INDIRA GANDHI DELHI TECHNICAL UNIVERSITY FOR WOMEN

(Established by Govt. of Delhi vide Act 9 of 2012)

Department of Information Technology
Proposed Teaching Scheme B.Tech (Artificial Intelligence and Machine Learning)
From Academic Session August 2022 (Odd semester) onwards

SEMESTER I

Code	Subject	L-T-P	Credits	Category
BAI-101	Intelligent Systems	3-0-0	3	DCC
BAI-103	Computer Organization and Architecture	3-0-2	4	DCC
BAI-110	Programming with Python	3-0-2	4	DCC
BAS-107	Applied Physics	3-0-2	4	ASH
BAS-109	Applied Mathematics	3-1-0	4	ASH
HMC-110	Communication Skills	3-1-0	4	HMC
		Total	**23**	

SEMESTER II

Code	Subject	L-T-P	Credits	Category
BAI-102	Object Oriented Programming using Java	3-0-2	4	DCC
BAM-102	Fundamentals of Data Structure	3-0-2	4	DCC
BAI-104	Introduction to Data Science	3-0-2	4	DCC
BAI-108	IT Workshop	1-0-2	2	DCC
BAS-106	Environmental Science	2-1-2	4	ASH
BAS-108	Probability and Statistics	3-1-0	4	ASH
		Total	**22**	

SEMESTER III

Code	Subject	L-T-P	Credits	Category
BAI-201	Artificial Intelligence	3-0-2	4	DCC
BAM-201	Database Management Systems	3-0-2	4	DCC
BCS-203	Discrete Structures	3-1-0	4	DCC
BIT-203	Software Engineering	3-0-2	4	DCC
Bxx-2xx	Open Elective Courses	-	4	OEC
GEC-201	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
BAM-253	Industrial Training/Internship	-	1	DCC
		Total	**23**	

List of Open Elective Courses (New Courses may be added)

Code	Subject	Code	Credits
BAS-201	Material Science and Engineering	3-1-0	4
BAS-203	Numerical Methods	3-1-0	4
BEC-209	Analog and Digital Electronics	3-0-2	4
BMA-209	Engineering Measurement and Metrology	3-0-2	4
BAI-203	IT Workshop using R (for other Dept.)	2-0-4	4
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SEMESTER IV

Code	Subject	L-T-P	Credits	Category
BAI-202	Computer Networks	3-0-2	4	DCC
BIT-202	Operating Systems	3-0-2	4	DCC
BAM-202	Machine Learning	3-0-2	4	DCC
BCS-204	Design and Analysis of Algorithms	3-0-2	4	DCC
Bxx-2xx	Open Elective Courses	3-0-2	4	OEC
HMC-202	Disaster Management	2-0-0	2	HMC
		Total	**22**	

List of Open Elective Courses (New Courses may be added)

Code	Subject	L-T-P	Credits
BAS-202	Nano Structures & Materials in Engineering	3-1-0	4
BAS-204	Optical Engineering	3-0-2	4
BAS-206	Optimization Techniques	3-1-0	4
BEC-210	Elements of Information Theory	3-1-0	4
BMA-210	Operations Management	3-1-0	4
BAI-206	Introduction to Data Science (for other Dept.)	3-0-2	4
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SEMESTER V

Code	Subject	L-T-P	Credits	Category
BAM-301	Optimization Techniques and Decision Making	3-0-2	4	DCC
BAM-303	Cryptography and Network Security	3-0-2	4	DCC
BAM-305	Social Networking and Mining	3-0-2	4	DCC
BCS-303	Theory of Computation	3-1-0	4	DCC
HMC-301	Professional Ethics and Human Values	3-0-0	3	HMC
BAM-353	Industrial Training/Internship	-	1	DCC
GEC-301	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
		Total	**22**	

SEMESTER VI

Code	Subject	L-T-P	Credits	Category
BAM-302	Reinforcement Learning	3-0-2	4	DCC
BAM-304	Neural Networks and Deep Learning	3-0-2	4	DCC
BAM-306	Computer Vision	3-0-2	4	DCC
BAM/BAI-3xx	Departmental Elective - I	-	4	DEC
BAM/BAI-3xx	Departmental Elective – II	-	4	DEC
HMC-30x	Management Elective	-	2	HMC
		Total	**22**	

List of Departmental Elective Courses (New Courses may be added)

Category	Course Code	Subject	L-T-P	Credits
Departmental Elective-I	BAI-306	Cloud computing & IoT	3-0-2	4
	BAI-308	Blockchain Technologies	3-0-2	4
	BAI-310	Quantum Computing	3-0-2	4
	BAM-308	Cyber Security and Forensics	3-0-2	4
Departmental Elective-II	BAI-312	Information Retrieval	3-0-2	4
	BAI-314	Recommender Systems	3-0-2	4
	BAI-316	Semantic Web	3-0-2	4
	BAM-309	Natural Language Processing	3-0-2	4
	BEC-318	Digital Image Processing	3-0-2	4

List of Management Elective Courses (New Courses may be added)

Course Code	Subject	L-T-P	Credits
HMC-302	Principles of Management	2-0-0	2
HMC-304	Marketing Management	2-0-0	2
HMC-306	Financial Management	2-0-0	2
HMC-308	Human Resource Management…	2-0-0	2

SEMESTER VII

Code	Subject	L-T-P	Credits	Category
BAI-410	Recent Trends in AI	3-0-2	4	DCC
BIT-407	Big Data Analytics	3-0-2	4	DCC
BAI-401	Multimodal Data Processing	3-0-2	4	DCC
BAM-4xx/BAI-4xx	Departmental Elective - III	-	4	DEC
BAM-4xx/BAI-4xx	Departmental Elective - IV	-	4	DEC
BAI-451	Minor Project	0-0-8	4	DCC
BAI-453	Internship	-	1	
		Total	25	

List of Departmental Elective Courses (New Courses may be added)

Category	Code	Subject	L-T-P	Credits
Departmental Elective -III	BAM-401	Data Warehousing and Data Mining	3-0-2	4
	BAM-403	Applications of Machine Learning in Cyber Security	3-0-2	4
	BIT-405	Soft Computing	3-0-2	4
	BAI-405	Speech Technology	3-0-2	4
	BAI-407	Pattern Recognition	3-0-2	4
	BIT-413	Software Project Management	3-1-0	4
Departmental Elective -IV	BAI-409	Conversational AI	3-0-2	4
	BIT-409	Distributed Systems	3-0-2	4
	BIT-417	E-Commerce	3-1-0	4
	BAI-411	Parallel and Distributed AI	3-0-2	4
	BAI-413	AI and Humanity	3-0-2	4

SEMESTER VIII

Code	Subject	L-T-P	Credits	Cat.
HMC-401	Creativity, Innovation and Entrepreneurship	3-0-0	3	HMC
BAI/BIT-4xx	Departmental Elective – V	-	4	DEC
BAI-4xx	Departmental Elective – VI	-	4	DEC
BAI-452	Industrial Project/R&D Project/Start-up Project	-	8	DCC
GEC-402	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
		Total	21	

List of Departmental Elective Courses (New Courses may be added)

Category	Code	Subject	L-T-P	Credits
Departmental Elective-V	BAI-402	Augmented Reality and Virtual Reality	3-0-2	4
	BAI-404	Social Media Analytics	3-0-2	4
	BAI-406	AI for Games	3-0-2	4
	BAI-408	Multi-agent Systems	3-0-2	4
	BIT-404	Requirement Estimation Theory	3-0-2	4
	BIT 412	Advanced Software Engineering	3-0-2	4
Departmental Elective-VI	BAI-410	Internet of Things	3-0-2	4
	BAI-412	Embedded Systems	3-0-2	4
	BAI-414	Bioinformatics and Computational Genomics	3-0-2	4
	BAI-416	AI in Healthcare	3-0-2	4
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Syllabus of 1st Year

(1st and 2nd semester)

INTELLIGENT SYSTEMS	
Course Code: BAI-101 Contact Hours: L-3 P-0 C-0 Course Category: DCC	Credits: 3 Semester: 1

Introduction

The field of computer science has continuously evolved to build intelligent systems. The design and development of intelligent systems grounded in the field of artificial intelligence is becoming quite popular in Computer Science. The fundamental question 'Can intelligent systems mimic humans and surpass them in all kinds of work?' has kept computer scientists occupied for many decades in the past, and will continue to occupy them in future. This course is a gentle introduction to the field of intelligent systems.

Course Objectives

- Understand the basic building blocks of Intelligent Systems.
- Appreciate some of the approaches to build Intelligent Systems.
- Understand the importance of application of Intelligent Systems in different domains.

Pre-requisites: None

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

- Understand the different approaches to the design of intelligent systems.
- Appreciate the importance of intelligent systems in different domains.
- Development of an intelligent system is not expected. But 'thinking' in that direction should start.

Pedagogy

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

Contents

UNIT- I	7 Hrs
Intelligence, Intelligent Systems, Characteristics of Intelligent Systems, Knowledge vs Intelligence, Knowledge Representation, Reasoning, Deductive vs. Inductive vs. Abductive Reasoning, Propositional Logic, Inference Foundations of AI, Intelligent Agents, Structure of Intelligent Agent. Environment of Intelligent Agent. Case Studies.	
UNIT - II	7 Hrs
Importance of Data, Dataset, Introduction to Data driven approaches, Introduction to Machine Learning, Training and Testing, Various approaches to intelligent system, Pattern recognition and classification,	
UNIT - III	7 Hrs
Domains of Intelligent Systems – Computer Vision, Natural Language Processing, Speech Processing, Mobile Robotics, Internet of Things (IoT), Intelligent IoT Applications, Drones, Intelligent Web Applications	
UNIT - IV	7 Hrs
Intelligent Applications – Agriculture, Healthcare, Education, Smart Cities, Autonomous Vehicle.	

Text Books	
1	Stuart J. Russel and Peter Norvig. Artificial Intelligence – A Modern Approach. 4th/Latest Edition, Pearson Education, 2020.
2	Deepak Khemani, A First course on Artificial Intelligence –McGraw Hill India, 2013
3	Peter Flach, The Art and Science of Machine Learning, Cambridge University Press, 2012.
Reference Books	
1	Josh Patterson, Adam Gibson. Deep Learning: A Practitioner's Approach. O'Reilly Media, 2017.
2	Gregory Dudek and Michael Jenkin. Computational Principles of Mobile Robotics. Cambridge University Press, 2012.

COMPUTER ORGANIZATION AND ARCHITECTURE	
Course Code: BAI-103 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 1

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

Course Objectives:

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

Pre-requisite: Fundamentals of computers and digital logic.

Course Outcome:
On successful completion of this course, the student should be able to:

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

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

Contents

UNIT-I	12 Hours
Digital Logic Circuit: Basic Logic functions, Synthesis of logic functions using basic and universal gates, Boolean Algebra Properties, Flip-Flops, Registers, Shift- Registers, Counters, Decoders, Multiplexers, Functional Unit of computer system. Data Representation: Data types, R & (R-1)'s Complements, Fixed-Point representation, Floating point representation. Register Transfer and Micro operations: Register transfer language, register transfer, Bus and Memory transfer, Arithmetic Micro operations, Logic Micro operations, Shift Microoperations	
UNIT-II	10 Hours
Basic Computer Organisation and Design: Instruction Codes, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt. Micro programmed Control: Control Memory. Central Processing Unit: Stack Organization, Instruction Formats, Addressing Modes, Program Control, Reduced Instruction Set Computer: RISC characteristics, CISC characteristics. Performance and Metrics	
UNIT-III	10 Hours
Pipelining and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipelining, Instruction Pipelining, RISC Pipelining, Vector Processing, Array Processors. Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating- Point Arithmetic Operations.	
UNIT-IV	10 Hours
Input-Output Organization: Peripheral Devices, Input-Output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupt, Direct Memory Access. Memory organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.	
Text Books	
1.	M. Morris Mano, Computer System Architecture, PHI, 3rd/Latest Edition
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th/Latest Edition, McGraw Hill.
3.	Martin S, Computer Organization, PHI publication, 2012
Reference Books	
1.	William Stallings, Computer Organization and Architecture, 6th/Latest Edition, Pearson/PHI.
2.	John L. Hennessy and David A. Patterson, Computer Architecture a quantitative approach, 4th Edition (Kindle)

PROGRAMMING WITH PYTHON	
Course Code: BAI-110 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 1

Introduction: Python is a versatile programming language, suitable for projects ranging from small scripts to large systems. It is widely used in many scientific areas for data exploration. This course will be useful for both text and data processing.

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Course Objective:

- To know the basics of algorithmic problem solving for reading and writing Python programs.
- To develop Python programs with conditions and loops.
- To use Python data structures –- lists, tuples dictionaries.
- To define Python functions and call them.
- To do input/output with files in Python

Prerequisite: Nil

Course Outcomes:

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

- Write python programs that solve simple business problems.
- Create python applications that are robust and multithreaded.
- Manage exceptions in Python
- Write simple GUI interfaces for a program to interact with users, and to understand the event-based GUI handling principles in python.

Pedagogy

Lectures will be imparted along with hands-on lab sessions and the latest real-world case studies where python can be used.

Contents

UNIT-1	10 hours
The Structuring Programming Principle, Program Structuring, Stepwise refinement, Introduction to Python programming language, The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators, Data and Expressions, Literals, Variables and Identifiers, Understanding error messages, Conditions, Boolean Logic, Logical Operators, ranges, Control statements: if-else, loops (for, while);	
UNIT-2	10 hours
Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab separated); String manipulations: subscript operator, indexing, slicing a string, Lists, Tuples, and Dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries; Function, Execution of A Function, Keyword and Default Arguments, Scope Rules.	
UNIT-3	10 hours
Exception, Testing and Debugging: Handling if exceptions to handle the code cracks, handling and helping file operations, coding with the exceptional handling and testing Anonymous method, Properties, Indexers, Exception Handling	
UNIT-4	10 hours
Python packages: Simple programs using the built-in functions of packages like matplotlib, numpy, pandas etc., Graphical user interfaces; Tkinter introduction, Tkinter and Python Programming, event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.	
Textbooks	
1. C. Dierbach, Introduction to Computer Science Using PYTHON: A Computational Problem-Solving Focus (1st Edition), Wiley, 2015.	
2. Let Us Python, Yashavant Kanetkar, BPB Publishers, 2019, 1st edition	
Reference Books	
1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist (2nd Edition), O'Reilly, 2016.	
2. Martin C. Brown, Python: The Complete Reference (4th Edition), McGraw-Hill, 2018.	

APPLIED PHYSICS	
Course Code: BAS-107 Contact Hours: L-3 T-0 P-2 Course Category: BAS	Credits: 4 Semester: 1

Introduction: Physics is a subject that is continuously evolving with latest research. The scientific principles of physics are basis of various devices, applications and technological breakthrough. This Applied Physics course has been designed to cover the wide ranging topics of the physics that have direct impact on technological advancements. In this course you will learn various concepts of modern and device oriented physics that will enhance your ability to apply fundamentals to various applications.

Course Objectives:

- To introduce the students with the wide ranging topics of the modern physics such as EMT, quantum mechanics, optics and sensor physics which form the underlying principles of various technologies.
- To develop their ability of solving real world problems, going a step ahead of what they have studied in school.
- To impart them an in-depth knowledge of everyday systems and physical phenomena surrounding them and underlying principles of physics behind those phenomenon.
- To enhance the ability of students to apply fundamentals to various applications.

Pre-requisites: None

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

- Gain knowledge and comprehend various fundamentals of physics.
- Build a sound foundation of applications of physics.
- Identify and analyze relationship between different principles of physics and integrate them for various applications.
- Evaluate and apply the quantitative and qualitative aspects of physics to innovate devices in the constantly competitive Technologies.

The comprehensive list of experiments in the lab will correlate and enhance the analytical skills and develop the ability of the students to think beyond the usual.

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

Content

UNIT-I	10 Hours
Electro Magnetic Theory: Electromagnetic Waves, Equation of Continuity, Maxwell's Equations, Displacement Current, Wave Equation, Poynting Theorem, Propagation of Electromagnetic Waves in Free Space	
UNIT-II	11 Hours
Optics: Interference due to Division of wave-front and Division of Amplitude, Interference in Parallel Thin Films, Newton's Rings, Fresnel Diffraction at Straight Edge, Fraunhoffer Diffraction due to Single Slit, N Slits, Diffraction Grating. Stimulated and Spontaneous Emission, Einstein's A and B Coefficients, LASER Principles and design, He-Ne LASER	
UNIT-III	11 HOUR
Quantum Mechanics: De Broglie Hypothesis and wave particle duality, Heisenberg Uncertainty Principle, Postulates of Quantum Mechanics, Wave Function and Properties, Schrodinger Wave Equation (time dependent & independent), Particle in Box (1-D)	
UNIT IV	10 HOUR
Physics of Sensors: Signals and Response, Sensor Characteristics (Transfer Function, Sensitivity, Calibration, Span, Accuracy, Non-linearity, Saturation, Repeatability, Dead Band, Resolution and Selectivity), Static and Dynamic Response, Sensor Classifications Resistive Sensors (Temperature/ Strain/ Moisture/ Gas or Chemical Sensor), AI based E-Nose (Qualitative)	

Text Books	
1	H. K. Malik And A. K. Singh, 2nd Edition, "Engineering Physics", McGraw Hill Ed, 2017.
2	Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 4th /Latest Edition, Springer, 2010.
Reference Books	
1	Ajoy K. Ghatak, "Optics",6th/Latest Edition, McGraw Hill Education India Private Limited, 2017.
2	F. K. Richtmyer, E. H. Kennard, and J. N. Cooper, "Introduction to Modern Physics" 6th/Latest Edition, McGraw Hill, 1997.
3	Arthur Beiser, Shobhit Mahajan and S. Choudhury, "Concepts of Modern Physics", 7th/Latest Edition, McGraw Hill, 2015.

APPLIED MATHEMATICS	
Course Code: BAS-109 Contact Hours: L-3 T-1 P-0 Course Category: BAS	Credits: 4 Semester: 1

Introduction:
Mathematics is used in almost every field of engineering be it computer science and information technology wherein it may be used in modeling, machine learning, image processing etc., or by electrical engineers for signal processing, control engineering or by mechanical engineers for design, modeling, manufacturing etc. But the problem faced by engineers is to how to apply the basic mathematical concepts in engineering problem which they would be dealing in coming years. The course covers the various topics of engineering mathematics such as matrices, sequences and series, calculus of functions of more than one variable and vector calculus.

Course Objective:

- The students will be made familiar with the concepts of matrices, sequences and series.
- To provide students with skills and knowledge of calculus of functions of several variables and vector calculus which would enable them to devise solutions for given situations they may encounter in day to day engineering problems.

Prerequisite: Fundamentals of matrices, calculus of functions of single variable, vectors.

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

- Build a sound foundation and have comprehensive knowledge of matrices, Infinite series, Fourier series, calculus of functions of more than one variable and vector calculus.
- Evaluate rank, inverse, Eigen values and Eigen vectors of a matrix.
- Determine the convergence/divergence of an infinite series, approximation of functions and error estimation using Taylor's series expansion.
- Analyze some mathematical problems encountered in engineering applications.
- Learn various concepts and applications of maxima and minima, multiple integrals, gradient, divergence, curl, Green's theorem, Gauss divergence theorem and Stoke's theorem.

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

Contents

UNIT-I	10 Hours
Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form), Linear dependence, Consistency of linear system of equations and their solution, Characteristic equation, Eigen values and eigen vectors, Cayley-Hamilton Theorem (without proof).	
UNIT-II	12 Hours
A brief Introduction to Vector Spaces, Subspaces, Rank and Nullity, Linear Transformations Laplace Transforms: Defn, Laplace transforms of some standard functions, inverse Laplace transforms, Convolution theorem. Fourier Series: Fourier Series, Fourier Series of even and odd functions, Fourier Series of functions having arbitrary periods, half range expansion. Fourier Transforms: Fourier transform, Sine and Cosine transforms	
UNIT-III	10 Hours
Differential Calculus: Functions of several variables: Limits, continuity and differentiability, Successive differentiation, Leibnitz theorem, Partial differentiation, Euler's Theorem for homogenous equations. Composite functions, Change of variables, Taylor's and Maclaurin's Series, maxima and minima, Lagrange's method of undetermined multiplier.	
UNIT-IV	10 Hours
Vector Calculus : Vector point functions, Gradient, Divergence and Curl and their physical interpretation, Line integrals, Multiple Integrals, Change of order of integration, Surface and Volume integrals, Green's, Gauss Divergence and Stoke's theorems (without proof).	

Text Books

1.	D. G. Zill and W. S. Wright, Advanced Engineering Mathematics, 6th Edition, The Jones and Bartlett Learning Publishers, 2016.
2.	Jain R. K. and Iyengar S. R. K., Advanced Engineering Mathematics, 4th Edition, Narosa Publishing House Pvt. Ltd.2012.
3.	Grewal, B. S. , Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017
4.	Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press

Reference Books

1.	George B. Thomas Jr., Ross L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education India, 2010
2.	Greenberg M., Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 1998.
3.	Kreyszig E. , Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2010.

COMMUNICATION SKILLS	
Course Code: HMC-110 Contact Hours: L-3 T-1 P-0 Course Category: HMC	Credits:4 Semester: 1

Introduction: This course facilitates communication skills development by exposing the students to various nuances of effective communication. The course provides an in-depth understanding of several key concepts of Communication like importance and functions of communication, barriers to communication, active listening, group discussions, presentation skills etc. The course also provides valid inputs on the *ethical* dimension of communication to enable the students to be ethical communicators.

The highlight of the course is special emphasis on Employment Communication i.e. job application and resume writing along with preparing and appearing for Interviews. The students are also acquainted with various forms of business correspondence used in organizations on a regular basis like agenda and minutes of meetings, business letters, reports etc.

Course Objectives:

- To enable students to evaluate their personal communication styles and improve upon it.
- To help the students understand the contemporary trends in communication.
- To facilitate the students in becoming aware of different communication theories and their application.
- To encourage students to develop their own unique style of communication.

Pre-requisites: None

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

- Evaluate and analyze their personal communication style while adapting their communication style to better expression of their ideas at workplace.
- Enhance their knowledge of contemporary trends for effective Communication
- Effective comprehension and application of different Communication theories.
- Synthesis their own unique communication style.

Pedagogy: Apart from interactive class teaching, various individual and group assignments are given. Group discussions, JAMs, role plays and presentations are conducted in class to enable students to practically apply the theories learnt during the course.

Contents

UNIT-I	10 Hours
Introducing Communication: Importance and function of Communication, Communication Cycle, Characteristics and Types of Communication, Channels and Medium of Communication, 7 C's of Communication, Barriers to Communication. Ethics of Communication (plagiarism, language sensitivity towards gender, caste, race, disability etc.	
UNIT-II	11 Hours
Everyday Communication: Non-Verbal Language (Symbols, Appearance, Paralanguage and Body Language, Proxemics, Chronemics), Listening Skills (Importance, Barriers, Essentials of Good Listening), Communication Skills (greetings, introducing, making requests, asking and giving permission, offering help and giving instructions and directions etc.), Understanding Telephone Skills (handling calls, leaving a message, asking and giving information and instructions etc.), Net Etiquettes.	
UNIT-III	11 Hours
Presentations & Employment Communication: Classroom Presentations (purpose, types, preparing and presenting - use of visual aids/ power point presentations), Group Discussion (purpose, strategies, guidelines etc.), Job Application (Resume and Cover Letter), Interview Skills (purpose, types of interviews, guidelines and preparing for facing the interviews). Presentation, Group discussion and Mock interview practice should be undertaken in class.	
UNIT-IV	10 Hours
Writing on the Job: Formal and Informal Writing, Basics of Paragraph Writing**,** Email Writing, Letters at the workplace, Meeting documentations (Agenda and Minutes of meeting etc.), Report Writing (characteristics, types, structure of formal report).	
Text Books	
1.	M. Raman and S. Sharma. Technical Communication: Principles and Practice, 3rd Edition, Oxford University Press, 2011.
2.	M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill Publications, 2005.
Reference Books	
1.	Lewis and Hedwig, Body Language: A Guide for Professionals, New Delhi, Response Books, 2000
2.	Sides and H. Charles, How to Write & Present Technical Information, Cambridge, CUP, 1999.
3.	S. Kumar and P. Lata. Language and Communication Skills for Engineers, Oxford University Press, 2018.
4.	Hasson, Gill. Brilliant Communication Skills. Pearson Education, 2012.

OBJECT ORIENTED PROGRAMMING USING JAVA	
Course Code: BAI-102 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 2

Introduction:

Java Programming is one of the most widely used programming language among developers and are preferred over other languages. This course introduces students to object-oriented concepts and its implementation in Java Language. The objective is to provide students with the use of the Java programming language for writing complex and stand-alone applications at the Intermediate level.

Course Objectives:

- To understand object oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
- To introduce the implementation of packages and interfaces
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using applets and swing controls.

Prerequisite: Any programming knowledge

Course Objectives:

On successful completion of this course, the student should be able to:

- Understand the basic principles of the object-oriented programming and to solve real world problems using OOP techniques with Java.
- Show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard
- Demonstrate an introductory understanding of graphical user interfaces, multithreaded programming, and event-driven programming.

Pedagogy:

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

Contents

UNIT I	10 Hours
An Overview of Java, Data types, Variables and Arrays, operators, expressions, control statements. Object-oriented thinking- A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances, Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts. Java buzzwords, Introducing classes, Methods and Classes, String handling.	
UNIT II	10 Hours
Inheritance– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Polymorphism-ad hoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Packages- Defining a Package, CLASSPATH, Access protection, importing packages.	
UNIT III	10 Hours
Interfaces- defining an interface, implementing interfaces, Nested interfaces, applying interfaces, variables in interfaces and extending interfaces. Stream based I/O(java.io) – The Stream classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics. Exception handling – Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes.	
UNIT IV	10 Hours
Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication. Event and GUI programming : Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.	

Text Books	
1	Java The complete reference, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd., 11th/Latest Edition, 2020
2	Understanding Object-Oriented Programming with Java, T. Budd, Pearson Education, Latest Edition
3	Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education, 2020
Reference Books	
1	Introduction to Java Programming (Comprehensive Version), Daniel Liang, 10th/Latest Edition, Pearson, 2018
2	Programming in Java, Sachin Malhotra & Saurabh Chaudhary, Oxford University Press, 1st/Latest Edition, 2018

INTRODUCTION TO DATA SCIENCE	
Course Code: BAI-104 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 2

Introduction:
This course serves as an introduction to the basics of Data Science including programming for Data Analytics, File Management and Data Visualization. The course aims to understand the underlying core concepts and emerging technologies in data science. The foundation is laid for big data applications ranging from social networks to medical and business informatics.

Course Objectives:

- To learn the Data Science concepts and its various Applications
- To understand the Data Science processes including Data Wrangling, Data Exploration and Data Visualization
- To explore various Packages and Libraries in Python for Mathematical Computing

Prerequisite: Python Programming

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

- Develop data analysis skills for solving practical problems involving large data.
- Convert analytical results into visual objects like charts, plots and others.
- Analyze data using Tableau for designing various visual features like Carts, Graphs, Plots and others
- To develop knowledge of working on large Data Science projects.

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

Contents

UNIT-I	10 Hours
Data Science Overview, Evolution of Data Science, Data Science Roles, Tools for Data Science, Applications of Data Science Data Science Process Overview, Defining Goals, Retrieving Data, Data Preparation, Data Exploration, Data Modeling, Presentation Data Science Ethics, Doing good Data Science, Owners of the Data, Valuing different aspects of Privacy, Getting Informed Consent, The Five Cs of Data Science, Diversity, Inclusion, Future Trends in Data Science.	
UNIT-II	12 Hours
Mathematical Computing with Python (NumPy):Working with NumPy Arrays, Data Types, Array Creation, Indexing and Slicing, Numerical Operations on Arrays, Array Functions, Data Processing using Arrays**,** Loading and Saving Data, Saving an Array, Loading an Array, Numpy Random Numbers Data Manipulation with Pandas: Data Wrangling, Data Exploration, Cleaning Data, Filtering, Merging Data, Reshaping Data, Data Aggregation**,** Reading and Writing Files, Loading and Saving Data with Pandas	
UNIT-III	10 Hours
Data Visualization in Python, Understanding Data Visualization, Creating different Visualization like Bar Charts, Line Plot, Area Plots, Histograms, Pie Charts, Box Plots, Scatter Plots, Time Series plots, Figures and Subplots, Plotting Functions with Pandas .	
UNIT-IV	10 Hours
Data Visualization using non programming tools like Tableau. Work with Filter, Parameters, Sets. Arithmetic and logical table. Data visualization techniques such as heat map, tree map, Pareto. Interactive dashboards, story interfaces, and how to share your work.	

Texts Books:

1.	Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing Data Science, Manning Publications Company, 1st/Latest Edition (2016).
2.	Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2017
3.	Joshua N. Milligan, Learning Tableau 2020: Create effective data visualizations, build interactive visual analytics and transform your organization, Packt Publishing Limited, 4th/Latest Edition (2020).

Reference Books

1.	Prateek Gupta, Data Science with Jupyter, BPB Publication, 1st/Latest Edition (2017)
2.	Joel Grus, Data Science from Scratch, O'Reilly, 2nd/Latest Edition (2019)
3.	Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O' Reilly, 1st/Latest Edition (2013)

FUNDAMENTALS OF DATA STRUCTURES	
Course Code: BAM-102 Contact Hours: L-3 T-0 P- 2 Course Category: DCC	Credits: 4 Semester: 3

Introduction:
Data structure is a specific way to store and organize data in a computer's memory so that these data can be used efficiently later. This course introduces about various data structures and their useful applications in computer science domain.

Course Objectives:

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

Pre-requisite: Fundamentals of Programming

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

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

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

Contents

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

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

IT WORKSHOP	
Course Code: BAI-108 Contact Hours: L-1 T-0 P-2 Course Category: DCC	Credits: 2 Semester: 2

Introduction: IT Workshop is a practical course where students will learn programming with R. R is capable of handling mathematical and statistical manipulations. It has its own programming language as well as built-in functions to perform any specialized task.

Course Objectives:

- To introduce students to the statistical package R for data analysis.
- To use R to perform descriptive statistics including graphics, perform basic inferential statistical analyses including regression analysis, read and write data files,
- To perform basic data manipulations (eg, creating new variables, merging data sets), write and use R script files, use R packages, write and use R functions, and perform basic programming in R.

Pre-Requisites: Fundamentals of Mathematics background.

Course Outcomes:

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

- Perform simple calculations, make simple plots and perform multiple operations in sequence, or at once
- Troubleshoot errors
- Perform exploratory data analysis, data modeling and interpretation of results
- Format “clean” data and clean up “dirty” data

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

Contents

UNIT I	11 Hours
An overview of R language: Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments. Getting R and Running R, R Packages Expressions, Objects, Symbols, Functions Special Values	
UNIT II	11 Hours
Constants, Numeric vectors, Character Vectors, Operators. R Syntax, Data Structure in R (Matrices, Arrays, Factors, Data frames), Attributes, Symbols and Environment, Functions, Loading, Saving, and Editing Data in R, Combining Datasets, Transformations, Binning Data	
UNIT III	10 Hours
Subsets, Summarizing Functions, Data Cleaning. Analyzing Data, Probability Distribution, Continuous Data , Discrete Data, T-test Design, Anova Test Design, Introduction to Regression, Linear model, Smoothening	
UNIT IV	10 Hours
Graphics and Plots: Scatter Plots, Bar Charts, Pie Charts, Three-dimensional Data, Plotting Distribution, Customizing Charts, Basic Graphic Functions, Common Arguments for Chart Functions.	

Text Books:

1	Long, James D., and Paul Teetor. R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics. O' Reilly Media, 2019.
2	Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R, Springer, 2016
3	Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, The R Software-Fundamentals of Programming and Statistical Analysis, Springer 2013

Reference Books:

1	Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, A Beginner's Guide to R (Use R), Springer 2009
2	Hadley Wickham, ggplot2 Elegant Graphics for Data Analysis, Springer 2016
3	Internet Sources: www.nptel.ac.in

ENVIRONMENTAL SCIENCES	
Course Code: BAS-106 Contact Hours: L-2 T-1 P-2 Course Category: ASH	Credits: 4 Semester: 2

Introduction:
A scientific study of the natural world and how it is influenced by people. It Surveys environmental studies, examining ecological, socioeconomic, and technological factors that influence the quality of life on Earth.

Course Objectives:

- Environmental science prepares students for career success in environmental monitoring and remediation, natural resources and conservation, public health, industrial environmental management.
- The curriculum is so designed that the students get an in-depth knowledge of the environment and various issues arising due to mismanagement of resources.

Pre-requisites: None

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

- Plan and execute experiments that demonstrate the use and understanding of modern instruments, accurate quantitative measurements, appropriate recording skills, safe lab practices.
- Understand and evaluate the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
- Analyze data statistically, assess reliability, interpret results and draw reasonable conclusions.
- Gain comprehensive knowledge of interdisciplinary branches like Toxicology, Green Technology, synthesis and applications of Eco friendly polymers.

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

Contents

UNIT-I	6 Hours
Natural Resources, Conservation and Management: Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water. Mineral resources: Environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs renewable and non-renewable energy sources. Resource Management-Concept of Sustainable development, Environmental Management Systems, Environmental Impact Assessment, Biodiversity- conservation and threats.	
UNIT-II	8 Hours
Environmental Pollution and Control: Air Pollution: Types of air pollutants; Source, effects, sink & control of common air pollutants (CO, oxides of nitrogen & sulphur, hydrocarbons and particulates), Photochemical smog, acid rain, greenhouse effect, global warming, Carbon dioxide sequestration and the concept of Carbon Credits Water Pollution: Classification of pollutants and their sources, Waste water treatment (Primary, secondary and tertiary treatment), Impact of water pollution on hydrological ecosystems. Solid and Hazardous Waste Pollution: Classification, waste treatment and disposal methods: Sanitary landfill, thermal processes, chemical and biological processes, disposal methods for nuclear waste, nuclear disaster (case study), disposal methods for e-waste. Green Technology And Green Chemistry: Introduction to concept of Green Technology and Zero Waste Technology, Green Chemistry & its basic principles, Atom Economy, evaluation of feedstock, reaction types, methods, reagents and solvents.	
UNIT-III	8 Hours
Fuels and Alternate Energy Sources: Classification, Calorific value of fuels (gross and net), Dulong's formula, Determination of calorific value of fuels using bomb's calorimeter, Determination of calorific value of fuels using Boy's Gas Calorimeter (Numericals). Liquid fuels-petroleum chemical composition, fractional distillation, Cracking – Thermal & catalytic cracking, Octane & Cetane numbers with their significance. Analysis of flue gases (Orsat's Apparatus)-(Numericals), Combustion of fuels. Use of alternate energy sources including solar energy harnessing (photovoltaics), wind energy, hydroenergy, geothermal energy, ocean energy, biodiesel, power alcohol, biomass energy.	
UNIT IV	6 Hours
Chemical Toxicology and Eco-Friendly Polymers Toxicology: terminology & toxic effects, chemical interactions, impact of toxic chemicals on enzymes, Biochemical effects of arsenic, mercury, lead, chromium, & cadmium. Polymers-Introduction: Functionality of monomer, polymerization, degree of polymerization, Number average and weight average molecular weight of polymers. Environmental degradation of polymers: Biodegradable, Photo-biodegradable polymers, Hydrolysis & Hydro-biodegradable polymers Biopolymers & Bioplastics.	

Text Books

1	Ranu Gadi, Sunita Rattan, Sushmita Mohapatra. A Text book of Environmental Studies (with experiments), 4th /Latest Edition, S. K. Kataria & Sons, 2014.
2	S. Rattan, "Applied Chemistry", S.K. Kataria & Sons, 2013.
3	S. S. Dara, D. D. Mishra. A Textbook of Environmental Chemistry and Pollution Control (With Energy, Ecology, Ethics and Society) S. Chand and Company Pvt. Ltd. (India), 2011.

Reference Books

1	Richard T. Wright, Environmental Science, 9th /Latest Edition, Pearson Education, 2007.

2	Gerard Kiely, Environmental Engineering, Special Indian Edition, McGraw-Hill Companies, 2007.
3	E. Barucha, Textbook of Environmental Studies for Undergraduate Courses, Universities Press (India) Pvt. Ltd., 2005.
4	C.N. Sawyer, P.L. McCarty, and G.F. Parkin, "Chemistry for Environmental Engg. and Science", 5th/Latest Edition, The McGraw-Hill Companies, 2003.
5	R. Rajagopalan, Environmental studies from crisis to cure, 3rd/ Latest Edition, Oxford University Press., 2016.

PROBABILITY AND STATISTICS	
Course Code: BAS-108 Contact Hours: L-3 T-1 P-0 Course Category: ASH	Credits: 4 Semester: 2

Students will learn fundamental rules of Probability, discrete and continuous distributions, and statistical methods most commonly used in Computer Science and & Engineering.

Course Objectives:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.

Course Outcomes:

On completion of the course, the student should be able to:

- Conduct simple calculations of probabilities and conditional probabilities, in particular by using methods for independent events;
- Give an account of basic properties for random variables and for the most common probability distributions, as well as calculations of expectations and variances for these distributions;
- Use probabilistic methods in some areas of applications;
- Explain the basics of statistical surveys and for methods of descriptive statistics;
- Implement the above concepts in EXCEL/R/Mathematica.

Prerequisite: NIL

Pedagogy:

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

Contents

UNIT – I	14 Hours
PROBABILITY AND RANDOM VARIABLES Concept of probability, additive and multiplicative law of probability, total and conditional probabilities, Baye's theorem. Measures of Central Tendency, dispersion, kurtosis, moments. Random Variables, density and distribution functions, mathematical expectation, variance, standard deviation and moment generating function.	
UNIT – II	8 Hours
TWO – DIMENSIONAL RANDOM VARIABLES Jointly distributed random variables, Marginal and conditional distributions, Expected values, Covariance and Correlation. Central limit theorem (for independent and identically distributed random variables).	
UNIT – III	10 Hours
PROBABILITY DISTRIBUTIONS AND REGRESSION Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. Linear Correlation, Correlation Coefficient, Rank Correlation Coefficient, Regression.	
UNIT –IV	10 Hours
APPLIED STATISTICS Formation of Hypothesis, Test of significance: Large sample test for single proportion, Difference of proportions, Single mean, Difference of means, and standard deviations. Test of significance for small samples: t- Test for single mean and difference of means, t-test for correlation coefficients, F- test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	
Case Study / Implementation of above concepts using Excel.	

Text Books

1.	Montgomery, Douglas C., and George C. Runger. "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th Edition (2018) or latest.
2.	Sheldon Ross M., Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, 6th Edition (2020) or latest.
3.	Rukmangadachari E., and Keshava, Reddy E. Probability and Statistics, Pearson Education India (2015) or latest.
4.	Ravichandran J., Probability and Statistics for Engineers. Wiley India, 2010.

Reference Books

1.	Devore, Jay L. "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage (2010) or latest.
2.	Scheaffer, Richard, Madhuri Mulekar, and James McClave. Probability and Statistics for Engineers. Nelson Education, 2010.
3.	Meyer, Paul L. Introductory Probability and Statistical Applications. 2nd Edition, Oxford and IBH publishing, 1965.
4.	Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S Chand Publications, 11th Edition(20) or latest