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.GujralPunjab Technical University

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.

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	Fundamentalsof Computer andIT	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

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**

I. K. Gujral Punjab Technical University

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

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**

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**

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

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

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

Semester –Sixth

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA2014	Skill Enhancement Course-III	Weka- Open Source Software Tool	3	0	0	40	60	100	3
UGCA2015	Skill Enhancement Course-Laboratory	Weka- Open Source Software Tool Lab	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
UGCA2020	Project	Project 2	0	0	4	60	40	100	2
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
UGCA2016	Business Intelligence
UGCA2010	Intelligent Systems
UGCA2018	Geographic Information Systems

Elective-I Laboratory	
Course Code	Course Title
UGCA2017	Business Intelligence Lab
UGCA2011	Intelligent Systems Lab
UGCA2019	Geographic Information Systems Lab

Elective-II	
Course Code	Course Title
UGCA2012	Social network Analysis
UGCA2006	Big Data Analytics
UGCA2008	Computer Vision

Elective-II Laboratory	
Course Code	Course Title
UGCA2013	Social network Analysis Lab
UGCA2007	Big Data Analytics Lab
UGCA2009	Computer Vision Lab

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

Course Code: UGCA1901
Course Name: Mathematics

Program: B.Sc. (AI & ML)	**L:**3 **T:**1 **P:**0
Branch: Computer Applications	**Credits:** 4
Semester: 1st	**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
Unit-I 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.	12 hours
Unit-II Logic Statement, Connectives, Basic Logic Operations (Conjunction, Disjunction, Negation) Logical Equivalence/Equivalent Statements, Tautologies and Contradictions.	10 hours
Unit -III Matrices Introduction, Types of Matrix (Row Matrix, Column Matrix, Rectangular Matrix, Square Matrix, Diagonal Matrix, Scalar Matrix, Unit Matrix, NullMatrix, ComparableMatrix, EqualMatrix), Scalar Multiplication, Negative of Matrix, Addition of Matrix, Difference oftwo	12 hours

Matrix, Multiplication of Matrices, Transpose of a Matrix.	
Unit-IV 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. RDSharma
2. Comprehensive Mathematics, ParmanandGupta
3. Elements of Mathematics, MLBhargava

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: 1st	**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-

CourseOutcomes:

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
Unit-I **Human Computer Interface** Concepts of Hardware and Software; Data and Information. **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. **Devices:** Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter. **Memory:** Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks.	12

Data Representation: Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication) Applications of IT.	
Unit-II **Concept of Computing, Types of Languages:** Machine, assembly and High level Language; Operating system as user interface, utility programs. **Word processing:** Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, equation editors.	10
Unit-III **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. **Presentation Graphics Software:** Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.	10
Unit-IV **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. Concept of Mobile Computing, Cloud Computing, Big Data and Internet of Things (IoT)	12

Text Books:

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

4. "Introduction to Information Technology", Satish Jain, AmbrishRai&Shashi Singh, Paperback Edition, BPB Publications,2014.

Reference Books:

1. "Introduction to Computers", Peter Norton
2. Computers Today, D. H. Sanders, McGrawHill.
3. "Computers", Larry long & Nancy long, Twelfth edition, PrenticeHall.
4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen F Monk, ThomsonLearning.
5. Computer Fundamentals, A. Goel, 2010, PearsonEducation

E Books/ Online learning material

1. www.sakshat.ac.in
2. https://swayam.gov.in/course/4067-computer-fundamentals

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: 1st	**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
Unit-I **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. **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. **Operators and Expressions:** Operators in Python, Expressions, Precedence, Associativity of Operators, Non AssociativeOperators.	12

Unit-II **Control Structures:** Decision making statements, Python loops, Python control statements. **Python Native Data Types:** Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods andoperations).	10
Unit-III **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. **Python Modules:** Module definition, Need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, PythonPackages.	12
Unit-IV **Exception Handling:** Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python. **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. **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.	10

Text Books:

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

ReferenceBooks:

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

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: 1st	**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
Unit-I 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.	4
Unit-II Downloading and installing free open source multimedia tool like GIMP, understanding its workspace (toolbox, menus, panels). **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	8
Unit-III **Transform Tools**: Common Features, Align, Move, Crop, Rotate, Scale, Shear, Perspective, Flip, The Cage Tool.	5

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-GalgotiaPublications pvt. Ltd,1998.

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: 1st	**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.

12.	Print Geometric and Harmonic means of a series input by the user.
13.	Evaluate the following expressions: a. $x-x^2/2!+x^3/3!-x^4/4!+\ldots x^n/n!$ b. $x-x^3/3!+x^5/5!-x^7/7!+\ldots x^n/n!$
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 *Rectangle,* constructed by a length & width, also design a method which will compute the area of a rectangle.
36.	Design a Python class named *Circle* 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 *text file*.
39.	Design a Python program to read first n lines of a *text file.*
40.	Construct a Python program to write and append text to a file and display the text.

Text Books:

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

ReferenceBooks:

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

Course Code: UGCA1906
Course Name:Fundamentals of Computer and ITLaboratory

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 1st	**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-

CourseOutcomes:

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, ApplyingTexteffects,UsingCharacterSpacing,BordersandColors,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.

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, DataValidation
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

Reference Books:

1. IT Tools, R.K. Jain, Khanna PublishingHouse
2. Introduction to Information Technology, ITL Education Solutions limited, PearsonEducation
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, ThomsonLearning

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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: 1st	**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-

CourseOutcomes:

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 communicationsuch 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 ofCommunication
- Types and modes ofCommunication

Unit- 2 (Language of Communication)

- Verbal and Non-verbal
- (Spoken andWritten)
- Personal, Social andBusiness
- Barriers andStrategies
- Intra-personal, Inter-personal and Groupcommunication

Unit-3 (Reading and Understanding)

- CloseReading
- Comprehension
- SummaryParaphrasing
- Analysis andInterpretation
- Translation(from Hindi/Punjabi to English andvice-versa)
  OR
  Precis writing /Paraphrasing (for International Students)
- Literary/KnowledgeTexts

Unit-4 (Writing Skills)

- Documenting
- ReportWriting
- Makingnotes
- Letterwriting

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 Heasly.Cambridge University Press.2006.

Course Code: BTHU104/18

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: 1st	**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-

CourseOutcomes:

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

- ListeningComprehension
- Self Introduction, Group Discussion and RolePlay
- Common Everyday Situations: Conversations andDialogues
- Communication atWorkplace
- Interviews
- FormalPresentations
- Monologue
- Effective Communication/ Mis-Communication

- PublicSpeaking

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 UniversityPress

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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: 1st	**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-

CourseOutcomes:

CO#	Course outcomes
CO1	To help the students appreciate the essential complementarily 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
Unit-I **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** 1. Understanding the need, basic guidelines, content and process for ValueEducation 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 HumanAspirations 4. Right understanding, Relationship and Physical Facilities- thebasic	8

requirements for fulfillment of aspirations of every human being with their correct priority 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 variouslevels	
Unit-II **Understanding Harmony in the Human Being - Harmony in Myself!** 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' - *Sukh*and*Suvidha* 3. Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer) 4. Understanding the characteristics and activities of 'I' and harmony in 'I' 5. Understanding the harmony of I with the Body: *Sanyam*and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity indetail *6.* Programs to ensure *Sanyam*and*Swasthya* - Practice Exercises and Case Studies will be taken up in Practice Sessions.	8
Unit-III **Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** 1. Understanding harmony in the Family- the basic unit of human interaction 2. Understandingvaluesinhuman-humanrelationship;meaningof *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship 3. Understanding the meaning of *Vishwas*; Difference between intention andcompetence 4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values inrelationship 5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva*as comprehensive Human Goals 6. Visualizing a universal harmonious order in society-Undivided	8

Society (*AkhandSamaj),* Universal Order (*SarvabhaumVyawastha)*- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.	
Unit-IV **Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** *1.* Understanding the harmony in theNature *2.* Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation innature *3.* Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasivespace *4.* Holistic perception of harmony at all levels ofexistence - Practice Exercises and Case Studies will be taken up in Practice Sessions.	4
Unit-V **Implications of the above Holistic Understanding of Harmony on Professional Ethics** 1. Natural acceptance of humanvalues 2. Definitiveness of Ethical HumanConduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic UniversalOrder 4. Competence in professionalethics: a) Ability to utilize the professional competence for augmenting universal humanorder, 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 productionsystems. 5. Case studies of typical holistic technologies, management models and productionsystems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists andmanagers b) Atthelevelofsociety:asmutuallyenrichinginstitutions and organizations.	5

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, *JeevanVidyaekParichay*,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 InternationalPublishers.
7. SubhasPalekar, 2000, *How to practice Natural Farming*, Pracheen (Vaidik) KrishiTantraShodh,Amravati.
8. Donella H. Meadows,Dennis L. Meadows,Jorgen Randers, William W. Behrens III, 1972, *Limits to Growth – Club of Rome's report*, UniverseBooks.
9. E G Seebauer& Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers*, Oxford UniversityPress
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. Reprinted2008.

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 UntoldStory*

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: 1st	**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.

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: 2nd	**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: Minimumtwoexercises 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
Unit I 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 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).	8 hours
Unit II Classification of Data Frequency Distribution: Introduction Classification of Data, Objectives of Classification, Methods of Classification, Ways to Classify Numerical Data or Raw Data. Tabular, Diagrammatic and Graphic Presentation of Data: Introduction to Tabular Presentation of Data, Objectivesof	12 hours

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 Disadvantageof Graphic Presentation, Types of Graphs.	
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.	12 hours
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.	12 hours

Text Books:

1. Statistics and Data Analysis, A.Abebe, J. Daniels, J.W.Mckean, December2000.
2. Statistics, Tmt. S. EzhilarasiThiru, 2005, Government ofTamilnadu.
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.

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: 2nd	**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
Unit-I **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. **Process & Thread Management**: Program vs. Process; PCB, State transitiondiagram, Scheduling Queues, Types of schedulers, Concept of Thread, Benefits, Types of threads, synchronization issues. **CPU Scheduling**: Need of CPU scheduling, CPU I/O Burst Cycle, Pre-emptivevs. Non-pre-emptive scheduling, Different scheduling criteria's, scheduling algorithms (FCSC, SJF, Round-Robin, Multilevel Queue).	12
Unit-II **Memory Management**: Introduction, address binding, relocation, loading,	11

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 BaerGalvin, Seventh Edition, Published byWiley-India.
2. Principals of Operating System by NareshChauhan, Published by OXFORD University Press,India.

Reference Books:

1. Operating Systems by SibsankarHaldar and Alex A. Aravind, Published by PearsonEducation.
2. Operating system by Stalling, W., Sixth Edition, Published by PrenticeHall (India)

Course Code: UGCA1915
Course Name: Data Structures

Program: B.Sc. (AI & ML)	**L**:3 **T**:1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester: 2nd	**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
Unit-I **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. **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.	10
Unit-II **Stacks and Queue**	8

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 PriorityQueue.	
Unit-III **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. **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.	14
Unit-IV **Graphs, Searching, Sorting and Hashing** **Graphs:** Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms. **Searching and Sorting:** Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort. **Hashing:** Hash Function, Types of Hash Functions, Collision, Collision Resolution Technique (CRT), Perfect Hashing	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., UIlman Jeffrey D., “Data Structures and Algorithms”,AddisonWesley

Reference books

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

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:2nd	**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	Applyappropriate 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.

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., UIlman Jeffrey D., “Data Structures and Algorithms”,AddisonWesley
3. Horowitz &Sawhaney: Fundamentals of Data Structures, GalgotiaPublishers.

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: 2nd	**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 differentconcepts.

Reference Books:

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

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: 2nd	**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 twoexercises 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)FrequencyCurve c) Ogive curves.
6:	Find out & display the Median and Mode from the following series by using suitable method:
7:	Calculate an appropriate measure of dispersion using grouped and ungrouped data.

Class	156-158	158-160	160-162	162-164	164-166
Frequency	4	8	28	51	89

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:	Represent the following data by suitable graphs, determine therefrom the number of children having IQ (i) Below 105 (ii) Above 124.

IQ	75-84	85-94	95-104	105-114	115-124	125-134
No.ofChildren	8	20	45	54	28	16

ReferenceBooks:

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

E-Books/ Online learningmaterial

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

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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: 2nd	**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-

CourseOutcomes:

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 abouttheir 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

• ForestEcosystem • Aquatic Ecosystem (Ponds, Lakes, River &Ocean)	
Unit-III **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 Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal), Urban problems related toEnergy	4
Unit-IV **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	4
Unit-V **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	4
Unit-VI	4

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	

Text Books:

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, NewDelhi.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd.Bikaner.
3. BharuchaErach, 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, Clanderson 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 EasternLtd.
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. Press1140p.
12. Jadhav, H &Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
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)

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, USA499p

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Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical andGeneral)
- General Awareness (Current Affairs andGK)
- CommunicationSkills
- PresentationSkills

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 videolectures
2. AptitudeTest
3. GroupDiscussion
4. Quiz(General/Technical)
5. Presentations by the students
6. Team buildingExercises

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: 3rd	**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
Unit-I Overview: foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents	12 hours
Unit-II 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.	12 hours
Unit-III 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. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.	10 hours

Unit-IV Expert Systems: Overview of expert system architecture, existing expert systems. 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	10 hours

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) 1sted.
2. Russel S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall (2014) 3rded.

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: 4th	**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
Unit-I Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurementsofAlgorithm,Timeandspacetrade-offs,Analysisofrecursive algorithms through recurrence relations: Substitution method, Recursion tree method.	12 hours
Unit-II Fundamental Algorithmic Strategies Brute-Force, Greedy, Dynamic Programming,Branch-and-BoundandBacktrackingmethodologiesforthe design of algorithms; Illustrations of these techniques for Problem-Solving: Bin Packing, Knap Sack, TSP.	12 hours
Unit-III Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS);Shortestpathalgorithms,Transitiveclosure,MinimumSpanningTree, Topological sorting, Network FlowAlgorithm.	10 hours
Unit-IV Tractable and Intractable Problems Computability of Algorithms, Computability classes – P, NP, NP-complete andNP-hard. Advanced Topics: Heuristic Algorithms, Random Algorithms.	10 hours

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, GalgotaPublications

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: 3rd	**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

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 DependenciesandFourthNormalForm,JoinDependenciesandFifthNormal 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/SQLTheProgrammingLanguageofOracle”,IvanBayross,BPBPublications,4thRevised Edition (2009)
2. “AnIntroductiontoDatabaseSystems”,C.J.Date,A.Kannan,S.Swamynathan,8thEdition,Pearson Education,(2006).
3. Database Management Systems, Raghu Ramakrishnan, McGraw-Hill, Third Edition,2014.

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: 4th	**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: 3rd	**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-.

CourseOutcomes:

CO#	Course outcomes
CO1	Able to understand various queries and their execution
CO2	Populate and query a database using SQL DML/DDL 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.	Consider the following schema for a Library Database: BOOK (*Book_id, Title, Publisher_Name, Pub_Year*) BOOK_AUTHORS (Book_id, Author_*Name*) PUBLISHER (*Name, Address, Phone*) BOOK_COPIES (*Book_id, Branch_id, No-of_Copies*) BOOK_LENDING (*Book_id, Branch_id, Card_No, Date_Out, Due_Date*) LIBRARY_BRANCH (*Branch_id, Branch_Name, Address*) Write SQL queries to 1. Retrieve details of all books in the library_id, title, name of publisher, authors,number of copies in each branch,etc. 2. Get the particulars of borrowers who have borrowed more than 3 books betweenJan

	2018 to Jun 2018 3. Delete a book in BOOK table. Update the contents of other tables to reflect thisdata manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simplequery. 5. Create a view of all books and its number of copies that are currently available inthe Library.
10.	Consider the following schema for Order Database: SALESMAN (*Salesman_id, Name, City, Commission*) CUSTOMER (*Customer_id, Cust_Name, City, Grade,Salesman_id*) ORDERS (*Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id*) Write SQL queries to 1. Count the customers with grades above Amritsar'saverage. 2. Find the name and numbers of all salesmen who had more than onecustomer. 3. List all salesmen and indicate those who have and don't have customers in theircities (Use UNIONoperation.) 4. Create a view that finds the salesman who has the customer with the highest order ofa day. 5. DemonstratetheDELETEoperationbyremovingsalesmanwithid1000.Allhisorders must also bedeleted.
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: 3rd	**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-.

CourseOutcomes:

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

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, Fileetc. **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, BPBPublication.
3. Rick Darnell et al, HTML 4 Unleashed, Tech mediaPublications.

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: 3rd	**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, BPBPublication.
3. Rick Darnell et al, HTML 4 Unleashed, Tech mediaPublications.

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: MachineLearning

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**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
Unit-I 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).	12 hours
Unit-II 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.	12 hours
Unit-III 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.	10 hours

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

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)

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: 4th	**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
Unit-I **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.	12 hours
Unit-II **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. **DataCleaning:**Consistencychecking,Heterogeneousandmissingdata,Data Transformation andsegmentation.	12 hours
Unit-III **Data visualization:** Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	10 hours
Unit-IV **Model Development** Simple and Multiple Regression Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines — Prediction and Decision Making. **Model Evaluation**	10 hours

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

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk fromthe Frontline.O'Reilly.
2. JureLeskovek,AnnandRajaramanandJeffreyUllman.MiningofMassiveDatasets.v2.1,Cambridge UniversityPress

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: 4th	**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
Unit-I Basics of computer graphics, Overview of 2D transformations, projection, color models, rendering and shading.	12 hours
Unit-II 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
Unit-III 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
Unit-IV 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: 4th	**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: 4th	**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: 4th	**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.

I. K. Gujral Punjab Technical University

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: 4th	**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
Unit-I DATABASE: Introduction to MySQL, Database connections, Executing queries, Handling error.	7 hours
Unit-II **Pandas Library:** Introduction, Environment Setup **Introduction to Data Structures:** Series, DataFrame, Panel, Basic Functionality, Descriptive Statistics, Function Application, Reindexing, Iteration, Sorting Working with Text Data, Options & Customization, Indexing & Selecting Data **Statistical Functions:** Window Functions, Aggregations, Missing Data, GroupBy, Merging/Joining, Concatenation, Date FunctionalityTimedelta, Categorical Data, Visualization	10 hours
Unit-III NumPy Library, Introduction, Environment, Ndarray 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	10 hours

Unit-IV Basic Introduction to Scipy, Seaborn, Scikit-learn Libraries	6 hours

Text Books:

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

Reference Book:

1. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010

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: 4th	**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

Course Code: UGCA1946
Course Name: R Programming

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 0**P**: 0
Branch: Computer Applications	**Credits**: 3
Semester: 5th	**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
Unit-I **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] **Vectors:** Scalars, Vectors, Arrays and Matrices, Declarations, Recycling, Common Vector Operations, Using all() and any(), Na and Null Values, Filtering, ifelse() Function.[CO3] **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]	8
Unit-II **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] **Factors and Tables:** Introduction, Common Functions use with Factors, Working with Tables.[CO4]	8

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: 5th	**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.

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 usingh R rogramming..
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.

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: 5th	**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
Unit-I **Overview of Computing Paradigm:** Recent trends in Computing -Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. [CO1] **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] **Migrating into a Cloud:** Introduction, Broad approaches to Migrating into the Cloud, The Seven-Step Model of Migration Into a Cloud. [CO2]	12
Unit-II **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] **Capacity Planning:** Elasticity vs Scalability, Introduction, Defining Baseline	12

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. 1.Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi, 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, JamesBroberg, AndrezeiM.Goscinski, Wiley India Pvt. Ltd, ISBN-13: 978-81-265-4125-6, New Delhi, India, 2011

Reference Books:

1. 1.Cloud Computing for Dummies, Fern Halper, Hurwitz, Robin Bloor, Marcia Kaufman, WileyIndia 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 ComputerEngineering, 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

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

Branch: Computer Applications	**Credits:** 2
Semester: 5th	**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: 5th	**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

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 OrganizingMaps :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:

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: 5th	**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:

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: 5th	**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	ToexplaintechniquestominetheWebandotherinformationnetworks,
CO2	Toimplement mining onSocialnetworks andSocialmedia
CO3	Toapplytheappropriate techniquefor dataanalysis
CO4	Toextractknowledgefromwebscaledatasetsbyvarioustechniques.
CO5	TobefamiliarwithclassicandrecentdevelopmentsinWebsearchandwebdata

Detailed Contents	Contact hours
Unit-I INTRODUCTION TO WEBDATAMINING Need, Importance, Applications of Web Data mining. Capturing-users web activities, Client side v/smiddleware v/s server side-dataand usage logging. Web Mining and its types, Web Usage Mining,WebStructure Mining, Web ContentMining [CO1]	8
Unit-II WEBUSAGEMINING LearningfromBrowser,ServerLogs,Identifyingfrequentitemsets,patternidentification,representing patterns in form of relations/Graphs. Understanding web application or website-Usage,Heatmaps.Usingstatisticaltoolsforusageanalysisandmachinelearningforprospectiveimprovements. [CO2, CO3]	8
Unit-III WEBSTRUCTUREMINING Understandinglinkstructureoftheweb,Staticv/sdynamic	8

linking,representingthelinkstructureasgraphs,identifyingmost/leastusedlinks,paths,Categorizinglinksbasedonrequired attributes, Clustering links based on required attributes. Web as a graph, identifying nodes, edges, in-degree, out-degree,HITS AlgorithmPageRankalgorithm. [CO4]	
Unit-IV WEBCONTENT MINING Storing web content as text, database, various document types, generating meta-information of webdocuments, labelling, tagging, identifying feature sets. Representing web documents, Vector SpaceModel.TF-IDF, web-page summarization, tokenization, n-gram analysis, categorizingwebpagesbasedon requiredattributes, Clusteringweb pagesbased onrequiredattributes. [CO5]	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: 5th	**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

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: 5th	**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	Toexplain the concept of naturallanguageprocessing
CO2	Toexplorethelinguisticfeaturesrelevantto each NLPtask.
CO3	To discuss the phases of Natural language Generation.
CO4	To applybasicalgorithmsin thisfield.

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

TextBooks:

1. TanveerSiddiqui,U.S.Tiwary,"NaturalLanguageProcessingandInformationRetrieval",OxfordUniversityPress,2012.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction toNaturalLanguageProcessing,ComputationalLinguisticsandSpeechRecognition",2ndEdition,PrenticeHall,2008.
2. JamesAllen,"NaturalLanguageUnderstanding",2ndedition,Benjamin/Cummingspublishingcompany, 1995.

Course Code: UGCA1994
Course Name: Natural Language Processing Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2

Semester: 5th	**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	Chucking
6	Named Entity Recognition
7	Mini Project based on NLP Application

Text Books:

TextBooks:

2. TanveerSiddiqui,U.S.Tiwary,"NaturalLanguageProcessingandInformationRetrieval",OxfordUniversityPress,2012.

Reference Books:

3. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction toNaturalLanguageProcessing,ComputationalLinguisticsandSpeechRecognition",2ndEdition,PrenticeHall,2008.
4. JamesAllen,"NaturalLanguageUnderstanding",2ndedition,Benjamin/Cummingspublishingcompany, 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: 5th	**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	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 ofsimulated 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.

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: 5th	**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 ofsimulated 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) — an autopilot — Telephone system — Inventory system — Traffic system — Banking system — Super markets — 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: 5th	**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-IMachine 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-IIDeep 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-IIIConvolution Networks: Convolution Operation, Pooling, Basic Convolution Function, Convolution Algorithm, Unsupervised Features and Neuroscientific for convolution Network. **(CO 3)**	8
Unit-IVSequence Modelling: Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder- Decoder Sequence-to-Sequence Architectures, Deep Recurrent	9

Network, Recursive Neural Networks and Echo State networks. (CO4)	

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: 5th	**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.
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)

Sixth Semester

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

Course Code: UGCA2006
Course Name: Big Data Analytics

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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:-NA-Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Explain the need of Big Data.
CO2	Discuss the architecture of Big Data
CO3	Setup environment for creating Big Data Applications
CO4	Implement basic applications of Big Data.

Unit 1 An Overview of Big Data and Big Data Analytics, Big Data sources, Application areas of Big Data. Understanding Hadoop and its Ecosystem. Brief intro to Hadoop Ecosystem components: Hadoop Distributed File System, MapReduce, YARN, HBase, Hive, Pig, Sqoop, ZooKeeper, Flume, Oozie, Ambari. Understanding a Hadoop cluster. [co1]	11
Unit 2 Overview of HDFS. Architecture of HDFS, Advantages and disadvantages of HDFS, HDFS Daemons, HDFS Blocks, HDFS file write and read, NameNode as SPOF, Hadoop HA, heartbeats, block reports and rereplication, Safemode of Namenode, Hadoop fs commands: cat, ls, put, get, rm, df, count, fsck, balancer, mkdir, du, copyfromlocal, copytolocal. [co2]	11
Unit 3 Hadoop fs commands: expunge, chmod, chown, chgrp, setrep, stat. Hadoop dfsadmin commands. Introduction to Apache Pig, Need of Pig, Installation of Pig, Execution modes of Pig, Pig – Architecture, Grunt shell and basic utility commands, Data types and Operators	10

in Pig, Analysing data stored in HDFS using Pig, Pig operators for Data analysis: Dump, Describe, Explanation, Illustration, Store. [co2, co3]	
Unit 4 Group, cogroup, join, split, filter, distinct, foreach, order by, limit operators. Functions in Pig: Eval functions, Load and store functions, Bag and tuple functions, String functions, Date time functions, Math functions, Case Studies: Analyzing various datasets with Pig. [co3, co4]	10

Suggested Books.

1. Big Data, Black Book by DT Editorial Services, Dreamtech Press.
2. Hadoop – The Definitive Guide 3rd Edition, Tom White/ OReilly-Yahoo press
3. Hadoop in Action, Chuck Lam/Manning
4. Hadoop – Beginner's Guide, Garry Turkington/Packt Publishing

Course Code: UGCA2007
Course Name: Big Data Analytics Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Installation of Big Data Tools.
CO2	Execute various HDFS commands
CO3	Data analytics using Pig.

Name of Experiment
1. Installation of Hadoop 2. Installation of HDFS, Pig, Hive etc 3. Running HDFS Daemons 4. Safemode and other Hadoop DFS Admin commands 5. Hadoopfs commands

6. Pig operators and functions
7. Accessing files in HDFS using Pig
8. Storing the processed files back to HDFS
9. Analysing datasets using Pig

1. Big Data, Black Book by DT Editorial Services, Dreamtech Press.
2. Hadoop – The Definitive Guide 3rd Edition, Tom White/ OReilly-Yahoo press
3. Hadoop in Action, Chuck Lam/Manning
4. Hadoop – Beginner's Guide, Garry Turkington/Packt Publishing

Course Code: UGCA2008
Course Name: Computer Vision

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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**: Elective
Total marks:100	

Prerequisite: -
Co requisite: - NA-
Additional material required in ESE: **-NA-**
Course Outcomes:

CO#	Course Outcomes
CO1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
CO2	Describe basic methods of computer vision related to multi-scale representation, edge detection.
CO3	Develop to build computer vision applications.
CO4	Implement object and scene recognition and categorization from images.

Detailed Contents	Contact hours
UNIT-I Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis, Edge detection, Edge detection performance, Hough transform, corner detection. [CO1]	10
UNIT-II Segmentation, Morphological filtering, Fourier transform. Feature extraction, shape, histogram, color, spectral, texture, using CV IP tools, Feature analysis, feature vectors, distance /similarity measures, data pre- processing. [CO2]	10

UNIT-III Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised. Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non- parametric methods. [CO3]	11
UNIT-IV Recent trends in Activity Recognition, computational photography, Biometrics. Implementation in python for activity recognition. [CO4]	11

References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisheretal.

Course Code: UGCA2009
Course Name: Computer Vision Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA
Co requisite: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Implement basic filtering on images.
CO2	Develop basic computer vision applications.
CO3	Implement object and scene recognition and categorization from images.

Name of Experiment
1. To perform variants of linear filter on an image. **2.** To perform median filter on an image. **3.** To perform all morphological filter operations on the image. **4.** To perform edge detection on an image using Sobel, Prewitt, Roberts and Canny Method. **5.** To perform Hough transform on an image.

6. Generate histogram and perform histogram equalization of an image.
7. To perform clustering using any technique on the image.
8. To perform various pattern classification and analysis techniques on images.
9. To perform various pattern clustering and analysis techniques on images.

References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary ofComputer VisionandImageProcessing,by Fisheretal.

Course Code: UGCA2010
Course Name: Intelligent System

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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**: Elective
Total marks:100	

Prerequisite: -
Co requisite: - NA-
Additional material required in ESE: **-NA-**
Course Outcomes:

CO#	Course Outcomes
CO1	Explain fundamental principles of intelligent systems.
CO2	Analyze the relative merits of a variety of AI problem solving techniques.
CO3	Represent knowledge using structured representations.
CO4	Implement different evolutionary algorithms in the field of intelligent systems.

Detailed Contents	Contact hours
UNIT-I Foundations to intelligent systems: Artificial neural networks, Back- propagation networks, Radial basis function networks, and recurrent networks, Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks. [CO1]	10
UNIT-II Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill- climbing search. Optimization and search such as stochastic annealing and genetic algorithm. [CO2]	10
UNIT-III	11

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures. [CO3]	
UNIT-IV Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. [CO4]	11

References:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rdedition

Course Code: UGCA2011
Course Name: Intelligent System Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Able to demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyses and compare the relative merits of a variety of AI problem solving techniques.

Sr. No	Name of Experiment
1.	Implementation of simple artificial neural network
2.	Implementation of neural network with back propagation.
3.	Implementation of radial basis function network.
4.	Implementation of recurrent neural network.
5.	Implementation of fuzzy neural network.
6.	Implementation of iterative deepening search.

7.	Implementation of Hill climbing Search algorithm.
8.	Implementation of optimization genetic algorithm.
9.	Implementation of induction based learning method such as decision tree.
10.	Implementation of statistical learning methods such as naive Bayes.

References:-

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.

2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rdedition.

Course Code: UGCA2012
Course Name: Social Network Analysis

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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**: Elective
Total marks:100	

Prerequisite: - NA
Co requisite: - NA-
Additional material required in ESE: **-NA-**
Course Outcomes:

CO#	Course Outcomes
CO1	Explain the concept of semantic web and related applications.
CO2	Discuss knowledge representation using ontology.
CO3	Analyze link prediction.
CO4	Implement sentiment analysis

Detailed Contents	Contact hours
UNIT-I Preliminaries: Graphs, Types of graphs, Representation, Bipartite graphs, Planar networks, The graph Laplacian, Random Walks, Maximum Flow and Minimum Cut Problem, Introduction to Approximation Algorithms. Introduction to Social Networks: Types of Networks: General Random Networks, Small World Networks, Scale-Free Networks; Examples of Information Networks; Static Unweighted and weighted Graphs, Dynamic Unweighted and weighted Graphs.	11

UNIT-II Walks: Random walk-based proximity measures, Other graph-based proximity measures. Clustering with random-walk based measures, Algorithms for Hitting and Commute, Algorithms for Computing Personalized Pagerank and Sim- rank. Community Detection: Basic concepts, Overview of Algorithms for Community Detection: Quality Functions, The Kernighan-Lin algorithm, Agglomerative/Divisive algorithms, Spectral Algorithms, Multi-level Graph partitioning, Markov Clustering; Community Discovery in Directed Networks , Community Discovery in Dynamic Networks, Community Discovery in Heterogeneous Networks, Evolution of Community.	10
UNIT-III Link Prediction: Feature based Link Prediction, Bayesian Probabilistic Models, Probabilistic Relational Models, Linear models. Event Detection: Classification of Text Streams, Event Detection and Tracking: Bag of Words, Temporal, location, ontology based algorithms. .	11
UNIT-IV Evolution Analysis in Text Streams, Sentiment analysis. Social Influence Analysis: Influence measures, Social Similarity - Measuring Influence, Influencing actions and interactions. Homophily, Influence maximization. * Implementation using Python.	10

TEXT BOOKS:

1. Peter Mika, ―Social Networks and the Semantic Web‖, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

REFERENCES

1. Guandong Xu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, ―Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, ―The Social Semantic Web‖, Springer, 2009.

Course Code: UGCA2013
Course Name: Social Network Analysis Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Create basic graphs
CO2	Analyze link prediction.
CO3	Implement sentiment analysis

Sr. No	Name of Experiment
1.	Implement basic concepts of network creation and graphs.
2.	Implementation of neural network with back propagation.
3.	Implement basis programs for pagerank and sim-rank.
4.	Implementation algorithms for community detection.
5.	Implementation algorithms for link detection
6.	Implementation algorithms for event detection
7.	Perform social influence analysis.

TEXT BOOKS:

1. Peter Mika, ―Social Networks and the Semantic Web‖, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

REFERENCES

1. Guandong Xu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, ―Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, ―The Social Semantic Web‖, Springer, 2009.

Course Code: UGCA2014
Course Name: Weka- Open Source Software Tool

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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:

CO#	Course Outcomes
CO1	Describe the need of WEKA
CO2	Import data in WEKA
CO3	Work with different file formats in WEKA
CO4	Implement data mining algorithms using WEKA.

Detailed contents	Contact hours
Overview of Data mining, steps in data mining, classification of data mining, overview of - classification, clustering, prediction, virtualization. WEKA — Introduction, characteristics, features, applications, WEKA — Installation, ,Launching Explorer. [CO1]	12 hours
Loading Data, Loading Data from Local File System, Loading Data from Web, Loading Data from DB, Creating datasets in memory, Generating artificial data , WEKA — File Formats. WEKA — Preprocessing the Data(Understanding Data, working with attributes, Applying Filters). [CO2]	10 hours
Arff Format, The ARFF Header Section, The ARFF Data Section, Generate ARFF file, Sparse ARFF files, Instance weights in ARFF files, Other Formats. Classification, Selecting a Classifier, Test Options, The Class Attribute , Training a Classifier ,The Classifier Output. Associating, Learning Associations, Selecting Attributes, Searching and Evaluating, Performing Selection. [CO3, CO4]	12 hours
Clustering, Selecting a Cluster, Cluster Modes, Ignoring Attributes, Working with Filters, Learning Clusters Implementing various Regression techniques using WEKA, Creating Decison tree using WEKA, Visualizing, The scatter plot matrix, Selecting an individual 2D scatter plot, Selecting Instances. CO4]	10 hours

Text Books:

1. 1. Practical Machine Learning: A Beginner's Guide to Data Mining with WEKA, by Andrew H. Johnston, No Starch Press, ISBN-10 : 1593278764, ISBN-13 : 978-1593278762.
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjit_rsjZn8AhVBFLcAHSHJD_EQFnoECBIQAQ&url=http%3A%2F%2Finfochim.u-strasbg.fr%2Fcgi-bin%2Fweka-3-9-1%2FWekaManual.pdf&usg=AOvVaw0W-0GltQc2a4vk2ZwdeEkr, “Weka Manual”.

Course Code: UGCA2015
Course Name: Weka- Open Source Software Tool Lab

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

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Import data in WEKA
CO2	Work with different file formats in WEKA
CO3	Implement data mining algorithms using WEKA.

Name of Experiment
1. Install Weka.
2. Work with explorer
3. Load data from local folder.
4. Load data from web
5. Creating datatset.
6. Implementing various pre-processing.
7. Implementing various classification algorithms.
8. Implementing various clustering algorithms.
9. Implementing various prediction algorithms.

Text Books:

1. 1. Practical Machine Learning: A Beginner's Guide to Data Mining with WEKA, by Andrew H. Johnston, No Starch Press, ISBN-10 : 1593278764, ISBN-13 : 978-1593278762.
   https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjit_rsjZn8AhVBFLcAHSHJD_EQFnoECBIQAQ&url=http%3A%2F%2Finfochim.u-strasbg.fr%2Fcgi-bin%2Fweka-3-9-1%2FWekaManual.pdf&usg=AOvVaw0W-0GltQc2a4vk2ZwdeEkr

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

Course Code: UGCA2016
Course Name: Business Intelligence

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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:

CO#	Course Outcomes
CO1	Describe the need of business intelligence system.
CO2	Discuss models of business intelligence
CO3	Explain data mining and its classifications
CO4	Illustrate various business intelligence applications.
CO5	Define knowledge management.

Detailed contents	Contact hours
Unit I **Business intelligence:** Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence **Decision support systems:** Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system. [co1]	12 hours
UNIT II **Mathematical models for decision making:** Structure of mathematical models, Development of a model, Classes of models **Data mining:** Definition of data mining, Representation of input data , Data mining process, Analysis methodologies **Data preparation**: Data validation, Data transformation, Data reduction **Overview of** Classification problems, Evaluation of classification models, Overview of **Clustering:** Clustering methods. [co2]	10 hours
UNIT III **Business intelligence applications:** **Marketing models**: Relational marketing, Sales force management, **Logistic and production models**: Supply chain optimization, Optimization models for logistics planning, Revenue management	10 hours

systems. **Data envelopment analysis**: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices [co3, co4]	
UNIT IV **Knowledge Management:** Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation, Roles of People in Knowledge Management **Expert Systems:** Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems [co5]	10 hours

Books and References:

1. Business Intelligence: Data Mining and Optimization for Decision Making Carlo Vercellis Wiley First 2009.
2. Decision support and Business Intelligence Systems Efraim Turban, Ramesh Sharda, Dursun Delen Pearson Ninth 2011.
3. Fundamental of Business Intelligence Grossmann W, Rinderle-MaSpringer First 2015

Course Code: UGCA2017
Course Name: Business Intelligence Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Implement data mining concepts.
CO2	Create fundamental business intelligence applications.
CO3	Perform various operations on data warehouse.

Name of Experiment
1 Import the legacy data from different sources such as (Excel , SqlServer, Oracle etc.) and load in the target system. 2 Perform the Extraction Transformation and Loading (ETL) process to construct the

database in the Sqlserver.
3 a. Create the Data staging area for the selected database.
b. Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.
4 a.Create the ETL map and setup the schedule for execution.
b. Execute the MDX queries to extract the data from the datawarehouse.
5 a. Import the datawarehouse data in Microsoft Excel and create the Pivot table and Pivot Chart.
b. Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis.
6 Design and generate necessary reports based on the data warehouse data.
7 Perform the data classification using classification algorithm.
8 Perform the data clustering using clustering algorithm.
9 Perform the Linear regression on the given data warehouse data.
10 Perform the logistic regression on the given data warehouse data

Course Code: UGCA2018
Course Name: Geographic Information Systems

Program: B.Sc. (AI & ML)	**L**: 3 **T**: 1**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**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:

CO#	Course Outcomes
CO1	Describe the features of GIS.
CO2	Describe the data representation for GIS.
CO3	Illustrate the spatial positioning system.
CO4	Implement mapping of various types of fields.

Detailed contents	Contact hours

Unit I **Introduction to GIS** **The nature of GIS:** Some fundamental observations, Defining GIS, GI Systems, GI Science and GI Applications, Spatial data and Geoinformation. **Geographic Information and Spatial Database** **Computer Representations of Geographic Information:** Regular tessellations, irregular tessellations, Vector representations, Topology and Spatial relationships, Scale and Resolution, Representation of Geographic fields, Representation of Geographic objects [co1]	12 hours
UNIT II **Data Management and Processing Systems** **Stages of Spatial Data handling:** Spatial data handling and preparation, Spatial Data Storage and maintenance, Spatial Query and Analysis, Spatial Data Presentation. **GIS and Spatial Databases:** Linking GIS and DBMS, Spatial database functionality [co2]	10 hours
UNIT III **Spatial Referencing and Positioning** **Spatial Referencing:** Reference surfaces for mapping, Coordinate Systems, Map Projections, Coordinate Transformations **Satellite-based Positioning:** Absolute positioning, Errors in absolute positioning, Relative positioning, Network positioning, code versus phase measurements, Positioning technology. **Data Entry and Preparation** **Spatial Data Input:** Direct spatial data capture, Indirect spatial data capture, Obtaining spatial data elsewhere **Data Quality:** Accuracy and Positioning, Positional accuracy, Attribute accuracy, Temporal accuracy, Lineage, Completeness, Logical consistency. **Data Preparation:** Data checks and repairs, Combining data from multiple sources **Point Data Transformation:** Interpolating discrete data, Interpolating continuous data [co3]	10 hours
UNIT IV **GIS and Maps, The Visualization Process, Visualization Strategies, The cartographic toolbox:** Mapping qualitative data, quantitative data, terrain elevation, time series, **Map Cosmetics, Map Dissemination** [co4]	10 hours

Books and References:

1. Introduction to Geographic Information Systems by Chang Kang-tsung (Karl), McGrawHill Any

Edition above 3rd Edition 2013
2. GIS Fundamentals: A First Text on Geographic Information Systems Paul Bolsatd XanEdu Publishing Inc 5th Edition.

Course Code: UGCA2019
Course Name: Geographic Information Systems Lab

Program: B.Sc. (AI & ML)	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**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: - NA-
Additional material required in ESE: - NA-
Course Outcomes: Students will be able to

CO#	Course Outcomes
CO1	Link GIS and DBMS
CO2	Prepare Spatial data
CO3	Mapping of fields.

Name of Experiment
Implement various practical's based on theory subject like 1. Linking GIS and DBMS 2. Loading spatial data. 3. Preparing and transforming data. 4. Creating spatial data 5. Mapping of fields.

Books and References:
1. Introduction to Geographic Information Systems by Chang Kang-tsung (Karl), McGrawHill Any Edition above 3rd Edition 2013
2. GIS Fundamentals: A First Text on Geographic Information Systems Paul Bolsatd XanEdu Publishing Inc 5th Edition.