

Scheme & Syllabus of
Bachelor of Science in Artificial Intelligence and
Machine Learning
B.Sc. (AI & ML)

Batch 2020 onwards



By

Board of Study Computer Applications

Department of Academics

I.K. Gujral Punjab Technical
University

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Bachelor of Science in Artificial Intelligence and Machine Learning B.Sc.(AI & ML):

It is an Under Graduate (UG) Programme of 3 years duration (6 semesters)

Eligibility: All those candidates who have passed 10+2 in Non-Medical from recognized Board / University / Council with atleast 50% marks (45% marks in case of candidate belonging to Reserved Category) in aggregate.

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First Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1901	Core Theory	Mathematics	3	1	0	40	60	100	4
UGCA1902	Core Theory	Fundamentals of Computer and IT	3	1	0	40	60	100	4
UGCA1914	Core Theory	Programming in Python	3	1	0	40	60	100	4
UGCA1958	Core Practical/Laboratory	Workshop on Multimedia Tools	0	0	4	60	40	100	2
UGCA1917	Core Practical/Laboratory	Programming in Python Laboratory	0	0	4	60	40	100	2
UGCA1906	Core Practical/Laboratory	Fundamentals of Computer and IT Laboratory	0	0	4	60	40	100	2
BTHU103/18	Ability Enhancement Compulsory Course (AECC)-I	English	1	0	0	40	60	100	1
BTHU104/18	Ability Enhancement Compulsory Course (AECC)	English Practical/Laboratory	0	0	2	30	20	50	1
HVPE101-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules	3	0	0	40	60	100	3
HVPE102-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules (Lab/Seminar)*	0	0	1	25	0	25	1
BMPD102-18		Mentoring and Professional Development **	0	0	1	25	0	25	1
	TOTAL		13	03	16	460	440	900	25

* The Human Values, De-addiction and Traffic Rules (Lab/ Seminar) and Mentoring and Professional Development course will have internal evaluation only.

See guidelines at the last page of this file

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Second Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1907	Core Theory	Fundamentals of Statistics	3	1	0	40	60	100	4
UGCA1923	Core Theory	Operating Systems	3	1	0	40	60	100	4
UGCA1915	Core Theory	Data Structures	3	1	0	40	60	100	4
UGCA1918	Core Practical/Laboratory	Data Structures Laboratory	0	0	4	60	40	100	2
UGCA1926	Core Practical/Laboratory	Operating Systems Laboratory	0	0	4	60	40	100	2
UGCA1911	Core Practical/Laboratory	Fundamentals of Statistics Laboratory	0	0	4	60	40	100	2
EVS102-18	Ability Enhancement Compulsory Course (AECC) -III	Environmental Science	2	0	0	40	60	100	2
BMPD202-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		11	3	13	365	360	725	21

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Semester -Third

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1973	Core Theory	Artificial Intelligence	3	1	0	40	60	100	4
UGCA1979	Core Theory	Design and Analysis of Algorithms	3	1	0	40	60	100	4
UGCA1922	Core Theory	Database Management Systems	3	1	0	40	60	100	4
UGCA1982	Core Practical/Laboratory	Design and Analysis of Algorithms Lab	0	0	4	60	40	100	2
UGCA1925	Core Practical/Laboratory	Database Management Systems Lab	0	0	4	60	40	100	2
UGCA1976	Core Practical/Laboratory	Artificial Intelligence Lab	0	0	4	60	40	100	2
UGCA1959	Skill Enhancement Course-I	Internet Tools and Applications	1	0	0	40	60	100	1
UGCA1960	Skill Enhancement Course- Laboratory	Internet Tools and Application Lab	0	0	2	30	20	50	1
		Mentoring and Professional Development *#	0	0	1	25	0	25	1
TOTAL			10	03	15	395	380	775	21

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Semester -Fourth

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1977	Core Theory	Machine Learning	3	1	0	40	60	100	4
UGCA1978	Core Theory	Data Science	3	1	0	40	60	100	4
UGCA1974	Core Theory	Image Processing	3	1	0	40	60	100	4
UGCA1980	Core Practical/Laboratory	Machine Learning Lab	0	0	4	60	40	100	2
UGCA1981	Core Practical/Laboratory	Data Science Lab	0	0	4	60	40	100	2
UGCA1975	Core Practical/Laboratory	Image Processing Lab	0	0	4	60	40	100	2
UGCA1983	Skill Enhancement Course-II	Advance Python Programming	3	0	0	40	60	100	1
UGCA1984	Skill Enhancement Course- Laboratory	Advance Python Programming Lab	0	0	2	30	20	50	1
		Mentoring and Professional Development *#	0	0	1	25	0	25	1
TOTAL			12	03	15	395	380	775	21

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Fifth Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1946	Skill Enhancement Course-III	R Programming	3	0	0	40	60	100	3
UGCA1952	Skill Enhancement Course-Laboratory	R Programming Laboratory	0	0	4	30	20	50	2
	Open Elective-I		3	0	0	40	60	100	3
	Elective-I		3	1	0	40	60	100	4
	Elective-II		3	1	0	40	60	100	4
	Elective-I Laboratory		0	0	4	60	40	100	2
	Elective-II Laboratory		0	0	4	60	40	100	2
UGCA1999	Project	Project 1	0	0	2	60	40	100	1
UGCA2000	Seminar	Seminar	0	0	2	50	-	50	1
BMPD502-18		Mentoring and Professional Development	0	0	1	25	-	25	1
	TOTAL		12	02	17	445	380	825	23

In case Open elective is not available, the student can opt for open elective 1 from the give list of elective subjects (theory only):

Elective -I	
Course Code	Course Title
UGCA1993	Natural Language Processing
UGCA1991	Web Mining & Recommender System
UGCA 1936	Cloud Computing

Elective-I Laboratory	
Course Code	Course Title
UGCA1994	Natural Language Processing Lab
UGCA1992	Web Mining & Recommender System Lab
UGCA 1942	Cloud Computing Lab

Elective-II	
Course Code	Course Title
UGCA1995	Modelling and Simulation
UGCA1997	Deep Learning
UGCA1989	Neural Network

Elective-II Laboratory	
Course Code	Course Title
UGCA1996	Modelling and Simulation Lab
UGCA1998	Deep Learning Lab
UGCA1990	Neural Network Lab

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Course Code: UGCA1901

Course Name: Mathematics

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 1 st	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: core/elective: Core

Prerequisite: Student must have the knowledge of Basic Mathematics.

Co requisite:NA.

Additional material required in ESE:-NA-

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

CO#	Course Outcomes
CO1	Represent data using various mathematical notions.
CO2	Explain different terms used in basic mathematics.
CO3	Describe various operations and formulas used to solve mathematical problems.

Detailed contents	Contact hours
<p><u>Unit-I</u> Set Introduction, Objectives, Representation of Sets (Roster Method, Set Builder Method), Types of Sets (Null Set, Singleton Set, Finite Set, Infinite Set, Equal Set, Equivalent Set, Disjoint Set, Subset, Proper Subset, Power Set, Universal Set) and Operation with Sets (Union of Set, Intersection of Set, Difference of Set, Symmetric Difference of Set) Universal Sets, Complement of a Set.</p>	12 hours
<p><u>Unit-II</u> Logic Statement, Connectives, Basic Logic Operations (Conjunction, Disjunction, Negation) Logical Equivalence/Equivalent Statements, Tautologies and Contradictions.</p>	10 hours
<p><u>Unit -III</u> Matrices Introduction, Types of Matrix (Row Matrix, Column Matrix, Rectangular Matrix, Square Matrix, Diagonal Matrix, Scalar Matrix, Unit Matrix, Null Matrix, Comparable Matrix, Equal Matrix), Scalar Multiplication, Negative of Matrix, Addition of Matrix, Difference of two</p>	12 hours

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Matrix, Multiplication of Matrices, Transpose of a Matrix.	
<u>Unit-IV</u> Progressions Introduction, Arithmetic Progression, Sum of Finite number of quantities in A.P, Arithmetic Means, Geometric Progression, Geometric Mean.	10 hours

Text Books:

1. Discrete Mathematics and Its Applications by Kenneth H. Rosen, McGraw Hill, 6th Edition.
2. College Mathematics, Schaum's Series, TMH.

Reference Books:

1. Elementary Mathematics, Dr. RD Sharma
2. Comprehensive Mathematics, Parmanand Gupta
3. Elements of Mathematics, ML Bhargava

E Books/ Online learning material

1. www.see.leeds.ac.uk/geo-maths/basic_maths.pdf
 2. www.britannica.com/science/matrix-mathematics
 3. www.pdfdrive.com/schaums-outline-of-discrete-mathematics-third-edition-schaums-e6841453.html
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Course Code: UGCA1902

Course Name: Fundamentals of Computer and IT

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 1 st	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Understanding the concept of input and output devices of Computers
CO2	Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices.
CO3	Understand an operating system and its working, and solve common problems related to operating systems
CO4	Learn basic word processing, Spreadsheet and Presentation Graphics Software skills.
CO5	Study to use the Internet safely, legally, and responsibly

Detailed Contents	Contact hours
<p>Unit-I</p> <p>Human Computer Interface Concepts of Hardware and Software; Data and Information.</p> <p>Functional Units of Computer System: CPU, registers, system bus, main memory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors.</p> <p>Devices: Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter.</p> <p>Memory: Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks.</p>	12

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<p>Data Representation: Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication) Applications of IT.</p>	
<p>Unit-II</p> <p>Concept of Computing, Types of Languages: Machine, assembly and High level Language; Operating system as user interface, utility programs.</p> <p>Word processing: Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, equation editors.</p>	10
<p>Unit-III</p> <p>Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs.</p> <p>Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.</p>	10
<p>Unit-IV</p> <p>The Impact of Computing and Internet on Society Introduction to Secure Electronic Transaction, Types of Payment System: Digital Cash, Electronic Cheque, Smart Card, Credit/Debit Card E-Money, Bit Coins and Crypto currency, Electronic Fund Transfer (EFT), Unified Payment Interface (UPI), Immediate Payment System (IMPS), Digital Signature and Certification Authority.</p> <p>Concept of Mobile Computing, Cloud Computing, Big Data and Internet of Things (IoT)</p>	12

Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education
2. Fundamentals of Computers, P. K.Sinha& P. Sinha, 2007, BPB Publishers.
3. IT Tools, R.K. Jain, Khanna Publishing House

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4. “Introduction to Information Technology”, Satish Jain, Ambrish Rai & Shashi Singh, Paperback Edition, BPB Publications, 2014.

Reference Books:

1. “Introduction to Computers”, Peter Norton
2. Computers Today, D. H. Sanders, McGraw Hill.
3. “Computers”, Larry long & Nancy long, Twelfth edition, Prentice Hall.
4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen F Monk, Thomson Learning.
5. Computer Fundamentals, A. Goel, 2010, Pearson Education

E Books/ Online learning material

1. www.sakshat.ac.in
 2. <https://swayam.gov.in/course/4067-computer-fundamentals>
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Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1914

Course Name: Programming in Python

Program: B.Sc. (AI & ML)	L:3 T:1 P:0
Branch: Computer Applications	Credits: 4
Semester: 1 st	Contact hours: 44 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Core
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE:-NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Familiar with Python environment, data types, operators used in Python.
CO2	Compare and contrast Python with other programming languages.
CO3	Learn the use of control structures and numerous native data types with their methods.
CO4	Design user defined functions, modules, and packages and exception handling methods.
CO5	Create and handle files in Python and learn Object Oriented Programming Concepts.

Detailed Contents	Contact hours
<p>Unit-I</p> <p>Introduction to Python Programming Language: Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages.</p> <p>Python Data Types & Input/Output: Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command.</p> <p>Operators and Expressions: Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators.</p>	12

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<p>Unit-II</p> <p>Control Structures: Decision making statements, Python loops, Python control statements.</p> <p>Python Native Data Types: Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods and operations).</p>	10
<p>Unit-III</p> <p>Python Functions: Functions, Advantages of Functions, Built-in Functions, User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables.</p> <p>Python Modules: Module definition, Need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages.</p>	12
<p>Unit-IV</p> <p>Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python.</p> <p>File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python.</p> <p>Classes and Objects: The concept of OOPS in Python, Designing classes, Creating objects, Accessing attributes, Editing class attributes, Built-in class attributes, Garbage collection, Destroying objects.</p>	10

Text Books:

1. Programming in Python, Pooja Sharma, BPB Publications, 2017.
2. Core Python Programming, R. NageswaraRao, 2nd Edition, Dreamtech.

Reference Books:

1. Python, The complete Reference, Martin C. Brown, McGraw Hill Education.
2. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY.

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Course Code: UGCA1958

Course Name: Workshop on Multimedia Tools

Program: B.Sc. (AI & ML)	L:0 T:0 P:4
Branch: Computer Applications	Credits: 2
Semester: 1 st	Contact hours: 2 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: Basic understanding of computer system and images.

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Define terms related to multimedia technologies.
CO2	Implement basic image editing.

Detailed contents	Contact hours
<p>Unit-I</p> <p>Introduction: Objectives – History of Multimedia – Its market – Content copyright – Resources for multimedia developers – Types of produces – Evaluation – Hardware Architecture – OS and Software – Multimedia Architecture – Software library – Drivers.</p>	4
<p>Unit-II</p> <p>Downloading and installing free open source multimedia tool like GIMP, understanding its workspace (toolbox, menus, panels).</p> <p>Paint Tools: Common Features, Dynamics, Brush Tools (Pencil, Paintbrush, Airbrush), Bucket Fill, Blend, Pencil, Paintbrush, Eraser, Airbrush, Ink, Clone, Heal, Perspective Clone, Blur/Sharpen, Smudge, Dodge/Burn, applying fills and outlines – creating default fills and outlines – gradient fill – types – custom fill – copy – clone – mesh – gradient mesh</p>	8
<p>Unit-III</p> <p>Transform Tools: Common Features, Align, Move, Crop, Rotate, Scale, Shear, Perspective, Flip, The Cage Tool.</p>	5

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Color Tools: Overview, Color Balance, Hue-Saturation, Colorize, Brightness-Contrast, Threshold, Levels, Curves, Posterize, Desaturate.	
Unit-IV Animation: Text Animation methods, building an animated GIF, Animating a still image, Morphing, re-synthesizer tool. Designing for a webpage: Web Design tools, Variable and fixed sized designs, Optimizing images for web.	5

*** Students can choose multimedia tool of their choice. Recommended tool is GIMP.**

Text Book:

1. A book of GIMP: A guide to nearly everything, Olivier Lecarme, KarineDelvare Published by no starch press, California.
 2. Multimedia Technology and Applications – David Hillman-Galgotia Publications pvt. Ltd, 1998.
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Course Code: UGCA1917

Course Name: Programming in Python Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 1 st	Contacthours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: 90%
Internal max. marks: 60	Duration of end semester exam (ESE): 3hrs
External max. marks: 40	Elective Status : Core
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: - Maintain practical note book as per the instructions given by the instructor.

Course Outcomes: Students will be able to :

CO#	Course outcomes
CO1	Solve simple to advanced problems using Python language.
CO2	Develop logic of various programming problems using numerous data types and control structures of Python.
CO3	Implement different data structures.
CO4	Implement modules and functions.
CO5	Design and implement the concept of object oriented programming structures.
CO6	Implement file handling.

List of assignments:

1.	Compute sum, subtraction, multiplication, division and exponent of given variables input by the user.
2.	Compute area of following shapes: circle, rectangle, triangle, square, trapezoid and parallelogram.
3.	Compute volume of following 3D shapes: cube, cylinder, cone and sphere.
4.	Compute and print roots of quadratic equation $ax^2+bx+c=0$, where the values of a, b, and c are input by the user.
5.	Print numbers up to N which are not divisible by 3, 6, 9,, e.g., 1, 2, 4, 5, 7,....
6.	Write a program to determine whether a triangle is isosceles or not?
7.	Print multiplication table of a number input by the user.
8.	Compute sum of natural numbers from one to n number.
9.	Print Fibonacci series up to n numbers e.g. 0 1 1 2 3 5 8 13.....n
10.	Compute factorial of a given number.
11.	Count occurrence of a digit 5 in a given integer number input by the user.

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12.	Print Geometric and Harmonic means of a series input by the user.
13.	Evaluate the following expressions: a. $x - x^2/2! + x^3/3! - x^4/4! + \dots x^n/n!$ b. $x - x^3/3! + x^5/5! - x^7/7! + \dots x^n/n!$
14.	Print all possible combinations of 4, 5, and 6.
15.	Determine prime numbers within a specific range.
16.	Count number of persons of age above 60 and below 90.
17.	Compute transpose of a matrix.
18.	Perform following operations on two matrices. 1) Addition 2) Subtraction 3) Multiplication
19.	Count occurrence of vowels.
20.	Count total number of vowels in a word.
21.	Determine whether a string is palindrome or not.
22.	Perform following operations on a list of numbers: 1) Insert an element 2) delete an element 3) sort the list 4) delete entire list
23.	Display word after Sorting in alphabetical order.
24.	Perform sequential search on a list of given numbers.
25.	Perform sequential search on ordered list of given numbers.
26.	Maintain practical note book as per their serial numbers in library using Python dictionary.
27.	Perform following operations on dictionary 1) Insert 2) delete 3) change
28.	Check whether a number is in a given range using functions.
29.	Write a Python function that accepts a string and calculates number of upper case letters and lower case letters available in that string.
30.	To find the Max of three numbers using functions.
31.	Multiply all the numbers in a list using functions.
32.	Solve the Fibonacci sequence using recursion.
33.	Get the factorial of a non-negative integer using recursion.
34.	Write a program to create a module of factorial in Python.
35.	Design a Python class named <i>Rectangle</i> , constructed by a length & width, also design a method which will compute the area of a rectangle.
36.	Design a Python class named <i>Circle</i> constructed by a radius and two methods which will compute the area and the perimeter of a circle.
37.	Design a Python class to reverse a string 'word by word'.
38.	Write a Python program to read an entire <i>text file</i> .
39.	Design a Python program to read first n lines of a <i>text file</i> .
40.	Construct a Python program to write and append text to a file and display the text.

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Text Books:

1. Programming in Python, Pooja Sharma, BPB Publications, 2017.
2. Core Python Programming, R. NageswaraRao, 2nd Edition, Dreamtech.

Reference Books:

1. Python, The complete Reference, Martin C. Brown, McGraw Hill Education.
 2. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY.
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Course Code: UGCA1906

Course Name: Fundamentals of Computer and IT Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 1 st	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Familiarizing with Open Office (Word processing, Spreadsheets and Presentation).
CO2	To acquire knowledge on editor, spread sheet and presentation software.
CO3	The students will be able to perform documentation and accounting operations.
CO4	Students can learn how to perform presentation skills.

Instructions:

Word Orientation:

The instructor needs to give an overview of word processor.

Details of the four tasks and features that would be covered Using word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

1.	Using word to create Resume Features to be covered: - Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.
2.	Creating an Assignment Features to be covered: - Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
3.	Creating a Newsletter Features to be covered :- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs
4.	Creating a Feedback form Features to be covered :- Forms, Text Fields, Inserting objects, Mail Merge in Word.

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Excel Orientation:	
The instructor needs to tell the importance of Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered Excel – Accessing, overview of toolbars, saving excel files,	
1.	Creating a Scheduler Features to be covered :- Gridlines, Format Cells, Summation, auto fill, Formatting Text
2.	Calculations Features to be covered: - Cell Referencing, Formulae in excel – average, std.deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP
3.	Performance Analysis Features to be covered :- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting
4.	Game (like Cricket, badminton) Score Card Features to be covered :- Pivot Tables, Interactive Buttons, Importing Data, Data Protection, Data Validation
Presentation Orientation:	
1.	Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered includes: - PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows
2.	This session helps students in making their presentations interactive. Topics covered includes : Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts
3.	Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides. Auto content wizard, Slide Transition, Custom Animation, Auto Rehearsing
4.	Power point test would be conducted. Students will be given model power point presentation which needs to be replicated
Internet and its Applications:	
The instructor needs to tell the how to configure Web Browser and to use search engines by defining search criteria using Search Engines	
1.	To learn to setup an e-mail account and send and receive e-mails
2.	To learn to subscribe/post on a blog and to use torrents for accelerated downloads
3.	Hands on experience in online banking and Making an online payment for any domestic bill

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Reference Books:

1. IT Tools, R.K. Jain, Khanna Publishing House
 2. Introduction to Information Technology, IITL Education Solutions limited,
Pearson Education
 3. Introduction to information technology, Turban, Rainer and Potter, John Wiley
and Sons
 4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen F Monk,
Thomson Learning
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: BTHU103/18

Course Name: English (Ability Enhancement Compulsory Course (AECC)-I)

Program: B.Sc. (AI & ML)	L: 1 T: 0 P: 0
Branch: Computer Applications	Credits: 1
Semester: 1 st	Contact hours: 11 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
CO2	To help the students become the independent users of English language
CO3	To develop in them vital communication skills which are integral to their personal, social and professional interactions.
CO4	The syllabus shall address the issues relating to the Language of communication.
CO5	Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills such as report writing, note taking etc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Detailed Contents:

Unit1- 1 (Introduction)

- Theory of Communication
- Types and modes of Communication

Unit- 2 (Language of Communication)

- Verbal and Non-verbal
- (Spoken and Written)
- Personal, Social and Business
- Barriers and Strategies
- Intra-personal, Inter-personal and Group communication

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Unit-3 (Reading and Understanding)

- Close Reading
- Comprehension
- Summary Paraphrasing
- Analysis and Interpretation
- Translation (from Hindi/Punjabi to English and vice-versa)

OR

Precis writing /Paraphrasing (for International Students)

- Literary/Knowledge Texts

Unit-4 (Writing Skills)

- Documenting
- Report Writing
- Making notes
- Letter writing

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press, 2006.
 2. *Business English*, Pearson, 2008.
 3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
 4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, DrRanjanaKaul, DrBratiBiswas
 5. *On Writing Well*. William Zinsser. Harper Resource Book. 2001
 6. *Study Writing*. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Name: English Practical/Laboratory (Ability Enhancement Compulsory Course (AECC))

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 2
Branch: Computer Applications	Credits: 1
Semester: 1 st	Contact hours: 2 hours per week
Internal max. marks: 30	Theory/Practical: Practical
External max. marks: 20	Duration of end semester exam (ESE): 3hrs
Total marks: 50	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
CO2	To help the students become the independent users of English language.
CO3	To develop in them vital communication skills which are integral to personal, social and professional interactions.
CO4	The syllabus shall address the issues relating to the Language of communication.
CO5	Students will become proficient in professional communication such as interviews, group discussions and business office environments, important reading skills as well as writing skills such as report writing, note taking etc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Monologue
- Effective Communication/ Mis- Communication

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- Public Speaking

Recommended Readings:

1. *Fluency in English - Part II*, Oxford University Press, 2006.
 2. *Business English*, Pearson, 2008.
 3. *Practical English Usage*. Michael Swan. OUP. 1995.
 4. *Communication Skills*. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
 5. *Exercises in Spoken English*. Parts.I-III. CIEFL, Hyderabad. Oxford University Press
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: HVPE101-18

Course Name: Human Values, De-addiction and Traffic Rules

Program: B.Sc. (AI & ML)	L: 3 T: 0 P: 0
Branch: Computer Applications	Credits: 3
Semester: 1 st	Contact hours: 33 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Ability Enhancement

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	To help the students appreciate the essential complementarity between ‘VALUES’ and ‘SKILLS’ to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CO2	To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way.
CO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behavior and mutually enriching interaction with Nature.

Note: This course is intended to provide a much needed orientational input in Value Education to the young enquiring minds.

Detailed Contents	Contact hours
<p>Unit-I</p> <p>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <ol style="list-style-type: none"> 1. Understanding the need, basic guidelines, content and process for Value Education 2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facilities- the basic 	8

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<p>requirements for fulfillment of aspirations of every human being with their correct priority</p> <ol style="list-style-type: none"> 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels 	
<p>Unit-II</p> <p>Understanding Harmony in the Human Being - Harmony in Myself!</p> <ol style="list-style-type: none"> 1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’ 2. Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukhand Suvidha</i> 3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’ 5. Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure <i>Sanyam</i> and <i>Swasthya</i> - Practice Exercises and Case Studies will be taken up in Practice Sessions. 	8
<p>Unit-III</p> <p>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship</p> <ol style="list-style-type: none"> 1. Understanding harmony in the Family- the basic unit of human interaction 2. Understanding values in human-human relationship; meaning of <i>Nyaya</i> and program for its fulfillment to ensure <i>Ubhay-tripti</i>; Trust (<i>Vishwas</i>) and Respect (<i>Samman</i>) as the foundational values of relationship 3. Understanding the meaning of <i>Vishwas</i>; Difference between intention and competence 4. Understanding the meaning of <i>Samman</i>, Difference between respect and differentiation; the other salient values in relationship 5. Understanding the harmony in the society (society being an extension of family): <i>Samadhan</i>, <i>Samridhi</i>, <i>Abhay</i>, <i>Sah-astitvaas</i> comprehensive Human Goals 6. Visualizing a universal harmonious order in society- Undivided 	8

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<p>Society (<i>AkhandSamaj</i>), Universal Order (<i>SarvabhaumVyawastha</i>)- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>	
<p>Unit-IV</p> <p>Understanding Harmony in the Nature and Existence - Whole existence as Co-existence</p> <ol style="list-style-type: none"> 1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature 3. Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space 4. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions. 	4
<p>Unit-V</p> <p>Implications of the above Holistic Understanding of Harmony on Professional Ethics</p> <ol style="list-style-type: none"> 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: <ol style="list-style-type: none"> a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: <ol style="list-style-type: none"> a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations. 	5

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Text Book

1. R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education*.

Reference Books

1. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and Harper Collins, USA.
2. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
3. A Nagraj, 1998, *Jeevan Vidyaek Parichay*, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991.
5. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Common wealth Publishers.
6. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.
7. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *Limits to Growth – Club of Rome’s report*, Universe Books.
9. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers*, Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, *Engineering Ethics (including Human Values)*, Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, *Foundations of Ethics and Management*, Excel Books.
12. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, <http://uhv.ac.in>
 2. Story of Stuff, <http://www.storyofstuff.com>
 3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
 4. Charlie Chaplin, *Modern Times*, United Artists, USA
 5. IIT Delhi, *Modern Technology – the Untold Story*
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: HVPE102-18

Course Name: Human Values, De-addiction and Traffic Rules (Lab/ Seminar)

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 1
Branch: Computer Applications	Credits: 1
Semester: 1 st	Contact hours: 1 hour per week
Internal max. marks: 25	Theory/Practical: Practical
External max. marks: 0	Duration of end semester exam (ESE): 3hrs
Total marks: 25	Elective status: Ability Enhancement

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

One each seminar will be organized on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar at least once during the semester. It will be binding for all the students to attend the seminar.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1907

Course Name: Fundamentals of Statistics

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 2 nd	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: Students must have the basic knowledge of mathematic terms.

Co requisite:NA

Additional material required in ESE:Minimum two exercises of each concept will be recorded in the file and the file will be submitted in End Semester Examinations.

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

CO#	Course Outcomes
CO1	Understand the science of studying & analyzing numbers.
CO2	Identify and use various visualization tools for representing data.
CO3	Describe various statistical formulas.
CO4	Compute various statistical measures.

Detailed Contents	Contact hours
<p>Unit I</p> <p>Statistics and Probability: Introduction to Statistics – Origin of Statistics, Features of Statistics, Scope of Statistics, Functions of Statics, Uses and importance of Statistics, Limitation of Statistics, Distrust of Statistics</p> <p>Collection of Data: Introduction to Collection of Data, Primary and Secondary Data, Methods of Collecting Primary Data, Methods of Secondary Data, Statistical Errors, Rounding off Data (Approximation).</p>	8 hours
<p>Unit II</p> <p>Classification of Data Frequency Distribution: Introduction Classification of Data, Objectives of Classification, Methods of Classification, Ways to Classify Numerical Data or Raw Data.</p> <p>Tabular, Diagrammatic and Graphic Presentation of Data: Introduction to Tabular Presentation of Data, Objectives of</p>	12 hours

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<p>Tabulation, Components of a Statistical Table, General Rules for the Construction of a Table, Types of Tables, Introduction to Diagrammatic Presentation of Data, Advantage and Disadvantage of Diagrammatic Presentation, Types of Diagrams, Introduction to Graphic Presentation of Data, Advantage and Disadvantage of Graphic Presentation, Types of Graphs.</p>	
<p>Unit III Measures of Central tendency: Introduction to Central Tendency, Purpose and Functions of Average, Characteristics of a Good Average, Types of Averages, Meaning of Arithmetic Mean, Calculation of Arithmetic Mean, Merit and Demerits of Arithmetic Mean, Meaning of Median, Calculation of Median, Merit and Demerits of Median, Meaning of Mode, Calculation of Mode, Merit and Demerits of Mode, Harmonic Mean- Properties- Merit and Demerits.</p>	<p>12 hours</p>
<p>Unit IV Measures of Dispersion: Meaning of Dispersion, Objectives of Dispersion, Properties of a good Measure of Dispersion, Methods of Measuring Dispersion, Range Introduction, Calculation of Range , Merit and Demerits of Range, Mean Deviation, Calculation of Mean Deviation , Merit and Demerits of Mean Deviation, Standard Deviation Meaning, Calculation of Standard Deviation , Merit and Demerits of Standard Deviation, Coefficient of Variation, Calculation of Coefficient Variance, Merit and Demerits of Coefficient of Variation.</p>	<p>12 hours</p>

Text Books:

1. Statistics and Data Analysis, A.Abebe, J. Daniels, J.W.Mckean, December 2000.
2. Statistics, Tmt. S. EzhilarasiThiru, 2005, Government of Tamilnadu.
3. Introduction to Statistics, David M. Lane.
4. Weiss, N.A., Introductory Statistics. Addison Wesley, 1999.
5. Clarke, G.M. & Cooke, D., A Basic course in Statistics. Arnold, 1998.

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Reference Books:

1. Banfield J.(1999), Rweb: Web-based Statistical Analysis, Journal of Statistical Software.
2. Bhattacharya,G.K. and Johnson, R.A.(19977), Statistical Concepts and Methods, New York, John Wiley & Sons.

E-Books/ Online learning material

1. http://onlinestatbook.com/Online_Statistics_Education.pdf
 2. <https://textbookcorp.tn.gov.in/Books/12/Std12-Stat-EM.pdf>
 3. <https://3lihandam69.files.wordpress.com/2015/10/introductorystatistics.pdf>
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1923

Course Name: Operating Systems

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 2 nd	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: Basic understanding of computer system.

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Discuss the evaluation of operating systems.
CO2	Explain different resource managements performed by operating system.
CO3	Describe the architecture in terms of functions performed by different types of operating systems.
CO4	Analyze the performance of different algorithms used in design of operating system components.

Detailed contents	Contact hours
<p>Unit-I</p> <p>Fundamentals of Operating system: Introduction to Operating system, Functions of an operating system. Operating system as a resource manager. Structure of operating system (Role of kernel and Shell). Views of operating system. Evolution and types of operating systems.</p> <p>Process & Thread Management: Program vs. Process; PCB, State transition diagram, Scheduling Queues, Types of schedulers, Concept of Thread, Benefits, Types of threads, synchronization issues.</p> <p>CPU Scheduling: Need of CPU scheduling, CPU I/O Burst Cycle, Pre-emptive vs. Non-pre-emptive scheduling, Different scheduling criteria's, scheduling algorithms (FCFS, SJF, Round-Robin, Multilevel Queue).</p>	12
<p>Unit-II</p> <p>Memory Management: Introduction, address binding, relocation, loading,</p>	11

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linking, memory sharing and protection; Paging and segmentation; Virtual memory: basic concepts of demand paging, page replacement algorithms.	
Unit-III I/O Device Management: I/O devices and controllers, device drivers; disk storage. File Management: Basic concepts, file operations, access methods, directory structures and management, remote file systems; file protection.	10
Unit-IV Advanced Operating systems: Introduction to Distributed Operating system, Characteristics, architecture, Issues, Communication & Synchronization; Introduction Multiprocessor Operating system, Architecture, Structure, Synchronization & Scheduling; Introduction to Real-Time Operating System, Characteristics, Structure & Scheduling.	11

Text Books:

1. Operating System Principles by Abraham Silberschatz and Peter Baer Galvin, Seventh Edition, Published by Wiley-India.
2. Principals of Operating System by Naresh Chauhan, Published by OXFORD University Press, India.

Reference Books:

1. Operating Systems by Sibsankar Haldar and Alex A. Aravind, Published by Pearson Education.
2. Operating system by Stalling, W., Sixth Edition, Published by Prentice Hall (India)

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1915

Course Name: Data Structures

Program: B.Sc. (AI & ML)	L:3 T:1 P:0
Branch: Computer Applications	Credits:4
Semester: 2 nd	Contact hours: 44 hours
Theory/Practical: Theory	Percentage of numerical/design problems: --
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Core
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:Students will be able to

CO#	Course outcomes
CO1	Apply appropriate constructs of Programming language, coding standards for application development
CO2	Use appropriate data structures for problem solving and programming
CO3	Use algorithmic foundations for solving problems and programming
CO4	Apply appropriate searching and/or sorting techniques for application development.
CO5	Develop programming logic and skills.

Detailed Contents	Contact hours
<p>Unit-I</p> <p>Introduction to Data Structures: Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion.</p> <p>Arrays, Pointers and Strings: Introduction to Arrays, Definition, One Dimensional Array and Multi-Dimensional Arrays, Pointer, Pointer to Structure, various Programs for Array and Pointer. Strings. Introduction to Strings, Definition, Library Functions of Strings.</p>	10
<p>Unit-II</p> <p>Stacks and Queue</p>	8

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<p>Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.</p>	
<p>Unit-III</p> <p>Linked Lists and Trees Introduction, Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List, Circular Linked List, And Circular Doubly Linked List.</p> <p>Trees Introduction to Tree, Tree Terminology Binary Tree, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Tree Traversal, Threaded Binary Tree, AVL Tree B Tree, B+ Tree.</p>	14
<p>Unit-IV</p> <p>Graphs, Searching, Sorting and Hashing Graphs: Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms.</p> <p>Searching and Sorting: Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort.</p> <p>Hashing: Hash Function, Types of Hash Functions, Collision, Collision Resolution Technique (CRT), Perfect Hashing</p>	12

Text Books

1. BrijeshBakariya. Data Structures and Algorithms Implementation through C, BPB Publications.
2. Kruse R.L. Data Structures and Program Design in C; PHI
3. Aho Alfred V., Hopperoft John E., Ullman Jeffrey D., “Data Structures and Algorithms”, AddisonWesley

Reference books

1. Horowitz &Sawhaney: Fundamentals of Data Structures, Galgotia Publishers.
2. YashwantKanetkar, Understanding Pointers in C, BPB Publications.
3. Horowitz, S. Sahni, and S. Rajasekaran, Computer Algorithms, Galgotia Pub. Pvt. Ltd., 1998.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1918

Course Name: Data Structures Laboratory

Program: B.Sc. (AI & ML)	L:0 T:0 P:4
Branch: Computer Applications	Credits:2
Semester: 2 nd	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of end semester exam (ESE): 3hrs
External max. marks: 40	Elective status: Core
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: - NA-

Course Outcomes:Student will be able to

CO#	Course outcomes
CO1	Apply appropriate constructs of Programming language, coding standards for application development
CO2	Develop programming skills for solving problems.
CO3	Apply appropriate searching and/or sorting techniques for application development.

Instructions:Programs may be developed in C/C++/Python/Javalanguage.

List of assignments:

1	Program for using Dynamic Functions (malloc(), calloc(), realloc() and free()) functions.
2	Program to insert, delete and traverse an element from an array
3	Program to merge one dimensional arrays
4	Program for addition and subtraction of two matrices.
5	Program for implementing multiplication of two matrices
6	Implement linear search using one and two dimensional array.
7	Program for implementing selection sort.
8	Program for implementing insertion sort.
9	Program for implementing quick sort.
10	Program for implementing merge sort.
11	Program to calculate length of the string using user defined function.
12	Program to concatenate and compare two strings using user defined function.
13	Program for using the concept of pointer to string.
14	Program to reverse a sentence by recursion.
15	Program to delete all repeated words in string.

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16	Program to find the number of vowels, consonants, digits and white space in a string.
17	Program to find the length of the longest repeating sequence in a string.
18	Program to find highest and lowest frequency character in a string.
19	Program for implementing Stack using array.
20	Program for implementing Stack using pointer.
21	Program for implementing multiple stack.
22	Program for converting infix to postfix form.
23	Program for implementing Queue using array.
24	Program for dynamic implementation of queue.
25	Program for implementing circular queue.
26	Program for implementing dequeue.
27	Program for implementing priority queue.
28	Program for implementing Singly Linked list.
29	Program for implementing Doubly Linked list.
30	Program for implementing Binary Search Tree.
31	Program for Breadth First Search (BFS) for graph traversal.
32	Program for Depth First Search (DFS) for graph traversal.

Reference Books:

1. BrijeshBakariya. Data Structures and Algorithms Implementation through C, BPB Publications.
 2. Aho Alfred V., Hopperoft John E., Ullman Jeffrey D., “Data Structures and Algorithms”, AddisonWesley
 3. Horowitz &Sawhaney: Fundamentals of Data Structures, Galgotia Publishers.
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1926

Course Name: Operating Systems Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 2 nd	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: After going through the practical, student will be able to:

CO#	Course outcomes
CO1	Install & configure different operating systems.
CO2	Write programs/ scripts for different scheduling algorithms.

Instructions:

1	Installation of windows OS.
2	Installation of Linux OS.
3	Dual boot installation of Operating systems.
4	Implementation of FCFS Scheduling algorithm
5	Implementation of SJF Scheduling algorithm
6	Implementation of Round-Robin Scheduling algorithm
7	Vi Editor & its commands
8	Shell Commands
9	Shell Scripting- Using variables
10	Shell Scripting- Input & Output
11	Shell Scripting- Data types
12	Shell Scripting- Use of arithmetic operators
13	Shell Scripting- if control statement programs
14	Shell Scripting- while control statement
15	Shell Scripting- for control statement

- Instructor can select programs of their own for implementing different concepts.

Reference Books:

1. Linux: The complete reference by Richard Petersen, Published by Tata McGraw- Hill Publication.
2. Operating System Principles by Abraham Silberschatz and Peter Baer Galvin, Seventh Edition, Published by Wiley-India.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1911

Course Name: Fundamentals of Statistics Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 2 nd	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: Students must have the knowledge of Spreadsheet.

Co requisite: The students will develop analytical behavior & will have better understanding of analyzing data and testing hypotheses.

Additional material required in ESE: Minimum two exercises of each concept will be recorded in the file and the file will be submitted in End Semester Examinations.

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

CO#	Course Outcomes
CO1	Represent data using various Frequency table and Graphs.
CO2	Apply various operations/ formulas using any software/package to solve statistical problems.

Instructions: Sample exercises are given below and Instructor can increase or decrease the experiments as per the requirement.

1:	Display the Maximum and Minimum market data.												
2:	Display year wise strength of the students of a college in Tabular form & Graphical form.												
3:	Calculate the average marks of the students of your College.												
4:	Print measure of Central Tendency using grouped and ungrouped data.												
5:	Construct & print frequency distribution using data with the following Techniques: a) Histogram b) Frequency Polygon c) Frequency Curve c) Ogive curves.												
6:	Find out & display the Median and Mode from the following series by using suitable method: <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">< /> Class < /></td> <td style="text-align: center;">156-158 < /></td> <td style="text-align: center;">158-160 < /></td> <td style="text-align: center;">160-162 < /></td> <td style="text-align: center;">162-164 < /></td> <td style="text-align: center;">164-166 < /></td> </tr> <tr> <td style="text-align: center;">Frequency < /></td> <td style="text-align: center;">4 < /></td> <td style="text-align: center;">8 < /></td> <td style="text-align: center;">28 < /></td> <td style="text-align: center;">51 < /></td> <td style="text-align: center;">89 < /></td> </tr> </table>	< /> Class < />	156-158 < />	158-160 < />	160-162 < />	162-164 < />	164-166 < />	Frequency < />	4 < />	8 < />	28 < />	51 < />	89 < />
< /> Class < />	156-158 < />	158-160 < />	160-162 < />	162-164 < />	164-166 < />								
Frequency < />	4 < />	8 < />	28 < />	51 < />	89 < />								
7:	Calculate an appropriate measure of dispersion using grouped and ungrouped data.												

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8:	Make an array and calculate range of the data.														
9:	Represent the placement record of the students of your college.														
10:	Calculate & display Letter Grade using spreadsheet.														
11:	<p>Represent the following data by suitable graphs, determine therefrom the number of children having IQ (i) Below 105 (ii) Above 124.</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">IQ</th> <th style="text-align: center;">75-84</th> <th style="text-align: center;">85-94</th> <th style="text-align: center;">95-104</th> <th style="text-align: center;">105-114</th> <th style="text-align: center;">115-124</th> <th style="text-align: center;">125-134</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">No. of Children</td> <td style="text-align: center;">8</td> <td style="text-align: center;">20</td> <td style="text-align: center;">45</td> <td style="text-align: center;">54</td> <td style="text-align: center;">28</td> <td style="text-align: center;">16</td> </tr> </tbody> </table>	IQ	75-84	85-94	95-104	105-114	115-124	125-134	No. of Children	8	20	45	54	28	16
IQ	75-84	85-94	95-104	105-114	115-124	125-134									
No. of Children	8	20	45	54	28	16									

Reference Books:

1. Statistics for Economics, TR Jain, VK Ohri.
2. Statistics and Data Analysis, A.Abebe, J. Daniels, J.W.Mckean, December 2000.

E-Books/ Online learning material

1. https://www.meritnation.com/cbse-class-11-commerce/economics/class_13_tr_jain.
2. http://college.cengage.com/mathematics/brase/understandable_statistics/9780618949922_ch03.pdf
3. http://www.rockcreekschools.org/pages/uploaded_files/Excel%201%20Lab%20Exercises.pdf

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: EVS102-18

Course Name: Environmental Science

Program: B.Sc. (AI & ML)	L: 2 T: 0 P: 0
Branch: Computer Applications	Credits: 2
Semester: 2 nd	Contact hours: 22 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Ability Enhancement

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Students will enable to understand environmental problems at local and national level through literature and general awareness.
CO2	The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
CO3	The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
CO4	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Detailed Contents	Contact hours
Unit-I Introduction to Environmental Studies Multidisciplinary nature of Environmental Studies: Scope & Importance Need for Public Awareness.	2
Unit-II Ecosystems Concept of an Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers) Energy Flow in an ecosystem: Food Chain, Food web and Ecological Pyramids Characteristic features, structure & functions of following Ecosystems:	4

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<ul style="list-style-type: none"> • Forest Ecosystem • Aquatic Ecosystem (Ponds, Lakes, River & Ocean) 	
<p>Unit-III</p> <p>Natural Resources Renewable & Non-renewable resources Forest Resources: Their uses, functions & values (Biodiversity conservation, role in climate change, medicines) & threats (Overexploitation, Deforestation, Timber extraction, Agriculture Pressure), Forest Conservation Act Water Resources: Their uses (Agriculture, Domestic & Industrial), functions & values, Overexploitation and Pollution of Ground & Surface water resources (Case study of Punjab), Water Conservation, Rainwater Harvesting, Land Resources: Land as a resource; Land degradation, soil erosion and desertification</p> <p>Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal), Urban problems related to Energy</p>	4
<p>Unit-IV</p> <p>Biodiversity & its conservation Types of Biodiversity: Species, Genetic & Ecosystem India as a mega biodiversity nation, Biodiversity hot spots and biogeographic regions of India Examples of Endangered & Endemic species of India, Red data book</p>	4
<p>Unit-V</p> <p>Environmental Pollution & Social Issues Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution Nuclear hazards and accidents & Health risks Global Climate Change: Global warming, Ozone depletion, Acid rain, Melting of Glaciers & Ice caps, Rising sea levels Environmental disasters: Earthquakes, Floods, Cyclones, Landslides</p>	4
<p>Unit-VI</p>	4

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Field Work Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary Documentation & preparation of a Biodiversity (flora & fauna) register of campus/river/forest Visit to a local polluted site: Urban/Rural/Industrial/Agricultural Identification & Photography of resident or migratory birds, insects (butterflies) Public hearing on environmental issues in a village	
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Text Books:

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, New Delhi.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clarendon Press Oxford (TB)
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment (R)
9. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
10. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
11. Heywood, V.H &Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
12. Jadhav, H &Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
13. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
14. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
15. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
16. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
17. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
18. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
19. Survey of the Environment, The Hindu (M)

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20. Townsend C., Harper J, and Michael Begon, Essentials of Ecology,
Blackwell Science (TB)
 21. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science
Publication (TB)
 22. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co.
Philadelphia, USA 499p
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Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Third Semester

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1973

Course Name: Artificial Intelligence

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 3 rd	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: Operating System, data structures.

Co requisite: -NA-

Additional material required in ESE: -NA-.

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

CO#	Course outcomes
CO1	Discuss the need of Artificial Intelligence.
CO2	Explain the knowledge representation in field of AI.
CO3	List various fields of AI.

Detailed contents	Contact hours
<p><u>Unit-I</u> Overview: foundations, scope, problems, and approaches of AI.</p> <p>Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents</p>	12 hours
<p><u>Unit-II</u> Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.</p>	12 hours
<p><u>Unit-III</u> Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.</p> <p>Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.</p>	10 hours

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<p><u>Unit-IV</u></p> <p>Expert Systems: Overview of expert system architecture, existing expert systems.</p> <p>Languages for AI problem solving: Introduction to PROLOG syntax and data structures, representing objects and relationships, built-in predicates. Introduction to LISP- Basic and intermediate LISP programming</p>	<p>10 hours</p>
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TextBooks:

1. Rich E., Knight K. and Nair B. S., Artificial Intelligence, Tata McGraw Hills (2009).
2. Luger F. G., Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009).

Reference Books:

1. Patterson W. D., Introduction to Artificial Intelligence and Expert Systems, Pearson (2015) 1st ed.
 2. Russel S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall (2014) 3rd ed.
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1979

Course Name: Design and Analysis of Algorithms

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 4 th	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Justify the correctness of algorithms;
CO2	Identify which design paradigm (greedy/ divide and conquer/backtrack etc.) should be used for different problems.
CO3	Demonstrate the ways to analyze approximation/randomized algorithms (expected running time, probability of error);
CO4	Explain the necessity for NP class based problems and explain the use of heuristic techniques.

Detailed contents	Contact hours
<p><u>Unit-I</u></p> <p>Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method.</p>	12 hours
<p><u>Unit-II</u></p> <p>Fundamental Algorithmic Strategies Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving: Bin Packing, Knap Sack, TSP.</p>	12 hours
<p><u>Unit-III</u></p> <p>Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.</p>	10 hours
<p><u>Unit-IV</u></p> <p>Tractable and Intractable Problems Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Advanced Topics: Heuristic Algorithms, Random Algorithms.</p>	10 hours

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Text Books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Data Structures and Algorithms in C++, Weiss, 4th edition, Pearson.
3. Fundamentals of Computer Algorithms – E. Horowitz, Sartaj Saini, Galgota Publications

Reference Books

1. Algorithm Design, 1stEdition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Course Code: UGCA1922

Course Name: Database Management Systems

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 3 rd	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Understand the basic concepts of DBMS.
CO2	Formulate, using SQL, solutions to a broad range of query and data update problems.
CO3	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
CO4	Understand the concept of Transaction and Query processing in DBMS.

Detailed contents	Contact hours
Unit-I Introduction of DBMS, Data Modeling for a Database, Three level Architecture of DBMS, Components of a DBMS. Introduction to Data Models, Hierarchical, Network and Relational Model, Comparison of Network, Hierarchical and Relational Model, Entity Relationship Model.	10 hours

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Unit-II Relational Database, Relational Algebra and Calculus, SQL Fundamentals, DDL, DML, DCL, PL/SQL Concepts, Cursors, Stored Procedures, Stored Functions, Database Triggers.	12 hours
Unit-III Introduction to Normalization, First, Second, Third Normal Forms, Dependency Preservation, Boyce-Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Domain-key normal form (DKNF).	12 hours
Unit-IV Database Recovery, Concurrency Management, Database Security, Integrity and Control. Structure of a Distributed Database, Design of Distributed Databases.	10 hours

Text Books:

1. "An Introduction to Database System", Bipin C. Desai, Galgotia Publications Pvt Ltd-New Delhi, Revised Edition, (2012).
2. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Tata McGraw Hill, 6th Edition, (2013).

Reference Books:

1. "SQL, PL/SQL The Programming Language of Oracle", Ivan Bayross, BPB Publications, 4th Revised Edition (2009)
 2. "An Introduction to Database Systems", C. J. Date, A. Kannan, S. Swamynathan, 8th Edition, Pearson Education, (2006).
 3. Database Management Systems, Raghu Ramakrishnan, McGraw-Hill, Third Edition, 2014.
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)
Course Code: UGCA1982
Course Name: Design and Analysis of Algorithms Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 4 th	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Write programs for various problems using different algorithm designs.
CO2	Compute the complexity of the algorithm.

Assignments:

1.	Code and analyze solutions to following problem with given strategies: i. Knap Sack using greedy approach ii. Knap Sack using dynamic approach
2.	Code and analyze to find an optimal solution to matrix chain multiplication using dynamic programming.
3.	Code and analyze to find an optimal solution to TSP using dynamic programming.
4.	Implementing an application of DFS such as: i. to find the topological sort of a directed acyclic graph ii. to find a path from source to goal in a maze.
5.	Implement an application of BFS such as: i. to find connected components of an undirected graph ii. to check whether a given graph is bipartite.
6.	Code and analyze to find shortest paths in a graph with positive edge weights using Dijkstra's algorithm.
7.	Code and analyze to find shortest paths in a graph with arbitrary edge weights using Bellman-Ford algorithm.
8.	Code and analyze to find shortest paths in a graph with arbitrary edge weights using Flyods' algorithm.
9.	Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Prims' algorithm
10.	Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Kruskals' algorithm.
11.	Coding any real world problem or TSP algorithm using any heuristic technique.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1925

Course Name: Database Management Systems Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 3 rd	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-.

Course Outcomes:

CO#	Course outcomes
CO1	Able to understand various queries and their execution
CO2	Populate and query a database using SQL DML/DDI commands.
CO3	Declare and enforce integrity constraints on a database
CO4	Programming PL/SQL including stored procedures, stored functions, cursors, packages
CO5	Able to design new database and modify existing ones for new applications and reason about the efficiency of the result

Instructions:

1.	Used of CREATE, ALTER, RENAME and DROP statement in the database tables (relations)
2.	Used of INSERT INTO, DELETE and UPDATE statement in the database tables (relations)
3.	Use of simple select statement.
4.	Use of select query on two relations
5.	Use of nesting of queries.
6.	Use of aggregate functions.
7.	Use of substring comparison.
8.	Use of order by statement.
9.	<p>Consider the following schema for a Library Database:</p> <p>BOOK (<i>Book_id, Title, Publisher_Name, Pub_Year</i>)</p> <p>BOOK_AUTHORS (<i>Book_id, Author_Name</i>)</p> <p>PUBLISHER (<i>Name, Address, Phone</i>)</p> <p>BOOK_COPIES (<i>Book_id, Branch_id, No-of_Copies</i>)</p> <p>BOOK_LENDING (<i>Book_id, Branch_id, Card_No, Date_Out, Due_Date</i>)</p> <p>LIBRARY_BRANCH (<i>Branch_id, Branch_Name, Address</i>)</p> <p>Write SQL queries to</p> <p>1. Retrieve details of all books in the library_id, title, name of publisher, authors, number of copies in each branch, etc.</p> <p>2. Get the particulars of borrowers who have borrowed more than 3 books between Jan</p>

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	<p>2018 to Jun 2018</p> <p>3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.</p> <p>4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.</p> <p>5. Create a view of all books and its number of copies that are currently available in the Library.</p>
10.	<p>Consider the following schema for Order Database:</p> <p>SALESMAN (<i>Salesman_id, Name, City, Commission</i>)</p> <p>CUSTOMER (<i>Customer_id, Cust_Name, City, Grade, Salesman_id</i>)</p> <p>ORDERS (<i>Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id</i>)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> Count the customers with grades above Amritsar's average. Find the name and numbers of all salesmen who had more than one customer. List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation.) Create a view that finds the salesman who has the customer with the highest order of a day. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
11.	Write a PL/SQL code to add two numbers and display the result. Read the numbers during run time.
12.	Write a PL/SQL code to find sum of first 10 natural numbers using while and for loop.
13.	Write a program to create a trigger which will convert the name of a student to upper case before inserting or updating the name column of student table.
14.	Write a PL/SQL block to count the number of rows affected by an update statement using SQL%ROWCOUNT
15.	Write a PL/SQL block to increase the salary of all doctors by 1000.

Reference Books:

1. "SQL, PL/SQL The Programming Language of Oracle", 4th Revised Edition, Ivan Bayross (2009).
2. "Oracle PL/SQL Programming", 5th Edition, Steven Feuerstein and Bill Pribyl (2009).

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)
Course Code: UGCA1976
Course Name: Artificial Intelligence Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 3 rd	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: C (in case implementing using C)

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Design solutions to basic problems in AI.
CO2	Implement solution to different AI problems

Instructions:

Use any language such as C/C++/LISP/PROLOG	
1.	Write a program to solve 8 queens' problem
2.	Solve any problem using depth first search.
3.	Solve any problem using best first search.
4.	Solve 8-puzzle problem using best first search
5.	Write A Program to Generate the output for A* Algorithm
6.	Write a program to implement tower of Hanoi
7.	Write a program to solve Hill climbing.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1959

Course Name: Internet Tools and Applications

Program: B.Sc. (AI & ML)	L: 1 T: 0 P: 0
Branch: Computer Applications	Credits: 1
Semester: 3 rd	Contact hours: 11 hours
Internal max. marks: 60	Theory/Practical: Theory
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Understand basic concepts of Internet.
CO2	Design a web page.
CO3	Understand various applications of Internet .

Detailed contents	Contact hours
<p>Unit-I</p> <p>Internet: Internet, its advantages, disadvantages, internet facilities through WWW and HTML, Internet Protocols, TCP/IP, FTP, newsgroups, remote logins, chat groups etc.</p>	2 hours
<p>Unit-II</p> <p>WWW: Client side, Server side, web browsers, web pages, locating information on the web.</p> <p>E-Mail: Architecture, various aspects, the user agent, message format, message transfer, e-mail privacy.</p> <p>Domain Name Server and its working</p>	3 hours
<p>Unit-III</p> <p>HTML: Introduction to HTML, Web structure of HTML document.</p> <p>Starting an HTML document: Head element, body element, style element, Script element, Text formatting, using lists to organize information.</p> <p>Organizing Data with Table: Basic table Structures, individual cells and headings, vertical controls, database considerations, displaying real data with a table.</p> <p>Table Layout and Presentation: Table Syntax, two column layout,</p>	3 hours

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staggered body with an index, traditional newspaper layout.	
Unit-IV Uniform Resource Locators (URLs): Absolute URLs, Relative URLs, fragment URLs, Types of URL Schemes- HTTP, mailto, news, FTP, Telnet, File etc. Using Hyper Links and Anchors: Uses to Hyper Links, Structure of Hyper Links, Links to specialized contents. Images: Adding Images to web page, using images as links, creating menus with image maps, image formats-GIF, JPEG etc.	3 hours

Text Books:

1. Corner, Internetworking with TCP-IP: Principles, Protocols and Architecture, PHI.
 2. Stephan Mack, Janan Platt, HTML 4.0 No Experience Required, BPB Publication.
 3. Rick Darnell et al, HTML 4 Unleashed, Tech media Publications.
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I. K. Gujral Punjab Technical University

Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1960

Course Name: Internet Tools and Applications Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 2
Branch: Computer Applications	Credits: 1
Semester: 3 rd	Contact hours: 2 hours per week
Internal max. marks: 30	Theory/Practical: Practical
External max. marks: 20	Duration of end semester exam (ESE): 3hrs
Total marks: 50	Elective status: Core

Prerequisite: No pre-requisite

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Understand basic concepts of Internet.
CO2	Design a web page.
CO3	Understand various applications of Internet .

Instructions:

1	Create a web page to show the structure of HTML
2	Show the use of formatting tags in HTML
3	Write HTML code to show the use of absolute and relative URL with Anchor Tag
4	Create a table in which colspan and rowspan elements are used.
5	Create a webpage to show the use of different lists available in HTML
6	Create a webpage to show the use of frame tag in HTML.
7	Create a webpage to show the use of different types of CSS
8	Create admission form for a college
9	Show the use of image tag and show images as buttons
10	Create a web page to show the use of image maps.

Text Books:

1. Corner, Internetworking with TCP-IP: Principles, Protocols and Architecture, PHI.
2. Stephan Mack, Janan Platt, HTML 4.0 No Experience Required, BPB Publication.
3. Rick Darnell et al, HTML 4 Unleashed, Tech media Publications.

Fourth Semester

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1977

Course Name: Machine Learning

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 4 th	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: - Artificial Intelligence

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Analyze methods and theories in the field of machine learning.
CO2	Discuss the role of decision tree learning, Bayesian learning, Genetic Algorithm and artificial neural network in real world problems.
CO3	Compare different learning models and algorithms and utilize existing machine learning algorithms

Detailed contents	Contact hours
<p><u>Unit-I</u> Basic concepts, Designing a learning system, Issues in machine learning. Overview of types of machine learning: Learning associations, Supervised learning (Classification and Regression Trees, Support vector machines), Unsupervised learning (Clustering), Instance-based learning (K-nearest Neighbor, Locally weighted regression, Radial Basis Function), Reinforcement learning (Learning Task, Q-learning, Value function approximation, Temporal difference learning).</p>	12 hours
<p><u>Unit-II</u> Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms. Bayesian Learning: Overview of Bayes theorem and concept learning, Naive Bayes Classifier, Bayesian belief networks.</p>	12 hours
<p><u>Unit-III</u> Artificial Neural Network: Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, Pairwise separation, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, Dynamically modifying network structure.</p>	10 hours

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Unit-IV Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms.	10 hours
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Text Books:

1. Mitchell M., T., Machine Learning, McGraw Hill (1997) 1stEdition.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2014) 3rdEdition.

References Books:

1. Bishop M., C., Pattern Recognition and Machine Learning, Springer-Verlag (2011) 2ndEdition.
 2. Michie D., Spiegelhalter J. D., Taylor C. C., Campbell, J., Machine Learning, Neural and Statistical Classification. Overseas Press (1994)
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1978

Course Name: Data Science

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 4 th	Contact hours: 44 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA- DBMS

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Explain how data is collected, managed and stored for data science;
CO2	Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
CO3	Implement data collection and management scripts.

Detailed contents	Contact hours
<p><u>Unit-I</u> Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.</p>	12 hours
<p><u>Unit-II</u> Data collection and management: Introduction, Sources of data, Data storage and management, Using multiple data sources. Data Preparation: Data formats, parsing and transformation, Scalability and real-time issues. Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.</p>	12 hours
<p><u>Unit-III</u> Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.</p>	10 hours
<p><u>Unit-IV</u> Model Development Simple and Multiple Regression Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Prediction and Decision Making. Model Evaluation</p>	10 hours

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Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection.	
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Text Books:

1. Cathy O’Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O’Reilly.
 2. Jure Leskovek, Annand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1974

Course Name: Image Processing

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 4 th	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Discuss the fundamental concepts of computer graphics
CO2	Explain the need of image processing
CO3	State the various filtering and transformations that can be applied on an image.

Detailed contents	Contact hours
<u>Unit-I</u> Basics of computer graphics, Overview of 2D transformations, projection, color models, rendering and shading.	12 hours
<u>Unit-II</u> Introduction of Image Processing, Image Processing areas and applications; Components of Image Processing; Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationships between pixels; color models.	12 hours
<u>Unit-III</u> Spatial Domain: Gray level transformations; Histogram processing; Basics of Spatial Filtering; Smoothing and Sharpening Spatial Filtering Frequency Domain: Introduction to Fourier Transform; Smoothing and Sharpening frequency domain filters; Ideal, Butterworth and Gaussian filters.	10 hours
<u>Unit-IV</u> Overview of Image Restoration Noise models and filters. Overview of Feature Extraction and Image Segmentation: Contour and shape dependent feature extraction, Detection of Discontinuities; Edge Linking and Boundary detection; Region based segmentation.	10 hours

Reference Books:

1. A. Plastock, Gordon Kalley, Computer Graphics, Schaum's Outline Series, 1986.
2. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
3. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
4. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1980

Course Name: Machine Learning Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 4 th	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-.

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

CO#	Course outcomes
CO1	Identify various tools for machine learning.
CO2	Implementation of various machine learning algorithms .

Instructions:

Exact choice of experiments to be decided by instructor.	
1.	Installation of any open source machine learning tool.
2.	Searching of data sets on the web.
3.	Implementation of various machine learning algorithms based on syllabus of core subject.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1981

Course Name: Data Science Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 4 th	Contact hours: 4 hours per week
Internal max. marks: 60	Theory/Practical: Practical
External max. marks: 40	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-.

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

CO#	Course outcomes
CO1	Perform different preprocessing on data.
CO2	Identify the need of different visualization tools

Assignments: Exact choice of experiments can be decided by the lab instructor.

1.	Select any data set from web and implement each type of data pre processing on it. Like data cleaning, various transformations and summarizations.
2.	Implement different visualization tools
3.	Search for any regression based data set on web and implement the prediction model on it.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1975

Course Name: Image Processing Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 2
Branch: Computer Applications	Credits: 1
Semester: 4 th	Contact hours: 2 hours per week
Internal max. marks: 30	Theory/Practical: Practical
External max. marks: 20	Duration of end semester exam (ESE): 3hrs
Total marks: 50	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Implement fundamental transformations on objects.
CO2	Implement transformations and enhancements on image

Assignments:

1.	Download any tool for image processing/ install C programming language.
2.	Implement Translation on an object in C/ C++.
3.	Implement scaling on a object in C/ C++.
4.	WAP to draw Histogram of digital Image
5.	WAP to enhance the quality of digital image.
6.	WAP to convert digital image from spatial domain to frequency domain.
7.	Implement low pass filters in frequency domain for image enhancement.
8.	WAP to segment digital image using thresholding approach.

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Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1983

Course Name: Advance Python Programming

Program: B.Sc. (AI & ML)	L: 3 T: 0 P: 0
Branch: Computer Applications	Credits: 1
Semester: 4 th	Contact hours: 33 hours
Internal max. marks: 40	Theory/Practical: Theory
External max. marks: 60	Duration of end semester exam (ESE): 3hrs
Total marks: 100	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Implement database connection using python
CO2	Use appropriate python libraries for various array, machine learning and data frames related problems.

Detailed contents	Contact hours
<p><u>Unit-I</u></p> <p>DATABASE: Introduction to MySQL, Database connections, Executing queries, Handling error.</p>	7 hours
<p><u>Unit-II</u></p> <p>Pandas Library: Introduction, Environment Setup</p> <p>Introduction to Data Structures: Series, DataFrame, Panel, Basic Functionality, Descriptive Statistics, Function Application, Reindexing, Iteration, Sorting</p> <p>Working with Text Data, Options & Customization, Indexing & Selecting Data</p> <p>Statistical Functions: Window Functions, Aggregations, Missing Data, GroupBy, Merging/Joining, Concatenation, Date Functionality Timedelta, Categorical Data, Visualization</p>	10 hours
<p><u>Unit-III</u></p> <p>NumPy Library, Introduction, Environment, Narray Object, Data Types, Array Attributes, Array Creation Routines, Array from Existing Data, Array From Numerical Ranges, Indexing & Slicing, Iterating Over Array, Array Manipulation, String Functions, Mathematical Functions, Arithmetic Operations, NumPy - Statistical Functions, Sort, Search & Counting Functions, NumPy - Matrix Library, NumPy - Linear Algebra, NumPy - Matplotlib, NumPy - Histogram Using Matplotlib, NumPy - I/O with NumPy</p>	10 hours

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<u>Unit-IV</u> Basic Introduction to Scipy, Seaborn, Scikit-learn Libraries	6 hours
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Text Books:

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
2. Python Training guide (BPB Publications)

Reference Book:

1. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1984

Course Name: Advance Python Programming Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 2
Branch: Computer Applications	Credits: 1
Semester: 4 th	Contact hours: 2 hours per week
Internal max. marks: 30	Theory/Practical: Practical
External max. marks: 20	Duration of end semester exam (ESE): 3hrs
Total marks: 50	Elective status: Core

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

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

CO#	Course outcomes
CO1	Write programs to implement basic database functions using python.
CO2	Implement various machine learning algorithms using python.

Assignments: Exact

1.	WAP to connect with MySQL
2.	WAP to implement various queries
3.	Implement various methods of NumPy Library
4.	Implement various methods of Pandas Library
5.	Implement various methods of Scipy Library
6.	Implement various methods of Seaborn Library
7.	Implement various methods of Scikit-learn Libraries

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1946

Course Name: R Programming

Program: B.Sc. (AI & ML)	L: 3 T: 0 P: 0
Branch: Computer Applications	Credits: 3
Semester: 5 th	Contact Hours: 33 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Skill Enhancement
Total marks: 100	

Prerequisite: Logics of basic programming terminologies.

Co requisite: Simulation study.

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	Identify the key components of R programming Language.
CO2	Define the concept of data Science.
CO3	Differentiate between vectors and arrays.
CO4	Outline the usage of data frames, lists, factors, tables and R structures.
CO5	Explain the need and utilization of various visualization tools.

Detailed Contents	Contact hours
<p>Unit-I</p> <p>R Programming Fundamentals: Introduction to R, Installing R, Windows/Linux/Mac Installation, Setting up Path, Using Packages, and Running R: Interactive Mode, Batch Mode, Getting Help, Startup and Shut Down.[CO1]</p> <p>Vectors: Scalars, Vectors, Arrays and Matrices, Declarations, Recycling, Common Vector Operations, Using all() and any(), Na and Null Values, Filtering, ifelse() Function.[CO3]</p> <p>Matrices and Arrays: Creating Matrices, General Matrix Operations, Applying Functions to Matrix Rows and Columns, Adding & Deleting Matrix Rows and Columns, Difference Between Matrix and Vector.[CO3]</p>	8
<p>Unit-II</p> <p>Lists: Creating Lists, General List Operations, Accessing List Components and Values, Applying Functions to Lists, Recursive Lists. Data Frames: Creating Data Frames, Merging Data Frames, Applying Functions to Data Frames. [CO4]</p> <p>Factors and Tables: Introduction, Common Functions use with Factors, Working with Tables.[CO4]</p>	8

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R Programming Structures: Control Statements, Arithmetic and Boolean Operators, Default Values for Arguments, Return Values, Recursion.[CO4]	
Unit-III Object Oriented Programming: Concept of Classes, S3 Classes, S4 Classes, S3 Versus S4 Classes, Managing Objects.[CO1] Input/Output: Accessing Keyboard and Monitor, Reading and Writing Files, Accessing the Internet. String Manipulation: Overview of String Manipulation Functions [grep(), nchar(), paste(), sprintf(), substr(), strsplit(), regexpr(), gregexpr(), Regular expression].[CO5]	8
Unit-IV Graphics: Creating Graphs, Customizing Graphs, Saving Graphs to Files, Creating 3D Plots. Debugging: Principles of Debugging, Use of Debugging Tool, Using R Programming Debugging Facilities. [CO3] Simulation: Generating Random Numbers, Setting the Random Number Seed, Simulating a Linear Model, Random Sampling.[CO5]	9

Text Books:

1. The ART of R Programming, Norman Matloff, No Starch Press.
2. R Programming for Data Science, Roger D. Peng, Lean Publishing.
3. R Programming for Beginners, S. Rakshit, TMH.

Reference Books:

1. Data Analytics using R, Seema Acharya, TMH.

Course Code: UGCA1952

Course Name: R Programming Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Skill Enhancement
Total marks: 100	

Prerequisite: - Logics of basic programming terminologies.

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Co requisite: - Simulation study.

Additional material required in ESE: - Record the *Simulation Results* on practical file.

Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Write programs for arrays and matrices.
CO2	Execute data frames and lists.
CO3	Differentiate between arrays from vectors.
CO4	Implement factors in R
CO5	Execute minor projects using R.

Instructions: All programs are to be developed in R Programming Language.

1.	Design a program to take input from the user (name and age) and display the values through R Programming.
2.	Write a program to get the details of the objects in memory using R Programming.
3.	Create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91 using R Programming.
4.	Create a vector which contains 10 random integer values between -50 and +50 using R Programming.
5.	Demonstrate through a program to display the details of the objects in memory.
6.	Write a R program to get the first 10 Fibonacci numbers.
7.	Show all prime numbers up to a given number using R programming..
8.	Design a R program to find the factors of a given number.
9.	Write a R program to find the maximum and the minimum value of a given vector.
10.	Write a program to get the unique elements of a given string and unique numbers of vector.
11.	Convert a given matrix to a 1 dimensional array through R programming.
12.	Write a R program to create an array of two 3x3 matrices each with 3 rows and 3 columns from the given two vectors.
13.	Create a 3 dimensional array of 24 elements using dim() function.
14.	Write a R program to create an array using four given columns, three given rows and two given tables, also display the contents of the array.
15.	To convert a given matrix to 1 dimensional array design a R program.
16.	Write a R program to concatenate two given factor in a single factor.
17.	Write a R program to create an 3 dimensional array of 24 elements using the dim() function.
18.	Construct a R program to create an array of two 3x3 matrices each with 3 rows and 3 columns from the given two vectors. Print the second row of the second matrix of the array and the element in the 3rd row and 3rd column of the 1st matrix.
19.	Write a R program to create a data frame from four given vectors.
20.	Write a program to get the structure of a given data frame.

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21.	Design a R program to get the statistical summary and nature of the data of a given data frame.
22.	Write a R program to extract specific column from a data frame using column name.
23.	Design a R program to create a data frame from four given vectors.
24.	Demonstrate a R program to get the structure of a given data frame.
25.	Write a R program to get the statistical summary and nature of the data of a given data frame.
26.	Design a R program to extract specific column from a data frame using column name.
27.	Demonstrate a R program to create a data frame from four given vectors.
28.	Write a R program to create a matrix taking a given vector of numbers as input. Display the matrix.
29.	Construct a R program to create a matrix taking a given vector of numbers as input and define the column and row names. Display the matrix.
30.	Write a R program to access the element at 3 rd column and 2 nd row, only the 3 rd row and only the 4 th column of a given matrix.
31.	Develop a R program to create a vector of a specified type and length. Create vector of numeric, complex, logical and character types of length 6.
32.	Write a R program to add two vectors of integers type and length.
33.	Design a R program to append value to a given empty vector
34.	Write a R program to multiply two vectors of integers type and length.
35.	Design a R program to create a list containing strings, numbers, vectors and a logical values.
36.	Write a R program to list containing a vector, a matrix and a list and give names to the elements in the list.
37.	Demonstrate a R program to find the levels of factor of a given vector.
38.	Write a R program to change the first level of a factor with another level of a given factor.
39.	Design a R program to create an ordered factor from data consisting of the names of months.
40.	Construct graphical output & display the results of any five tasks using simulator.

Text Books:

1. The ART of R Programming, Norman Matloff, No Starch Press.
2. R Programming for Data Science, Roger D. Peng, Lean Publishing.
3. R Programming for Beginners, S. Rakshit, TMH.

Reference Books:

1. Data Analytics using R, Seema Acharya, TMH.

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Course Code: UGCA1936

Course Name: Cloud Computing

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact hours: 44 hours
Theory/Practical: Theory	Percentage of numerical/design problems: --
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Define the concept of cloud computing.
CO2	Outline the benefits if migrating to a cloud solution for different applications.
CO3	Compare different virtualization technologies.
CO4	Identify various resources needed to build cloud.
CO5	Explain various security threats to cloud.

Detailed contents	Contact hours
<p>Unit-I</p> <p>Overview of Computing Paradigm: Recent trends in Computing -Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. [CO1]</p> <p>Introduction to Cloud Computing: Vision of Cloud Computing, Defining a Cloud, Cloud delivery Model, Deployment Model, Characteristics, Benefits of Cloud Computing, Challenges ahead. Cloud computing vs. Cluster computing vs. Grid computing.[CO1]</p> <p>Migrating into a Cloud: Introduction, Broad approaches to Migrating into the Cloud, The Seven-Step Model of Migration Into a Cloud. [CO2]</p>	12
<p>Unit-II</p> <p>Virtualization: Introduction, Characteristics of Virtualized environment, Taxonomy of Virtualization techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Hypervisor Technology Examples- Xen, VMware, Microsoft Hyper-V. [CO3]</p> <p>Capacity Planning: Elasticity vs Scalability, Introduction, Defining Baseline</p>	12

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and Metrics-Baseline Measurements, System Metrics, Load Testing, Resource Ceilings, Server and Instance types; Network Capacity, Scaling. [C04]	
Unit-III SLA Management in Cloud Computing: Inspiration, Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA management in Cloud. Automated Policy-based management.[CO4] Securing Cloud services: Cloud Security, Securing Data- Brokered Cloud Storage Access, Storage location and tenancy, Encryption, Auditing and compliance. Steps to ensure security over cloud.[CO5]	10
Unit-IV Cloud Platforms in Industry: Amazon Web Services-Compute Services, Storage Services, Communication Services, Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life Cycle. Cost Model. Microsoft Azure-Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. [CO4]	10

Text Books:

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India, Feb 2013.
2. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, ISBN-13: 978-81-265-2980-3, New Delhi, India, 2011.
3. Cloud Computing: Principles and paradigms, Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski, Wiley India Pvt. Ltd, ISBN-13: 978-81-265-4125-6, New Delhi, India, 2011

Reference Books:

1. Cloud Computing for Dummies, Fern Halper, Hurwitz, Robin Bloor, Marcia Kaufman, Wiley India Pvt. Ltd, ISBN-13: 978-0-47-0597422, New Delhi, India, 2011.
2. Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, ISBN-13: 978-8-12-6528837, New Delhi, India, 2011.

E Books/ Online learning material

1. P.D. Kaur, I. Chana, Unfolding the distributed computing paradigm, in: Proceedings of the IEEE International Conference on Advances in Computer Engineering, ACE, Bangalore, Karnataka, India, 2010, pp. 339–342.
2. P. Mell and T. Grance, “The NIST definition of cloud computing (draft), NIST Spec. Publ. 800 (2011) 7.

Course Code: UGCA1942

Course Name: Cloud Computing Laboratory

Program: BCA	L: 0 T: 0 P: 4
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of end semester exam (ESE): 3hrs
External max. marks: 40	Elective status: Elective
Total marks: 100	

Prerequisite: Working Knowledge of Operating system

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Identify major commercial projects in the field of cloud computing
CO2	Design basic cloud applications
CO3	Execute basic functionalities of open source tools like Open Stack.
CO4	Implement virtualization
CO5	Define major services provided by cloud service provider.

Instructions:

1.	Enlist various companies in cloud business and the corresponding services provided by them and tag them under SaaS , PaaS & IaaS.
2.	Create a warehouse application using tools supplied by any SaaS provider.
3.	Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S. Learn creation, migration, cloning and managing of virtual machines.
4.	Using public cloud service providers tools for exploring the usage of IaaS, PaaS and SaaS cloud services.
5.	Setting up a private cloud using open source tools (Eucalyptus/Open Stack etc.).

Course Code: UGCA 1989

Course Name: Neural Networks

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact Hours: 33 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: Computer Networks.

Co requisite: Machine Learning

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
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I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

CO1	Understand basic concepts of neural networks.
CO2	Use neural networks to perform classification for single class and multiclass problems.
CO3	Learn and apply the concept of self-organizing maps.
CO4	To be able to formalize the problem, to solve it by using a neural network.

Detailed Contents	Contact hours
Unit-I NEURAL NETWORK BASICS- Classical AI and Neural Networks, Characteristics of Neural Networks, Historical perspective, Models of Artificial Neuron & activation functions, Artificial Neuron Model and Linear Regression, Nonlinear Activation Units and Training of Artificial Neural Networks, Learning Mechanisms: Gradient Descent Algorithm, Learning Mechanisms-Hebbian, Competitive, Boltzmann , Universal function approximation. [CO 1]	8
Unit-II SINGLE LAYER AND MULTI LAYER PERCEPTRONS- Representation of perceptron, Linear separability, Perceptron Learning, Single-Layer Perceptrons, Unconstrained Optimization, Gauss-Newton's Method, Linear Least Squares Filters, Least Mean Squares Algorithm , Perceptron Convergence Theorem, Back Propagation Algorithm, Practical Consideration in Back Propagation Algorithm, Training of single layer and multilayer perceptron, Solution of Non-Linearly Separable Problems Using MLP, Heuristics For Back-Propagation [CO 2]	8
Unit-III Multi- Class Classification Using Multi-layered Perceptrons, Associative Memory Networks- Associative Memory Model, Conditions for perfect Recall in Associative memory, Radial basis function Networks, Separability and Interpolation, Learning Mechanisms in RBF, Comparison Between MLP and RBF, Introduction to Principal Components and Analysis, Dimensionality reduction Using PCA Hebbian- based Principal Component Analysis [CO 4]	8
Unit-IV Self Organizing Maps :Introduction to Self Organizing Maps, Cooperative and Adaptive Processes in SOM, Vector-Quantization Using SOM, Competitive learning, Mexican Hat networks [CO 3]	9

Text Books:

- 1) Neural Networks, fuzzy Logic, and Genetic Algorithms, Rajasekaran & Vijayalakhmi Pai, Pearson 2011
- 2) Principles of Soft Computing, Sivanandam, Deepa, Wiley, 2014

Reference Books:

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

1) Neural Networks – A Classroom Approach, Satish Kumar, Tata McGraw Hill, 2010

Course Code: UGCA 1990

Course Name: Neural Networks Lab

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Elective
Total marks: 100	

Prerequisite: Computer Networks.

Co requisite: Machine Learning

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	Xreate environment for implementing neural network applications.
CO2	Use neural networks to perform classification for single class and multiclass problems.
CO3	To be able to formalize the problem, to solve it by using a neural network.

LIST OF PRACTICALS

1.	Study and installation of Matlab or any other open tool for implementing neural network-based exercises.
2.	Implement basic programs for understanding data types, operators, control statements and writing scripts.
3.	Write a program to plot straight line and sine curve.
4.	Write a program in Matlab for plotting multiple curves in single figure
5.	Write a program in Matlab to plot Activation function used in neural network
6.	Write a program in Matlab to plot piecewise continuous activation function
7.	Write a program to create the Perceptron.
8.	Write a program in Matlab for Pattern Classification using Perceptron network
9.	Write a program for creating a Back Propagation Feed-forward neural network
10.	Write a program to illustrate how the perception learning rule works for non-linearly separable problems
11.	Write a program to illustrate Linearly non-separable vectors

Text Books:

I. K. Gujral Punjab Technical University
Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

- 1) Neural Networks, fuzzy Logic, and Genetic Algorithms, Rajasekaran & Vijayalakhmi Pai, Pearson 2011
- 2) Principles of Soft Computing, Sivanandam, Deepa, Wiley, 2014

Reference Books:

- 1) Neural Networks – A Classroom Approach, Satish Kumar, Tata McGraw Hill, 2010

Course Code: UGCA1991

Course Name: Web Mining & Recommender System

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact Hours: 33 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: Fundamental concepts of internet.

Co requisite: Simulation study.

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	To explain techniques to mine the Web and other information networks,
CO2	To implement mining on Social networks and Social media
CO3	To apply the appropriate technique for data analysis
CO4	To extract knowledge from web scale datasets by various techniques.
CO5	To be familiar with classic and recent developments in Web search and web data

Detailed Contents	Contact hours
Unit-I INTRODUCTION TO WEB DATA MINING Need, Importance, Applications of Web Data mining. Capturing-users web activities, Client side v/s middleware v/s server side-data and usage logging. Web Mining and its types, Web Usage Mining, Web Structure Mining, Web Content Mining [CO1]	8
Unit-II WEB USAGE MINING Learning from Browser, Server Logs, Identifying frequent item sets, pattern identification, representing patterns in form of relations/Graphs. Understanding web application or website- Usage, Heat maps. Using statistical tools for usage analysis and machine learning for prospective improvements. [CO2, CO3]	8
Unit-III WEB STRUCTURE MINING Understanding link structure of the web, Static v/s dynamic linking, representing	8

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<p>the link structure asgraphs, identifying most / least used links, paths, Categorizing links based on required attributes, Clustering links based on required attributes. Web as a graph, identifying nodes, edges, in-degree, out- degree, HITS Algorithm Page Rank algorithm. [CO4]</p>	
<p>Unit-IV WEB CONTENT MINING</p> <p>Storing web content as text, database, various document types, generating meta-information of web documents, labelling, tagging, identifying feature sets. Representing web documents, Vector Space Model.TF-IDF, web-page summarization, tokenization, n-gram analysis, categorizing web pages based on required attributes, Clustering web pages based on required attributes. [CO5]</p>	9

Text Books:

1. SoumenChakrabarti, Mining the Web, Morgan-Kaufmann, first edition, 2002
2. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011).
3. Bing Liu, Web Data Mining: Exploring Hyperlinks, Content, and Usage Data, 2nd Edition, Springer, 2011

Course Code: UGCA1992

Course Name: Web Mining & Recommender System Lab

Program: B.Sc. (AI & ML)	L: 0 T: 0 P:4
Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Elective
Total marks: 100	

Prerequisite: - fundamental concepts of internet and programming.

Co requisite: - Simulation study.

Additional material required in ESE: - Record the *Simulation Results* on practical file.

Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Prepare the data for web mining
CO2	Apply training to data.
CO3	Analyze text mining techniques

Practicals

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12.	To List applications for mining.
13.	Study of File format for data mining.
14.	To convert various data files.
15.	Training the given dataset for an application.
16.	Testing the given dataset for an application.
17.	Study of Data pre-processing techniques.
18.	Study and analysis of Text mining techniques.
19.	Use of Jupyter notebook.
20.	Application of Python NLTK.
21.	Use of NLTK Tagging and Chunking.

Text Books:

1. SoumenChakrabarti, Mining the Web, Morgan-Kaufmann, first edition, 2002
2. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011).
3. Bing Liu, Web Data Mining: Exploring Hyperlinks, Content, and Usage Data, 2nd Edition, Springer, 2011

Course Code: UGCA1993

Course Name: Natural Language Processing

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact Hours: 33 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: Logics of basic programming terminologies.

Co requisite: Simulation study.

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	To explain the concept of natural language processing
CO2	To explore the linguistic features relevant to each NLP task.
CO3	To discuss the phases of Natural language Generation.
CO4	To apply basic algorithms in this field.

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Detailed Contents	Contact hours
Unit-I OVERVIEW AND LANGUAGE MODELING Overview - Origins and challenges of NLP-Language and Grammar-Processing Indian Languages - NLP Applications-Information Retrieval - Language Modeling: Various Grammar - based Language Models - Statistical Language Model. [CO1]	8
Unit-II WORD LEVEL AND SYNTACTIC ANALYSIS Word Level Analysis - Regular Expressions - Finite-State Automata - Morphological Parsing - Spelling Error Detection and correction - Words and Word classes - Part-of Speech Tagging. Syntactic Analysis – Context - free Grammar - Constituency - Parsing - Probabilistic Parsing. [C02]	8
Unit-III SEMANTIC ANALYSIS AND DISCOURSE PROCESSING Semantic Analysis - Meaning Representation - Lexical Semantics – Ambiguity - Word Sense Disambiguation - Discourse Processing – cohesion - Reference Resolution - Discourse Coherence and Structure. [CO2]	8
Unit-IV NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION Natural Language Generation - Architecture of NLG Systems - Generation Tasks and Representations - Application of NLG. Machine Translation - Problems in Machine Translation - Characteristics of Indian Languages - Machine Translation Approaches - Translation involving Indian Languages. [CO3][CO4]	9

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2012.

Reference Books:

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Prentice Hall, 2008.
2. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin /Cummings publishing company, 1995.

Course Code: UGCA1994

Course Name: Natural Language Processing Lab

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
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Bachelor of Science in Artificial Intelligence & Machine Learning (B.Sc. AI & ML)

Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Elective
Total marks: 100	

Prerequisite: - Logics of basic programming terminologies.

Co requisite: - Simulation study.

Additional material required in ESE: - Record the *Simulation Results* on practical file.

Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Apply preprocessing to text.
CO2	Implement different linguistic features and phases of NLP.
CO3	Create basic NLP applications

Practicals

Write programs to implement the following:	
1	Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2	Morphological Analysis
3	N-gram model
4	POS tagging
5	Chunking
6	Named Entity Recognition
7	Mini Project based on NLP Application

Text Books:

Text Books:

2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2012.

Reference Books:

3. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
4. James Allen, "Natural Language Understanding", 2nd edition, Benjamin /Cummings publishing company, 1995.

Course Code: UGCA1995

Course Name: Simulation and Modelling

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact Hours: 33 hours

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Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: --

Co requisite: --

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	Understand the fundamental elements of simulation system models and its phases.
CO2	Analyze a real-world problem and apply modelling methodologies to develop a discrete-event simulation model
CO3	Learn the discrete and continuous system, generation of random variables, analysis of simulation output and simulation languages.
CO4	Compare and evaluate the operation of simulated system and make improvement according to the simulation results.

Detailed Contents	Contact hours
Unit-I Introduction to Simulation: System Models: System Concept, Boundary Environment, Continuous and discrete systems, Real Time Simulation; Types of simulation model (Static Physical, Dynamic Physical, Static Mathematical); Phases and Steps in Simulation Study; Advantages & Disadvantages of Simulations; Areas of Applications. [CO 1]	8
Unit-II Simulation of Continuous Systems: Simulation of Queuing system, Simulation of single and two server queues; Markov Chains: Introduction, Application and examples; Network Model of a project. Probability concepts in simulation: Stochastic variables and probability functions; Discrete system simulation; fixed time step vs event-to-event model, Generation of Random numbers, Monte Carlo Computation vs Stochastic simulation. [CO 2]	8
Unit-III Random Numbers: Introduction, Table, Pseudo Random Numbers; Generation of Random Numbers – Uniform (Linear Congruential Method) and Non-Uniform (Inverse Transformation, Rejection); Testing for Randomness: Uniformity (frequency) test (Kolmogorov-Smirnov Test; Chi-Square Test); Testing for auto correlation; Poker test; Gap test. [CO 3]	8
Unit-IV Verification and Validation of Simulation Model: Modeling Building; Verification of Simulation Model; Calibration and Validation of Models Analysis of Simulation Output: Nature of problem; Estimation methods; Simulation run statistics; Replication of runs; Elimination of internal bias Comparison and Evaluation of Alternative System Designs. [CO 4]	9

Text Books:

1. Jerry Banks, John S. Carson II, Barry L.Nelson and David M.Nicol, "Discrete- event system and simulation", Prentice Hall of India.
2. Averill M.Law, "Simulation Modeling and Analysis", Tata McGraw Hill India.
3. David Cloud, Larry Rainey, "Applied Modeling and Simulation", Tata McGraw Hill.
4. Lawrence M. Leemis, Stephen K. Park, "Discrete – Event Simulation: A First Course", Pearson Education.

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Reference Books:

1. Narsingh Deo "System Simulation with Digital Computers" PHI
2. G. Gordon "System Simulation" PHI
3. Gabriel A. Wainer, "Discrete-event modeling and simulation: a practitioner's approach", CRC Press.
4. Bernard P. Zeiger, Herbert Praehofer, Tag Gon Kim, "Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems", Academic Press.
5. Walter J. Karplus, George A. Bekey, Boris YakobKogan, "Modeling and simulation: theory and practice", Springer.

Course Code: UGCA1996

Course Name: Simulation and Modelling Laboratory

Program: B.Sc. (AI & ML)	L: 0 T: 0 P: 4
Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Elective
Total marks: 100	

Prerequisite: --

Co requisite: --

Additional material required in ESE: Record the *Simulation Results* on practical file.

Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Basic concept of simulation tools
CO2	Understand Discrete systems modeling and simulation ie General Purpose Simulation System (GPSS)
CO3	Learn about Continuous system modeling and simulation (CSMP)
CO4	Compare and evaluate the operation of simulated system and make improvement accordingly.

Suggested Tools - Scilab, Tortuga and Extend. Introduction to network simulators - NS2, CloudSim, Wireshark.

1.	Practical Implementation of Basic Operations on Matrices.
2.	Analysis of Discrete and Continuous Distributions.
3.	Practical Implementation of Monte-Carlo Simulation method.
4.	Practical Implementation of Queuing Models
5.	Simulate a network using any network simulator.
6.	Generation of Random Numbers using Linear Congruential Method.
7.	Practical Implementation of Chi-square goodness-of-fit test.
8.	Evaluation of system design of a system.
9.	Describe and Design Simulation of (Any 3) <ul style="list-style-type: none"> — an autopilot — Telephone system — Inventory system — Traffic system — Banking system — Super markets

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| <ul style="list-style-type: none"> — Communication systems — Production system; etc. |
|--|

Text Books:

1. Jerry Banks, John S. Carson II, Barry L.Nelson and David M.Nicol, "Discrete- event system and simulation", Prentice Hall of India.
2. Averill M.Law, "Simulation Modeling and Analysis", Tata McGraw Hill India.
3. David Cloud, Larry Rainey, "Applied Modeling and Simulation", Tata McGraw Hill.
4. Lawrence M. Leemis, Stephen K. Park, "Discrete – Event Simulation: A First Course", Pearson Education.

Course Code: UGCA1997

Course Name: Deep Learning

Program: B.Sc. (AI & ML)	L: 3 T: 1 P: 0
Branch: Computer Applications	Credits: 4
Semester: 5 th	Contact Hours: 33 hours
Theory/Practical: Theory	Percentage of numerical/design problems: 40%
Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: -

Co requisite: -

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	Comprehend the advancements in learning techniques
CO2	Compare and explain various deep learning architectures and algorithms.
CO3	Demonstrate the applications of Convolution Networks
CO4	Apply Recurrent Network for Sequence Modelling

Detailed Contents	Contact hours
Unit-I Machine Learning Basics: Learning, Under-fitting, Overfitting, Estimators, Bias, Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning, Unsupervised Learning and Stochastic Gradient Decent. (CO1)	8
Unit-II Deep Feedforward Network: Feed-forward Networks, Gradient-based Learning, Hidden Units, Architecture Design, Computational Graphs, Back-Propagation, Regularization, Parameter Penalties, Data Augmentation, Multi-task Learning, Bagging, Dropout and Adversarial Training and Optimization. (CO2)	8
Unit-III Convolution Networks: Convolution Operation, Pooling, Basic Convolution Function, Convolution Algorithm, Unsupervised Features and Neuroscientific for convolution Network. (CO 3)	8

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Unit-IV Sequence Modelling: Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder- Decoder Sequence-to-Sequence Architectures, Deep Recurrent Network, Recursive Neural Networks and Echo State networks. (CO4)	9
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Text Books:

1. Goodfellow L., Bengio Y. and Courville A., Deep Learning, MIT Press (2016).
2. Patterson J. and Gibson A., Deep Learning: A Practitioner's Approach, O'Reilly (2017), 1st ed.

Reference Books:

1. Haykin S., Neural Network and Machine Learning, Prentice Hall Pearson (2009), 3rd ed.
2. Geron A., Hands-on Machine Learning with Sci-kit and TensorFlow, O'Reilly Media (2017)

Course Code: UGCA1998

Course Name: Deep Learning Lab

Program: B.Sc. (AI & ML)	L: 0 T: 0 P:4
Branch: Computer Applications	Credits: 2
Semester: 5 th	Contact hours: 4 hours per week
Theory/Practical: Practical	Percentage of numerical/design problems: --
Internal max. marks: 60	Duration of End Semester Exam (ESE): 3hrs
External max. marks: 40	Elective Status: Elective
Total marks: 100	

Prerequisite: - Logics of basic programming terminologies.

Co requisite: - Simulation study.

Additional material required in ESE: - Record the *Simulation Results* on practical file.

Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Create basic networks for deep learning.
CO2	Implement applications like classification and object detection using CNN
CO3	Implement mining problems using CNN.

Instructor can implement the exercises using any tool	
1.	Implement Simple Programs like vector addition.
2.	Implement a simple problem like regression model.
3.	Implement a perceptron model.
4.	Implement a Feed-Forward Network.
5.	Implement an Object Detection using CNN.
6.	Implement an Image Classifier using CNN.

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7.	Implement Text Classification using CNN.
8.	Implement 2 differing mining problems in Recurrent Neural network.

Text Books:

3. Goodfellow L., Bengio Y. and Courville A., Deep Learning, MIT Press (2016).
4. Patterson J. and Gibson A., Deep Learning: A Practitioner's Approach, O'Reilly (2017), 1st ed.

Reference Books:

3. Haykin S., Neural Network and Machine Learning, Prentice Hall Pearson (2009), 3rd ed.
4. Geron A., Hands-on Machine Learning with Sci-kit and TensorFlow, O'Reilly Media (2017)