0	6	3	Offline
Total Credits of Semester – V				14	3	14	24	

			Semester – VI					
S. No.	CBCS Category ***	Course Code	Course Name	L	T	P	Credits	Mode of Delivery
1	CC13	BDF601	Mobile Forensics and Wireless Security	4	0	0	4	Offline
2	LAB – 1	BDF691	Mobile Forensics and Wireless Security Lab	0	0	4	2	Offline
3	CC14	BDF602	Malware Analysis	4	0	0	4	Offline
4	LAB – 2	BDF692	Malware Analysis Lab	0	0	4	2	Offline
5	DSE – 3	BDF603	Students will choose from the DSE Basket	5	1	0	6	Blended
6	DSE – 4	BDF604	Students will choose from the DSE Basket	3	0	0	3	Offline
7	DSE	BDF681	Project Work	0	0	6	3	Offline
Total Credits of Semester – V				14	3	14	24	

Core Course Subject Details:

Semester I

Course: Fundamentals of Digital Systems

Code: BDF101

Course Objective: This course builds an understanding of the structure of computers and how they execute programs. The course introduces data representation, computer arithmetic, and machine instruction set design. It is intended to provide working knowledge of digital logic levels and help application of knowledge to understand, design and perform analysis of various digital electronic circuits.

Sl.	Course Outcome	Mapped Modules
1	Students will be able to understand the concept of Number System and implement binary and hexadecimal number system	M1
2	Students will be able to understand the concept of Logic Gates	M1, M2
3	Students will be able to understand and implement the concept of Boolean Algebra	M2, M3
4	Students will be able to understand and implement the concept of Combinational Logic	M2, M3, M4
5	Students will be able to understand and implement the concept of Sequential Circuit	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Number Systems	12	10	1,2	
M 2	Logic Gates	8	15	1,2	
M 3	Boolean Algebra and Logic Simplifications.	10	15	2,3,4	
M 4	Combinational Logic and its functions,	10	30	3,4	
M 5	Sequential Circuits	16	30	3,4,5	
		56	100		

Paper: Fundamentals of Digital Systems (Including Lab)
Code: BDF101 (Lab Code: BDF191)
Contacts Hours / Week: 3L + 1T +4P
Credits: 4+2

Module 1:
Number Systems, Operations and Codes, Decimal Numbers, Binary Numbers, Decimal to Binary Conversion, Binary Arithmetic, 1's and 2's complement of binary numbers, Signed numbers, Arithmetic operations with signed numbers, Hexadecimal numbers, Binary to hexadecimal conversion, Hexadecimal to binary conversion, Hexadecimal to decimal conversion, Decimal to Hexadecimal conversion, Hexadecimal addition and subtraction, Octal numbers, Octal to decimal conversion, Decimal to Octal conversion, Octal to binary conversion, Binary to Octal conversion, Binary coded decimal, 8421 BCD code, BCD addition, Digital codes- gray code, binary to gray code conversion, Alphanumeric codes, parity codes. (12 hours)

Module 2:
Logic Gates, Logic Levels and Waveforms, Logic Levels and Digital waveforms, Logic Gates: AND, OR, NOT, XOR, XNOR, NAND (Definition, Symbols, Truth Tables and Operation). Universal Property of NAND and NOR gates. Logic gate operations with pulse waveforms. (8 hours)

Module 3:
Boolean algebra and Logic Simplifications. Boolean operations and expressions, Laws and rules of Boolean algebra, De Morgan's theorems, Boolean analysis of logic circuits, simplification using Boolean algebra, standard forms of Boolean expression, Boolean expressions and truth tables. The Karnaugh Map, Karnaugh SOP minimization, Karnaugh POS minimization, Five variable Karnaugh maps. (12 hours)

Module 4:
Combinational Logic and its functions, Basic combinational Logic circuits, implementing combinational logic, combinational logic using NAND and NOR gates, Basic overview of logic functions, Basic adders, parallel binary adders, comparators, decoders, encoders, code converters, multiplexers, demultiplexers, parity generators/ checkers. (10 hours)

Module 5:
Sequential Circuits, Latches, RS flip flop using NAND/ NOR gates, Clocked RS, D, JK and T flip flops, Edge triggered flip flops, Master slave flip flops, Asynchronous counter operation, Synchronous counter operations, Up/ Down Synchronous counter, Design of synchronous counters. Basic shift register functions. Serial in-Parallel out shift registers, Parallel in -Serial out shift registers, Serial in- Serial out shift registers, Parallel in Parallel out shift registers. (16 hours)

Reference Books:
1. Floyd and Jain- Digital Fundamentals, Eighth Edition, Pearson Education.
2. A P Malvino and D P Leach, Digital Principles and Applications, Fourth edition, Tata McGraw Hill Publishers, co Ltd.
   Brian Holdsworth Clive Woods, Digital Logic Design, Fourth Edition, Elsevier Science &Technology
3. M. Morris Mano and Michael D. Ciletti, Digital Design with an Introduction to Verilog HDL, Fifth Edition, Pearson Education Limited
4. M. Morris Mano, Digital Logic & Computer Design, Pearson Education India

Course: Introduction to Programming

Code: BDF102

Course Objective: The course is designed to provide working knowledge and develop programming skills by using contemporary programming language. Students will develop problem solving strategies and skills of logical thinking that will help them to solve real world problems. Also, by learning the basic programming constructs students will be able to learn any other programming languages in future.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of programming fundamentals	M1
2	Students will understand the concept of Classes and Objects	M1, M2
3	Students will be able to understand and implement the concept of Constructors	M1, M3
4	Students will be able to understand and implement the concept of Inheritance	M1, M4
5	Understand and remember the concept and use of Pointers	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to programming,	8	10	1,2	
M 2	Classes and Objects	14	20	1,2	
M 3	Constructors	12	20	2,3,4	
M 4	Inheritance	10	20	3,4	
M 5	Pointers	12	30	3,4,5	
		56	100		

Paper: Introduction to Programming (Including Lab)

Code: BDF102 (Lab Code: BDF192)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1:
Introduction to programming, Classification of computer languages, Language translators (Assembler, Compiler, Interpreter), Linker, Characteristics of a good programming language, Factors for selecting a language, Subprogram, Purpose of program planning, Algorithm, Flowchart, Pseudo code, Control structures (sequence, selection, Iteration), Testing and debugging. Procedure Oriented Programming- Object Oriented Programming- A simple C++ program- Structure of C++ program- Tokens- Data types- variables- Symbolic constants- Reference by variables-Operators in C++- Operator precedence- Control structures- Arrays. (8 hours)

Module 2:
Classes and Objects, Function in C++ - The main function, Function prototyping- Call by value- Call by reference- Return by reference. Basic concepts of object-oriented programming- Benefits of OOP- Applications of OOP. Specifying a class- Defining member functions-Private member functions- Arrays within a class - Memory allocation for objects-Static data members - Static member functions -Arrays of objects -Friendly functions. (14 hours)

Module 3:
Constructors, Default constructor-Parameterized constructor-Copy constructor- Multiple constructors-Constructors with default arguments- Dynamic constructor-Destructors- Operator overloading- Unary and Binary operator overloading- Overloading using friends- Rules for overloading- Type conversion. (12 hours)

Module 4:
Inheritance, Defining derived classes-Visibility modes-Single, Multilevel, Multiple, Hierarchical and Hybrid inheritance- Virtual base classes- Abstract classes- Constructors in derived classes. (10 hours)

Module 5:
Pointers, Pointers to objects- this pointer-Pointers to derived classes- Virtual functions- Pure virtual functions-Opening and closing a file- File opening modes- File pointers and their manipulations- Sequential input and output operations. (12 hours)

Reference Books:
1. Ashok N. Kamthane, Object oriented Programming with ANSI & Turbo C++, First Edition, 2011, Pearson India.
2. P K Sinha & Priti Sinha, Computer Fundamentals, Reprint 2018, BPB Publications.
3. Balagurusamy, Object Oriented Programming with C++, E. Fifth edition, Tata McGrawEducation Hill, 2011.
4. Ashok Kamthane, Programming in C, Third Edition, 2015, Pearson Education.
5. D Ravichandran, Programming with C++, Second edition, 2002, Tata McGraw- Hill.

Semester II

Course: Introduction to Digital Forensics & Cyber Laws

Code: BDF201

Course Objective: The course is designed to provide basic knowledge and impart skills of Digital Forensics Technology. To provide students with the ability of analyze and validate Forensics Data. The course also provides knowledge on Cyber Laws, which will help the students to understand and analyze the legal aspects related to cyber-crimes.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the basic concepts of Cyber Forensics	M1
2	Students will be able to Comprehend facts and ideas about Types of Computer Forensics Systems	M1, M2
3	Students will learn about the Evidence collection and data seizure procedures	M2, M3
4	Students will be able to know about different cyber laws	M4
5	Students will be able to understand different types of cyber-attacks and related cyber crimes	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Cyber forensics:	12	10	1,2	
M 2	Types of Computer Forensics Systems	10	10	1,2	
M 3	Evidence Collection and Data Seizure	12	20	2,3,4	
M 4	Cyber Law	10	30	2.3,4	
M 5	Cyber Crimes	12	30	4,5	
		56	100		

Paper: Introduction to Digital Forensics & Cyber Laws (Including Lab)
Code: BDF201 (Lab Code: BDF291)
Contacts Hours / Week: 4L + 4P
Credits: 4+2

Module 1
Introduction to Cyber forensics: Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases. Analyzing malicious software. Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems. (12 hours)

Module 2
Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft, Biometric Security Systems, Router Forensics. Cyber forensics tools and case studies. Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking. (10 hours)

Module 3
Evidence Collection and Data Seizure: Why Collect Evidence, Collection Options Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Controlling Contamination: The Chain of Custody, Reconstructing the Attack, The digital crime scene, Investigating Cybercrime, Investigating Web attacks, Investigating network Traffic ,Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events. (12 hours)

Module 4
Cyber Law: Basic of law, Understanding cyber space, Defining cyber law, Scope and jurisprudence, Concept of jurisprudence, Overview of Indian legal system, Introduction to IT Act 2000, Amendment in IT Act. (10 hours)

Module 5
Cyber Crimes: Types of cybercrimes– Against individual institution, and states-various offenses and punishments, digital signature-concepts of public key and private key, certification authorities and their role, creation and authentication of digital signature. E-contracting- Salient features of E-contracts, formation of E-contracts and types, E-governance, E-governance models, E-commerce- salient features and advantages. (12 hours)

Reference Books:
1. John R. Vacca, Charles River Media, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, 2005

2. Christof Paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2010, Second Edition, Springer's.
3. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, First edition, 2009
4. Barkhs and U. Rama Mohan, Cyber Law Crimes, Third Edition, 2017, Asia Law House
5. ViveekSood, Cyber Laws Simplified, Fourth reprint 2008, McGraw Hill.

Course: Data Structures and Algorithms

Code: BDF202

Course Objective: The learner should be well versed with the various data structures, fundamentals of algorithms, different sorting and searching techniques and will be able to use them appropriately as per need during development of programs. The course will also teach how to solve problems using data structures suchas linear lists, stacks, queues, hash tables, binary trees, heaps, binary search trees, and graphs and writing programs for these solutions.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand and implement the basic concepts of Data Structure	M1
2	Students will be able to understand how stack data structure work in computer memory to implement a program	M1, M2
3	Students will be able to understand how queue data structure work in computer memory to implement a program	M1, M3
4	Students will be able to understand how tree data structure work in computer memory to implement a program	M1, M4
5	Students will be able to understand and implement the concept of sorting	M3, M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Data Structures	12	10	1,2	
M 2	Stack	10	20	1,2	
M 3	Queue	12	20	2,3,4	
M 4	Trees	10	20	3,4	
M 5	Sorting	12	20	4,5	
		56	100		

Paper: Data Structures and Algorithms (Including Lab)

Code: BDF202 (Lab Code: BDF292)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1
Introduction to Data Structures: Basic Terminology, Data Structure Operations; Algorithm: Definition, Algorithm Analysis, Complexity, Asymptotic Notation, Recursion. Array: Introduction, Linear Arrays, Representation of Linear Arrays in Memory, operations; Multidimensional Arrays. (12 hours)

Module 2
Stack: Introduction, Array Representation and Basic Operations; Implementation of Stacks. Application of Stacks, Evaluating Arithmetic Expression using Stacks, Infix to Postfix Notation, Evaluating a Postfix Notation. (10 hours)

 Module 3
Queue: Introduction, Implementation of Queue, Priority Queue, Dequeue, Linked List: Introduction, Representation of Linked List, operations in Linked List, Doubly and Circular Linked List. (12 hours)

Module 4
Trees: Introduction, Binary Trees, Representation, Traversing and its Algorithms, AVL tree. (10 hours)

Module 5
Sorting: Bubble sort, Insertion sort, Selection sort, Heap sort, Quick sort, Merge sort; Comparison of sorting algorithms. Searching: Linear Search, Binary Search; Comparison of searching algorithms. (12 hours)

Reference Books:
1. Seymour Lipschutz, Schaum's Outline Series: Theory and Problems of Data Structures, 1986, McGraw- Hill.
2. Goodrich Michael T, Data Structures and Algorithms in C++, Second edition, 2016, Wiley.
3. Mark allenWeiss, Data structures and Algorithm Analysis in C++, Third edition, 2007, Pearson Education India.
4. Seymour Lipschutz, Data Structures, Revised First edition, 2014, McGraw Hill Education.
5. Robert Sedgewick, Algorithms in C++, 2001, Addison-Wesley

Semester III

Course: Computer Networks and Network Security

Code: BDF301

Course Objective: The course is designed to provide basic knowledge of computer networking and develop in students an understanding of different components of computer networks, various protocols, modern technologies and their applications. The course will also introduce students to various protocols for network security and technologies to protect networks from security threats.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of computer networking and get the knowledge of different Network models and protocols	M1
2	Students will be able to understand the concept of computer security in terms of computer network.	M1, M2
3	Students will be able to understand the concept of cryptography and will know about different types of cryptography and some basic cryptographyalgorithm.	M2, M3
4	Students will be able to understand how the transport layer security has been implemented	M3,M4
5	Students will be able to understand the concept of electronic mail security	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Computer Network Model and Protocol:	12	10	1,2	
M 2	Computer Security Concepts	10	20	1,2	
M 3	Basic Cryptography	12	30	2,3,4	
M 4	Transport-Level Security	10	20	4,5	
M 5	Electronic Mail Security	12	20	3,4,5	
		56	100		

Paper: Computer Networks and Network Security (Including Lab)

Code: BDF301 (Lab Code: BDF391)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1
Computer Network Model and Protocol: Types of Computer Networks, Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model. Protocol Hierarchies Network layer: Routing Algorithm, ARP,RARP-Transport Layer: Elements of transport protocols, UDP, Segment Structure, TCP ,Service model, TCP Protocol, Application Layer: HTTP, DNS. (12 hours)

Module 2
Computer Security Concepts, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. Access Control Models, Chinese Wall, Clark-Wilson, Bell-LaPadula, Non-Interference and Role Base Model. (10 hours)

Module 3
Basic Cryptography, Symmetric Encryption Principles, Symmetric Block Encryption Algorithms. Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures. Key Distribution and User Authentication: Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure. (12 hours)

Module 4
Transport-Level Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell (SSH). IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange. (10 hours)

Module 5
Electronic Mail Security: Pretty Good Privacy, S/MIME. Intruders: Intruders, Intrusion Detection, Password Management. Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations. (12 hours)

Reference Books:
1. William Stallings, Network security essentials, fourth edition, 2011 Pearson Education Computer
2. S. Tanenbaum, Networks, Andrew fifth Edition, 2013, Pearson Education India.
3. Behrouz A. Forouzan, Data communications and networking, 2017,McGraw Hill Education
4. W. Stallings, Cryptography and network security: Principles and practice, Fifth Edition, Upper Saddle River, NJ: Prentice Hall
5. M. Merkow, & J. Breithaupt, Information security: Principles and practices, Second Edition, 2006, Upper Saddle River, NJ: Prentice Hall

Course: Cyber Security

Code: BDF302

Course Objective: The course is designed to provide basic knowledge of Cyber Security and develop skills in students to analyze and resolve security issues in networks and computer systems. The course is also designed to provide knowledge on practical hacking techniques and their countermeasures.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Ethical Hacking.	M1
2	Students will be able to understand the concept of information gathering and its different types	M1, M2
3	Students will be able to understand the concept of scanning	M2, M3
4	Students will be able to understand the concept of system and network-based hacking and its counter measure.	M3, M4
5	Students will be able to understand the concept of Web Application Security and itscounter measure.	M3, M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Ethical Hacking,	8	10	1,2	
M 2	Information Gathering	8	10	1,2	
M 3	Scanning	12	20	2,3,4	
M 4	System and Network Hacking	14	30	2.3,4	
M 5	Web Application Security	14	30	3,4,5	
		56	100		

Paper: Cyber Security (Including Lab)
Code: BDF302 (Lab Code: BDF392)
Contacts Hours / Week: 3L + 1T+4P
Credits: 4+2

Module 1
Introduction to Ethical Hacking, Introduction Ethical Hacking terminology- Five stages of hacking-Vulnerability Research Legal implication of hacking Impact of hacking. (8 hours)

Module 2
Information Gathering, Foot printing & Social engineering Information gathering methodologies-Competitive Intelligence- DNS Enumerations- Social Engineering attacks. (8 hours)

Module 3
Scanning, Scanning & Enumeration Port Scanning-Network Scanning- Vulnerability Scanning-NMAP scanning tool- OS Fingerprinting Enumeration. (12 hours)

Module 4
System and Network Hacking, System Hacking Password cracking techniques- Key loggers-Escalating privileges- Hiding Files- Steganography technologies- Countermeasures. Active and passive sniffing- ARP Poisoning. (14 hours)

Module 5
Web Application Security, SQL Injection, Different types of SQL Injection, Cross Site Scripting - Session Hijacking- DNS Spoofing- Conduct SQL Injection attack - Countermeasures. (14 hours)
Reference Books:
1. Kimberly Graves, "CEH: Official Certified Ethical Hacker Review Guide", Wiley Publishing Inc., 2007.
2. Shakeel Ali &TediHeriyanto, Backtrack -4: Assuring security by penetration testing, PACKT Publishing.
3. M. Merkow, & J. Breithaupt, Information security: Principles and practices, Second Edition, 2006, Upper Saddle River, NJ:Prentice Hall
4. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, Second Edition, Upper Saddle River, NJ:Prentice HalL
5. Gary McGraw, Software Security: Building Security, Edition 2006, Addison-Wesley

Course: Biometric Security

Code: BDF303

Course Objective: The course is designed to provide basic knowledge of Biometric Security and develop skills to understand and analyze biometric systems at the component level and ability to analyze and design basic biometric system applications and how a system can be secured using biometric measures.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Biometric fundamentals andstandards	M1
2	Students will be able to understand the concept of Physiological Biometric Technologies and will also be able to analyze its workflow and different components.	M1, M2
3	Students will be able to understand the detailed concept of Physiological BiometricTechnologies	M2,M3
4	Students will be able to understand the concept of Signature and handwritingtechnology	M3,M4
5	Understand the concept of Multi biometrics and multi factor biometrics	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Biometric fundamentals and standards	10	10	1,2	
M 2	Physiological Biometric Technologies	12	20	1,2	
M 3	Physiological Biometric Technologies (Cont.)	12	40	2,3,4	
M 4	Signature and handwriting technology	12	30	2.3,4	
M 5	Multi biometrics and multi factor biometrics	10	100		

Paper: Biometric Security

Code: BDF303

Contacts Hours/Week:5L+1T

Credits:6

Module 1
Biometric fundamentals and standards: Definition, Biometrics versus traditional techniques, Characteristics, Key biometric processes: Verification - Identification - Biometric matching, Performance measures in biometric systems, assessing the privacy risks of biometrics - Designing privacy sympathetic biometric systems, Different biometric standards, and Application properties. (10 hours)

Module 2
Physiological Biometric Technologies: Fingerprints, Technical description, characteristics, Competing technologies, strengths, weaknesses, deployment, Facial scan, Technical description, characteristics, weaknesses-deployment, Iris scan, Technical description, characteristics, strengths, weaknesses, deployment. (12 hours)

Module 3
Physiological Biometric Technologies (Cont.), Retina vascular pattern, Technical description, characteristics, strengths, weaknesses, Deployment, Hand scan, Technical description, characteristics, strengths, weaknesses deployment, DNA biometrics. Behavioral Biometric Technologies: Handprint Biometrics, DNA Biometrics. (12 hours)

Module 4
Signature and handwriting technology, technical description, classification, keyboard / keystroke dynamics, Voice, data acquisition, feature extraction, characteristics, strengths, weaknesses, deployment. (12 hours)

Module 5
Multi biometrics and multi factor biometrics, two-factor authentication with passwords, tickets and tokens, executive decision, implementation plan. (10 hours)

Reference Books:
1. Anil K Jain, Patrick Flynn and Arun A Ross, Handbook of Biometrics, 2010, Springer, USA.
2. John R Vacca, Biometric Technologies and Verification Systems, 2009.Elsevier, USA
3. Samir Nanavathi, Michel Thieme, and Raj Nanavathi,, Biometrics -Identity verification in a network, 1st Edition, 2002. Wiley Eastern.
4. John Chirillo and Scott Blaul, Implementing Biometric Security, 1st Edition, 2005, Wiley Eastern Publication.
5. John Berger, Biometrics for Network Security, 1st Edition,2004, Prentice Hall.

Semester IV

Course: Cryptography

Code: BDF401

Course Objective: The course is designed to provide basic knowledge of Cryptography and help understand how encryption can be used to secure information in storage and during transfer over insecure channels. The course also aims at introducing students to the various encryption techniques and algorithms.

Sl.	Course Outcome	Mapped Module
1	Students will be able to learn the evolution of cryptography and important terminologies	M1
2	Students will be able to understand the concept of Basic Protocols	M1, M2
3	Students will be able to understand the concept of Advanced Protocol	M2,M3
4	Students will be able to understand the concept of Cryptographic technique andalgorithm.	M3,M4
5	Students will be able to understand and analyze the concept of Hash Function	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Foundation, Terminology	10	10	1,2	
M 2	Basic Protocols	12	20	1,2	
M 3	Advanced Protocols	12	20	2,3,4	
M 4	Cryptographic Techniques	12	30	3,4	
M 5	One way Hash Function	10	20	3,4,5	
		56	100		

Paper: Cryptography (Including Lab)
Code: BDF401 (Lab Code: BDF491)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1
Foundation, Terminology, Substitution Cipher and Transposition Cipher, Simple XOR, One Time Pads, Computer Algorithms, Large Numbers, Cryptographic Protocols, Communication using Symmetric Cryptography, One Way Functions-One Way Hash Function Communications using Public Key Cryptography, Digital Signatures-Digital Signature with Encryption, Random and Pseudo Random Sequence Generation. (10 hours)

Module 2
Basic Protocols-Key Exchange, Authentication, Authentication and Key Exchange, Formal Analysis of Authentication and Key Exchange Protocols-Multiple Key Public Key Cryptography, Secret Splitting-Secret Sharing. Intermediate Protocols, Timestamp Services- Sublimal Channel, Undeniable Digital Signature- Proxy Signature, Group Signature. (12 hours)

Module 3
Advanced Protocols, Zero knowledge proofs, Zero knowledge proofs of identity, Blind Signature, Identity based Public key cryptography-Digital Certified Mail. Esoteric Protocol, Secure Elections, Secure Multiparty Computation, Anonymous Multiparty Computation- Anonymous Message Broadcast, Digital Cash. (12 hours)

Module 4
Cryptographic Techniques, Key length, Key Management, Public Key Cryptography Versus Symmetric Cryptography, Encrypting communication Channel, Encrypting Data for storage-Hardware vs software Encryption. Cryptographic Algorithm, Information Theory, Data Encryption Standard (DES), IDEA, Blowfish. (12 hours)

Module 5
One way Hash Function- N Hash- MD4- MD5-MD2- Secure Hash Algorithm (SHA)- Public Key algorithms, Knapsack Algorithm, RSA- Public Key Digital Signature Algorithms- Digital Signature Algorithm(DSA)- DSA Variants- Gost Digital Signature Algorithm, Key Exchange Algorithm- Diffie Hellman – Station to Station Protocol, Encrypted Key Exchange. (10 hours)

Reference Books:
1. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in, Second Edition, 1996, John Wiley & Sons, Inc.
2. William Stallings, Cryptography and Network Security: Principles and Practice, Sixth Edition, 2013, Pearson
3. M. Merkow, & J. Breithaupt, Information security: Principles and practices, Second
4. Edition, 2006, Upper Saddle River, NJ: Prentice Hall
5. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, Second Edition, Upper Saddle River, NJ: Prentice HalL
6. Niels Ferguson, Bruce Schneier, Practical Cryptography, Edition 2003, Wiley

Course: Software Engineering

Code: BDF402

Course Objective: The course is designed to provide basic knowledge of Software development and understand the fundamental software processes and life cycles. The course will help students develop skills enabling them to develop, test and maintain software.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Software Engineering and why it is needed	M1
2	Students will be able to understand the concept of Software Development Life Cycle (SDLC) and also different SDLC Models	M1, M2
3	Students will be able to understand the concept of Software Requirement Analysis and different Specification Requirements	M2, M3
4	Students will be able to understand the concept of Design and principles	M3, M4
5	Students will be able to understand and implement the procedure of Software Testing	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Software Engineering	12	10		
M 2	Software life cycle models	10	20		
M 3	Software Requirement Analysis and Specification Requirements	12	20		
M 4	Design concept and principles	8	20		
M 5	Software Testing	14	30		
		56	100		

Paper: Software Engineering (Including Lab)

Code: BDF402 (Lab Code: BDF492)

Contacts Hours / Week: 4L + 4P
Credits: 4+2

Module 1
Introduction to Software Engineering, Definition, Program Vs Software, and Software process, Software Characteristics, Brief introduction about product and process, Software process and product matrices. (12 hours)

Module 2
Software life cycle models, Definition, Waterfall model, Increment process models, Evolutionary process models, Selection of a life cycle model. (10 hours)

Module 3
Software Requirement Analysis and Specification Requirements, Engineering type of requirements, Feasibility Studies, Requirement Elicitation, Various steps for requirement analysis, Requirement documentation, Requirement validation. Project planning-Size estimation, cost estimation, the constructive cost model (COCOMO) (12 hours)

Module 4
Design concept and principles: architectural designs, user interface design. (8 hours)

Module 5

Software Testing: What is testing: Test, Test case and Test Suit, Verification and Validation, Alpha, beta and acceptance testing, functional testing, Levels of testing, types of s/w test, black box testing, Unit testing, integration testing, validation testing, testing boundary conditions, structural testing, regression testing, system testing and debugging. (14 hours)

Reference Books:
1. Roger S. Pressman, Software Engineering, Sixth edition, 2004, Tata McGraw - Hill International Edition.
2. K.K. Aggarwal &Yogesh Singh, Software Engineering Programs Documentation Operating procedures, Edition 2003, New Age International Publishers
3. Ian Sommerville, Software engineering, Sixth edition, 2001, Pearson education Asia.
4. Mall Rajib, Fundamentals of Software Engineering, Fifth Edition, PHI Learning
5. Mike Cohn, User Stories Applied: For Agile Software Development, Edition 2004, Addison-Wesley

Course: Image Processing

Code: BDF403

Course Objective: The course is designed to provide basic knowledge of Image Processing and familiarize students with image enhancement and restoration techniques. The course will help students understand how the knowledge of image processing and pattern recognition can effectively be applied to digital forensic.

Sl.	Course Outcome	Mapped Module
1	Students will be able to learn about Fundamental steps of image processing	M1
2	Students will be able to learn and further study about Morphological and other area operations	M1, M2
3	Students will be able to understand the concept and technique of Image compression	M2, M3

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Fundamental steps of image processing	16	20	1,2	
M 2	Morphological and other area operations	20	40	1,2	
M 3	Image compression	20	40	2,3,4	
		56	100		

Paper: Image Processing (Including Lab)

Code: BDF403 (Lab Code: BDF493)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1
Fundamental steps of image processing, components of an image processing system. The image model and image acquisition, sampling and quantization, relationship between pixels, distance functions, scanner. Statistical and spatial operations, Intensity functions transformations, histogram processing, smoothing & sharpening – spatial filters Frequency domain filters, homomorphism filtering, image filtering & restoration. Inverse and wiener filtering. FIR wiener filter. Filtering using image transforms, smoothing splines and interpolation. (16 hours)

Module 2
Morphological and other area operations, basic morphological operations, opening and dosing operations, dilation erosion, Hit or Miss transform, morphological algorithms, extension to grey scale images. Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edge detection, gradient operators, compass and Laplace operators, edge linking and boundary detection, thresholding, region-based segmentation, segmentation by morphological watersheds. (20 hours)

Module 3
Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression, image data compression-predictive technique, pixel coding, transfer coding theory, lossy and lossless predictive type coding, Digital Image Water marking. (20 hours)

Reference Books:
1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Third edition. Pearson Education.
2. Jufus T. Tou, and Rafel C. Gonzalez, Pattern recognition Principles, Edition 1974, Addislon-Wesfy Publishing Company.
3. M.Anji Reddy. Y.Hari Shankar, Digital Image Processing, Edition 2011, BS Publications.
4. Milan Sonka. Vaciav Hlavac and Roger Boie, Image Processing. Analysis and Machine Vision, Second Edition, Thomson learning
5. William k. Prati , Digital Image Processing, Fourth Edition, John Wiley edition.

Semester V

Course: Computer Forensics

Code: BDF501

Course Objective: The course is designed to provide basic knowledge of Computer Forensics and help students develop skills in applying the various forensic techniques and tools in investigation of cyber security incidents, evidence collection and analysis, and report writing.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Computer Forensics	M1
2	Students will be able to understand and learn about the techniques of Data Acquisition	M1, M2
3	Students will be able to understand the process and methodologies for Volatile memoryForensics	M2,M3
4	Students will be able to understand the process and methodologies for Operating System Forensics	M3, M4
5	Students will be able to understand the concept of Event Analysis and NetworkForensics	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to computer forensics	8	10	1,2	
M 2	Data Acquisition	8	10	1,2	
M 3	Volatile Memory Forensics	10	30	2,3,4	
M 4	OS Forensics	16	30	3,4	
M 5	Event Analysis and Network Forensics	14	20	3,4,5	
		56	100		

Paper: Computer Forensics (Including Lab)

Code: BDF501 (Lab Code: BDF591)

Contacts Hours / Week: 4L + 4P
Credits: 4+2

Module 1
Introduction to computer forensics: Introduction, Investigating Computer Crime, Steps to Prepare for a Computer Forensics Investigation, Computer Forensics Investigation Methodology. (8 hours)

Module 2
Data Acquisition: Data Acquisition and Duplication Concepts, Data Acquisition Types, Validation Methods. (8 hours)

Module 3
Volatile Memory Forensics: RAM Memory Forensics, Defeating Anti forensic technique (Steganography, Password breaking, and decryption), and Deleted File Recovery. (10 hours)

Module 5
OS Forensics: Operating System Forensics, Windows Forensics, Linux Forensics, Metadata Extraction. (16 hours)

Module 6
Event Analysis and Network Forensics: Event Log Analysis, Registry Analysis, Network Forensics, Investigating EMail Crimes, Report Writing and Presentation. (14 hours)

Reference Books:
1. Fraud,Kenneth C.Brancik, Insider Computer, Edition 2008, Auerbach Publications Taylor & Francis Group.
2. William Oettinger, Learn Computer Forensics: A Beginner's Guide to Searching, Analyzing, and Securing Digital Evidence, Edition 2020, Packet Publishing.
3. Gerard Johansen, Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats, Second Edition, Packet Publishing.
4. Joakim Kävrestad, Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications, Edition 2018, Springer publications.
5. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Second Edition, Springer, 2014.

Course: Preserving and Recovering Digital Evidence

Code: BDF502

Course Objective: The course is designed to provide basic knowledge of the techniques employed for Preserving and Recovering Digital Evidence. Students will be introduced to the laws related to computer crime and methodologies applied to investigation process.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Digital Investigation	M1
2	Students will be able to understand the concepts of Computer basics for digital investigators	M1, M2
3	Students will be able to understand the process and methodologies of Networks and Digital Forensics	M2, M3
4	Students will be able to understand the process and methodologies of Investigating Computer Crime	M3, M4
5	Students will be able to understand the Guidelines for Digital investigation	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Digital Investigation	12	20	1,2	
M 2	Computer basics for digital investigators	14	30	1,2	
M 3	Networks and Digital Forensics	12	20	2,3,4	
M 4	Investigating Computer Crime	10	20	3,4	
M 5	Guidelines	8	10	3,4,5	
		56	100		

Paper: Preserving and Recovering Digital Evidence (Including Lab)

Code: BDF502 (Lab Code: BDF592)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1

Digital Investigation: Digital evidence and computer crime, history and terminals of computer crime investigation, technology and law, the investigate process, investigate reconstruction, modus operandi, motive and technology, digital evidence in the court room. (12 hours)

Module 2
Computer basics for digital investigators: applying forensic science to computers, forensic examination of windows systems, forensic examination of Unix systems, forensic examination of Macintosh systems, forensic examination of handheld devices. (14 hours)

Module 3
Networks and Digital Forensics: Networks basics for digital investigators, applying forensic science to networks, digital evidence on physical and datalink layers, digital evidence on network and transport layers, digital evidence on the internet. (12 hours)

Module 4
Investigating Computer Crime: Investigating computer intrusions, investigating cyber stalking, digital evidence as alibi. (10 hours)

Module 5
Guidelines: Handling the digital crime scene – digital evidence examination guidelines. (8 hours)

Reference Books:

1. Eoghan Casey, Digital Evidence and Computer Crime Forensic science, Computers and Internet, Second Edition, 2011, Elsevier Academic Press.

2. Daniel J Capra, Shira A Scheindlin, An Electronic Discovery and Digital Evidence in a Nut Shell, Third Edition, 2009 The Sedona Conference-Academic Press.

3. Perio,Jack Wiles, Anthony Reyes , Jesse Varsalone, The Best Damn Cybercrime and Digital Forensics Book, Edition 2007 Syngress Publishing.

4. Eoghan Casey, Computer Evidence and Computer Crime: Forensic Science, Computers,and the Internet. Casey 2000, Cambridge University Press.

5. Vacca, John R, Computer Forensics Computer Crime Scene Investigation, Edition 2002, Charles River Media.

Semester VI

Course: Mobile Forensics and Wireless Security Code:

BDF601

Course Objective: The course is designed to provide basic knowledge of Mobile Forensics and Wireless Security. Students will be introduced to the security and privacy problems of wireless networks and the techniques that are employed in Mobile Forensics for investigation, evidence collection and analysis of cybercrimes.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Wireless Fundamentals	M1
2	Students will be able to understand the Standards and Policy Solutions	M1, M2
3	Students will be able to understand the concept of Security Principles	M2, M3
4	Students will be able to understand and implement WLAN Configuration	M3, M4
5	Students will be able to understand the concept of Global Mobile Satellite Systems	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Wireless Fundamentals	10	10	1,2	
M 2	Standards and Policy Solutions	12	30	1,2	
M 3	Security Principles	12	20	2,3,4	
M 4	WLAN Configuration	10	20	3,4	
M 5	Global Mobile Satellite Systems	12	20	3,4,5	
		56	100		

Paper: Mobile Forensics and Wireless Security (Including Lab)

Code: BDF601 (Lab Code: BDF691)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1
Wireless Fundamentals: Wireless Hardware, Wireless Network Protocols, Wireless Programming WEP Security. Wireless Cellular Technologies, concepts, Wireless reality, Security essentials, Information classification standards, Wireless Threats: Cracking WEP, Hacking Techniques, Wireless Attacks, Airborne Viruses. (10 hours)

Module 2
Standards and Policy Solutions, Network Solutions, Software Solutions, Physical Hardware Security, Wireless Security, Securing WLAN, Virtual Private Networks, Intrusion Detection System, Wireless Public Key infrastructure. Tools, auditing tools, Pocket PC hacking, wireless hack walkthrough. (12 hours)

Module 3
Security Principles, Authentication, Access control and Authorization, Non-repudiation, privacy and Confidentiality, Integrity and Auditing, Security analysis process. Privacy in Wireless World, Legislation and Policy, Identify targets and roles analysis, Attacks and vulnerabilities, Analyze mitigations and protection. (12 hours)

Module 4
WLAN Configuration, IEEE 802.11, Physical layer, media access frame format, systematic exploitation of 802.11b WLAN, WEP, WEP Decryption script, overview of WEP attack, Implementation, Analyses of WEP attacks. (10 hours)

Module 5
Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols. Server-side programming in Java, Pervasive web application architecture, Device independent example application. (12 hours)

Reference Books:
1. Russel Dean Vines, Wireless Security Essentials: Defending Mobile from Data Piracy, First Edition, 2002, John Wiley & Sons.
2. Cyrus, Peikari and Seth Fogie, Maximum Wireless Security, Edition 2002, SAMS Publishing.
3. Yi-Bing Lin and Imrich Chlamtac, Wireless and Mobile Networks Architectures, Edition 2001, John Wiley & Sons.
4. Raj Pandya, Mobile and Personal Communication systems and services, Edition 2001, Prentice Hall of India.
5. Tara M. Swaminathan and Charles R. Eldon, Wireless Security and Privacy- Best Practices and Design Techniques, Edition 2002, Addison Wesley.

Course: Malware Analysis

Code: BDF602

Course Objective: The course is designed to provide basic knowledge and impart skills of analyzing Malware, understanding purpose and behavior of malware, and applying the various tools and techniques in malware analysis.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Malware and malware world	M1
2	Students will be able to understand the concept of Malware Analysis and Lab Setup	M1, M2
3	Students will be able to know how to implement the methodologies for Static malware Analysis	M2, M3
4	Students will be able to know how to implement the methodologies for Dynamic malware Analysis	M3, M4

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	World of Malwares	6	10	1,2	
M 2	Malware Analysis Lab Setup	10	20	1,2	
M 3	Static Analysis	20	30	2,3,4	
M 4	Dynamic Analysis	20	40	3,4	
		56	100		

Paper: Malware Analysis (Including Lab)

Code: BDF602 (Lab Code: BDF692)

Contacts Hours / Week: 4L + 4P

Credits: 4+2

Module 1

World of Malwares, What is Malware? Kinds of Malware, Why Malware is being created? Various Terminology about Malware. (6 hours)

Module 2

Malware Analysis Lab Setup, Creating your own Virtual World, A Copy of Windows XP / 7, Tools for analysis of the Windows Malware, Prohibition on Connection between Virtual System and Host System. (10 hours)

Module 3
Static Analysis: Basic Static Analysis of Malware, Anti-Virus Scanning, Hashing: Fingerprint of Malware, Detecting Packers, Analyzing PE file Headers and Sections. (20 hours)

Module 4
Dynamic Analysis: Basic Dynamic Analysis of Malware, Running Malware using Sandboxes, Analyzing the Process of Malware, Monitoring, Registry Changes, Network Traffic Analysis. (20 hours)

Reference Books:
1. M.Y. Iscan and S.R. Loth, The scope of forensic anthropology in, Introduction to Forensic Sciences, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
2. Monnappa K A, Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware, Edition 2018, Packt Publishing.
3. Abhijit Mohanta and Anoop Saldanha, Malware Analysis and Detection Engineering: A Comprehensive Approach to Detect and Analyze Modern Malware, Edition 2020, Apress publication.
4. Victor Marak, Windows Malware Analysis Essentials, Edition 2015, Packt Publishing.
5. Christopher C. Elisan, Advanced Malware Analysis, First Edition, McGraw-Hill Education

Generic Elective Courses

Course: The Yoga Professional

Course Code: BDF103A

Mode: Offline/ Blended

Course Objective: The course is designed to provide understanding about the textual and grammatical aspects of Sanskrit language to enable the students to better imbibe the essence of the yogic concepts. The students will be able to interpret the new dimensions of yoga and education and be able to apply principles of yoga for personality development through objectivity.

Sl	Course Outcome	Mapped modules
1	Students will be able to read and understand the colloquial words of Sanskrit	M1, M2
2	Students will be able to write in Sanskrit and have some idea about grammar	M1, M2
3	Students will be able to communicate and comprehend Sanskrit to the best of their ability	M1, M2, M3
4	Students will be able to understand the Interface between Culture & Psychology	M4
5	Students will be able to apply the principles of Culture & Basic Psychological Processes	M5
6	Students will be able to assess the importance of Culture & Gender interrelation	M6

Module Number	Content	Total Hours	% of questions	Covered CO	Blooms Level	Remarks (If any)
Module 1	Introduction to reading, writing &speaking of Sanskrit language	10	15	1,2,3	2,3	
Module 2	Grammatical aspects of Sanskritlanguage	10	15	1,2,3	2,3	
Module 3	Transliteration according to authentic dictionary method	10	10	3	2,3	
Module 4	Interface between Culture & Psychology	10	10	4	2,3	
Module 5	Culture & Basic Psychological Processes	10	30	5	2,3,4,5	
Module 6	Culture & Gender	10	20	6	2,3,5	
		60	100			

Detailed Syllabus:

Module 1
Vowels and Consonants, pronunciation, articulation of each letter and the technical names of the letters according to their articulation, similar and dissimilar letters and how to write them. Consonants combined with vowels, pronunciation and writing, special letters which do not follow the general method.

Module 2
Conjunct letters, rules to combine consonants, special consonants, how Sanskrit articulation can be applied to languages like English, special attention to Anusvara, when it can be written in the form of a nasal, two consonant combinations and three consonant combinations, their writing practice, special conjunct letters and their writing.

Module 3

Transliteration according to authentic dictionary method.

Module 4
Interface between Culture & Psychology Methods of Understanding Culture, Scope of Cultural Psychology, Mechanisms of Cultural Transmission

Module 5
Culture & Basic Psychological Processes Interrelation between Culture, Perception, Cognition Emotional expressions and Culture

Module 6
Culture & Gender, Culture and Gender stereotype

Reference Books:

1. Dr. Sarasvati Mohan, Sanskrit Level-1 Sharadh Enterprises, Bangalore, 2007.
2. Dr. Sarasvati Mohan, DVD and CD. (Publication of Akshram and Hindu SevaPrathisthana)

Course: Indian History & Culture

Course Code: BDF103B

Mode: Offline/ Blended

Course Objective: The course is expected to familiarize the student to theories of state, feudalism, political structure and periodization in history, based on the Indian examples from early medieval period. The students will try to understand the origin, development and decline of the civilizations.

Sl	Course Outcome	Mapped modules
1	Students will be able to read and understand the pre-historic period	M1, M2
2	Students will be able to read and understand the Mauryan Period	M1, M2
3	Students will be able to read and understand the history of Medieval India	M1, M2, M3
4	Students will be able to understand the political condition of India after the Moghuls	M4
5	Students will be able to understand social and religious reforms movement in India	M5
6	Students will be able to understand the concept of cultural tourism	M6

Module Number	Content	Total Hours	% of questions	Covered CO	Blooms Level	Remarks (If any)
Module 1	The pre-historic period	10	15	1,2,3	2,3	
Module 2	Mauryan Period	10	15	1,2,3	2,3	
Module 3	History of Medieval India	10	10	3	2,3	
Module 4	Political Condition of India after Moghul	10	10	4	2,3	
Module 5	Social and religious reforms movement in India	10	30	5	2,3,4,5	
Module 6	Concept of Cultural Tourism	10	20	6	2,3,5	
		60	100			

Detailed Syllabus:

Module 1
The pre-historic period, Indus Valley Civilization - Source of Information, Characteristics of Indian culture & society in the pre-historic ages and Indus valley civilization. Vedic Period – Early and Later Vedic period. Jainism, Teaching & Principles of Jainism, Contribution of Jainism to Indian Culture. Buddhism- Rise and Growth, Doctrines of Buddhism.

Module 2
Mauryan Period – origin, growth and contribution, Sunga Dynasty, Kusana Dynasty, Gupta Period – political, religious, socio-cultural and economic development during Maurya to Gupta period. Art & Architecture during Mauryan and Gupta period Political condition of North India, South India and Eastern India after Guptas.

Module 3
History of Medieval India 1206 - 1526 A.D. Rise of Turks, causes of Success of Arab invasion and its impact, Slave Dynasty, Khaliji Dynasty, Tughlaq Dynasty, Sayyid Dynasty, Lodhi Dynasty. Moghul dynasty. Indo Islamic & Mughal Architecture.

Module 4
Political Condition of India after Moghul- Decline of Mughal emperor and its impact. Shivaji & the rise of the Marathas. Advent of Europeans in India – Establishment of East India company and other European companies. Establishment of British Rule in India.

Module 5
Social and religious reforms movement in India, Brahma Samaj, Arya Samaj, Rama Krishna Mission, Social Traditions, Economic, political, religious and social development post-Independence.

Module 6
Concept of Cultural Tourism. Performing Arts- Classical Music, Classical Dance- various formation, Theatre, Visual Arts- Paintings, Sculpture, Different fairs & festivals in India. Various handicrafts items in India, folk culture in India.

Reference Books:

1. Themes of Indian History – Part 1, 2, 3 – NCERT (2013)
2. Mitter. Partha (2001), Indian Art, Oxford Publications, London
3. R. S. Sharma – India's ancient Past, Oxford University Press
3. Romila Thapar- Penguin History of India
4. R.C.Mazumdar, H.C.Roychowdhury & K. K. Dutta Advance History of India
5. Singhania. Nitin (2015), Indian Art and Culture, Tata McGraw Hill Education.

Course: Cinema and Other Arts

Course Code: BDF103C

Mode: Offline/ Blended

Course Objective: The course is designed to provide a general understanding and appreciation of the history of world cinema, acclaimed international films, artists, and movements. The students will be able to gain a multiple cultural perspective based on the underlying theories and principles of cinema and media.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the fundamental components of a Cinema and other arts	M1, M2, M3, M4, M5, M6
2	Students will be able to remember the readings and understand the perspective	M1, M2
3	Students will be able to understand the nuances of modern painting	M2, M3
4	Students will be able to understand the nuances of Indian painting	M2, M3, M4
5	Students will be able to understand and examine the Indian and Western music	M1, M2, M5
6	Students will be able to analyze the music of parallel and commercial Indian cinema	M1, M2, M5, M6

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
Module 1	Pre-Renaissance	10	15	L1, L2	
Module 2	Renaissance and Perspective	10	15	LI, L2	
Module 3	Modern Painting	08	15	L1, L2	Workshop
Module 4	Indian Painting	08	15	L1, L2	Workshop
Module 5	Fundamentals of music	12	15	L2, L3	Workshop
Module 6	Music and cinema	12	25	L2, L3	Workshop
		60	100		

Detailed Syllabus:

Module 1
Pre-Renaissance: Visual representations in cave paintings, in folk cultures and early civilizations like Egypt Visual representations in Greece: A breakaway from earlier practices Visual representations in ancient and medieval India: Ajanta cave paintings, Mughal miniature, Kangra, Ragmalaetc.

Module 2
Renaissance and Perspective the Renaissance at a Glance from The Enquiring Eye – European Renaissance Art, Development of the idea of perspective; Use of camera obscura and camera lucida Selected Readings from John Berger's Ways of Seeing, Dutch painting; Baroque, Rococo and Mannerism.

Module 3
Modern Painting: Impressionism, Expressionism, Surrealism, Cubism.

Module 4
Indian Painting Raja Ravi Verma, Bengal School Contemporary Masters.

Module 5
Fundamentals of music: Tone, note, key, octave, musical scales – diatonic and tempered scales, chords, melody, harmony, swar and shruti Folk music, forms and structures of Indian classical music, forms and structures of western classical music; Evolution of musical forms, Music industry and popular music; Urban folk music, Blues, Jazz, Rock.

Module 6
Music and cinema; Music for Cinema Comparison of the two art forms – music and cinema; Ray and Ghatak's ideas on structural similarities of music and cinema Analysis of structures of films to compare with musical forms Musical accompaniment of films – from live musical accompaniment of silent era to present day. Diagetic and extra-diagetic music Analysis of music tracks of selected films Electronic Vs acoustic musical accompaniment (Has to be done as a workshop by a music composer) Item numbers of Bollywood films

Reference Books:

1. Satyajit Ray, Our Films Their Films
2. Ritwik Ghatak, Rows and Rows of Fences
3. E. H. Gombirch, The Story of Art, Phaidon Publications
4. Hendrik Willen Van Loon, The Arts of Mankind
5. Hugh Honour and John F. Fleming, The Visual Arts: A History. Prentice Hall, 2005. Sylvan Barnet, A Short Guide to Writing About Art. Prentice Hall, 2007.
6. The Enquiring Eye – European Renaissance Art (National Gallery of Art, Washington)
7. Herbert Read, The Meaning of Art 11. Walter Pater The Renaissance
8. Nothing If Not Critical: Selected Essays on Art and Artists
9. What Are You Looking At: 150 Years of Modern Art in a Nutshell by Will Gompertz
10. Art and Illusion: A Study in the Psychology of Pictorial Representation by E.H. Gombrich

Course: Health Education & Communication

Course Code: BDF103D

Mode: Offline/ Blended

Course Objective: The course is designed to provide basic knowledge about the health and health communication. The students will be able to use information, communication and education across media for the public towards ensuring equitable access to health for both prevention and cure.

Sl	Course Outcome	Mapped modules
1	Students will be able to explain the concept of health and the knowledge of health education in society	M1
2	Students will be able to apply the modern technology in health care sectors	M2
3	Students will be able to describe the different model of communication	M3
4	Students will be able to develop the communications to the different field of society	M4
5	Students will be able to able to use the computer as a tool in health care	M5
6	Students will be able to understand how to aware the people about the health	M6

Module Number	Content	Total Hours	%age of questions	Blooms Level(if applicable)	Remarks (If any)
M 1	Concept Of Health and Health Education	16	20	L1, L2	
M 2	Health Education & Artificial Intelligence	8	10	L1, L2	
M 3	Heath Communication	10	10	L1, L2	
M 4	Mass communication and role of media	8	10	L1, L2	
M 5	Tools used for communication	8	30	L1, L2	LAB
M 6	Presentation on concept of health and health education	10	20	L1, L2	LAB
		60	100		

Detailed Syllabus:

Module 1
Concept of Health and Health Education: Definition of physical health, mental health, social health, spiritual health determinants of health, indicatory of health, concept of disease, natural history of diseases, the disease agents, concept of prevention of diseases.
Health Education: Principles & Objectives, Levels of Health Education, Educational Methods, Evaluation & practice of Health Education in India.
Family planning: Demography and family planning: Demography cycle, fertility, family planning, contraceptive methods, behavioral methods, natural family planning methods, chemical methods, mechanical methods, hormonal contraceptives, population problem of India.

Module 2
Health Education & Artificial Intelligence: Changes in the workforce, Robots, assisting the human experts or completely robotic diagnosis, medical training: to train paramedical students, AI can play a big role, Virtual health assistants, advanced health research, Clinical and administrative task handling.

Module 3
Heath Communication: Basic Concept & Principles of Communication, Definition, Purpose, Types of Communication, Communication Process, Directions of Communication: Upward, Downward, Lateral, Factors influencing Communication, Barriers of Effective communication, How to overcome the Barriers Models of communication: Aristotle Model, Shannon and Weaver model, Schramm Model, Laegans Model, Fano Model, Literer's Model, Westly Maclean's Model.

Module 4
Mass Communication and Role of Media: Mass communication & Role of Media in health education, Information Communication Technologies (ICT) in health care and awareness. (Telemedicine & e-health, community radio) Future trends in information and communications systems:

Module 5
Tools Used for Communication: Introduction to PC Operating System and MS office package - Windows 10/Ubuntu, MS Office 2016 / Office360 (MS Word, MS Excel, MS PowerPoint, MS Outlook, Internet and Email)

Module 6
Presentation on Concept of Health and Health Education

Reference Books:

1. Health Education – A new approach – L. Ramachandran & T. Dharmalingan
2. Health Communication in the 21st Century, By Kevin B. Wright, Lisa Sparks, H. Dan O'Hair, Blackwell publishing limited, 2013,
3. Health Communication: From Theory to Practice, By Renata Schiavo, Published by Jossey Bash. 4.Health Communication, R.D. Karma Published by Mohit Publications 2008.
4. 5.Counseling Skills for Health Care Professionals, 1st Edition, Rajinikanth AM, Jaypee Brothers, 20

Course: Basic Mathematics & Statistics

Course Code: BDF203A

Mode: Offline/ Blended

Course Objective: The course is designed to provide a basic applied knowledge of mathematics. The students will be to apply the number system & basic algebra, set theory, determinants and matrices, limits, continuity, differentiation & Integration, data frequency & distribution and measures of central tendency and measures of dispersion for solving business problems and statistical problems

Sl	Course Outcome	Mapped modules
1	Students will understand the Number system and basics of Algebra	M1
2	Students will be able to understand Set Theory along with permutations and combinations	M1,M2,
3	Students will be able to apply mathematical model to general problem	M2,M3
4	Students will be able to analyze the problems	M3, M4
5	Students will be able to evaluate problems	M4, M5
6	Students will be able to understand and implement the measures of Central Tendency and Dispersion	M4, M5, M6

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	The Number System and Basic Algebra	8	10	1,2	
M 2	Set Theory and Permutation and Combination	10	15	1,2	
M 3	Determinants and Matrices	10	15	1,2	
M 4	Limits, Continuity, Differentiation and Integration	16	35	1,2,3	
M 5	Data, Frequency Distribution	6	10	1,2,3	
M 6	Measures of Central Tendency and Measures of Dispersion	10	15	1,2,3	
		60	100		

Detailed Syllabus:

Module 1
The Number System – Positive and Negative Integers, Fractions, Rational and Irrational Numbers, Real Numbers, Problems Involving the Concept of Real Numbers.
Basic Algebra – Algebraic Identities, Simple Factorizations; Equations: Linear and Quadratic (in Single Variable and Simultaneous Equations). Surds and Indices; Logarithms and Their Properties (Including Change of Base); Problems Based on Logarithms.

Module 2
Set Theory-Introduction; Representation of sets; Subsets and supersets; Universal and Null sets; Basic operations on sets; Laws of set algebra; Cardinal number of a set; Venn Diagrams; Application of set theory to the solution of problems
Permutations and Combinations – Fundamental principle of counting; Factorial notation. Permutation: Permutation of n different things; of things not all different; restricted permutations; circular permutations. Combination: different formulas on combination. Complementary combination; restricted combination; Division into groups. Mixed problems on permutation and combination

Module 3
Determinants- Determinants of order 2 and 3; minors and cofactors; expansion of determinants; properties of determinants; Cramer's rule for solving simultaneous equations in two or three variables
Matrices- Different types of matrices; Matrix Algebra – addition, subtraction and multiplication of matrices; Singular and non-singular matrices; adjoint and inverse of a matrix; elementary row / column operations; Solution of a system of linear equations using matrix algebra. Concept of Eigen Value, Eigenvector.

Module 4
Differentiation: Meaning & geometrical interpretation of differentiation; standard derivatives (excluding trigonometric functions); rules for calculating derivatives; logarithmic differentiation. Integration: Meaning, Standard formulas, Substitution, Integration by parts (Excluding Trigonometric functions)

Module 5
Frequency Distributions- Attribute and variable; Frequency distribution of an attribute; Discrete and continuous variables; Frequency distributions of discrete and continuous variables; Bivariate and Multivariate Frequency Distributions. Diagrammatic representation of a frequency distribution: case of an attribute; case of a discrete variable: column diagram, frequency polygon and step diagram; case of a continuous variable: histogram and ogive.

Module 6
Measures of Central Tendency- Definition and utility; Characteristics of a good average; Different measures of average; Arithmetic Mean; Median; Other positional measures – quartiles, deciles, percentiles; Mode; Relation between Mean, Median and Mode; Geometric and Harmonic Mean. Choice of a suitable measure of central tendency.
Measures of Dispersion- Meaning and objective of dispersion; Characteristics of a good measure of dispersion; Different measures of dispersion – Range, Quartile Deviation, Mean Deviation, Mean Absolute Deviation, Standard Deviation; Comparison of the different measures of Dispersion. Measures of relative dispersion – Coefficient of Variation. Combined mean and standard deviation. Introduction to Skewness, Kurtosis, Moments.

Reference Books:

1. H. S. Hall & S. R. Knight – Higher Algebra; Radha Publishing House.
2. Reena Garg, Engineering Mathematics, Khanna Publishing House.
3. Sancheti & Kapoor – Business Mathematics; Sultan Chand & Company.
4. R. S. Soni – Business Mathematics – Pitambar Publishing House.
5. N G Das, Statistical Methods (Combined edition volume 1 & 2), McGraw Hill Education.
6. J K Sharma: Business Statistics, fifth edition, Vikas Publishing house.
7. S. C. Gupta and V. K. Kapoor. Fundamentals of Mathematical Statistics. Sultan Chand & Sons.

Course: Operations Research

Course Code: BDF203B Mode:

Offline/ Blended

Course Objective: Learn how to solve problem in optimized way using various technique like game theory, LPP in real life problem. Understand the optimization method to evaluate the reliability and validity of a measuring to other real-life problem.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand to Linear Programming Problems (LPP)	M1
2	Students will be able to understand the solutions of Linear Programming Problems	M1, M2,
3	Students will be able to understand the concept of Network Analysis in terms of shortest path	M2, M3
4	Students will be able to understand the concept of Inventory Control	M3, M4
5	Students will have an introduction to Game Theory	M4, M5
6	Students will have an introduction to Queuing Theory	M4, M5, M6

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	Linear Programming Problems (LPP)	8	10	1, 2	
M 2	Solution of Linear Programming Problems	10	15	1, 2	
M 3	Network Analysis	10	15	1, 2	
M 4	Inventory Control	16	35	1, 2, 3	
M 5	Game Theory	6	10	1, 2, 3	
M 6	Queuing Theory	10	15	1, 2, 3	
		60	100		

Detailed syllabus:

Module 1
Linear Programming Problems (LPP): Basic LPP and Applications; Various Components of LP Problem Formulation.

Module 2
Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples. Solution of LPP by Simplex Method; Charnes' Big-M Method; Duality Theory. Transportation Problems and Assignment Problems.

Module 3
Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).

Module 4
Inventory Control: Introduction to EOQ Models of Deterministic and Probabilistic; Safety Stock; Buffer Stock.

Module 5
Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.

Module 6
Queuing Theory: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems.

Reference Books:

1. H. A. Taha; "Operations Research"; Pearson.
2. P. M. Karak; "Linear Programming and Theory of Games"; ABS Publishing House.
3. Ghosh and Chakraborty; "Linear Programming and Theory of Games"; Central Book Agency.

Course: Probability & Statistics

Course Code: BDF203C

Mode: Offline/ Blended

Course Objective: Throughout the course, students will be expected to demonstrate their understanding of probability & statistics by being able to learn probability and random variables and various discrete and continuous probability distributions and their properties, basic ideas of statistics including measures of central tendency, correlation and regression, statistical methods of studying data samples.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the concept of Partial Differential Equations	M1
2	Students will be able to understand the concept of probability theory	M1, M2,
3	Students will be able to understand the concept of Basic Statistics, Measures ofCentral tendency	M2, M3

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	Partial Differential Equations	20	30	1,2	
M 2	Probability spaces	20	30	1,2	
M 3	Basic Statistics, Measures of Central tendency	20	40	1,2,3	
		60	100		

Detailed syllabus:

Module 1
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and nonhomogeneous linear partial differential equations of second order by complimentary function and particular integral method. Second- order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

Module 2

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables;

Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 3

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Reference Books:

1. Erwin Kreyszig; "Advanced Engineering Mathematics"; 9 th Edition; John Wiley & Sons.
2. N. G. Das; "Statistical Methods"; Tata Mc.Graw Hill.
3. P. G. Hoel, S. C. Port and C. J. Stone;   "Introduction to Probability Theory"; Universal Book Stall.
4. W. Feller; "An Introduction to Probability Theory and its Applications"; 3rd Edition; Wiley.

Course: Mathematics for Computing

Course Code: BDF203D

Mode: Offline/ Blended

Course Objective: Throughout the course, students will be expected to demonstrate their understanding of Mathematics by being able to understand and solve mathematical problems with linear Algebra, differential and integral calculus, numerical methods and statistics.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand Modern algebra and Trigonometry concept	M1
2	Students will be able to understand the concept of Calculus in terms of limit,continuity, Differentiation, Integration and differential equation.	M1, M2,
3	Students will be able to understand the concept of Complex Numbers	M2, M3
4	Students will be able to understand the solution of Matrices and Determinants	M3, M4
5	Students will be able to implement solution of problem related to Infinite Series	M4, M5
6	Students will be able to understand the concept of Probability and statistics	M6

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	Modern algebra and Trigonometry	8	10	1, 2	
M 2	Calculus	16	35	1, 2	
M 3	Complex Numbers	10	15	1, 2	
M 4	Matrices and Determinants	10	15	1, 2, 3	
M 5	Infinite Series	6	10	1, 2, 3	
M 6	Probability and statistics	10	15	1, 2, 3	
		60	100		

Detailed Syllabus:

Module 1

Modern algebra and Trigonometry: Set, Relation, Mapping, Binary Operation, Addition Modulo n, Multiplication modulo n, semi group, properties of groups, subgroup.
Radian or circular Measure, Trigonometric Functions, Trigonometric ratios of angle θ when θ is acute, trigonometric ratios of certain standard angles, allied angles, compound angles, multiple and sub- multiple angles.

Module 2

Calculus: Limits and Continuity, The real number system, The concept of limit, concept of continuity. Differentiation, Differentiation of powers of x, Differentiation of ex and log x, differentiation of trigonometric functions, Rules for finding derivatives, Different types of differentiation, logarithmic differentiation, differentiation by substitution, differentiation of implicit functions, differentiation from parametric equation. Differentiation from first principles.
Integrations, Integration of standard Functions, rules of Integration, More formulas in integration, Definite integrals.
Differential equations, First order differential equations, practical approach to Differential equations, first order and first degree differential equations, homogeneous equations. Linear equations, Bernoulli's equation, Exact Differential Equations.

Module 3

Complex Numbers: Complex Numbers, Conjugate of a complex number, modulus of a complex Number, geometrical representation of complex number, De Moivre's theorem, nth roots of a complex number.

Module 4

Matrices and Determinants: Definition of a matrix, Operations on matrices, Square Matrix and its inverse, determinants, properties of determinants, the inverse of a matrix, solution of equations using matrices and determinants, solving equations using determinants.

Module 5

Infinite Series: Convergence and divergence, series of positive terms, binomial series, exponential series, logarithmic series.

Module 6

Probability and statistics: Concept of probability, sample space and events, three approaches of probability, Kolmogorov's axiomatic approach to probability, conditional probability and independence of events, bay's theorem.
Introduction to Statistics: Measures of central Tendency, Standard Deviation, Discrete series. Methods, Deviation taken from assumed mean, continuous series, combined standard deviation, coefficient of variation, variance.

Reference Books:
    1. S. K. Mapa; "Higher Algebra"; Levant Books.
    2. Chakravorty and Ghosh; "Advanced Higher Algebra"; U N Dhar Pvt. Ltd.
    3. Das and Mukherjee; "Integral Calculus"; U N Dhar Pvt. Ltd.
    4. Das and Mukherjee; "Differential Calculus"; U N Dhar Pvt. Ltd.

Course: Data Analytics

Course Code: BDF304A

Mode: Offline/ Blended

Course Objective: The objective of the course is to define the process of data analysis using analytical and logical reasoning to gain information from the data to find meaning in data so that the derived knowledge can be used to make informed decisions and develop intelligent decision support systems.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the difference between data and information	M1
2	Students will be able to understand the concept of descriptive statistics.	M1, M2,
3	Students will be able to understand the concept of Basic Analysis Techniques	M2, M3
4	Students will be able to understand the concept of data analysis techniques	M3, M4
5	Students will be able to learn about the different case studies of data analysis	M4, M5

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	Data definition	10	10	1,2	
M 2	Descriptive Statistics	16	30	1,2	
M 3	Basic Analysis Techniques	12	20	1,2	
M 4	Data analysis techniques	12	20	1,2,3	
M 5	Case studies	10	20	1,2,3	
		60	100		

Detailed Syllabus:

Module 1
Data definition: Definitions of data and Analysis Techniques Elements, Variables, and Data categorization Levels of Measurement Data management and indexing

Module 2
Descriptive Statistics: Measures of central tendency Measures of location of dispersions.

Module 3
Basic Analysis Techniques: Basic analysis techniques Statistical hypothesis generation and testing Chi- Square test, t-Test, Analysis of variance Correlation analysis. Maximum likelihood test.

Module 4
Data analysis techniques: Regression analysis Classification techniques Clustering Association rules analysis.

Module 5
Case studies: Understanding business scenarios Feature engineering and visualization

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

Course: Mathematics for Machine Learning

Course Code: BDF304B

Mode: Offline/ Blended

Course Objective: The objective of the course is to understand of Mathematics by being able to understand and solve mathematical problems with linear Algebra, numerical methods and Machine Learning Techniques.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the concept of Linear Algebra	M1
2	Students will be able to learn Analytic Geometry	M1, M2,
3	Students will be able to learn about the technique of Matrix Decompositions	M2, M3
4	Students will be able to understand the concept of Vector Calculus	M3, M4
5	Students will be able to understand the concept of Probability and Distributions	
6	Students will be able to learn and implement the Continuous Optimization	M4, M5

Module Number	Content	Total Hours	%age of questions	Blooms Level (if applicable)	Remarks (If any)
M 1	Linear Algebra	10	10	1, 2	
M 2	Analytic Geometry	10	30	1, 2	
M 3	Matrix Decompositions	10	20	1, 2	
M 4	Vector Calculus	10	20	1, 2, 3	
M 5	Probability and Distributions	10	20	1, 2, 3	
M6	Continuous Optimization	10			
		60	100		

Detailed Syllabus:

Module 1
Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces.

Module 2
Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

Module 3
Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny.

Module 4
Vector Calculus: Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Back propagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

Module 5:
Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform

Module 6
Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

Reference Books:
1. Marc Peter Deisenroth, Aldo Faisal, et al.; "Mathematics For machine Learning"; Cambridge University Press.
2. David Barber; "Bayesian Reasoning and Machine Learning"; Cambridge University Press.

Course: IT Literacy

Course Code: BDF304C

Mode: Offline/ Blended

Course Objective: This course is designed impart a foundational level appreciation for the implementation of IT in business and management. Students will be utilizing digital tools for communication, researching and interpreting digital information, developing advanced spreadsheets, understanding operating systems and word processing functions, supporting the evaluation, selection and application of office productivity software appropriate to a sports management context.

Sl	Course Outcome	Mapped modules
1	Students will be able to identify the principal components of a relevant computer system and describecomputer technology for communication in management.	M1, M3
2	Students will be able to interpret fundamental hardware components that make up a computer's hardware and the role of each of these components relevant to Management.	M1, M2
3	Students will be able to relate the usage of Digital innovations in Sports Threats and Opportunities of Digital Application in Sports, SWOT analysis.	M2, M4
4	Students will be able to explain the role of information technology in presentation supporting the functionsof large sport events and their stakeholders, as well as the needs of sports federations.	M1, M2, M3
5	Students will be able to understand the emerging technological trends, as well as solutions andapplications that will impact broadcasting and media industries and spectators' experience.	M1, M4, M5, M6
6	Students will be able to demonstrate developing technology solutions and understanding the limits of data capture (what, how, and why) in sport.	M4, M6

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Data and Information Storage	12	20	1,2	
M2	Digital Transformation and innovation in Sports Management	10	15	1, 2	
M3	Presentation Software	08	15	1, 2	
M4	Management Information System	08	15	1, 2	
M5	DOS System commands and editors	10	15	2,3	
M6	Programs involving the use of arrays with subscripts and pointers	12	20	2, 3	
		60	100		

Detailed Syllabus:

Module 1
Data and Information Storage: Data and Information, definition and meaning, Data Storage device: Primary storage – RAM, ROM, EEROM, PROM, EPROM; Secondary storage – direct access devices, serial access devices: hard disks, CD-ROM, DVD Central Processing Unit – Control Unit. Computer languages, machine language, assembly language and high-level language, role of assembler and compiler. Storage devices, floppy disc, hard disc, CD ROM and DVD. Importance of Computer as data storage for Business and Management. Fundamental Hardware Applications in Sports Management – RFID Chips, Sensors, Timing System, and their applications in Sports Management.
Operating System and Application Software: Meaning of software; broad classification of software; system. Software and application software; utilities. Systems software – Operating systems: Brief introduction to different types of operating systems like DOS, Windows, Unix, Linux etc., Importance and application of Cloud, Mobile, Artificial Intelligence in Sports Management. Use.

Module 2
Digital Transformations and Innovations– Digital Transformation and future changes, challenges in Management, factors of success, Impact of Digital media on business, new digitized innovations in modern Management. Impact of Digital media, SWOT analysis. Role of Data Bases - Roles, Types, Functions, Current Practice and Future Potentials, Importance of digital technology in Management.

Module 3
Presentation Software - Power Point – Creating new presentations – Auto content wizard – Using template – Blank presentation – Opening existing presentations – Adding, editing, deleting, copying,

hiding slides – Presentations – Applying new design – Adding graphics – Using headers and footers – Animation's text – Special effects to create transition slides – Controlling the transition speed – Adding sounds to slides – Using action buttons. Word processing software: WORD – Creating a new document with templates & Wizard – Creating own document – Opening/modifying a saved document – converting files to and from other document formats – Using keyboard short-cuts & mouse – Adding symbols & pictures to documents – header and footers – Finding and replacing text – spell check and Grammar check – Formatting text - paragraph formats - adjusting margins, line space – character space – Changing font type, size – Bullets and numbering – Tables – Adding, editing, deleting tables – Working within tables – Adding, deleting, modifying rows and columns – merging & splitting cells. Spreadsheet software - EXCEL – Working with worksheets – cells – Entering, editing, moving, copying, cutting, pasting, transforming data – Inserting and deleting of cells, rows & columns – Working with multiple worksheets – switching between worksheets – moving, copying, inserting & deleting worksheets – Using formulas for quick Calculations – Working & entering a Formula – Formatting a worksheet – Creating and editing charts – elements of an Excel Chart – Selecting data to a chart – Types of chart – chart wizard – Formatting chart elements – Editing a chart – Printing charts.

Module 4
Management Information Management (MIS) - database management, data communications, transaction processing information systems, decision support systems, information reporting systems, office automation, networks, expert systems, and systems analyses and design. ERP: Introduction – Need for ERP – Advantages – Major ERP Packages – Applications.

Module 5
DOS System commands and Editors (Preliminaries) used in Sports Management. UNIX system commands and vi (Preliminaries) – Applications in Management. Programs to demonstrate control structure: text processing, use of break and continue, etc. Programs involving functions and recursion, Use and application in Business and Management.

Module 6
Programs involving the use of arrays with subscripts and pointers, Programs using structures and files. Applications of C Language. Microsoft office - Word, Excel, PowerPoint, Mail merge, Internet – Use and Applications.

Reference Books:
1. Mano – Computer System Architecture; Pearson Education
2. Tanenbaum – StructuredComputer Organization, Pearson Education
3. Martin & Powell – Information Systems: A Management Perspective; McGraw-Hill
4. Laudon& Laudon – Management Information Systems: Pearson Education
5. Introduction to Computers with MS-Office, Leon, TMH
6. Running MS – DOS by Van Wolverton, 20th Anniversary Edition
7. C Programming Language (Prentece Hall Software) by Brian W. Kernighan
8. Let Us C by Yashavant Kanetkar.

Course: Applied Cryptography

Course Code: BDF304D

Mode: Offline/ Blended

Course Objective: The objective of this course is to understand the basic concept of encryption and decryption for secure data transmission. Also analyze and compare various cryptography techniques and concept of digital signature and its applications.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the concept of cryptography and its necessity in information security	M1, M3
2	Students will be able to understand the concept of number theory and mathematics related to cryptography	M1, M2
3	Students will be able to understand the concept of Symmetric Key Cryptography	M2, M4
4	Students will be able to understand the concept of Asymmetric Key Cryptography	M1, M2, M3
5	Students will be able to understand the concept of Authentication and its different protocols	M1, M4, M5, M6

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction of cryptography	10	10	1,2	
M2	Introduction to Number Theory	12	10	1, 2	
M3	Symmetric Key Cryptography	14	30	1, 2	
M4	Asymmetric Key Cryptography	14	30	1, 2	
M5	Authentication	10	20	2,3	
		60	100		

Detailed Syllabus:

Module 1
Introduction: Need for Security, Security approaches, Principles of Security, Types of Attacks, and Plain Text & Cipher. Text, Transposition Techniques, Substitution Techniques, Encryption & Decryption, Symmetric Key & Asymmetric Key Cryptography, Key Range & Key Size.

Module 2
Introduction to Number Theory, Modular Arithmetic, Prime Numbers, Residue Classes, Euler's Totient Function, Fermat's Theorem and Euler's Generalization, Euclidean Algorithm, Extended Euclidean Algorithm for Multiplicative Inverse, Primitive Roots & Discrete Logarithm, Chinese Remainder Theorem, Gauss Theorem.

Module 3
Symmetric Key Cryptography: Overview, Block Cipher, DES Algorithm, Strength of DES, AES Algorithm, Evaluation Criteria for AES, Modes of Operations.

Module 4
Asymmetric Key Cryptography: Principles of Public Key Cryptography, RSA Algorithm, Key Management, Man in the Middle Attack, Diffie-Hellman Key Exchange Algorithm.

Module 5
Authentication: Authentication Requirement, Functions, Message Digest, Hash Function, Security of Hash Function, Kerberos, Digital Signature Standard, Digital Signature Algorithms – DSA, ElGamal Signature, Authentication Protocols.

Reference Books:
1. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in, Second Edition, 1996, John Wiley & Sons, Inc.

2. William Stallings, Cryptography and Network Security: Principles and Practice, SixthEdition, 2013, Pearson

3. M. Merkow, & J. Breithaupt, Information security: Principles and practices, Second Edition, 2006, Upper Saddle River, NJ: Prentice Hall

4. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, Second Edition, Upper Saddle River, NJ: Prentice HalL

5. Niels Ferguson, Bruce Schneier, Practical Cryptography, Edition 2003, Wiley

Course: Entrepreneurship Theory & Practice

Course Code: BDF404A

Mode: Offline/ Blended

Course Objective: To understand the function of the entrepreneur in the successful, commercial application of innovations. Also, to investigate methods and behaviors used by entrepreneurs to identify business opportunities and put them into practice.

SL NO.	Course Outcome	Mapped Modules
1.	Students will be able to understand the basics and needs ofEntrepreneurship.	M1
2	Students will be able to to help Entrepreneurs develop the need and nature so, thatthey can run their business.	M1, M2
3	Students will be able to help generate startups with various business decisions.	M1, M3
4	Students will be able to develop skills of Entrepreneurship.	M1, M4
5	Students will be able to develop business projects which develop to buildbusiness projects.	M2, M5
6	Student will be able to describe examples of entrepreneurial businessand actual practice, both successful and unsuccessful, and explainthe role and significance of entrepreneurship as a career, in the firm, and in society.	M2, M6
7	Student will be able to understand the importance and role of ethical,sustainability, innovation and global issues for strategic decision making.	M2, M7
8	Student will evaluate different modes of entering entrepreneurship. Student will be able to understand the importance and role of ethical, sustainability, innovation and global issues forstrategic decision making	M2, M8

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction to Entrepreneurship	8	10	1,2	
M2	Entrepreneurial Behavior	8	10	1, 2,3	
M3	Entrepreneurial Traits	8	10	3,4	
M4	Project Feasibility Analysis	8	10	3,4,5	
M5	Creativity	8	20	4,5,6	
M6	Innovation	8	20	6,7	
M7	Understanding the Market	6	10	6,7,8	
M8	Resource Mobilization	6	10	6,7,8	
		60	100		

Detailed Syllabus:

Module 1
Introduction to Entrepreneurship: Theories of Entrepreneurship, Role and Importance of Entrepreneur in Economic Growth.

Module 2
Entrepreneurial Behavior: Entrepreneurial Motivation, Need for Achievement Theory, Risk-taking Behavior, Innovation and Entrepreneur.

Module 3
Entrepreneurial Traits: Definitions, Characteristics of Entrepreneurs, Entrepreneurial Types, Functions of Entrepreneur.

Module 4
Project Feasibility Analysis: Business Ideas – Sources, processing; Input Requirements, Sources of Financing, Technical Assistance, Marketing Assistance, Preparation of Feasibility Reports, Legal Formalities and Documentation.

Module 5
Creativity: Introduction – Meaning - Scope – Types of Creativity – Importance of Creativity – Steps of Creativity

Module 6
Innovation: Introduction –Steps in Innovation – Stages of of Innovation – Technology aspects in Innovation.

Module 7
Understanding the Market: Types of Business: Manufacturing, Trading and Services – Market Research - Concept, Importance and Process - Market Sensing and Testing

Module 8
Resource Mobilization: Types of Resources - Human, Capital and Entrepreneurial tools and resources- Selection and utilization of human resources and professionals like Accountants, Lawyers, Auditors, Board Members, etc. Role and Importance of a Mentor- Estimating Financial Resources required. Methods of meeting the financial requirements – Debt vs. Equity.

Reference Books:
1. Entrepreneurship, Arya Kumar, Pearson.
2. Introducing Entrepreneurship Development, Chakraborty, Tridib, Modern Book Agency.
3. Entrepreneurial Policies and Strategies, Manimala, M.J., TMH
4. Everyday Entrepreneurs - The harbingers of Prosperity and creators of Jobs, Dr. ArunaBhargava.

Course: Principles of Management

Course Code: BDF404B

Mode: Offline/ Blended

Course Objective: The objective of this course is to study the functions and principles of management to learn the application of the principles in an organization and enable the effective and barriers communication in the organization by studying the system and process of effective controlling in the organization.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand the concept of Management	M1, M3
2	Students will be able to understand the approaches to Management	M1, M2
3	Students will be able to understand the Planning and Decision Making	M2, M4
4	Students will be able to understand the concept of Organization Design and Structure	M1, M2, M3
5	Students will be able to understand the concept of Directing	M1, M4, M5, M6
6	Students will get to know about the Controlling & Change	M4, M6

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction to Management	8	10	1,2	
M2	Approaches to Management	10	15	1, 2	
M3	Planning And Decision Making	12	20	1, 2	
M4	Organization Design and Structure	10	20	1, 2	
M5	Directing	10	15	2,3	
M6	Controlling & Change	10	20	2, 3	
		60	100		

Detailed Syllabus:

Module 1

Introduction to Management: Nature, meaning and significance of management, Management as a Science or an Art, Difference between management & administration; management as a process,

management as a functions, managerial skills, and managerial roles in organization; quality of a good manager; relevance of management in Hospital and Health Sector.

Module 2
Approaches to Management: Classical, Neo-classical and Modern Contributors to Management Thought, Taylor and Scientific Theory, Fayol's and Organization Theory, Elton Meyo & Behavioural school & human relations school; Peter Drucker and Management Thought.; Various Approaches to Management i.e., system approach, contingency approach etc., Indian Management Thought.

Module 3
Planning And Decision Making: Planning: Nature, importance, forms, types, making planning effective, Significance & Limitations of Planning; Planning Premises – Meaning & Types, Strategic Planning – Meaning & level, BCG model etc., MBO – Meaning, Process, importance; Decision Making – Meaning, Types, Process, schools of decision making.

Module 4
Organization Design And Structure: Organization – Meaning, Process, Principles, Or Organization Structure – Determinants and Forms: Line, Functional, Line & Staff, Project, Matrix and Committees; Formal and Informal Organization; Departmentation – Meaning and Bases; Span of Control – Meaning and Factors Influencing; Authority, Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree of Decentralization; Difference between Delegation and Decentralization. Organization structure common in tourism industry.

Module 5
Directing: motivation & leadership- Motivation – Meaning, Definition, Significance & Limitations; contemporary theories of motivation; Financial and non-financial incentives of Motivation; Leadership - Definition, Significance of Leadership, Leadership styles; Process and Barriers of Communication.

Module 6
Controlling & Change: Control – meaning & importance of control, steps of controlling process, designing control systems, financial control; Organizational change – meaning, drivers of change, process of change, resistance to change, overcoming resistance to change; Management trends in Health Sector - managing quality, innovation, concern for environment &sustainability of the organization & industry.

Reference Books:
1. Management: Stoner James. A., Freeman Edward, Gilbert Daniel, Pearson
2. Weihrich and Koontz, et al: Essentials of Management; Tata McGraw Hill
3. V.S.P Rao & Hari Krishna: Management-Text & Cases, Excel Books 4. Ramaswami T: Principles of Mgmt., Himalaya Publishing
4. Dipak Kumar Bhattacharyya: Principles of Management - Text and Cases, Pearson.
5. Robbins, S. P: Management, Prentice Hall.

Course: Economics

Course Code: BDF404C

Mode: Offline/ Blended

Course Objective: To gain an understanding of economic concepts for Capital Markets. Also establish a link between various components of the Capital Markets.

Sl	Course Outcome	Mapped modules
1	Students will be able to get introduced to the concept of Economics and business	M1, M3
2	Students will be able to understand and analyses demand	M1,M2
3	Students will be able to understand the Supply and Production Decisions and Cost of Production	M2, M4
4	Students will be able to understand concept of cost	M1, M2, M3
5	Students will be able to understand the concept of Pricing of a product	M1, M4, M5

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction	10	10	1,2	
M2	Demand Analysis	12	10	1, 2	
M3	Supply and Production Decisions and Cost of Production	14	30	1, 2	
M4	Cost concepts	14	30	1, 2	
M5	Pricing Practices	10	20	2,3	
		60	100		

Detailed Syllabus:

Module 1
Introduction: Scope and Importance of Business Economics Basic tools- Opportunity Cost principle- Incremental and Marginal Concepts Basic economic relations - functional relations: equations- Total, Average and Marginal relations Use of Marginal analysis in decision making, The basics of market demand, market supply and equilibrium price- shifts in the demand and supply curves and equilibrium

Module 2

Demand Analysis: Demand Function - nature of demand curve under different markets Meaning, significance, types and measurement of elasticity of demand (Price, income cross and promotional)- relationship between elasticity of demand and revenue concepts Demand estimation and forecasting: Meaning and significance - methods of demand estimation: survey and statistical methods (numerical illustrations on trend analysis and simple linear regression)

Module 3
Supply and Production Decisions and Cost of Production: Production function: short run analysis with Law of Variable Proportions- Production function with two variable inputs- isoquants, ridge lines and least cost combination of inputs- Long run production function and Laws of Returns to Scale - expansion path - Economies and diseconomies of Scale.
Cost concepts: Accounting cost and economic cost, implicit and explicit cost, fixed and variable cost - total, average and marginal cost - Cost Output Relationship in the Short Run and Long Run (hypothetical numerical problems to be discussed), LAC and Learning curve - Break even analysis (with business applications)

Module 4
Market structure: Perfect competition and Monopoly and Pricing and Output Decisions under Imperfect Competition: Short run and long run equilibrium of a competitive firm and of industry - monopoly - short run and long- run equilibrium of a firm under Monopoly
Monopolistic competition: Equilibrium of a firm under monopolistic competition, debate over role of advertising (topics to be taught using case studies from real life examples)
Oligopolistic markets: key attributes of oligopoly - Collusive and non-collusive oligopoly market - Price rigidity - Cartels and price leadership models (with practical examples)

Module 5
Pricing Practices: Cost oriented pricing methods: cost – plus (full cost) pricing, marginal cost pricing, Mark up pricing, discriminating pricing, multiple – product pricing - transfer pricing Case studies on how pricing methods are used in business world.

Reference Books:
1. Roy E. Bailey; "The Economics of Financial Markets"; Cambridge Press University; 2005.
2. Paul Heyne, Peter Boettke, David Prychitko; "The Economic way of Thinking"; Pearson.
3. Milton Friedman; "Money Mischief" Harcourt Group Publishers.

Course: Accounting

Course Code: BDF404D

Mode: Offline/ Blended

Course Objective: The objective of this course is to articulate the financial concepts of accounting in companies to gain a clear understanding of Financial Accounting with the help of case studies.

Sl	Course Outcome	Mapped modules
1	Students will have an introduction to Accounting	M1, M3
2	Students will be able to understand the concept of GAAP	M1, M2
3	Students will be able to understand the concept Accounting Mechanics	M2, M4
4	Students will be able to Prepare for Financial Statements with Adjustment Entries.	M2, M3, M4
5	Students will be able to learn about the Revenue Recognition and Measurement	M5, M6
6	Students will be able to understand Fixed Assets and Depreciation Accounting	M6, M7
7	Students will be able to have Complete Understanding of Corporate Financial Statements	M7,M8
8	Students will be able to know and remember about the Important Accounting Standards	M8, M9
9	Students will be able to understand the concept Financial Statements of Companies	M9, M10
10	Students will be able to understand the concept Inflation Accounting & Ethical Issue in Accounting	M10
11	Students will be able to study Case Studies and Presentations	M11

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction to Accounting	5	5	1,2	
M2	Introduction and Meaning of GAAP	5	10	1, 2	
M3	Accounting Mechanics	5	10	1, 2	
M4	Preparation of Financial Statements with Adjustment Entries.	5	10	1, 2	
M5	Revenue Recognition and Measurement	5	10	2,3	
M6	Fixed Assets and Depreciation Accounting	5	10		

M7	Preparation and Complete Understanding of Corporate Financial Statements	5	10		
M8	Important Accounting Standards	5	5		
M9	Financial Statements of Companies	10	10		
M10	Inflation Accounting & Ethical Issue in Accounting	5	10		
M11	Case Studies and Presentations	10	10		
		60	100		

Detailed Syllabus:

Module 1
Introduction to Accounting: Introduction to concepts of Accounting Concept and necessity of Accounting, An Overview of Income Statement and Balance Sheet.

Module 2
Introducing the meaning of GAAP, Concepts of Accounting, Impact of Accounting, Concepts on Income Statement and Balance Sheet.

Module 3
Accounting Mechanics: Understanding of Accounting Mechanics, Process leading to preparation of Trial Balance and Financial Statements.

Module 4
Preparation of Financial Statements with Adjustment Entries: Understanding the Preparation of Financial Statements with Adjustment Entries.

Module 5
Revenue Recognition and Measurement: Describing Revenue Recognition and Measurement Capital and Revenue Items, Treatment of R & D Expenses, Preproduction Cost, Deferred Revenue Expenditure etc.

Module 6
Fixed Assets and Depreciation Accounting: Describing Fixed Assets and Depreciation Accounting Evaluation and Accounting of Inventory.

Module 7
Preparation and Complete Understanding of Corporate Financial Statements: Preparation and Complete Understanding of Corporate Financial Statements 'T' Form and Vertical Form ofFinancial Statements.

Module 8
Important Accounting Standards: Corporate Financial Reporting – Analysis of Interpretation thereof with reference to Ratio Analysis. Fund Flow, Cash Flow. Corporate Accounting. Accounting of Joint Stock Companies: Overview of Share Capital and Debentures, Accounting for Issue and forfeiture of Shares, Issue of Bonus Share, Issue of Debentures.

Module 9
Financial Statements of Companies: Financial Statements of Companies: Income Statement and

Balance Sheet in Schedule, Provisions of the Companies Act: Affecting preparation of Financial Statements, Creative Accounting, Annual Report, Presentation and analysis of Audit reports and Directors report. (Students should be exposed to reading of Annual Reports of Companies both detailed and summarized version).

Module 10
Inflation Accounting & Ethical Issue in Accounting: Describing Inflation Accounting & Ethical Issue in Accounting.

Module 11
Case Studies and Presentations

Reference Books:
1. P C Tulsian; "Financial Accounting"; Pearson; 2002.
2. Gregory Becker; "Accounting Principles: The ultimate Begineers Guide to Accounting"; Pearson.
3. M C Shukla S C GuptaT S Grewal; "Advanced Accounting Vol - I"; S. CHAND; 2018.
4. M C Shukla S C Gupta T S Grewal; "AdvancedAccounting Vol - II"; S. CHAND; 2018.

Skill Enhancement Courses

Course: Operating Systems and System Software

Course Code: BDF305A

Contacts Hours / Week: 2L

Credits: 2

Course objective: The course is designed to provide basic knowledge of Operating Systems and an overview of the Linux Operating System. The course will help students understand processes scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand about the concept of Operating System	M1
2	Students will be able to understand the concept of process management in an operatingsystem.	M1, M2
3	Students will be able to understand the concept of storage management in an operatingsystem.	M2, M3
4	Students will be able to understand the concept microprocessor and macro processor	M3, M4
5	Students will be able to understand the concept of Loading, Linking & Relocating in anoperating system.	M4, M5
6	Students will be able to learn about the concept and command of Linux operatingsystem	M5, M6
7	Students will be able to understand the concept of System Administration	M6, M7

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Definition- Functions	2	10	1,2	
M 2	Process management	2	10	1,2	
M 3	Storage Management	2	10	2,3,4	
M 4	General concepts	2	10	3,4	
M 5	Loading, Linking & Relocating	2	10	4,5	

M 6	Overview of Linux	5	30	6,7	
M 7	System Administration	5	20	5,6,7	
		20	100		

Detailed Syllabus:

Module 1
Definition- Functions- OS as Resource Manager, Types – Structure- Concept of Batch Processing, Multi-programming, Multi-user systems and Real-time systems, POST Bootstrapping – Kernel (2 hours)

Module 2
Process management: process concept, process scheduling, operations on processes, cooperating processes, inter-process communication, communication in client server systems, threads, overview, multithreading models, CPU scheduling, scheduling criteria, CPU scheduling algorithms, process synchronization, critical-section problem semaphores, deadlocks, prevention, avoidance and detection. (2 hours)

Module 3
Storage Management: memory management, contiguous memory allocation, paging, segmentation, segmentation with paging, virtual memory, demand paging, page replacement. I/O hardware, I/O Software, Disks – Disk Scheduling. File organization, File system implementation, allocation methods, Security, Protection mechanism. (2 hours)

Module 4
General concepts - system software and application software, Assemblers- Design of assembler, Macros and Macro processor, Macro definitions& Instructions, Features of macro facility, Nested macros calls. (2 hours)

Module 5
Loading, Linking & Relocating- Loading& Linking Schemes- Relocatablity of Programs, Concepts of Binders, Linking Loaders, Overlays, Dynamic Binders, Design of an absolute loader. Compilers – Different phases of compilers (2 hours)

Module 6
Overview of Linux: Architecture of Linux, features, advantages, Booting process, kernel, Shell Types, Shell variables, Linux file system, simple commands- echo, date, cal, etc. Commands for files and directories- mkdir, cd, pwd, ls, rmdir, mv, cp, rm, more, less. Creating and viewing file using cat. File permissions chmod- filters—head, tail, cut, paste, sort, uniq, grep, pipe,tr, tee- Communication &Scheduling commands- mail, wall, write, talk, at, cron, crontab. (5 hours)

Module 7
System Administration: Creating and deleting users-mounting file systems - mount, umount- changing passwords- passwd. Network administration – netstat, ping, ifconfig, traceroute-remote login-telnet, ssh, file transfer-ftp. Process related commands- ps, kill, nice, time- archiving- tar, gzip, Installation of packages using rpm command- Understanding various servers- DHCP, DNS, Apache, squid. (5 hours)

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 8th Revised edition, 2008, Wiley.

2. D.M. Dhammdhere, System programming &Operating Systems, Second revised edition, reprint 2009. Tata McGraw Hill

3. Manick& Donovan, Operating System, reprint 2008, McGrawHill

4. H M Deitel, Operating system, 2007, Pearson Education

5. John J Donovan, System Programming, 2017, Tata McGraw Hill

Course: Operating Systems with Linux

Course Code: BDF305B

Contacts Hours / Week: 2L

Credits: 2

Course Objective: The course is designed to understand the fundamental utilities which are required on daily basis to work on a modern operating system. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems. On successful completion of this course students will be able to make effective use of Linux utilities to solve problems

Sl	Course Outcome	Mapped modules
1	Students will be able to learn fundamental components of a computer operating system	M1
2	Students will be able to understand policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems	M2, M3
3	Students will be able to understand the basic commands of Linux operating system	M4
4	Students will be able to understand & Apply the knowledge to create file system and directories	M1, M4, M5
5	Students will be able to apply the knowledge to create processes, perform pattern matching	M1, M4, M6
6	Students will be able to application of the gathered knowledge to develop simple programs	M1, M4, M5, M6

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction	4	5	1	
M 2	Process	10	20	1,2	
M 3	Resource Manager	6	15	2	
M 4	Introduction to Unix OS	12	20	2,3	
M 5	Files	12	20	3	
M 6	Shells & Process	12	20	4	
		56	100		

Detailed Syllabus:

Module 1
Introduction: Importance of OS, Basic concepts and terminology, Types of OS, Different views, Journey of a command execution, Design and implementation of OS.

Module 2
Process: Concept and views, OS view of processes, OS services for process management, Scheduling algorithms, Performance evaluation; Inter-process communication and synchronization, Mutual exclusion, Semaphores, Hardware support for mutual exclusion, Queuing implementation of semaphores, Classical problem of concurrent programming, Critical region and conditional critical region, Monitors, Messages, Deadlocks.

Module 3
Resource Manager: Memory management, File management, Processor management,Device management.

Module 4
Introduction to UNIX Operating System: Introduction to UNIX UNIX operating system, UNIX architecture: Kernel and Shell, Files and Processes, System calls, Features of UNIX, POSIX and single user specification, Internal and external commands.
Utilities of UNIX Calendar (cal), Display system date (date), Message display (echo), Calculator (bc), Password changing (password), Knowing who are logged in (who), System information using uname, File name of terminal connected to the standard input (tty)
UNIX file system File system, Types of file, File naming convention, Parent – Child relationship, HOME variable, inode number, Absolute pathname, Relative pathname, Significance of dot (.) and dotdot (..), Displaying pathname of the current directory (pwd), Changing the current directory (cd), Make directory (mkdir), Remove directories (rmdir), Listing contents of directory (ls), Very brief idea about important file systems of UNIX: /bin, /usr/bin, /sbin, /usr/sbin, /etc, /dev, /lib, /usr/lib, /usr/include, /usr/share/man, /temp, /var, /home

Module 5

Files: Ordinary file handling Displaying and creating files (cat), Copying a file (cp), Deleting a file (rm), Renaming/ moving a file (mv), Paging output (more), Printing a file (lp), Knowing file type (file), Line, word and character counting (wc), Comparing files (cmp), Finding common between two files (comm), Displaying file differences (diff), Creating archive file (tar), Compress file (gzip), Uncompress file (gunzip), Archive file (zip), Extract compress file (unzip), Brief idea about effect of cp, rm and mv command on directory.
File attributes File and directory attributes listing and very brief idea about the attributes, File ownership, File permissions, Changing file permissions – relative permission & absolute permission, Changing file ownership, Changing group ownership, File system and inodes, Hard link, Soft link, Significance of file attribute for directory, Default permissions of file and directory and using umask,Listing of modification and access time, Time stamp changing (touch), File locating (find).

Module 6
Shell and Process: Shell Interpretive cycle of shell, Types of shell, Pattern matching, Escaping, Quoting, Redirection, Standard input, Standard output, Standard error, /dev/null and /dev/tty, Pipe, tee, Command substitution, Shell variables
Process Basic idea a`bout UNIX process, Display process attributes (ps), Display System processes, Process creation cycle, Shell creation steps (init ->getty -> login -> shell), Process state, Zombie state, Background jobs (& operator, nohup command), Reduce priority (nice), Using signals to kill process,

Sending job to background (bg) and foreground (fg), Listing jobs (jobs), Suspend   job, Kill   a job, Execute at specified time (at and batch) (Total Hours – 6)

Reference Books:
1. Operating Systems, Galvin, John Wiley
2. Operating Systems, Milankovic, TMH
3. UNIX-Concepts & Applications, Sumitava Das, TMH
4. Learning UNIX Operating System, Peek, SPD/O'REILLY
5. Understanding UNIX, Srirengan, PHI
6. Essentials Systems Administration, Frisch, SPD/O'REILLY

Course: Course: Programming for Problem Solving

Course Code: BDF305C

Contacts Hours / Week: 2L

Credits: 2

Course objective: The objective of this course is write efficient algorithms to solve various problems and use various constructs of the programming language such as conditionals, iteration, and recursion in programming.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand basics of Computers and computer program	M1
2	Students will be able to learn Conditional Control Statements and how it use	M2, M3
3	Students will be able to understand the concept of Pre-processors and Arrays	M3
4	Students will be able to understand the concept of Pointers	M3, M4,
5	Students will be able to understand the concept of Structures and File	M4, M5

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction to Computers	2	10	1	
M 2	Conditional Control Statements	4	20	1,2	
M 3	Pre-processors and Arrays	4	20	2	
M 4	Pointers	5	30	2,3	
M 5	Structures and File	5	20	3, 4	
		20	100		

Detailed Syllabus:

Module 1
Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. Number Systems: Binary, Octal, Decimal, Hexadecimal Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

Module2
Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If- Else, Switch-Statement and Examples. Loop Control Statements: For, While, DoWhile and Examples. Continue, Break and Goto statements Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. Recursion- Recursive Functions. Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

Module 3
Pre-processors and Arrays: Pre-processor Commands Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.

Module 4
Pointers: Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, Lvalue and Rvalue, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command Line Arguments. Strings - Concepts, C Strings, String Input/ Output Functions, Arrays of Strings, String Manipulation Functions.

Module 5
Structures and File: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self-Referential Structures, Unions, Type Definition (typedef), Enumerated Types. Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/ Output Functions, Character Input/ Output Functions.

Reference Books:

1. Yashavant Kanetkar; "Let us C"; 13th Edition; BPB Publication.

2. E. Balaguruswamy; "Programming in ANSI C"; Tata McGraw-Hill.

3. Gary J. Bronson; "A First Book of ANSI C"; 4th Edition; ACM.

4. Byron Gottfried Schaum's; "Outline of Programming with C"; McGraw-Hill.

5. Brian W. Kernighan and Dennis M. Ritchie; "The C Programming Language"; Prentice Hall of India.

Course: Introduction to Financial Technology

Course Code: BDF305D

Contacts Hours / Week: 2L

Credits: 2

Course objective: Providing a comprehensive idea about different technology issue and latest trends in Information technology that are highly applicable to today's competitive technology driven world. Also impart knowledge regarding Artificial Intelligence, office automation, distributed data processing and familiarize students with ERP, IS strategy and effects, Knowledge engineering and data warehouse.

Sl	Course Outcome	Mapped modules
1	Students will be able to understand financial technology	M1
2	Students will be able to understand the concept of Computer Based Information Systems	M2, M3
3	Students will be able to understand the concept of Pre-processors and Arrays	M4
4	Students will be able to learn IS strategy and effects of IT on competition	M3, M4

Module	Content	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction	5	20	1	
M 2	Computer Based Information Systems	5	20	1,2	
M 3	Artificial Intelligence Based Systems	5	30	2	
M 4	Introduction to IS strategy and effects of IT on competition	5	30	2,3	
		20	100		

Detailed Syllabus:

Module 1
Introduction: Use of computers for managerial applications, Technology issues and data processing in organizations, Introduction to Information Systems, shift in Information system thinking, latest trends in Information Technology.

Module2
Computer Based Information Systems: office automation systems. Decision making and MIS, transaction processing systems. Decision support system, Group Decision Support, Executive Information systems, DSS generator.

Module 3
Artificial Intelligence Based Systems: Introduction to Artificial Intelligence Based Systems, End user computing, distributed data processing. Deciding on IS architecture, IT leadership & IS strategic planning.

Module 4
Introduction to IS strategy and effects of IT on competition: Introduction to: ERP, re-engineering work processes for IT applications, Business Process Redesign Knowledge engineering and data warehouse.

Reference Books
1. O'Brien; "Management Information System"; TMH.
2. Kelkar; "Management Information System: A Concise Study"; PHI.
3. Janaki; "Raman Decision support Systems"; PHI.
4. M.M. Oka; "Business Application of Computers"; EPH.

Course: Database Management Systems and Security

Code: BDF405A

Contacts Hours / Week: 2L

Credits: 2

Course Objective: The course is designed to provide basic knowledge of Database Management Systems. The course aims at introducing students to the basic concepts of modelling, management, and implementation of database management systems. The students will learn the basic principles and methodologies to ensure security of data at rest within databases.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Database	M1
2	Students will be able to learn about the concept of physical data organization	M1, M2
3	Students will be able to learn Introduce the concept of Database Security	M2, M3
4	Students will be able to learn about the concept and technique for Crash Recovery	M3, M4
5	Students will be able to understand and implement the Security Mechanism inDatabase	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to database	4	10		
M 2	Physical Data organization	4	20		
M 3	Introduction to Databases Security	4	20		
M 4	Crash Recovery	4	20		
M 5	Security Mechanisms	4	30		
		20	100		

Detailed Syllabus:

Module 1
Introduction to database: Characteristics of the Database approach, Problems with file system data management, Data models, Schemas and instances, Database System Architecture, Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages. Data models, Entity Relationship (ER), Mapping ER Model to Relational Mode, Weak and strong entity, Enhanced Entity Relationship (EER) and object modeling. Specialization and generalization, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations. (4 hours)

Module 2
Physical Data organization, Hashed files, Indexed files, B- Trees, sequential Organization files. The relational Data model concepts, Relational model constraints, Relational algebra, Tuple relational calculus, Domain relational calculus, SQL. Database design, Functional dependencies, Basic definitions, Trivial and non-trivial dependencies, Closure of a set of dependencies, closure of a set of attributes ,Irreducible set of dependencies, Non loss decomposition and functional dependencies First, Second and Third Normal forms, Boyce –Codd Normal forms. (4 hours)

Module 3
Introduction to Databases Security, Problems in Databases. Database Integrity and Security Concepts, Domain constraints, Referential Integrity .Introduction to database security concepts, Methods for database security, Discretionary access control method, Mandatory access control and role base access control for multilevel security. Use of views in security enforcement. Overview of encryption technique for security. Statistical db security. (4 hours)

Module 4
Crash Recovery, Failure classification, Recovery concepts, Log base recovery techniques (Deferred and Immediate update), Checkpoints, Recovery with concurrent transactions (Rollback, checkpoints, commit), Database backup and recovery from catastrophic failure. Shadow paging. Security Models - 2 Bell and LaPadula's Model Biba's Model, Dion's Model, The Lattice Model for the Flow Control. (4 hours)

Module 5
Security Mechanisms: User Identification/Authentication Memory Protection, Resource Protection, Control Flow Mechanisms Isolation Security .Secure DBMS Design Security. A Model for the Protection of Object Oriented Systems, SORION Model for the Protection of Object-Oriented Databases. (4 hours)

Reference Books:
1. Silberschatz, H.F Korth , and S Sudarsan, Database system concepts, Fouth Edition, 2002 Tata McGraw Hill.
2. Hassan A. Afyouni, Database Security and Auditing, India Edition,2009 cengageLearning.
3. Silvana Castano, Database Security, Second edition 1994, Pearson Education.
4. Elmasri and Navathe, Fundamentals of Database Systems, Edition 2003, Pearson Education.
5. Peter Rob, Carlos Coronel, Database systems- Design Implementation and Management, Tenth edition, 2012, Course Technology.

Course: e-Commerce security

Code: BDF405B

Contacts Hours / Week: 2L

Credits: 2

Course Objective: The objective of this course is to understand what e-Commerce is, how e-commerce security works and develop secure website.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the e- commerce security	M1
2	Students will be able to learn how to create e-commerce website	M1, M2
3	Students will be able to understand the concept of Mobile Commerce	M2, M3
4	Students will be able to learn about the concept of security approach in e-commercewebsite	M3, M4

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction	2	20		
M 2	Ecommerce Website Creation	6	30		
M 3	Mobile Commerce	6	20		
M 4	Security	6	30		
		20	100		

Detailed Syllabus:

Module 1
Introduction: Ecommerce, doing business on the internet, the scope of ecommerce, using the web to reach customers, benefits of ecommerce market, Ecommerce technology, the internet environment. E-business models and markets, business models, e business market, traditional buy build approach and vendors, online sales channels, the advantages of outsourcing and infrastructure of TCP.

Module 2
Ecommerce Website Creation: Ecommerce website creation: the elements of ecommerce, website server, developing an e-commerce website, requirements for your site, building the site, implementation. Building shopping base systems, a shopping cart scenario, a customer servlet, real world application model, loose coupling.

Module 3
Mobile Commerce: Mobile commerce: wireless industry standard, wireless communication, platforms based of commerce, wireless wan, facilities for wireless-s environment. Concerns for mobile enterprise.

Module 4
Security: Security issues, security solution, symmetric and asymmetric cryptosystems, RSA, DES platforms, Protocols for secure messaging, secure electronic transaction protocol, electronic cash over the internet, internet security. Electronic payment system, issues, smart cards, digital currencies.

Reference Books:
1. Pete loshin and vecca; "Electronic commerce".
2. Janice Reynolds; "The complete e-commerce book"; 2nd Edition; CRC Press.
3. Carol Guercio Traver and Kenneth C. Laudon; "E-commerce: Business, Technology, Society"; 2nd Edition; Pearson.
4. Daniel D'Apollonio; "E-commerce A Beginners Guide To Ecommerce".

Course: Web security

Code: BDF405C

Contacts Hours / Week: 2L

Credits: 2

Course Objective: The course objective is to understand the fundamental security principles of the web. The course provides an overview of the most common attacks and illustrates fundamental countermeasures that every web application should implement.

Sl.	Course Outcome	Mapped Module
1	Students will be able to understand the concepts of web security	M1
2	Students will be able to understand the dangers of an insecure communicationchannel	M1, M2
3	Students will be able to understanding the interplay between authentication,authorization and session management	M2, M3
4	Students will be able to understand the concept of different web attack	M3, M4
5	Students will be able to learn and implement Secure Web Application	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction	2	10		
M 2	Communication Threat	4	20		
M 3	Authentication	4	20		
M 4	Web Attacks	6	30		
M5	Secure Web Application	4	20		
		20	100		

Detailed Syllabus:

Module 1
Introduction: Introduction to the web security landscape, and an overview of the most relevant threats. Understanding the security model of the web, and the recent evolution towards client-centric security.

Module 2
Communication Threat: Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS and dealing with the impact on your application. Insights into the latest evolutions for HTTPS deployments.

Module 3
Authentication: Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process, prevent authorization bypasses and harden session management mechanisms.

Module 4
Web Attacks: Investigation of injection attacks over time. Understanding the cause behind both server-side and client-side injection attacks. Execution of common injection attacks, and implementation of various defenses.

Module 5
Secure Web Application: Overview of current best practices for building secure web applications.

Reference Book:

1. Gene Spafford and Simson Garfinkel; "Web Security, Privacy & Commerce"; 2nd Edition; O'Reilly.

2. Ben Walther and Paco Hope; "Web Security Testing Cookbook: Systematic Techniques to Find Problems Fast"; O'Reilly;

Course: Secure Software Design

Code: BDF405D

Contacts Hours / Week: 2L

Credits: 2

Course Objective: This course is design to implement security in software design.

Sl.	Course Outcome	Mapped Module
1	Students will be able to learn secure software design	M1
2	Students will be able to learn about the software design	M1, M2
3	Students will be able to implement security in software design and development	M2, M3

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction	4	20		
M 2	Software Design Model	8	40		
M 3	Software Assurance Model	8	40		
		20	100		

Detailed Syllabus:

Module 1
Defining computer security, the principles of secure software, trusted computing base, etc, threat modelling, advanced techniques for mapping security requirements into design specifications. Secure software implementation, deployment and ongoing management.

Module 2
Software Design Model: Software design and an introduction to hierarchical design representations. Difference between high-level and detailed design. Handling security with high-level design. General Design Notions. Security concerns designs at multiple levels of abstraction, Design patterns, quality assurance activities and strategies that support early vulnerability detection, Trust models, security Architecture & design reviews.

Module 3
Software Assurance Model: Identify project security risks & selecting risk management strategies, Risk Management Framework, Security Best practices/ Known Security Flaws, Architectural risk analysis, Security Testing & Reliability (Penn testing, Risk- Based Security Testing, Abuse Cases, Operational testing, Introduction to reliability engineering, software reliability, Software Reliability approaches, Software reliability modelling.

Reference Books:
1. W. Stallings; "Cryptography and network security: Principles and practice"; Fifth Edition; Upper Saddle River, NJ: Prentice Hall.
2. C. Kaufman, r. Perlman, & M.Speciner; "Network security: Private communication in apublic world"; Second Editin; Upper Saddle River, NJ: Prentice HalL.
3. C. P. Pfleeger, S. L. Pfleeger; "Security in Computing"; Fourth Eition; Upper Saddle River, NJ:Prentice Hall.
4. Gary McGraw; "Software Security: Building Security"; Addison-Wesley.
5. M. Merkow, & J. Breithaupt; "Information security: Principles and practices"; Upper Saddle River, NJ:Prentice Hall.

Discipline Specific Elective

Course: Computer Organization and Embedded Networking

Code: BDF503A
Contacts Hours / Week: 5L+1T
Credits: 6

Course Objective: To ensure the students acquire knowledge of organization and architecture of digital computers and embedded systems.

Sl	Course Outcome	Mapped Module
1	Students will be able to understand the basic Computer Organization and Design	M1
2	Students will be able to understand the concept of Memory Organization	M1, M2
3	Students will be able to understand the concept of Intel 80286 Processor	M2, M3
4	Students will be able to understand the concept of 8051 Micro Controller	M1, M4
5	Students will be able to learn and implement Embedded Systems	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Basic Computer Organization and Design	2	10	1,2	
M 2	Memory Organization	4	20	1,2	
M 3	Intel 80286 Processor	4	20	2,3,4	
M 4	8051 Micro Controller	4	20	3,4	
M5	Introduction to Embedded Systems	6	30	3,4,5	
		20	100		

Detailed Syllabus:

Module 1

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control. Data Representation: Signed Magnitude, 1's Complement and 2's Complement. (2 hours)

Module 2

Memory Organization: Memory Hierarchy, Main Memory, RAM, ROM, Cache Memory: Associative Mapping, Direct Mapping, Set Associative Mapping. (4 hours)

Module 3

Intel 80286 Processor: Internal Block Diagram, Signal Descriptions, Real Address Mode Operation, Protected Mode Operation. Intel 80386: Architecture pins and signals. Pentium Processor: Architecture- System Architecture, Branch Prediction. (4 hours)

Module 4

8051 Micro Controller: Architecture, Pins and Signals, Addressing Modes, Instruction Sets. (4 hours)

Module 5

Introduction to Embedded Systems: Embedded systems, Processor embedded into a system, Embedded hardware units and devices in system. Embedded Networking- Introduction, I/O devices ports and buses- serial bus communication protocols, RS 232 standard, RS 485, RS422, CAN bus. Serial Peripheral Interface (SPI), Inter integrated circuits. Need for device drivers.(6 hours)

Reference Books:
1. Computer System Architecture, M Morris Mano, 3rd edition, Prentice Hall of India (PHI), 2007.
2. Advanced microprocessors and peripherals, A K Ray and K M Bhurchandi, 2nd edition, The McGraw Hill Pvt Ltd, 2012.
3. Embedded System, Architecture, Programming and Design, Raj Kamal, 2nd edition, The McGraw Hill Companies, 2009.

Course: Linear Algebra and Natural Language Processing

Code: BDF503B
Contacts Hours / Week: 5L + 1T
Credits: 2

Course Objective: This course provides the mathematical concepts of data processing in computers.

Sl	Course Outcome	Mapped Module
1	Students will be able to learn the concept of Linear Algebra	M1
2	Students will be able to understand the concept of Linear Algebra and Vectordifferential calculus	M1, M2
3	Students will be able to understand the concept of Linear Algebra and Matrix	M2, M3
4	Students will be able to understand mathematical Logic	M1, M4
5	Students will be able to understand the concept of Formal languages	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Linear Algebra	2	10	1,2	
M 2	Linear Algebra and Vector differential calculus	4	20	1,2	
M 3	Linear Algebra and Matrix	4	20	2,3,4	
M 4	Logic	4	20	3,4	
M5	Formal languages	6	30	3,4,5	
		20	100		

Detailed Syllabus:

Module 1
Linear Algebra: Matrices and operations, Linear Systems, Vectors: Addition and Scalar Multiplication, Linear Systems of Equations. Gauss Elimination: Linear Independence, Rank of a Matrix. Vector Space: Solutions of Linear Systems: Existence, Uniqueness.

Module 2
Linear Algebra and Vector differential calculus: Determinants, Vector space, Cramer's Rule- Inverse of a Matrix. Gauss–Jordan Elimination- Vector Spaces, Inner Product Spaces, Linear Transformations- Vectors in 2 space and 3 space-Inner product-Vector product

Module 3
Linear Algebra and Matrix: The Matrix Eigen value Problem, Determining Eigen values and Eigenvectors- Some Applications of Eigen value Problems- Symmetric, Skew-Symmetric, and Orthogonal Matrices –Eigen bases, Diagonalization, Quadratic Forms. Set theory: Set notation and description, Basic set operations, Venn diagrams, Laws of set theory, Partition -min sets- Principle of inclusion and exclusion.

Module 4
Logic: Propositions, Logical operators, Truth tables, Normal forms - Laws of logic - Proofs in propositional calculus – Predicates – variables – Quantifiers – Standard Forms – Inference in Predicate calculus – Mathematical induction. Functions and Relations: Injective, Surjective, Bijective functions - composition, identity, inverse; Relations - properties of relations - closure operations on relations.

Module 5
Formal languages: Four classes of grammars (Phrase Structure, Context sensitive, Context Free, Regular) - definitions - Context free Grammar : Right most, Left most derivations – Syntax trees – Unambiguity, Ambiguity – Construction of grammars for languages – Derivation of languages from grammars – Regular expressions. Finite automata: Definition of Deterministic Finite state Automaton (DFA), Non deterministic Finite state Automaton (NFA) - equivalence of DFA and NFA - Equivalence of regular grammars and finite automata. Push Down Automata (PDA): Informal description - definition - Deterministic PDA - Equivalence of acceptance by final state and empty stack - Equivalence of PDA's and Context Free languages.

Reference Books:
1. Advanced Engineering Mathematics, Erwin Kreyzig, 9th edition, John Wiley & Sons, Inc, 2006
2. Discrete mathematics and its applications, Kenneth H Rosen, 7th edition, McGraw-Hill Higher Education, 2012
3. Introduction to Automata Theory, Languages and Computation, John E Hopcroft, Rajeev Motwani, and Jeffrey D.Ullman, Addison-Wesley/Pearson, 2006.
4. Introduction to Languages and the Theory of Computation, John C Martin, 3rd edition, Tata McGraw-Hill Education Pvt. Ltd., 2007

Course: Security Testing

Code: BDF503C
Contacts Hours / Week: 5L+1T
Credits: 2

Course Objective: This course provides the concepts of security testing for a software.

Sl	Course Outcome	Mapped Module
1	Students will be able tounderstand the concept of Access control Testing	M1
2	Students will be able to learn how to perform Security Audit	M1, M2
3	Students will be able to learn to perform Software testing	M2, M3
4	Students will be able to understand the concept of Log Analysis	M1, M4
5	Students will be able to understand the concept of Test Management	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Access control Testing	4	20	1,2	
M 2	Security Audit	4	20	1,2	
M 3	Software testing	4	20	2,3,4	
M 4	Log Analysis	4	20	3,4	
M5	Test Management	4	20	3,4,5	
		20	100		

Detailed Syllabus:

Module 1
Access control Testing: Access control tests of Networks (External interface): Networks (Internal interface and DMZ); Physical access testing – piggybacking, anonymous entry and break-in; wireless access testing; Board classed of testing – Black box of zero knowledge; crystal box or full knowledge testing and grey box testing. (4 hours)

Module 2
Security Audit: Choosing the standard against which to audit – ISO27001; PCI-DSS; ISACA Standards; NIST guidelines; national and sector specific standards (eg., RBI guidelines for Bank in India); auditing security policies and procedures; Review and report on IT landscape; defining scope of security audit; maintaining independence and objectivity in audit; internal and third party audit. (4 hours)

Module 3
Software testing: Static Testing and dynamic testing; traceability matrix; synthetic transitions; fuzzing of fuzz testing; specific testing to meet different purposes – unit testing, installation testing, integration testing, regression testing, acceptance testing, alpha and beta testing; combinatorial software testing. (4 hours)

Module 4
Log Analysis: Identify, collect, collect and retain logs; maintain integrity of logs; types of logs – antivirus
logs; IDS/IPS logs; Remote access logs; web proxy generated logs; logs from authentication servers; router logs and firewall logs; log filtering; response to log alerts; transpiration, storage and retrieval of logs. (4 hours)

Module 5
Test Management: Deciding objectives of testing; routine vs ad-hoc testing; periodicity of testing and coverage. of key areas in the organizational; acting on test results; scheduling the test; selecting test participants; surprise vs planned tests; live vs; simulated tests; crating, using and destroying test data; sanitization of information for testing; precautions when using production data for testing. (4 hours)

Reference Books:

1. Silberschatz, H.F Korth , and S Sudarsan, Database system concepts, Fouth Edition, 2002 Tata McGraw Hill.

2. Hassan A. Afyouni, Database Security and Auditing, India Edition,2009 cengageLearning.

3. Fraud,Kenneth C.Brancik, Insider Computer, Edition 2008, Auerbach Publications Taylor & Francis Group.

4. William Oettinger, Learn Computer Forensics: A Beginner's Guide to Searching, Analyzing, and Securing Digital Evidence, Edition 2020, Packet Publishing.

5. Gerard Johansen, Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats, Second Edition, Packet Publishing.

Course: Advanced Networking and IoT

Code: BDF504A
Contacts Hours / Week: 3L
Credits: 3

Course Objective: This course aims to mould experts in advanced network tools and IoT.

Sl	Course Outcome	Mapped Module
1	Students will be able to understand the concept of Internet and how it works	M1
2	Students will be able to understand IPV6, Discuss about its structure and protocols	M1, M2
3	Students will be able to learn to measure Network Performance	M2, M3
4	Students will be able to understand the concept of Internet of Things	M1, M4
5	Students will be able to learn how to Govern Internet of Things	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Internetworking	4	20	1,2	
M 2	The Future IP	4	20	1,2	
M 3	Network Performance	4	20	2,3,4	
M 4	Internet of Things	4	20	3,4	
M5	Governing Internet of Things	4	20	3,4,5	
		20	100		

Detailed Syllabus:

Module 1
Internetworking: Concepts, Architecture, and Protocols, Internet Addressing, Datagram

Forwarding, Support Protocols and Technologies. (4 hours)

Module 2
The Future IP (IPv6), TCP: Reliable Transport Service, Internet Routing And Routing Protocols. (4 hours)

Module 3
Network Performance (QoS and DiffServ), Multimedia and IP Telephony (VoIP), Network Security, Trends in Networking Technologies and Uses. (4 hours)

Module 4
Internet of Things: An Overview, Programming Frameworks for Internet of Things, Security and Privacy on the Internet of Things, Internet of Things: Robustness and Reliability. (4 hours)

Module 5
Governing Internet of Things: Issues, Approaches, and New Paradigms, Obfuscation and Diversification for Securing the Internet of Things (IoT), Applied Internet of Things, Internet of Vehicles and Applications. (4 hours)

Reference Books:
1. Douglas E. Comer; "Computer Networks and Internets"; Fifth Edition, Pearson; 2009.
2. Rajkumar Buyya, Amir Vahid Dastjerdi; "Internet of Things Principles and Paradigms"; FirstEdition, Morgan Kaufman, 2016.
3. Maciej Kranz; "Building the Internet of Things: Implement New Business Models, DisruptCompetitors, Transform Your Industry"; Wiley; 2016.
4. Rajkumar Buyya Amir Vahid Dastjerdi; "Internet of Things: Principles and Paradigms" FirstEdition; 2016.
5. Jamil Y. Khan, Mehmet R. Yuce; "Internet of Things (IoT): Systems and Applications"; FirstEdition; Jenny Stanford Publishing; 2019.

Course: Cloud Architectures And Security

Code: BDF504B
Contacts Hours / Week: 3L
Credits: 3

Objective of Course: Ensure deep knowledge in cloud systems.

Sl.	Course Outcome	Mapped Module
1	Introduce the concept of cloud computing	M1
2	Learn about the Technologies and the processes required when deploying web services	M1, M2
3	Understand the concept of security in cloud infrastructure	M2, M3
4	Understand the concept of Multi-tenancy Issues	M3, M4
5	Understand the concept of Security management in the cloud	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Cloud Computing	4	20	1,2	
M 2	Technologies and the processes required when deploying web services	4	20	1,2	
M 3	Security Concepts	4	20	2,3,4	
M 4	Multi-tenancy Issues	4	20	3,4	
M 5	Security management in the cloud	4	20	3,4,5	
		20	100		

Detailed Syllabus:

Module 1
Introduction to Cloud Computing: Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. (4 hours)

Module 2
Technologies and the processes required when deploying web services: Deploying a web

service from inside and outside a cloud architecture, advantages and disadvantages-Development environments for service development; Amazon, Azure, Google App. (4 hours)

Module 3
Security Concepts: Confidentiality, privacy, integrity, authentication, nonrepudiation, availability,access control, defence in depth, least privilege- how these concepts apply in the cloud and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud. (4 hours)

Module 4
Multi-tenancy Issues: Isolation of users/VMs from each other- How the cloud provider can provide this- Virtualization System Security Issues: e.g. ESX and ESXi Security, ESX file system security- storage considerations, backup and recovery- Virtualization System Vulnerabilities. (4 hours)

Module 5
Security management in the cloud: security management standards- SaaS, PaaS, IaaS availability management- access control- Data security and storage in cloud. (4 hours)

Reference Books:

1. Gautam Shroff; "Enterprise Cloud Computing Technology Architecture Applications"; FirstEdition; Cambridge University Press; 2010.

2. Toby Velte, Anthony Velte, Robert Elsenpeter; "Cloud Computing, A Practical Approach";First Edition; Tata McGraw-Hill Osborne Media; 2009.

3. Tim Mather, Subra Kumaraswamy, Shahed Latif; "Cloud Security and Privacy: An EnterprisePerspective on Risks and Compliance"; First Edition; O'Reilly Media; 2009.

4. Ronald L. Krutz, Russell Dean Vines; "Cloud Security"; Wiley; 2010.

5. Brij B. Gupta; "Cloud Security Concepts, Applications and Perspectives" First Edition; CRCPress; 2021.

Course: Image Processing And Security

Code: BDF504C
Contacts Hours / Week: 3L

Credits: 3

Objective Of Course: To familiarize with image processing and its security mechanisms.

Sl.	Course Outcome	Mapped Module
1	Students will be able understand the concepts of Image Processing and Security	M1
2	Students will be able understand the concept of Image enhancement in spatial domain	M1, M2
3	Students will be able learn about the concept of Image segmentation	M2, M3
4	Students will be able understand the concept of Steganography and Watermarking	M3, M4
5	Students will be able learn about the Models of water marking	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction to Image Processing And Security	4	20		
M 2	Image enhancement in spatial domain	4	20		
M 3	Image segmentation	4	20		
M 4	Steganography and Watermarking	4	20		
M5	Models of water marking	4	20		
		20	100		

Detailed Syllabus:

Module1
Introduction: steps in image processing, Image acquisition, representation, sampling and quantization, relationship between pixels. colour models: basics of color image processing. (4 hours)

Module 2
Image enhancement in spatial domain: some basic gray level transformations, histogram processing, enhancement using arithmetic / logic operations, basics of spatial filtering

and smoothing. Image restoration: Model of degradation and restoration process, noisemodels, restoration in the presence of noise, periodic noise reduction. (4 hours)

Module 3
Image segmentation: Thresholding and region based segmentation. Image compression: Fundamentals – models – information theory – error free compression –Lossy compression: predictive and transformcoding.JPEG and MPEG standard. (4 hours)

Module 4
Steganography and Watermarking: Information Hiding, Steganography, and Watermarking, Importance of Digital Watermarking, Importance of Steganography, Applications of Watermarking, Applications of Steganography, Properties of Watermarking Systems, Properties of Steganographic and Steganalysis Systems. (4 hours)

Module 5
Models of water marking: Communications, Communication based models, geometric models, detection by correlation. Basic message coding: mapping messages into meaasge vectors. Whater marking with side information: informed embedding, watermarking using side information. (4 hours)

Reference Books:
1. R.C. Gonzalez, R.E.Woods; "Digital Image processing"; Second Edition; Pearson Education;2002.
2. Ingemar J. Cox, MattheW, L. Miller Jeffrey A. Bloom , Jessica Fridrich Ton Kalker; "DigitalWatermarking and Steganography"; Second Edition; 2008.
3. Jufus T. Tou, and Rafel C. Gonzalez, Pattern recognition Principles, Edition 1974, Addislon-Wesfy Publishing Company.
4. M.Anji Reddy. Y.Hari Shankar, Digital Image Processing, Edition 2011, BS Publications.
5. Milan Sonka. Vaciav Hlavac and Roger Boie, Image Processing. Analysis and MachineVision, Second Edition, Thomson learning

Course: Data Warehousing and Data Mining

Code: BDF603A
Contacts Hours / Week: 5L+1T
Credits: 6

Course Objective: To ensure the students acquire knowledge of Data Warehousing and Data Mining.

Sl.	Course Outcome	Mapped Module
1	Introduction to basic of Data Warehousing	M1
2	Understand the concept of Data Processing, Language, Architecture, and Concept Description.	M1, M2
3	Learn about the concept of Association Rule	M2, M3
4	Understand the concept of Classification and Clustering	M3, M4
5	Know about the recent trends	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Basic of Data Warehousing	4	20		
M 2	Data Processing, Language, Architecture, and Concept Description.	4	20		
M 3	Association Rule	4	20		
M 4	Classification and Clustering	4	20		
M5	Recent Trends	4	20		
		20	100		

Detailed Syllabus:

Module 1:

Introduction − Data warehouse − Multidimensional data model − Data warehouse architecture − Implementation − Further development − Data warehousing to data mining.

Module 2:

Why preprocessing − Cleaning − Integration − Transformation − Reduction − Discretization – Concept hierarchy generation − Data mining primitives − Query language − Graphical user interfaces −Architectures − Concept description − Data generalization − Characterizations − Class comparisons −Descriptive statistical measures.

Module 3:

Association rule mining − Single-dimensional boolean association rules from transactional databases −Multi level association rules from transaction databases

Module 4:

Classification and prediction − Issues − Decision tree induction − Bayesian classification − Association rule based − Other classification methods − Prediction − Classifier accuracy − Cluster analysis − Types of data − Categorization of methods − Partitioning methods − Outlier analysis.

Module 5:

Multidimensional analysis and descriptive mining of complex data objects − Spatial databases − Multimedia databases − Time series and sequence data − Text databases − World Wide Web − Applications and trends in data mining.

Reference Books:

1. Han, J. and Kamber, M., "Data Mining: Concepts and Techniques", Harcourt India / Morgan Kauffman, 2001.

2. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education 2004.

3. Sam Anahory and Dennis Murry, "Data Warehousing in the real world", Pearson Education, 2003.

4. David Hand, Heikki Manila and Padhraic Symth, "Principles of Data Mining", PHI 2004.

5. W.H.Inmon, "Building the Data Warehouse", 3rd Edition, Wiley, 2003.

6. Alex Bezon and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", McGraw-HillEdition, 2001.

Course: Blockchain and Crypto currency
Code: BDF603B
Contacts Hours / Week: 5L+1T
Credits: 6

Course Objective: To learn Blockchain systems, Able to analyse Decentralized systems, o understand Tokenization and ICOs, o describe Cryptography of Blockchain.

Sl.	Course Outcome	Mapped Module
1	Explain cryptographic building blocks and reason about their security.	M1
2	Define Bitcoin's consensus mechanism.	M1, M2
3	Learn how the individual components of the Bitcoin protocol make the whole system works: transactions, script, blocks, and the peer-to-peer network	M2, M3, M4
4	Define how mining can be re-designed in alternative cryptocurrencies	M4, M5
5	Know about the recent trends	M5, M6

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction	2	10		
M 2	Basic Distributed Computing	2	10		
M 3	Basic Crypto primitives	4	20		
M 4	Blockchain 1.0	4	20		
M5	Blockchain 2.0	4	20		
M6	Blockchain 3.0	4	20		
		20	100		

Detailed Syllabus:

Module 1:

Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

Module 2:

Basic Distributed Computing Atomic Broadcast, Consensus, Byzantine Models of fault tolerance.

Module 3:

Basic Crypto primitives Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero- knowledge systems

Module 4:

Blockchain 1.0 Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.

Module 5:

Blockchain 2.0 Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts.

Module 6:

Blockchain 3.0 Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain.

Reference Books:

1. Don Tapscott, Alex Tapscott, Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World Paperback.

2. William Mougayar, The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology.

Course: Mobile Ad-hoc Network security
Code: BDF603C
Contacts Hours / Week: 5L+1T
Credits: 6

Course Objective: To learn Realize the research aspects in the field of intrusion detection systems, Optimize performance of detection systems by employing various machine learning techniques, Apply knowledge of machine learning in system and network protection.

Sl.	Course Outcome	Mapped Module
1	Basic Introduction to Mobile Ad-hoc Network security.	M1
2	Learn Architecture and Implementation	M1, M2
3	Introduce students to need for Intrusion Detection Systems.	M2, M3
4	Enable students to use various tools for Intrusion Detection Mechanisms.	M4, M5
5	Know about the Legal issue and organization standers	M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Introduction	4	20		
M 2	Architecture and Implementation	4	20		
M 3	Justifying intrusion detection	4	20		
M 4	Application and Tools	4	20		
M5	Legal issue and organization standers	4	20		
		20	100		

Detailed Syllabus:

Module 1:

Introduction to Mobile Ad-hoc Network Security, Understanding Intrusion Detection – Intrusion detection and prevention basics – IDS and IPS analysis schemes, Attacks, Detection approaches –Misuse detection – anomaly detection – specification based detection – hybrid detection THEORETICAL FOUNDATIONS OF DETECTION: Taxonomy of anomaly detection system – fuzzy logic – Bayes

theorem – Artificial Neural networks – Support vector machine – Evolutionary computation – Association rules – Clustering.

Module 2:

Centralized – Distributed – Cooperative Intrusion Detection – Tiered architecture.

Module 3:

Intrusion detection in security – Threat Briefing –Quantifying risk – Return on Investment (ROI)

Module 4:

Tool Selection and Acquisition Process – Bro Intrusion Detection – Prelude Intrusion Detection – Cisco Security IDS – Snorts Intrusion Detection – NFR security.

Module 5:

Law Enforcement / Criminal Prosecutions – Standard of Due Care – Evidentiary Issues, Organizations and Standardizations.

Reference Books:

1. Rafeeq Rehman, Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID, First Edition, Prentice Hall.

2. Carl Enrolf, Eugene Schultz, Jim Mellander, Intrusion detection and Prevention, McGrawHill.

3. Earl Carter, Jonathan Hogue, Intrusion Prevention Fundamentals, Pearson Education

4. Ali A. Ghorbani, Wei Lu, Network Intrusion Detection and Prevention: Concepts and Techniques, Springer.

5. Paul E. Proctor, The Practical Intrusion Detection Handbook, Prentice Hall.

6. Ankit Fadia and Mnu Zacharia, Intrusiion Alert, Vikas Publishing housePvt.

Course: Crime and Society

Code: BDF604A

Contacts Hours / Week: 3L

Credits:3

Course Objective: To know importance of criminology, criminal behavior and consequences of crime in society.

Sl.	Course Outcome	Mapped Module
1	The importance of criminology	M1
2	The causes of criminal behavior	M1, M2
3	The significance of criminal profiling to mitigate crime.	M2
4	The consequences of crime in society	M3

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Basics of Criminology	5	30		
M 2	Crime	10	40		
M 3	Criminal Justice System	5	30		
		20	100		

Detailed Syllabus:

Module 1:

Definition, aims and scope. Theories of criminal behavior – classical, positivist, sociological. Criminal anthropology. Criminal profiling. Understanding modus operandi. Investigative strategy. Role of media

Module 2:

Elements, nature, causes and consequences of crime. Deviant behavior. Hate crimes, organized crimes and public disorder, domestic violence and workplace violence. White collar crimes Victimology. Juvenile delinquency. Social change and crime. Psychological Disorders and Criminality. Situational crime prevention.

Module 3:

Broad components of criminal justice system. Policing styles and principles. Police's power of investigation. Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders. Human rights and criminal justice system in India.

Reference Books:

1. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

2. 2. D.E. Zulawski and D.E. Wicklander, Practical Aspects of Interview and Interrogation, CRC Press, Boca Raton (2002).

3. 3. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

4. 4. J.L. Jackson and E. Barkley, Offender Profiling: Theory, Research and Practice, Wiley, Chichester (1997).

5. 5. R. Gupta, Sexual Harassment at Workplace, LexisNexis, Gurgaon (2014).

Course: Economic Offences

Code: BDF604B

Contacts Hours / Week: 3L

Credits: 3

Course Objective: To learn Economic crimes in India are linked to several other crimes, Types of common economic offences and their consequences and Steps involved in mitigating economic crimes.

Sl.	Course Outcome	Mapped Module
1	Basic economic and financial terminology	M1
2	Economic crimes in India are linked to several other crimes	M1, M2
3	Economic crimes often have a bearing on national security	M2, M3
4	Types of common economic offences and their consequences	M3
5	Steps involved in mitigating economic crimes.	M3

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Taxonomy of Economic Offences/Criminogenic Factors	5	30		
M 2	Applied Economics in Processing Evidence	10	40		
M 3	Prevention of Economic Offences	5	30		
		20	100		

Detailed Syllabus:

Module 1:

Fundamentals of economics in economic offences. Tax evasion. Excise duty evasion. Fraudulent bankruptcy. White collar crime. Economic exclusion. Black money. Corruption and bribery of public servants. Money laundering and hawala transactions. Insurance frauds. Corporate frauds. Bank frauds. Ponzi scheme. Pyramid scheme. Illicit trafficking in contraband goods. Illicit trafficking in arms. Illicit trafficking in explosives. Illicit drug trafficking. Trafficking in human organs. Cultural objects trafficking. Racketeering in employment. Racketeering in false travel documents.

Module 2:

Forensic accountancy and forensic auditing. Valuation of economic losses. Violation of Intellectual Property Rights

Module 3:

Legislations to deal with different forms of economic offences. RBI Act. SEBI Act. Competition Commission of India Act. Credit card frauds. Enforcement agencies to deal with different forms of economic offences. International perspectives – measures adopted by FBI and INTERPOL. Case histories of economic offences.

Reference Books:

1. R.V. Clarke, Situational Crime Prevention: Successful Case Studies, 2nd Edition, Criminal Justice Press, New York (1997).

2. 2. S.P. Green, Lying, Cheating and Stealing: A Moral Theory of White Collar Crime, Oxford University Press, Oxford (2006).

3. 3. G. Geis, R. Meier, L. Salinger (Eds.), White-Collar Crime: Classic & Contemporary Views, Free Press, New York (1995).

4. 4. J. Reiman, The Rich get Richer and the Poor get Prison, Allyn & Bacon, Boston (1998).

5. 5. Indian Audit and Accounts department, Audit of Fraud, Fraud Detection and Forensic Audit, 2007.

6. 6. State Crime Branch, Haryana, Investigation of Economic Offences.

Course: Criminalistics

Code: BDF604C

Contacts Hours / Week: 3L

Credits: 3

Course Objective: To learn Economic crimes in India are linked to several other crimes, Types of common economic offences and their consequences and Steps involved in mitigating economic crimes.

Sl.	Course Outcome	Mapped Module
1	The methods of securing, searching and documenting crime scenes	M1
2	The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes	M1, M2
3	The legal importance of chain of custody	M2, M3
4	The tools and techniques for analysis of different types of crime scene evidence.	M3

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Crime Scene Management	5	30		
M 2	Crime Scene Evidence	5	30		
M 3	Forensic Physics	10	40		
		20	100		

Detailed Syllabus:

Module 1:

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes. Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who?, what?, when?, where?, why?) and 1H (how?). Crime scene logs.

Module 2:

Classification of crime scene evidence – physical and trace evidence. Locard principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene.

Module 3:

Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact. Paint evidence – collection, packaging and preservation. Analysis by destructive and nondestructive methods. Importance of paint evidence in hit and run cases. Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres. Soil evidence – importance, location, collection and comparison of soil samples. Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces. Toolmark evidence. Classification of toolmarks. Forensic importance of toolmarks. Collection, preservation and matching of toolmarks. Restoration of erased serial numbers and engraved marks. Forensic gemology.

Reference Book:

1. M. Byrd, Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence, CRC Press, Boca Raton (2001).

2. T.J. Gardener and T.M. Anderson, Criminal Evidence, 4th Ed., Wadsworth, Belmont (2001).

3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

Ability Enhancement Compulsory Course

Course: English Communication

Code: BDF104

Course Objective: The course is designed to develop the student's communicative competence in English by giving adequate exposure in the four communication skills - LSRW - listening, speaking, reading and writing and the related sub-skills, thereby, enabling the student to apply the acquired communicative proficiency in social and professional contexts.

Sl.	Course Outcome	Mapped Module
1	Students will be able to Remember & Understand the basic concepts of the usage of English grammar & vocabulary in communication.	M1
2	Students will be able to Comprehend facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating themain ideas given in written texts.	M1, M2
3	Students will be able to Synthesise and Apply acquired linguistic knowledge in producing various types of written texts	M1, M3
4	Students will be able to Comprehend facts and ideas from aural inputs and Synthesise and Apply acquired linguistic knowledge in giving spoken response	M1, M4

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Functional grammar & Vocabulary	2	10	1,2	
M 2	Reading Skills	2	20	1,2	
M 3	Writing Skills	8	40	2,3,4	
M 4	Listening & Speaking Skills	8	30	2.3,4	
		20	100		

Paper: English Communication
Code: BDF104

Contact Hours / Week: 2L

Credits: 2

Module 1:
Functional Grammar & Vocabulary: Tense: Formation and application; Affirmative / Negative / Interrogative formation; Modals and their usage; Conditional sentences; Direct and indirect speech; Active and passive voice; usage of common phrasal verbs, synonyms & antonyms. (2 hours)

Module 2:
Reading Skills: Comprehension passages; reading and understanding articles from technical writing. Interpreting texts: analytic texts, descriptive texts, discursive texts; SQ3R reading strategy. (2 hours)

Module 3:
Writing Skills: Writing business letters - enquiries, complaints, sales, adjustment, collection letters, replies to complaint & enquiry letters; Job applications, Résumé, Memo, Notice, Agenda, Reports – types & format, E-mail etiquette, advertisements (8 hours)

Module 4:
Listening & Speaking: Listening: Listening process, Types of listening; Barriers in effective listening, strategies of effective listening Speaking: Presentations, Extempore, Role-plays, GD, and Interview. (2 hours)

Reference Books:

1. Bhatnagar, M &Bhatnagar, N (2010) Communicative English for Engineers and Professionals. New Delhi: Pearson Education.

2. Raman, M & Sharma, S (2017) Technical Communication. New Delhi: OUP.

3. Kaul, Asha (2005) The Effective Presentation: Talk your way to success. New Delhi: SAGE Publication.

4. Sethi, J &Dhamija, P.V. (2001), A Course in Phonetics and Spoken English. New Delhi: PHI.

5. Murphy, Raymond (2015), English Grammar in Use. Cambridge: Cambridge University Press

Course: Environmental Science

Code: BDF204

Course Objective: The course is designed to provide basic knowledge of Environmental Science and give students an understanding of how science and the scientific methods can be applied to address environmental problems.

Sl.	Course Outcome	Mapped Module
1	Students will be able understand the concept of Environmental Science	M1
2	Students will be able understand and learn Fundamentals of EnvironmentalChemistry	M1, M2
3	Students will be able Gather knowledge about Principles and scope of ecology	M2, M3
4	Students will be able understand and learn Environmental Geosciences	M3, M4
5	Students will be able understand and analyze Sun as source of energy	M4, M5

Module Number	Content	Total Hours	% of questions	Blooms Level (if applicable)	Remarks (if any)
M 1	Definition	2	10	1,2	
M 2	Fundamentals of Environmental Chemistry	4	20	1,2	
M 3	Principles and scope of ecology	4	20	3,4	
M 4	Environmental Geosciences	6	30	3,4,5	
M 5	Sun as source of energy	4	20	4,5	
		20	100		

Paper: Environmental Science

Code: BDF204

Contacts Hours / Week: 2L

Credits: 2

Module–1
Definition, Principles and scope of Environmental Science. Earth, Man and Environment. Ecosystems, Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind. Atmospheric stability, inversions and mixing height, wind roses. Natural resources, conservation and sustainable development. (2 hours)

Module 2
Fundamentals of Environmental Chemistry, Chemical composition of Air: Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry. Chemistry of air pollutants, Photochemical smog. Water Chemistry, Principles of Analytical Methods: Titrimetry, Gravimetry, Colourimetry, Spectrophotometry. Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis, X-ray fluorescence, X-ray diffraction, Flame photometry. (4 hours)

Module 3
Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation. Ecosystem, Common flora and fauna in India Aquatic Microflora of Atmosphere: Air Sampling techniques, Identification of aeroallergens. Air-borne diseases and allergies. Environmental Biotechnology: Fermentation Technology, Vermiculture technology, Bio fertilizer technology. (4 hours)

Module 4
Environmental Geosciences, Earth's Processes and Geological Hazards, Mineral Resources and Environment: Resources and Reserves, Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. Water Resources and Environment, Resources of oceans. Ocean pollution by toxic wastes. Human use of surface and groundwaters. Groundwater pollution. Land use Planning, Environmental Geochemistry, Biogeochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land. Principles of Remote sensing and its application of Environmental Sciences. Application of GIS in Environmental Management. (6 hours)

Module 5
Sun as source of energy; solar radiation and its spectral characteristics; Fossil fuels– classification, composition, physicochemical characteristics and energy content of coal, petroleum and natural gas. Principles of generation of hydroelectric power, nuclear energy– fission and fusion; magnetohydrodynamic power, bio-energy–energy from biomass and biogas, anaerobic digestion;

energy use pattern in different parts of the world. Environmental implication of energy use; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy (4 hours)

Reference Books:
1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International
3. Bill Gates, How to Avoid A Climate Disaster The Solutions We Have And The Breakthroughs We Need, Edition 2021, Penguin Random House India.
4. Y.K. Singh, Textbook for Environmental Science, Edition 2006, New Age International
5. JS Singh SP Singh SR Gupta, Ecology Environmental Science and Conservation, Edition 2014, S Chand & Co Ltd