Scheme & Syllabus of

Master of Computer Applications

(MCA)

Batch 2019 onwards

By

Board of Study Computer Applications

Department of Academics

IK Gujral Punjab Technical University

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

PROGRAM OUTCOMES (POs)

Computational Knowledge: Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

Problem Analysis: Identify, formulate, research literature, and solve complex computing problem searching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

Design /Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

Conduct investigations of complex Computing problems: User search-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.

Life-long Learning: Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team to manage projects and in multidisciplinary environments.

Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.

Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

First Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
PGCA1901	Core Theory	Mathematics	4	0	0	30	70	100	4
PGCA1902	Core Theory	Fundamentals of Computer and Programming in Python	4	0	0	30	70	100	4
PGCA1903	Core Theory	Operating System	4	0	0	30	70	100	4
PGCA1904	Core Theory	Relational Database Management System	4	0	0	30	70	100	4
PGCA1905	Ability Enhancement Compulsory Course (AECC)	Technical Communication	3	0	0	30	70	100	3
PGA1906	Core Practical/Laboratory	Fundamentals of Computer and Programming in Python Laboratory	0	0	4	70	30	100	2
PGCA1907	Core Practical/Laboratory	Relational Database Management System Laboratory	0	0	4	70	30	100	2
PGCA1908	Ability Enhancement Compulsory Course (AECC)	Technical Communication Laboratory	0	0	2	30	20	50	1
	TOTAL		**19**	**0**	**10**	**320**	**430**	**750**	**24**

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Second Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
PGCA1909	Core Theory	Web Technologies	4	0	0	30	70	100	4
PGCA1910	Core Theory	Computer Networks	4	0	0	30	70	100	4
PGCA1911	Core Theory	Object Oriented Programming using C++	4	0	0	30	70	100	4
PGCA1912	Core Theory	Software Engineering	4	0	0	30	70	100	4
PGCA1913	Core Theory	Data Structures	4	0	0	30	70	100	4
PGCA1914	Core Practical/Laboratory	Web Technologies Laboratory	0	0	4	70	30	100	2
PGCA1915	Core Practical/Laboratory	Object Oriented Programming using C++ Laboratory	0	0	4	70	30	100	2
PGCA1916	Core Practical/Laboratory	Data Structures Laboratory	0	0	4	70	30	100	2
	TOTAL		**20**	**0**	**12**	**360**	**440**	**800**	**26**

Third Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
PGCA1917	Core Theory	Discrete Structures & Optimization	4	0	0	30	70	100	4
PGCA1918	Core Theory	Advanced Java	4	0	0	30	70	100	4
PGCA1919	Core Theory	Computer Graphics	4	0	0	30	70	100	4
PGCA1920	Core Theory	Design & Analysis of Algorithms	4	0	0	30	70	100	4
PGCA1921	Core Theory	E- Commerce & Digital Marketing	4	0	0	30	70	100	4
PGCA1922	Core Practical/Laboratory	Advanced Java Laboratory	0	0	4	70	30	100	2
PGCA1923	Core Practical/Laboratory	Computer Graphics Laboratory	0	0	4	70	30	100	2
PGCA1924	Core Practical/Laboratory	Design & Analysis of Algorithms Laboratory	0	0	4	70	30	100	2
	TOTAL		**20**	**00**	**12**	**360**	**440**	**800**	**26**

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Fourth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
PGCA1925	Core Theory	Advanced Computer Networking	4	0	0	30	70	100	4
PGCA1926	Core Theory	Artificial Intelligence & Soft Computing	4	0	0	30	70	100	4
PGCA1927	Core Theory	Theory of Computation	4	0	0	30	70	100	4
	Elective – I		4	0	0	30	70	100	4
	Elective – II		4	0	0	30	70	100	4
PGCA1928	Core Practical/ Laboratory	Advanced Computer Networking Laboratory	0	0	4	70	30	100	2
PGCA1929	Core Practical/ Laboratory	Artificial Intelligence & Soft Computing Laboratory	0	0	4	70	30	100	2
	Elective – II Laboratory		0	0	4	70	30	100	2
	TOTAL		**20**	**00**	**12**	**380**	**420**	**800**	**26**

Students will undergo 4 weeks Institutional Summer Training after 4th semester. Examination will be conducted along with 5th semester practical.

Elective – I	
Course Code	**Course Title**
PGCA1930	Software Project Management
PGCA1931	Software Testing & Quality Assurance
PGCA1932	Information Security and Cyber Law

Elective – II	
Course Code	**Course Title**
PGCA1933	Mobile Applications Development
PGCA1935	Simulation & Modelling
PGCA1937	Cloud Computing

Elective – II Laboratory	
Course Code	**Course Title**
PGCA1934	Mobile Applications Development Laboratory
PGCA1936	Simulation & Modelling Laboratory
PGCA1938	Cloud Computing Laboratory

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1901
Course Name: Mathematics

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: Student must have the knowledge of Basic Mathematics.
Co requisite: Students should have the fundamental knowledge of logical decisions.
Additional material required in ESE: Minimum two exercises of each concept will be recorded in the file and the file will be submitted in End Semester Examinations.

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

CO#	Course outcomes
CO1	Represent data using various mathematical notions.
CO2	Explain different terms used in Basic Calculations
CO3	Describe various Operations and Formulas used to solve variety of Mathematical Problems.

Detailed contents	Contact hours
Part-A **Number System:** Introduction to (Natural number, Integer Number, Real Number, Rational Number and Irrational number), Sum and Products of Rational numbers, Multiplying & Dividing Powers (Integer Exponents), Powers of Products & Quotients (Integer Exponents), Radicals (Introduction to Square Root, Simplifying Square Root, Introduction to Cube Root, Simplifying Cube Root). **Set:** 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.	22 hours

Part-B	
Logic Statement: Connectives, Basic Logic Operations (Conjunction, Disjunction, Negation) Logical Equivalence/Equivalent Statements, Tautologies and Contradictions. **Matrices :** Matrices Introduction, Objectives, Meaning, Types of Matrix (Row Matrix, Column Matrix, Rectangular Matrix, Square Matrix, Diagonal Matrix, Scalar Matrix, Unit Matrix, Triangular Matrix, Null Matrix, Comparable Matrix, Equal Matrix) Algebra of Matrices (Scalar Multiplication, Negative of Matrix, Addition of Matrix, Difference of two Matrix, Multiplication of Matrices, Transpose of a Matrix).	22 hours

Text Books:

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

Reference Books:

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

E Books/ Online learning material

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

---

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1902
Course Name: Fundamentals of Computer and Programming in Python

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices.
CO2	Understand an operating system and its working, and solve common problems related to operating systems
CO3	Familiar with Python environment, data types, operators used in Python.
CO5	Compare and contrast Python with other programming languages.
CO6	Learn the use of control structures and numerous native data types with their methods.
CO7	Design user defined functions, modules, and packages.
CO8	Identify and handle the exceptions in programs through appropriate exceptions handling methods

Detailed contents	Contact hours
Part-A **Functional Units of Computer System:** Concepts of Hardware and Software; Data and Information, CPU, registers, system bus, main memory unit, cache memory, Motherboard, Ports and Interfaces, expansion cards, 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, storage disks.	22 hours

Data Representation: Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication) **Concept of Computing:** Types of Languages: Machine, assembly and High level Language; Operating system as user interface, utility programs. **Applications of IT and Impact of Internet on Society** Introduction to Bluetooth, Cloud Computing, Big Data, Data Mining, Mobile Computing and Internet of Things (IoT) **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 Associative Operators. **Control Structures:** Decision making statements, Python loops, Python control statements.	
Part-B **Python Native Data Types:** Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods and operations). **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, Python Packages.	22 hours

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.	

Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education
2. Fundamentals of Computers, P. K.Sinha & P. Sinha, BPB Publishers.
3. Computer Fundamentals, A. Goel, 2010, Pearson Education.
4. Programming in Python, Pooja Sharma, BPB Publications, 2017.
5. Core Python Programming, R. Nageswara Rao, 2nd Edition, Dreamtech.
6. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY.

Reference Books:

1. "Introduction to Computers", Peter Norton
2. Computers Today, D. H. Sanders, McGraw Hill.
3. "Computers", Larry long & Nancy long, Prentice Hall.
4. Python, The complete Reference, Martin C. Brown, Mc Graw Hill Education.

E Books/ Online learning material:

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

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1903
Course Name: Operating System

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**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	Identify the role of different components of operating systems.
CO2	Implement various strategies for task management in operating systems.
CO3	Explain various implementation issues in operating systems.
CO4	Discuss how various resource managements are implemented in operating systems.

Detailed contents	Contact hours
Part- A **Fundamentals of Operating system**: What is 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 management**: Definition of process, process states, Process Control Block, Scheduling Queues, Schedulers, context switch. **Inter Process Communication:** Communication/message passing mechanisms, threading, multithreading models, multicore programming, Fundamental concepts of OpenMP. **Process Synchronization**: Cooperating process, critical section problem, mutex locks, semaphores, deadlock and starvation, bounded buffer problem, reader-writer problem. **CPU scheduling**: Basic concepts, Scheduling criteria, single processor scheduling, multiprocessor scheduling, real time scheduling, Algorithm Evaluation. **Deadlock**: Definition, necessary conditions, Resource Allocation Graph, Prevention, Avoidance, Detection and Recovery.	22 hours
Part-B **Memory Management**: Address binding, Dynamic linking and loading,	22hours

Contiguous memory allocation techniques (fixed and variable sized partitions), Fragmentation and its types, Non-Contiguous memory allocation techniques, Paging, Segmentation, paging with segmentation, Need of Virtual memories, Demand paging, performance measuring of demand paging, Page replacement Algorithms, allocation of frames, Concept of Thrashing **Device Management**: Secondary storage structure, disk scheduling, Disk management, RAID structure, Role of I/O traffic controller, scheduler. **File Management**: File concepts, access methods, directory and disk structure, file system structure, file system and directory implementation, Protection and Security.	

Case Studies:
LINUX Operating System and Windows Operating System.
*** These cases studies can be taken as part of tutorial and assignment work. Case studies will not be considered while setting up the end semester examination.**

Text Books:

1. Operating System Principles by Abraham Silberschatz and Peter Baer Galvin, Seventh Edition, Published by Wiley-India.
2. Operating Systems by Stuart E. Madnick, John J. Donovan, Published by Mac-Graw-Hill.

Reference Books:

1. Principals of Operating System by Naresh Chauhan, Published by OXFORD University Press, India.
2. Operating Systems by Sibsankar Haldar and Alex A. Aravind, Published by Pearson Education.
3. Operating system by Stalling, W., Sixth Edition, Published by Prentice Hall (India)

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1904
Course Name: Relational Database Management System

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Understand the basic concepts of RDBMS.
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	Apply the concept of Transaction Management in RDBMS.

Detailed contents	Contact hours
Part A **Introduction:** Purpose of Database Systems, Database-System Applications, Database Management System (DBMS) Fundamentals (View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators), Relational Database Management System (RDBMS) Fundamentals (Structure of Relational Databases, Database Schema, Keys, Relational Query Languages, Relational Operations). **SQL:** Types of SQL (DCL- DDL- DML)- SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization, Accessing SQL From a Programming Language, Functions and Procedures, Triggers, Introduction to Database Application Development (Embedded SQL, Dynamic SQL, JDBC, SQLJ).	22 hours

Part B	22 hours
Database Design: The Entity-Relationship Model, Entity-Relationship Diagrams, Features of Good Relational Designs, Atomic Domains and First Normal Form, Functional-Dependency and Second Normal Form, Transitive Dependency and Third Normal Form, Boyce–Codd normal form (BCNF), Multivalued Dependency and Fourth Normal Form, join dependency and Fifth normal form (5NF), Domain-key normal form (DKNF). **Transaction Management:** Query Processing, Concurrency Control, Database Security, Database Recovery.	

Text Books:

1. Database System Concept, Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Sixth Edition, 2013, McGraw-Hill

Reference Books:

1. An Introduction to Database System, Bipin C. Desai, Revised Edition, 2012, Galgotia Publications Pvt Ltd-New Delhi;
2. Database Management Systems, Raghu Ramakrishnan, Third Edition, 2014, McGraw-Hill;
3. SQL, PL/SQL The Programming Language of Oracle, Ivan Bayross, 4th Revised Edition,2009, BPB Publications;
4. An Introduction to Database Systems, C.J.Date, A.Kannan, S.Swamynathan, 8th Edition, 2006, Pearson Education.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1905
Course Name: Technical Communication

Program: MCA	**L:** 3 **T:** 0 **P:** 0
Branch: Computer Applications	**Credits:** 3
Semester: 1st	**Contact hours:** 33 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Ability Enhancement

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	The objective of the course is to help the students become the independent users of English language.
CO2	Students will acquire basic proficiency in reading & listening, comprehension, writing and speaking skills.
CO3	Students will be able to understand spoken and written English language, particularly the language of their chosen technical field.
CO4	They will be able to converse fluently.
CO5	They will be able to produce on their own clear and coherent texts.

Detailed contents	Contact hours
Part A **Basics of Technical Communication:** Functions of Communication- Internal & External Functions, Models-Shannon & Weaver's model of communication, Flow, Networks and importance, Barriers to Communication, Essential of effective communication (7C's and other principles), Non-verbal Communication. **Basic Technical Writing:** Paragraph writing (descriptive, Imaginative etc.), Precise writing, reading and comprehension, Letters– Format &various types.	16 Hours
Part B **Advanced Technical Writing:** Memos, Reports, E-Mails & Net etiquettes, Circulars, Press Release, Newsletters, Notices. Resume Writing, Technical Proposals, Research Papers, Dissertation and Thesis, Technical Reports,	17 Hours

Instruction Manuals and Technical Descriptions, Creating Indexes, List of References and Bibliography. **Verbal Communication:** Presentation Techniques, Interviews, Group Discussions, Extempore, Meetings and Conferences. **Technical Communication:** MS-Word, Adobe Frame maker and ROBO Help * Lab Exercises based on Listening and Speaking skills	

Text Books:

1. Vandana R Singh, The Written Word, Oxford University Press, New Delhi.
2. K K Ramchandran, et al Business Communication, Macmillan, New Delhi.
3. Swati Samantaray, Business Commnication and Commnicative English, Sultan Chand, New Delhi.
4. S.P. Dhanavel English and Communication Skills for Students of Science and Engineering (with audio CD).

Course Code: PGCA1906
Course Name: Fundamentals of Computer and Programming in Python Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 1st	**Contact hours**: 4 hours per week
Internal max. marks: 70	**Theory/Practical**: Practical
External max. marks: 30	**Duration of end semester exam (ESE)**: 3hrs
Total marks: 100	**Elective Status (Core/elective):** Core

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

Course Outcomes:

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 using Python.
CO4	Implement modules and functions using Python.

CO5	Design and implement the concept of object oriented programming structures.
CO6	Implement file handling

Instructions: All programs are to be developed in *Python* programming language.

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. $x-x^2/2!+x^3/3!- x^4/4!+\dots x^n/n!$ b. $x-x^3/3!+x^5/5!- x^7/7!+\dots x^n/n!$
14.	Print all possible combinations of 4, 5, and 6.
15.	Compute transpose of a matrix.
16.	Perform following operations on two matrices. 1) Addition 2) Subtraction 3) Multiplication
17.	Count occurrence of vowels.
18.	Count total number of vowels in a word.
19.	Determine whether a string is palindrome or not.
20.	Perform following operations on a list of numbers: 1) Insert an element 2) delete an element 3) sort the list 4) delete entire list
21.	Perform sequential search on a list of given numbers.
22.	Perform sequential search on ordered list of given numbers.
23.	Maintain practical note book as per their serial numbers in library using Python dictionary.
24.	Perform following operations on dictionary 1) Insert 2) delete 3) change
25.	Check whether a number is in a given range using functions.
26.	Write a Python function that accepts a string and calculates number of upper case letters and lower case letters available in that string.
27.	To find the Max of three numbers using functions.

28.	Multiply all the numbers in a list using functions.
29.	Solve the Fibonacci sequence using recursion.
30.	Get the factorial of a non-negative integer using recursion.
31.	Write a program to create a module of factorial in Python.
32.	Design a Python class named *Rectangle,* constructed by a length & width, also design a method which will compute the area of a rectangle.
33.	Design a Python class named *Circle* constructed by a radius and two methods which will compute the area and the perimeter of a circle.
34.	Design a Python class to reverse a string 'word by word'.
35.	Write a Python program to read an entire *text file*.
36.	Design a Python program to read first n lines of a *text file.*

Text Books:

1. Core Python Programming, R. Nageswara Rao, 2nd Ediiton, Dreamtech.
2. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY.

Reference Books:

Python, The complete Reference, Martin C. Brown, Mc Graw Hill Education.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1907
Course Name: Relational Database Management System Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 1st	**Contact hours:** 4 hours per week
Internal max. marks: 70	**Theory/Practical:** Practical
External max. marks: 30	**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 Out comes:

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
CO5	Able to design new database and modify existing ones for new applications and reason about the efficiency of the result

Assignments:

1.	Implementation of DDL Commands to perform creation of table, alter, modify and drop column operations.
2.	Implementation of Constraint • Check Constraint • Entity Integrity Constraint • Referential Integrity Constraint • Unique Constraint • Null Value Constraint
3.	Implementation of DML and DCL Commands.
4.	Implementation of Data and Built in Functions in SQL.
5.	Implementation of Nested Queries and Join Queries.
6.	Implementation of Cursors.
7.	Implementation of Procedures and Functions.
8.	Implementation of Triggers.
9.	Implementation of Embedded SQL.
10.	Database design using E-R model and Normalization: • Pay Roll System • Banking System

	• Library Management System
11.	For the following University Database applications, Design and Develop Conceptual Data Model (E-R Diagram) with all the necessary entities, attributes, constraints and relationships. Design and build Relational Data Model for application specifying all possible constraints. *University Database* - The IKGPTU is a University with several campuses scattered across Punjab. Academically, the university is divided into a number of Departments, such as Department of CSE, Department of Architecture, Department of Management etc. Some of the Departments operate on a number of campuses. Each Department is headed by a Head and has a number of teaching and non-teaching staff. Each Department offers many courses. Each course consists of a fixed core of subjects and a number of electives from other courses. Each student in the University is enrolled in a single course of study. A subject is taught to the students who have registered for that subject by a teacher. A student is awarded a grade in each subject taken.

Reference Books:

1. SQL, PL/SQL The Programming Language of Oracle, Ivan Bayross, 4th Revised Edition, 2009, BPB Publications;
2. Oracle PL/SQL Programming, Steven Feuerstein and Bill Pribyl, 5th Edition, 2009, O'Reilly Media;
3. Database System Concept, Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Sixth Edition, 2013, McGraw-Hill.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1908
Course Name: Technical Communication Laboratory

Program: MCA	**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:** Ability Enhancement

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	The objective of the course is to help the students become the independent users of English language.
CO2	Students will acquire basic proficiency in listening and speaking skills.
CO3	Students will be able to understand spoken English language, particularly the language of their chosen technical field.
CO4	They will be able to converse fluently
CO5	They will be able to produce on their own clear and coherent texts.

Assignments:

Interactive practice sessions in Language Lab on Oral Communication	
1.	Listening Comprehension
2.	Self-Introduction, Group Discussion and Role Play
3.	Common Everyday Situations: Conversations and Dialogues
4.	Communication at Workplace
5.	Interviews
6.	Formal Presentations

Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1909
Course Name: Web Technologies

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: Student must have the basic knowledge of any text editor like Notepad, Notepad++ and Edit plus etc.
Co requisite: Student must know the background of Markup Language.
Additional material required in ESE:

- Demonstration of the website of college/ specific department/specific cells etc. will be presented by the students during the final practical.
- Developed Website/s must be made online by the student/s.
- Printouts of the Main Page of the website must be arranged on Practical file during daily lab work and must be submitted in the final examinations.

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

CO#	Course Outcomes
CO1	Understand the basics of Internet and Web Services.
CO2	Describe and differentiate Programming Language and Markup Language.
CO3	Connect various web pages and web sites together.
CO4	Capture user input from the remote users.
CO5	Learn connectivity concepts of Front End and Back End.

Detailed Contents	Contact hours
Part-A **Internet Basics:** Basic concepts, communicating on the internet, internet domains, internet server identities, establishing connectivity on the internet client IP address, How IP addressing came into existence? A brief overview TCP/IP and its services, transmission control protocol. **Introduction To HTML:** Information Files Creation, Web Server, Web Client/Browser, Hyper Text Markup Language (HTML Tags, Paired Tags, Singular Tags), Commonly Used HTML Commands (Document Head, Document Body), Title and Footer, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines).	24 hours

Basic Formatting Tags: HTML Basic Tags, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines), Text Styles (Bold, Italics, Underline), Other Text Effects (Centering (Text, Images etc.), Spacing (Indenting Text), HTML Color Coding. **Basic Formatting Tags**: HTML Basic Tags, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines), Text Styles (Bold, Italics, Underline), Other Text Effects (Centering (Text, Images etc.), Spacing (Indenting Text), HTML Color Coding. Lists **Type of Lists** (Unordered List (Bullets), Ordered Lists (Numbering), Definition Lists. **Adding Graphics To HTML Documents:** Using The Border Attribute, Using The Width And Height Attribute, Using The Align Attribute, Using The Alt Attribute. **Tables:** Introduction (Header, Data rows, The Caption Tag), Using the Width and Border Attribute, Using the Cell padding Attribute, Using the Cell spacing Attribute, Using the BGCOLOR Attribute, Using the COLSPAN and ROWSPAN Attributes Tag.	
Part-B **Linking Documents:** Links (External Document References, Internal Document References), Image As Hyperlinks. **Frames:** Introduction to Frames: The<FRAMESET> tag, The <FRAME> tag, Targeting Named Frames. DHTML: Cascading Style Sheets, Style **Introduction to JavaScript:** Introduction to JavaScript: JavaScript in Web Pages (Netscape and JavaScript, Database Connectivity, Client side JavaScript, Capturing User Input); The Advantages of JavaScript (an Interpreted Language, Embedded within HTML, Minimal Syntax -Easy to Learn, Quick Development, Designed for Simple, Small Programs, Performance, Procedural Capabilities, Designed for Programming User Events, Easy Debugging and Testing, Platform Independence/Architecture Neutral); Writing JavaScript into HTML. **Forms Used by a Web Site:** The Form Object, The Form Object's Methods (The Text Element, The Password Element, The Button Element, The Submit (Button) Element, The Reset (Button) Element, The Checkbox Element, The Radio	20 hours

Element, The Text Area Element, The Select and Option Element, The Multi Choice Select Lists Element) Other Built-In Objects in JavaScript (The String Object, The Math Object, The Date Object), User Defined Objects (Creating a User Defined Object, Instances, Objects within Objects).	

Text Books:

1. Internet for EveryOne: Alexis Leon, 1st Edition, Leon Techworld, Publication, 2009.
2. Greenlaw R; Heppe, "Fundamentals of Internet and WWW", 2nd Edition, Tata McGraw-Hill, 2007.
3. RajKamal, "Internet& Web Technologies",edition Tata McGraw-Hill Education.2009.
4. Chris Payne, "Asp in 21 Days", 2nd Edition, Sams Publishing, 2003 PDCA.
5. A Beginner's Guide to Html Http://www.Ncsa.Nine.Edit/General/Internet/Www/Html.Prmter

E-Books/ Online learning material:

1. https://www.tutorialspoint.com/html/html_tutorial.pdf
2. https://www.w3schools.com/js/
3. https://www.w3schools.com/html/
4. https://www.cs.uct.ac.za/mit_notes/web_programming.html
5. http://www.pagetutor.com/table_tutor/index.html

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1910
Course Name: Computer Networks

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**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	Familiar with the different Network Models.
CO2	Understand different protocols working at Medium Access Sublayer.
CO3	Learn the concept of network routing through algorithms.
CO4	Learn and understand Internet protocols and network security.

Detailed contents	Contact hours
Part A **Computer Networks**: Uses of computer Networks, Goals and applications of networks, Computer Network Structure and Architecture, Reference models: OSI model, TCP/IP model, Comparison of TCP/IP and OSI models. **Medium Access Sublayer:** Static and dynamic channel allocation for LAN and MAN ALOHA Protocols, LAN Protocols: CSMA, CSMA/CD, Collision Free protocol **Networking and Internetworking devices:** Repeater, bridges, routers, gateways, switches.	22 Hours
Part B **High speed LAN:** FDDI, Fast Ethernet, HIPPI, Fiber channel. LAN IEEE 802.x standards. **Routing:** Static vs. Dynamic Routing, various Routing Algorithms. Congestion Control: Causes of Congestion, Various Congestion Control Strategies and Algorithms	22 Hours

Internet protocols: Principles of Internetworking, connectionless internetworking, Internet protocols, IPv6. **Network Security:** Security requirements and attacks, Encryption Public key encryption and digital Signatures. distributed applications: SNMP, SMTP, HTTP.	

Text Books:

1. A.S. Tannenbaum, "Computer Networks", 3rd Edition, Prentice Hall, 1999.
2. Data Communications & Networking by Forouzan, Tata McGraw Hills.

Reference Books:

1. D.E. Cormer," Computer Networks and Internet", 2nd Edition, Addison Wesley Publication, 2000.
2. D. Bertsekas and R.Gallagar, "Data Networks", 2nd Edition, Prentice-Hall, 1992.
3. Stevens W.R.," UNIX Network Programming," Prentice Hall, 1990.

Course Code: PGCA1911
Course Name: Object Oriented Programming using C++

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Understand Object oriented approach for finding solutions to various problems with the help of C++ language.
CO2	To understand Object oriented approach for finding Solutions to various problems with the help of C++ language.
CO3	Create computer based solutions to various real-world problems using C++

Detailed contents	Contact hours
Part A **Fundamentals of Object Oriented Programming:** Introduction to Object Oriented Programming (OOP) and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Difference between Procedure oriented Language (C) and Object Oriented Language. **Fundamentals of C/C++:** I/O statements, Assignment Statements, Constants, Variables, Operators and Expressions, Standards and Formatted statements, Keywords, Data Types and Identifiers. **Control Structures:** Introduction, Decision making with if – statement, if – else and Nested if, while and do-while, for loop. Jump statements: break, continue, switch Statement. **Arrays:** Introduction to Arrays, Array Declaration, Single and Multidimensional Array, Memory Representation, Matrices, Strings and String handling functions. Structures and Union.	22 hours
Part B **Classes & Objects:** Classes & Functions, Scope Resolution Operator, Private, Protected and Public Member Functions, Nesting of Member Functions. Creating Objects, accessing class data members, Accessing member functions. **Concept of Constructors:** Introduction to constructors, Parameterized constructors, Copy Constructor, Multiple constructors in class, Dynamic initialization of objects, Destructors. **Inheritance:** Constructors/ destructors under inheritance, Types of inheritance: - Single inheritance, Multiple inheritance, Multilevel inheritance, Hierarchical inheritance and Hybrid inheritance. **Operator Overloading:** Function, Unary and Binary operators. Binding, Friend and Virtual Functions. **Introduction to file handling:** Opening and Closing files, Various modes, Various methods on files.	22 hours

Text Books:

1. Object Oriented Programming with C++, E. Balaguruswami, Fourth Edition, Tata Mc-Graw Hill
2. Programming using C++, D. Ravichandran, Tata Mc-Graw Hill
3. Object Oriented Programming Using C++, Salaria, R. S, Fourth Edition, Khanna Book Publishing

Reference Books:

1. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia Publications.
2. The C++ Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley Publishing Company.

E Books/ Online learning material:

1. www.sakshat.ac.in

Course Code: PGCA1912
Course Name: Software Engineering

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Aware about the engineering approach to analysis, design and built the software
CO2	Understand the phases and activities involved in the software life cycle models
CO3	Analyse problems, and identify and define the computing requirements appropriate to its solution.
CO4	Apply design and development principles in the construction of software systems of varying complexity

CO5	Apply current techniques, skills, and tools necessary for computing practice.
CO6	Apply various testing techniques to test a software
CO7	Measure various characteristics of software.
CO8	Compare and choose between maintenance and reengineering of software, when there is requirement to make changes in the software.

Detailed contents	**Contact hours**
Part A Introduction to the Discipline, The Software Process, Software Engineering Practice, Software Development Myths. Prescriptive Process Models (The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models), Specialized Process Models (Component-Based Development, The Formal Methods Model, Aspect-Oriented Software Development), The Unified Process, Phases of the Unified Process, Personal and Team Process Models (Personal Software Process, Team Software Process). Requirements Engineering, Understanding of Software Requirements, Building the Analysis Model, The Design Process, Design Concepts, The Design Model (Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Deployment-Level Design Elements).	22 hours
Part B Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging, Software Testing Fundamentals, White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing. A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for the Design Model, Metrics in the Process and Project Domains, Software Measurement. Software Maintenance, Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, The Economics of Reengineering.	22 hours

Text Books:

1. Software Engineering–A Practitioner's Approach, Roger S. Pressman and Bruce R. Maxim, Eighth Edition, 2015, McGrawHill.

Reference Books:

1. An Integrated Approach to Software Engineering, Pankaj Jalota, Third Edition, 2005, Narosa Publishing House;
2. Software Engineering, Ian Sommerville, Ninth Edition, 2011, Addison-Wesley.

Course Code: PGCA1913
Course Name: Data Structures

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 30	**Theory/Practical:** Theory
External max. marks:70	**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: Student will be able to

CO#	Course outcomes
CO1	Choose appropriate data structure as applied to specified problem definition.
CO2	Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
CO3	Apply concepts learned in various domains like DBMS, compiler construction, computer graphics etc.
CO4	Use linear and non-linear data structures like stacks, queues , linked list etc.
CO5	Develop his/her logics and programming skills

Detailed contents	**Contact hours**
Part-A **Stack and Queue:** contiguous implementations of stack, various operations on stack, various polish notations-infix, prefix, postfix, conversion from one to another-using stack; evaluation of post and prefix expressions. Contiguous implementation of queue: Linear queue, its drawback; circular queue; various operations on queue; linked implementation of stack and queue- operations	20 hours

General List and Trees: list and it's contiguous implementation, it's drawback; singly linked list-operations on it; doubly linked list-operations on it; circular linked list; linked list using arrays. Tree definitions-height, depth, order, degree, parent and child relationship etc; Binary Trees- various theorems, complete binary tree, almost complete binary tree; Tree traversals-preorder, in order and post order traversals, their recursive and non recursive implementations; expression tree- evaluation; linked representation of binary tree-operations. Threaded binary trees; forests, conversion of forest into tree. Heap-definition.	
Part-B **Searching, Hashing and Sorting:** requirements of a search algorithm; sequential search, binary search, indexed sequential search, interpolation search; hashing-basics, methods, collision, resolution of collision, chaining; Internal sorting- Bubble sort, selection sort, insertion sort, quick sort, merge sort on linked and contiguous list, shell sort, heap sort, tree sort. **Graphs: related definitions:** graph representations- adjacency matrix, adjacency lists, adjacency multilist; traversal schemes- depth first search, breadth first search; Minimum spanning tree; shortest path algorithm; kruskals & dijkstras algorithm.	24 hours

Text Books

1. Brijesh Bakariya. Data Structures and Algorithms Implementation through C, BPB Publications.
2. Data Structures, Schaum Series, TMH.
3. Kruse R.L. Data Structures and Program Design in C; PHI
4. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D., "Data Structures and Algorithms", AddisonWesley

Reference Books:

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

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1914
Course Name: Web Technologies Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 2nd	**Contact hours:** 4 hours per week
Internal max. marks: 70	**Theory/Practical**: Practical
External max. marks: 30	**Duration of End Semester Exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: Students must have the knowledge of editors like Notepad etc. and basic understanding of Scripting Language/s.
Co requisite: Knowledge of Networking, Internet, Client Server concepts, Static & Dynamic environment of the websites etc.
Additional material required in ESE:

- Demonstration of the website of college/ specific department/specific cells etc. will be presented by the students during the final practical.
- Developed Website/s must be made online by the student/s.
- Printouts of the Main Page of the website must be arranged on Practical file during daily lab work and must be submitted in the final examinations.

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

CO#	Course Outcomes
CO1	Understand Static and Dynamic concepts of web designing.
CO2	Develop ability to retrieve data from a database and present it online.
CO3	Design web pages that apply various dynamic effects on the web site.
CO4	Solve complex and large problems using Scripting Language & Markup Language.

Instructions: Instructor can increase/decrease the experiments as per the requirement.
Assignments:

1.	Design index page of a book Titled Web Designing.
2.	Create a simple HTML page to demonstrate the use of different tags.
3.	Display Letter Head of your college on a web page & it must be scrolling Right to Left.
4.	Create a link to move within a single page rather than to load another page.
5.	Display “Name of University” using different Text formatting Tags.
6.	Design Time Table of your department and highlight most important periods.
7.	Use Tables to provide layout to your web page.
8.	Embed Audio and Video into your web page.
9.	Divide a web page vertically and display logo of your college in left pane and logo of university in right pane.
10.	Create Bio- Data of an employee.

11.	Design front page of a hospital with different styles.
12.	Design a web page and display horizontally two different web pages at a time.
13.	Write a program to create a login form. On clicking the submit button, the user should get navigated to a profile page.
14.	Write a HTML code to create a Registration Form. On submitting the form, the user should be asked to login with the new credentials.
15.	Write a HTML code to create website in your college or department and create link for Tutorial of specific subject.
16.	Write a program to perform following operations on two numbers input by the user: Addition 2) Subtraction 3) Multiplication 4) Division.
17.	Design a program to solve quadratic equations.
18.	Write a program to determine greatest number of three numbers.
19.	Write a script to compute, the Average and Grade of students marks.
20.	Design a scientific calculator and make event for each button using scripting language.
21.	Write a script to check whether a number is even or odd?
22.	Write a program to show whether a number is prime or not?
23.	Write a program to show multiplication table of any number.
24.	Write a program to find the factorial of any number.
25.	Write a program to show Fibonacci Series between 0 to 74.

Reference Books:

1. Greenlaw R; Hepp E, "Fundamentals of Internet and www", 2nd Edition, Tata. McGraw-Hill, 2007.
2. A Beginner's Guide to HTML Http://www.Ncsa.Nine.Edit/General/Internet/www/ html.prmter.

Online Experiment material:

1. https://www.w3schools.com/html/html_examples.asp
2. https://www.cs.uct.ac.za/mit_notes/web_programming.html

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1915
Course Name: Object Oriented Programming using C++ Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 1st	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** --
Internal max. marks: 70	**Duration of end semester exam (ESE):** --
External max. marks: 30	**Elective status:** Core/~~Elective~~
Total marks: 100	

Prerequisite: --
Co requisite: --
Additional material required in ESE: --

Course Outcomes:

CO#	Course outcomes
CO1	To learn programming from real world examples.
CO2	To understand Object oriented approach for finding solutions to various problems with the help of C++ language.
CO3	To create computer based solutions to various real-world problems using C++
CO4	To learn various concepts of object oriented approach towards problem solving

Assignments:

Instructions: All programs are to be developed in C++ programming language.	
1.	Write a menu driven program to perform the following (a) Area of circle (b) Circumference of a circle (c) Area of a triangle (d) Area of a rectangle
2.	Write a menu driven program with suitable checks to convert a given decimal number into either of the following (a) Binary equivalent (b) Octal equivalent (c) Hexadecimal equivalent
3.	Write a program to add all the ODD numbers between 10 to 100 and divisible by given number 'n'.
4.	Write a program to find the mean, median and mode of n numbers
5.	Write a program using control structures that prints the factorial of a given number.
6.	Write a program to print first n prime numbers.
7.	Write a program to prepare a year wise calendar and also print a leap year.
8.	Write a program to read a number n, and digit d, and check whether d is present in the number n. If it is so find out the position of d in the number n.
9.	Write a program using functions to find the sum of the following series: (a) Sum = 1+2+3+……+n

	(b) sum =1+3+5+……..+n (c) sum = x+x^2/2i+x^4/4+x^6/6+……+x^n/n.
10.	Write a function to generate a Fibonacci series of 'n' numbers where n is any given number.
11.	Write a program to display the address and the content of a pointer variable.
12.	Write a program to display the memory address of a variable using pointer before increment/ decrement and after increment/ decrement.
13.	Write a program to display the contents of a variable before and after the function is invoked using a call by value
14.	Write a program to exchange the contents of two variables using a call by value.
15.	Write a program to exchange the contents of two variables using a call by reference.
16.	Write a program to swap two values using reference variables.
17.	Write a program to demonstrate how a function can be passed to another function as a formal argument. This program should perform addition and subtraction of two floating point numbers by another function which takes the formal arguments of the functions add(),sub() and return the result.
18.	Using pointer Write a program to find the transpose of a matrix.
19.	Write a program to copy the contents of one string to another string using a pointer method.
20.	Write a program to display the contents of a structure using function definition.
21.	Write a menu driven program to perform the following arithmetic operations of a complex number using a structure. (a)Addition (b) Subtraction (c) Multiplication (d) Division
22.	Write a program to assign data to the data members of a class and then display back on the screen.
23.	Write a program to perform simple arithmetic operations using class.
24.	Write a program with the employee class that creates two employees, sets their age, years of experience and salary and print their values.
25.	Write a program to assign value to the members of a class objects using a pointer structure operator (- >).
26.	Write a program to define a nested class "student_info" which contains data members such as name, roll number and sex, and also consist of one more class "date" whose data members are day, month and year. Again the class is defined with one more class "age_class" whose data member is age. The values of the student_info are read from the keyboard and the contents of the class have to be displayed on the screen.
27.	Write a program to create memory space for a class object using the new operator and to destroy it using the delete operator.
28.	Write a program to read the derived class data members such as name, roll number, sex, height and weight from the keyboard and display the contents of the class on the screen. (Single Inheritance / Multiple Inheritance).
29.	Write a program to demonstrate how function overloading is carried out for swapping of two variables of the various data types, namely integers, floating point numbers and character types.
30.	Write a program to find area of rectangle and circle by function overloading.
31.	Write a program to create a class of objects, namely obja and objb. The contents of object obja is assigned to the object objb using the conventional assignment technique.
32.	Write a program to perform simple arithmetic operations (subtract) of two complex numbers by using operator (-) overloading.

33.	Write a program to explain the concept of virtual function.
34.	Write a program to illustrate how to assign the pointer of the derived class to the object of a base class using explicit casting.
35.	Write a program to copy the contents of a file into another.
36.	Write a program to find the number of lines, words and character in a text.
37.	Write a program to read a file and to display the contents of the file on the screen with line number.

Reference Books:

1. Object Oriented Programming with C++, E. Balaguruswami, Fourth Edition, Tata Mc-Graw Hill
2. Programming using C++, D. Ravichandran, Tata Mc-Graw Hill
3. Object Oriented Programming Using C++, Salaria, R. S, Fourth Edition, Khanna Book Publishing

---

Course Code: PGCA1916
Course Name: Data Structures Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 2nd	**Contact hours:** 4 hours per week
Internal max. marks: 70	**Theory/Practical:** Practical
External max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Student will be able to apply appropriate constructs of Programming language, coding standards for application development
CO2	Students will be able to programming skills for solving problems.
CO3	Select appropriate searching and/or sorting techniques for application development.
CO4	Students will be able to learn graphs and its techniques.

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

Sr. No.	Assignments

1	Write an algorithm and program to search an element using linear search.
2	Write a program to implement Binary search tree.
3	Write Quick Short algorithm and program in language C.
4	Implement the Polynomial representation using Array.
5	Create a program to sort it in ascending order using heap sort (Min Heap and Max Heap both). Given an array of 6 elements: 15 | 19 | 10 | 7 | 17 | 16
6	Write programs for finding the element in the array using the binary search method using iteration and recursion concepts.
7	Write a program to create a link list and perform operation such as insert, delete, update and reverse.
8	Write a program to insert value in a Linear Array at Specified Position.
9	Write a program to swap two number using calls by value and call by reference.
10	Write a C program to simulate the working of a circular queue of integers using an array. Provide the following operations, Insert, Delete.
11	Write a program to sort elements using Merge Sort method.
12	Write a program to design a priority queue which is maintained as a set of queues (maximum of three queues). The elements are inserted based upon the given priority; the deletion of an element is to be done starting from the first queue, if it is not empty. If it is empty then second queue will be deleted and so on.
13	Write a program to support the following operations on doubly link list where each node consists of integers.
14	Write a program to construct a stack of integers and to perform the following options on it PUSH POP The program should print appropriate messages for stack overflow, stack underflow and stack empty.
15	Write a program to find shortest path using Dijkstra's Algorithm
16	Write a C program using dynamic variables and pointers to construct a queue of integers using singly link list and perform the following operations. Insert Delete
17	The program should print appropriate messages for queue full and queue empty conditions
18	Write a program to arrange words in dictionary order using Binary Search Tree (In order Traversal) and implement binary search tree for word representation and make in order traversal for sorting in dictionary order
19	Write a program to implement Breadth First Search and Depth First Search Algorithm.
20	Write a program to implement any one hashing techniques in c and also measure its complexity.

Reference Books:

1. Brijesh Bakariya. 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, Galgotia Publishers.

Course Code: PGCA1917
Course Name: Discrete Structures & Optimization

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**Elective status:** Core
Total marks: 100	

Prerequisite: Basic Mathematical Knowledge
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Apply the operations of sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion
CO2	Apply rules of inference, proof by contradiction, proof by cases, and write proofs using symbolic logic and Boolean Algebra
CO3	Solve counting problems by applying elementary counting techniques using the product and sum rules, permutations, combinations, the pigeon-hole principle.
CO4	Determine if a given graph is simple or a multigraph, directed or undirected, cyclic or acyclic, and determine the connectivity of a graph.

Detailed contents	Contact hours
Part A **Sets, relations, and functions:** Introduction, Combination of Sets, ordered pairs, proofs of general identities of sets, relations, operations on relations, properties of relations and functions, Hashing Functions, equivalence relations, compatibility relations, partial order relations.	24 Hours

Rings and Boolean algebra: Rings, Subrings, Morphism of rings ideals and quotient rings. Euclidean domains, Integral domains and fields, Boolean Algebra, Direct product morphisms, Boolean sub-algebra, Boolean Rings, Application of Boolean algebra (Logic Implications, Logic Gates, Karnaugh map) **Combinatorial Mathematics:** Basic counting principles, Permutations and combinations, Inclusion and Exclusion, Principle Recurrence relations, Generating Function, Pigeon Hole Principle, Application	
Part B **Monoids and Groups:** Groups, Semigroups and monoids, Cyclic semigraphs and submonoids, Subgroups and Cosets. Congruence relations on semigroups. Morphisms. Normal subgroups. Dihedral groups. **Graph Theory:** Graph- Directed and undirected, Eulerian chains and cycles, Hamiltonian chains and cycles Trees, Chromatic number Connectivity, Graph coloring, Plane and connected graphs, Isomorphism and Homomorphism. Applications.	20 Hours

Text Books:

1. Discrete Mathematics (Schaum series), Lipschutz (McGraw Hill).
2. Applied Discrete Structures for Computer Science, Alan Doerr and Kenneth Levarseur (Creative Commons) 2012.

Reference Books:

1. Discrete Mathematics and its Applications, Kenneth H Rosen.(McGraw Hill)
2. Discrete Mathematics and Graph Theory, Sartha, (Cengage Learning)
3. Elements of discrete mathematics. C L Liu (McGraw Hill)

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1918
Course Name: Advanced Java

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**Elective status:** Core
Total marks: 100	

Prerequisite: -Understanding of Core Java concepts.
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Learn the advanced features of Java and write the programs.
CO2	Work with API and implement Serialization concept of Java.
CO3	Learn Java Generics and develop Projects.

Detailed contents	Contact hours
Part A **Servlets:** The life cycle of Servlet, Java Servlet Development kit, Servlet API, Reading the servlet parameters, Reading initialization parameters, Handling HTTP requests and responses, Using cookies, Session tracking and security issues. **Java Server Pages (JSP):** JSP Architecture, Life cycle of JSP, JSP syntax basics– Directives, Declarations, Scripting, Standard actions, Custom tag libraries, Implicit objects, Object scope. Synchronization issues, Session management. **Struts :** Introduction to struts framework, understanding basic architecture of Model, view, controller. Deploying the application in struts with database connectivity.	22 Hours
Part B **Hibernate :** Introduction to hibernate framework, understanding basic architecture of Model, view, controller. Basic concepts of creating pojo files, reverse mapping, object creation in hibernate ,database connectivity . **Enterprise Java Bean:** The bean developer kit (BDK), Use of JAR files, The java beans API, Creating a JavaBean, Types of beans, Stateful session bean, Stateless session bean, Entity bean.	22 Hours

Remote Method Invocation: Defining the remote interface, Implementing the remote interface, Compiling and executing the server and the client. **Common Object Request Broker Architecture (CORBA):** Overview of technical architecture, CORBA basics, CORBA services.	

Text Books:

1. Herbert Schildt , "The Complete Reference Java 2" , Tata McGraw -Hill.
2. H.M. Deital, P.J. Dietal and S.E. Santry, "Advanced Java 2 Platform HOW TO PROGRAM", Prentice Hall.

Reference Books:

1. Grey Cornell and Hortsmann Cay S., "Core Java", Sun Microsystems Press.
2. Philip Hanna, "JSP: The Complete Reference", Tata McGraw –Hill.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1919
Course Name: Computer Graphics

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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	Understand the working of various display devices.
CO2	Familiarize themselves with the working of algorithms using 2-D & 3-D transformations.
CO3	Understand the concept of shading algorithms.

Detailed contents	Contact hours
Part A **Introduction:** Overview of Computer Graphics, Computer Graphics applications, Different I/O devices with specialized graphics features, **Display technologies**- Storage Tube graphic displays, Raster Scan Systems, Random Scan Systems, LCD and LED displays, Cathode ray tube, Color CRT, Video basics – Video controller, Random-scan display processor. Color Models (RGB and CMY), color lookup Table. **2D Primitives:** Scan conversion basics, Algorithm for scan converting a point, Scan converting a line – Direct Method, Digital differential Analyser Algorithm, Bresenham's Line algorithm with derivation, Scan converting Circle – Bresenham's circle drawing algorithm with derivation, Midpoint circle drawing algorithm with derivation, Scan converting Ellipse with derivation. **2D Viewing**: Window to viewport transformations, 2D transformations– Scaling, Translation, Rotation, Reflection, Shear, Matrix representations and homogeneous coordinates, Composite transformations.	22 Hours
Part B	22 Hours

Clipping and Filling Techniques: Algorithm for point clipping, Line clipping (Cohen Sutherland, Liang Barsky algorithms), Polygon clipping, Text clipping. Boundary fill, Floodfill algorithms. **3D Concepts and Object Representation:** Representation of 3D transformations, 3D viewing, Viewing pipeline, Viewing coordinates, Parallel and perspective transformations with their classifications. **Visible-Surface Determination**: Techniques for efficient visible-surface algorithms, Categories of algorithms, Back face removal, The z-Buffer algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method. **Rendering Methods**: Light sources, Illumination and shading models for polygons, Ray tracing, Reflectance properties of surfaces, Types of reflections- Ambient, Specular and Diffuse reflections, Phong's model, Gouraud shading.	

Text Books:

1. D. Hearn and M.P. Baker, "Computer Graphics", PHI/Pearson Education.
2. Zhigand Xiang, Roy Plastock, **"**Computer Graphics", Tata Mc-Graw Hill.

Reference Books:

1. C. Foley, VanDam, Feiner and Hughes, "Computer Graphics Principles & Practice", Pearson Education.
2. Amarendra N Sinha, Arun D Udai, "Computer Graphics", Tata Mc-Graw Hill.
3. Rogers, Adams, "Mathematics Elements for Computer Graphics", Tata Mc-Graw Hill.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1920

Course Name: Design & Analysis of Algorithms

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks:30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**Elective status:** Core
Total marks: 100	

Prerequisite: - Student must have knowledge about Data Structures**.**

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Categorize problems based on their characteristics and practical importance
CO2	Develop Algorithms using iterative/recursive approach
CO3	Design algorithm using an appropriate design paradigm for solving a given problem
CO4	Classify problems as P, NP or NP Complete

Detailed contents	Contact hours
Part A Algorithms: Analyzing algorithms, order arithmetic, Time and space complexity of an algorithm, comparing the performance of different algorithms for the same problem. Different orders of growth. Asymptotic notation. Polynomial vs. Exponential running time. Principles of Algorithm Design. Mathematical analysis of Recursive and Non-recursive algorithms. Basic Algorithm Design Techniques: Divide-and-conquer, Greedy approach, Randomization and dynamic programming. Example problems on Backtracking: n-Queens problem, Hamiltonian Circuit Problem, Subset – Sum Problem. Branch-and- Bound: Assignment Problem, Knapsack Problem, Traveling Salesperson Problem.	24 Hours
Part B Sorting and searching: Insertion and selection sort, Binary search in an ordered array. Sorting algorithms such as Merge sort, Quick sort, Heap sort, Radix Sort, and Bubble sort with analysis of their running times. Lower bound on sorting. Exhaustive search and String Matching. Graphs and NP-completeness: Graph traversal: Breadth-First Search (BFS) and Depth-First Search (DFS). Applications of BFS and DFS. Shortest	20 Hours

paths in graphs: Dijkstra algorithm. Definition of class NP, P, NP-hard and NP-complete problems.	

Text Books:

1. Horowitz E., Sahani S., Rajasekharan S.: Computer Algorithms, Galgotia Publication
2. A.V.Aho, J.E.Hopcroft, and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education India
3. J.Kleinberg and E.Tardos, Algorithm Design by, Pearson Education India
4. Coremen T.H., Leiserson C.E., and Rivest R.L.: Introduction to Algorithms, PHI

Reference Books:

1. Anany Levitin: Introduction to the Design and Analysis of Algorithms, Pearson Education, 2nd Edition.
2. Michael T Goodrich and Roberto Tamassia : Algorithm Design, Wiley India
3. R C T Lee, S S Tseng, R C Chang, Y T Tsai : Introduction to Design and Analysis of Algorithms: A Strategic Approach, Tata McGraw Hill

---

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1921
Course Name: E-Commerce & Digital Marketing

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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	Understand various applications and scope of ecommerce.
CO2	Acquire knowledge of various payment modes used in ecommerce today.
CO3	Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan
CO4	Describe how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy, Developing effective digital and social media strategies
CO5	Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media

Detailed contents	Contact hours
Part A Introduction to Electronic Commerce: Technical Components of E-commerce, E-Commerce Framework, E-Commerce Applications and Electronic Business. Internet Service provider and World wide web. Architectural Framework for Electronic Commerce, WWW as the Architecture and Hypertext publishing. Electronic payment System : Types and Traditional payment, Value exchange system, Electronic funds transfer, Digital Token Based Electronic Payment System, Smart Cards – Credit Cards, Risk in Electronic Payment Systems, Designing Electronic Payment Systems. Electronic Data Interchange : Concepts and applications of EDI and Limitation. EDI and Electronic Commerce standardization and EDI – EDI Software Implementation. EDI Applications in Business – EDI: Legal,	22 Hours

Security and Privacy issues. E- Governance for India : Indian customer EDI system and Service centres.	
Part B Introduction to Digital Marketing : Components of Online Marketing (Email, Forum, Social network, Banner, Blog) , Impact of Online Marketing, Basics of Affiliate Marketing, Viral Marketing, Influencer Marketing, Referral Marketing, Online Advertising, Mobile Marketing, Web analytics and Email Marketing. Search Engine Optimization (SEO) and Social Engine Marketing (SEM).: Importance of Internet and Search Engine and Role of Keywords in SEO, On-Page Optimization (Onsite) and Off Page Optimization. Introduction to Social Media Marketing (SMM). Website Planning & Creation : Content Marketing Strategy, Keywords Research and Analysis, Web Presence and Creating content. Successful content marketing strategies and case studies.	22 Hours

Text Books:

1. Whitley, David, "E-Commerce Strategy, Technologies and Applications", Tata McGraw Hill.
2. Laudon and Traver, "E-Commerce: Business, Technology & Society", Pearson Education
3. Damian Ryan, Calvin Jone. Kogan Page; "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation".

Reference Books:

1. Seema Gupta, Digital Marketing, McGraw Hill
2. Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.
3. Shivani Karwal, "Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing", CreateSpace Independent Publishing Platform, 1st edition.
4. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
5. Venakataramana Rolla, "Digital Marketing Practice guide for SMB: SEO, SEM and SMM", CreateSpace Independent Publishing Platform, First edition.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1922
Course Name: Advanced Java Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 70	**Duration of end semester exam (ESE): -**
External max. marks: 30	**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	Learn the advanced features of Java and write the programs.
CO2	Work with API and implement Serialization concept of Java.
CO3	Learn Java Generics and develop Projects.
CO4	Understand to use digital marketing for developing effective digital and social media strategies

S.No.	Practical Assignments (Java)
1.	Create a Servlet to handle HTTP Requests and Responses.
2.	Implementation of the concept of Cookies and Session Tracking.
3.	Illustrate the concept of JavaServer Pages (JSP).
4.	Create a JavaBean by using Bean Developer Kit (BDK).
5.	Implementation of various types of beans like Session Bean and Entity Bean.
6.	Introduction to Struts platform with basic connectivity.
7.	Deploying first sample program using MVC architecture in struts.
8.	Implementing database connectivity in struts.
9.	Creating one sample application in struts.
10.	Introduction to Hibernate framework.
11.	Creating simple Hibernate application.
	Practical Assignments (SEO)
12.	Take a web site and prepare the SEO report of the website including status of following factors: Title tag, meta-description tag, header tags, keyword consistency, number of back links, robots.txt and xml sitemaps then after going through the steps of SEO prepare the report.
13.	Discuss any five tools to prepare the list of ten organic key words for SEO purpose.
14.	Optimize the images in the website using suitable methods and compare the reports before and after the SEO steps.
15.	Write the robot and sitemap file of a website under consideration.

Text Books:

1. Herbert Schildt , “The Complete Reference Java 2” , Tata McGraw -Hill.

2. H.M. Deital, P.J. Dietal and S.E. Santry, "Advanced Java 2 Platform How To Program", Prentice Hall.
3. Laudon and Traver, "E-Commerce: Business, Technology & Society", Pearson Education
4. Shivani Karwal, "Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing", CreateSpace Independent Publishing Platform, 1st edition.

Reference Books:

1. Grey Cornell and Hortsmann Cay S., "Core Java", Sun Microsystems Press.
2. Philip Hanna, "JSP: The Complete Reference", Tata McGraw –Hill..

Course Code: PGCA1923

Course Name: Computer Graphics Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 4
Semester: 3rd	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 70	**Duration of end semester exam (ESE): -**
External max. marks: 30	**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	Understand & visualize the working of algorithms behind display of 2-D & 3-D objects.
CO2	Design structured, well-commented, understandable programs and implement algorithms in any programming language.
CO3	Possess the skills to test and debug programs in the laboratory.

S.No.	Name of Experiment
1.	Write a program to plot a pixel on the screen in a particular color.
2.	Write a program for creating a simple two-dimensional shape of any object using lines, circle, etc.
3.	Using different graphics functions available for text formatting, write a program for displaying text in different sizes, different colors, font styles.

4.	Implement the DDA algorithm for drawing line (programmer is expected to shift the origin to the center of the screen and divide the screen into required quadrants)
5.	Write a program to input the line coordinates from the user to generate a line using Bresenham's method and DDA algorithm. Compare the lines for their values on the plotted line.
6.	Write a program to generate a complete moving wheel using Midpoint circle drawing algorithm and DDA line drawing algorithm.
7.	Write a program to draw an ellipse using the Midpoint ellipse generation algorithm for both the regions.
8.	Write a program to draw any 2-D object and perform the transformations on it according to the input parameters from the user, namely: Translation, Rotation or Scaling**.**
9.	Write a program to rotate a triangle about any one of its end coordinates.
10.	Write program to draw a house like figure and perform the following operations. a. Scaling about the origin followed by translation. b. Scaling with reference to an arbitrary point.
11.	Write a program for filling a given rectangle with some particular color using boundary fill algorithm.
12.	Write a program for filling a polygon using Scan line Polygon fill algorithm.
13.	Write a program to perform clipping on a line against the clip window using any line clipping algorithm. The output must be twofold showing the before clipping and after clipping images.
14.	Write a program to implement the Sutherland Hodgeman Polygon Clipping algorithm for clipping any polygon.

Text Books:

1. Zhigang Xiang, Roy A. Plastock, "Schaum's Outline of Computer Graphics 2/E", 2nd Edition, Tata Mc-Graw Hill
2. Yashavant Kanetkar, "Graphics under C", BPB Publications.

Reference Books:

1. C. Foley, VanDam, Feiner and Hughes, "Computer Graphics Principles & Practice", Pearson Education.
2. Amarendra N Sinha, Arun D Udai, "Computer Graphics", Tata Mc-Graw Hill.
3. Rogers, Adams, "Mathematics Elements for Computer Graphics", Tata Mc-Graw Hill.

Course Code: PGCA1924

Course Name: Design & Analysis of Algorithms Laboratory

Program: MCA	L:0 T:0 P:4
Branch: Computer Applications	**Credits:** 2
Semester: 3rd	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:**--
Internal max. marks: 70	**Duration of end semester exam (ESE):**--
External max. marks: 30	**Elective status:** core/~~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	To learn programming from real world examples.
CO2	To create computer based solutions to various real-world problems
CO3	Implement Algorithms using iterative/recursive approach
CO4	Implement algorithm using an appropriate design paradigm for solving a given problem

Write programs in C/C++/Python/Java	
Note : The elements can be read from a file or can be generated using the random number generator.	
1	Write recursive and iterative implementations for sorting an array with n numbers using the following algorithms: (a) mergesort (b) heapsort (c) quicksort
2	Vary n from small numbers to as large as possible numbers and compare the machine run times of (a) recursive mergesort vs iterative mergesort (b) recursive heapsort vs iterative heapsort (c) recursive quicksort vs iterative quicksort and generate a plot where n is in the x-axis and time is in the y-axis. For each n, generate the inputs of the n-sized array in a random fashion and take the result for a particular n averaged over a few runs.
3	Write recursive and iterative implementations for the following algorithms: (a) breadth first search in a directed graph and undirected graph (b) depth first search in a directed graph and undirected graph. Given any edge, your program should be able to classify the edge (e.g. tree edge, back edge, forward edge, cross edge, etc.)
4	Implement Recursive Binary search and Linear search and determine the time required to search an element. Repeat the experiment for different values of N, the

	number of elements in the list to be searched and plot a graph of the time taken versus N.
5	Sort a given set of elements using the Insertion sort method and determine the time required to sort the elements. Repeat the experiment for different values of N, the number of elements in the list to be searched and plot a graph of the time taken versus N.
6	Write a program to detect the following: (a) all cut vertices in a directed graph and undirected graph (b) all bridges in a directed graph and undirected graph (c) all strongly connected components in a directed graph
7	Implement algorithm for String Matching.
8	Find the Binomial Co-efficient using Dynamic Programming.
9	Implement any problem using Back Tracking.
10	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
11	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
12	Check whether a given graph is connected or not using DFS method.
13	Find Minimum Cost Spanning Tree of a given undirected graph.
14	Implement Floyd's algorithm for the All-Pairs-Shortest-Paths Problem. Compute the transitive closure of a given directed graph using Warshall's algorithm.
15	Prepare 5 mini Projects on realistic problems.

Text Books:

1. Horowitz E., Sahani S., Rajasekharan S.: Computer Algorithms, Galgotia Publication
2. A.V.Aho, J.E.Hopcroft, and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education India
3. J.Kleinberg and E.Tardos, Algorithm Design by, Pearson Education India
4. Coremen T.H., Leiserson C.E., and Rivest R.L.: Introduction to Algorithms, PHI

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1925
Course Name: Advanced Computer Networking

Program: MCA	**L**:4 **T**:0 **P**:0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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 the different Network Models.
CO2	Understand different protocols working at Medium Access Sub layer.
CO3	Learn the concept of network routing through algorithms.
CO4	Learn and understand Internet protocols and network security.

Detailed contents	Contact hours
Part A **Computer Networks**: Uses of computer Networks, Goals and applications of networks, Computer Network Structure and Architecture, Reference models: OSI model **Physical Layer:** Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Multiplexing : Frequency Division, Time Division, Wavelength Division, Introduction to Transmission Media : Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (radio, microwave, infrared) **Data Link Layer**: Design issues, Framing, Error detection and correction codes: parity, checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP. **Network Layer:** Design issues, IPv4 classful and classless addressing, subnetting, Routing algorithms: distance vector, Congestion control: Principles of Congestion Control, Congestion prevention policies, Leaky bucket and token bucket algorithms	22 Hours

Medium Access Sub-Layer: Static and dynamic channel allocation, Random Access: ALOHA, CSMA-CA/CD protocols, Controlled Access: Polling, Token Passing **Transport Layer**: Elements of transport protocols: addressing, connection establishment and release, flow control and buffering, multiplexing and de-multiplexing, crash recovery, introduction to TCP/UDP protocols and their comparison. **Application Layer:** World Wide Web (WWW), Domain Name System (DNS), E-mail, File Transfer Protocol (FTP) TCP/IP model, Comparison of TCP/IP and OSI models.	
Part B An Overview of Select Wireless and Mobile Networking Technologies: Principles, WLANs: IEEE 802.11,Cellular Networks, Issues in Seamless Mobility **Adhoc networks:** Features, advantages and applications, Adhoc versus Cellular networks, Network architecture, Protocols: MAC protocols, Routing protocols, Technologies. **Wireless Communication Systems**: Evolution, examples of wireless communication systems, 2G Cellular networks, Evolution for 2.5G TDMA Standards, IS-95B for 2.5G CDMA. **Wireless System Design:** Introduction, Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems.	22 Hours

Text Books:

1. A.S. Tannenbaum, “Computer Networks", 3rd Edition, Prentice Hall, 1999.
2. Data Communications & Networking by Forouzan, Tata McGraw Hills.
3. Larry L. Peterson & Bruce S. Davie: Computer Networks: A Systems Approach, 5th Edition, Morgan Kaufmann / Elsevier, New Delhi, 2012, reprint 2016.
4. James F. Kurose & Keith W. Ross: Computer Networking: A Top-Down Approach, 7 th Edition, Pearson Education Inc. Boston, 2016.

Reference Books:

1. D.E. Cormer," Computer Networks and Internet”, 2nd Edition, Addison Wesley Publication, 2000.
2. D. Bertsekas and R.Gallagar, “Data Networks”, 2nd Edition, Prentice-Hall, 1992.
3. Stevens W.R.," UNIX Network Programming," Prentice Hall, 1990.

Course Code: PGCA1926
Course Name: Artificial Intelligence & Soft Computing

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** --
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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	Understand the significance and domains of Artificial Intelligence and knowledge representation.
CO2	Examine the useful search techniques; learn their advantages, disadvantages and comparison.
CO3	Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
CO4	Apply artificial neural networks and fuzzy logic theory for various problems.
CO5	Determine the use of Genetic algorithm to obtain optimized solutions to problems.

Detailed contents	Contact hours
Part A **Introduction**-What is intelligence? Foundations of artificial intelligence (AI).History of AI. AI problems: Toy Problems, Real World problems- Tic-Tac-Toe, Water Jug, Question-Answering, 8-puzzle, 8-Queens problem. Formulating problems, Searching for Solutions. **Knowledge Representation:** Propositional Logic, Propositional Theorem proving-Inference and Proofs, Proof by Resolution, Horn Clauses and definite Clauses, Forward and Backward chaining; First order Logic, Inference in First order Logic. **Informed (Heuristic) Search Strategies-** Hill Climbing, Simulated Annealing, Greedy best-first search, A* and optimal search, Memory-bounded heuristic search.	22 Hours

Natural language processing: Grammars, Parsing, Semantic Analysis and Pragmatics.	
Part B **Introduction:** What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing. **Neural Networks:** Introduction, What is Neural Network, Learning rules and various activation functions, Supervised Learning Networks, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications. Unsupervised Learning Networks. **Fuzzy Systems:** Fuzzy Set theory, Fuzzy vs. Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification. **Genetic Algorithm:** History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. Introduction to Hybrid Systems.	22 Hours

Text Books:

1. Artificial Intelligence-A Modern Approach, Russel and Norvig, Prentice Hall.
2. Artificial Intelligence, Elaine Rich, Kevin Knight and SB Nair, 3 Ed.,Tata McGraw-Hill.
3. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Wiley India
4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.

Reference Books:

1. Artificial Intelligence-A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers.
2. Soft Computing: With Matlab Programming, N. P. Padhy, S. P. Simon, Oxford Higher Education
3. Neuro - Fuzzy & Soft Computing - C. T. Sun, E. Mizutani, J. S. R. Jang, Pearson

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1927
Course Name: Theory of Computation

Program: MCA	**L:**4 **T:**0 **P:**0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:**
Internal max. marks: 30	**Duration of end semester exam (ESE):**
External max. marks:70	**Elective status: core/elective** 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	Use basic concepts of formal languages of finite automata techniques.
CO2	Design Finite Automata's for different Regular Expressions and Languages.
CO3	Construct context free grammar for various languages.
CO4	**S**olve various problems of applying normal form techniques, push down automata and Turing Machines.
CO5	**S**olve computational problems regarding their computability and complexity and prove the basic results of the theory of computation.

Detailed contents	Contact hours
Part A Formal Language, Non-Computational Problems, Diagonal Argument, Russels's Paradox. **Theory of Automata:** Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Mealy and Moore Models, Minimization of Finite Automata. **Regular Sets and Regular Grammars:** Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, Non-Regular Languages, Lexical Analysis. **Context Free Language:** Properties of Context Free Language, Chomsky Classification of Languages, Context Free Grammar,	22 hours

Simplification of Context Free Grammar, Chomsky Normal Form, Greibach Normal Form.	
Part B **Push Down Automata:** Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and Pushdown Automaton (PDA), Non-Deterministic Pushdown Automaton (NPDA). **Turing Machines (TM):** Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis. **Recursive and Recursively-Enumerable Languages;** Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems. **Unsolvable Problems and Computational Complexity:** Unsolvable Problem, Halting Problem, Post Correspondence Problem, Unsolvable Problems for Context-Free Languages, Measuring and Classifying Complexity, Tractable and Intractable Problems.	22 hours

Text Books:

1. Jeffrey Ullman and John Hopcroft, Introduction to Automata Theory, Languages, and Computation, 3e, Pearson Education India (2008).
2. K.L.P. Mishra, Theory of Computer Science: Automata, Languages and Computation, Prentice Hall India Learning Private Limited (2006).
3. John Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Higher Education (2007).

Reference Books:

1. Introduction to Computer Theory, Daniel. I.A. Cohen , John Wiley & Sons.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1928
Course Name: Advanced Computer Networking Laboratory

Program: MCA	**L**:0 **T**:0 **P**:4
Branch: Computer Applications	**Credits:** 2
Semester: 4th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 70	**Duration of end semester exam (ESE):**
External max. marks: 30	**Elective status:** Core
Total marks: 100	

Prerequisite: Computer Networks
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Familiarize themselves with the different Network Models.
CO2	Understand working of different devices used to set up LAN.
CO3	Learn the concept of network routing.
CO4	Learn and understand Internet protocols and network security.

S.No.	Name of Experiment
1.	Familiarization with Networking Components and devices: LAN Adapters, Switches, Routers etc.
2.	Familiarization with Transmission media and Tools: Co-axial cable, UTP Cable, Crimping Tool, Connectors etc.
3.	Preparing Straight and Cross Cables.
4.	Study of various LAN Topologies and their creation using Network devices, Cables and Computers.
5.	Configuration of TCP/IP Protocols in Windows and Linux.
6.	Implementation of File and Printer sharing.
7.	Designing and Implementing Class A, B, C Network.
8.	Subnet Planning and its Implementation.
9.	Installation of ftp server and client.
10.	To develop programs for simulating routing algorithms for Adhoc networks.
11.	To install any one open source packet capture software like packet tracer etc.
12.	To configure Wireless Local Loop.
13.	To configure WLAN.
14.	To configure Adhoc Networks.
15.	To install and configure wireless access points.

Text Books:

1. A.S. Tannenbaum, “Computer Networks", 3rd Edition, Prentice Hall, 1999.
2. “Data Communications & Networking”, Behrouz A. Forouzan, Fifth Edition, Tata McGraw Hill.

Reference Books:

1. D.E. Cormer," Computer Networks and Internet”, 2nd Edition, Addison Wesley Publication, 2000.
2. D. Bertsekas and R.Gallagar, “Data Networks”, 2nd Edition, Prentice-Hall, 1992.
3. Stevens W.R.," UNIX Network Programming," Prentice Hall, 1990.

Course Code: PGCA1929
Course Name: Artificial Intelligence & Soft Computing Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 30	**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	Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
CO2	Apply artificial neural networks and fuzzy logic theory for various problems.
CO3	Determine the use of Genetic algorithm to obtain optimized solutions to problems.

Instructions: Develop the assignments in MATLAB/Python.

Assignments:

1.	Use logic programming in Python to check for prime numbers.
2.	Use logic programming in Python parse a family tree and infer the relationships between the family members.
3.	Python script for building a puzzle solver.

4.	Implementation of uninformed search techniques in Python.
5.	Implementation of heuristic search techniques in Python.
6.	Python script for tokenizing text data.
7.	Extracting the frequency of terms using a Bag of Words model.
8.	Predict the category to which a given piece of text belongs.
9.	Python code for visualizing audio speech signal
10.	Python code for Generating audio signals
11.	Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
12.	Implement AND function using ADALINE with bipolar inputs and outputs.
13.	Implement AND function using MADALINE with bipolar inputs and outputs.
14.	Construct and test auto associative network for input vector using HEBB rule.
15.	Construct and test auto associative network for input vector using outer product rule.
16.	Construct and test heteroassociative network for binary inputs and targets.
17.	Create a back propagation network for a given input pattern. Perform 3 epochs of operation.
18.	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations.
19.	Maximize the function $f(x)=x^2$ using GA, where x ranges form 0-25. Perform 6 iterations.

Text Books:

1. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Wiley India
2. Artificial Intelligence with Python, Prateek Joshi, Packt Publishing.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.

Reference Books:

1. Soft Computing: With Matlab Programming, N. P. Padhy, S. P. Simon, Oxford Higher Education
2. Neuro - Fuzzy & Soft Computing - C. T. Sun, E. Mizutani, J. S. R. Jang, Pearson

---

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1930
Course Name: Software Project Management

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3 hrs
External max. marks: 70	**Elective status:** Core
Total marks: 100	

Prerequisite: Software Engineering (PGCA1912)
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Understand and practice the process of project management
CO2	Develop the scope of work, provide accurate cost estimates and to plan the various activities.
CO3	Understand and use risk management analysis techniques that identify the factors that put a project at risk and to quantify the likely effect of risk on project timescales
CO4	Identify the resources and people required for a project and to produce a work plan and resource schedule.

Detailed contents	Contact hours
Part A **Project Management Fundamentals**- Basic Definitions, Project Stakeholders and Organizational, Influences on Project Management, Project Management Processes, Project Initiating Processes. **Planning and Resourcing a Project** - Identifying Requirements, Creating the Work Breakdown structure, Developing the Project Schedule, Developing a Project Cost Estimate, Planning Quality, Organizing the Project Team, Planning for Potential Risks **Project Evaluation and Planning** - Activities in Software Project Management, Overview of Project Planning, Stepwise planning, contract management, Software processes and process models. Cost Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques, Risk Evaluation. Project costing, COCOMO 2, Staffing pattern, Effect of schedule compression, Putnam's equation, Capers Jones estimating rules of	22 Hours

thumb, Project Sequencing and Scheduling Activities, Scheduling resources, Critical path analysis, Network Planning, Risk Management, Nature and Types of Risks, Managing Risks, Hazard Identification, Hazard Analysis, Risk Planning and Control, PERT and Monte Carlo Simulation techniques.	
Part B **Executing and Managing a Project** -Project Executing Processes-Acquiring and Developing the Project Team, Managing the Project Team, Managing Stakeholder Expectations, Directing and Managing the Project while assuring Quality. **Project Monitoring and Controlling Processes** - Verifying and Controlling Scope, Managing Schedule and Cost, Controlling Quality, Monitoring and Controlling Risks. Integrated Change Control, Project Closing Process, Collecting Data, Visualizing Progress, Cost Monitoring review techniques, Project termination review, Earned Value analysis, Change Control, Software Configuration Management (SCM), Managing Contracts, Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Management and Acceptance. **Quality Management and People Management**- Introduction, Understanding Behaviour, Organizational Behaviour, Selecting The Right Person for The Job, Motivation, The Oldman – Hackman Job Characteristics Model, working in Groups, Organization and team structures, Decision Making, Leadership, Organizational Structures, Stress, Health and Safety. Overview of project management tools for softwares.	22 Hours

Text Books:

1. Bob Hughes, Mike Cotterell, "Software Project Management", Tata McGraw Hill.
2. Royce, "Software Project Management: A Unified Framework, Pearson Education.

Reference Books:

1. Robert K. Wysocki, "Effective Software Project Management", Wiley
2. Ian Sommerville, Software Engineering, Seventh Edition, Pearson Education.
3. R.S. Pressman, Software Engineering: A Practitioner's Approach, Sixth Edition, Tata McGraw-Hill.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1931
Course Name: Software Testing & Quality Assurance

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3 hrs
External max. marks: 70	**Elective status:** Core
Total marks: 100	

Prerequisite: Software Engineering (PGCA1912)
Co requisite: -NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Understand various approaches of software testing and quality assurance for software development.
CO2	Create test strategies, design test cases, prioritize and execute them.
CO3	Identify various risks involved with software projects and build risk management
CO4	Plan and execute software management and configuration activities.

Detailed contents	Contact hours
Part A **Software Testing:** Testing, Verification and Validation, Test Strategies for Conventional and Object Oriented Software, Unit Testing, Integration Testing, Validation Testing, Alpha and Beta Testing, System Testing, Recovery Testing, Security Testing, Stress Testing, Performance Testing, Metrics for Source Code, Metrics for Testing, Debugging Process, Debugging Strategies. **Testing Techniques:** Software Testing Fundamentals, Black Box and White Box Testing, Basis Path Testing, Flow Graph Notation, Independent Program Paths, Graph Matrices, Control Structure Testing, Condition Testing, Data Flow Testing, Loop Testing, Graph Based Testing Methods, Equivalence Partitioning, **Object Oriented Testing Methods:** Applicability of Conventional Test Case Design Methods, Issues in Object Oriented Testing, Fault-Based Testing, Scenario-Based Testing, Random Testing and Partition Testing for Classes, Inter Class Test Case Design. **Testing Process and Specialized Systems Testing:** Test Plan Development, Requirement Phase, Design Phase and Program Phase Testing, Testing	26 Hours

Client/Server Systems, Testing Web based Systems, Testing Off the-Shelf Software, Testing in Multiplatform Environment, Testing for Real Time Systems, Testing Security.	
Part B **Software Quality Assurance Concepts and Standards:** Quality Concepts, Quality Control, Software Quality Attributes, Quality Assurance, SQA Activities, Software Reviews, Formal Technical Reviews, Review Guidelines, Software Reliability, Software Safety, Quality Assurance Standards, ISO 9000, ISO 9001:2000, ISO 9126 Quality Factors, CMM, CMMI, PCMM, TQM, Six Sigma, SPICE, Software Quality Assurance Metrics. **Risk Management and Change Management:** Software Risks, Risk Identification, Risk Projection, Risk Refinement, The RMMM Plan, Software Configuration Management, Baselines, Software Configuration Items, SCM Process: Version Control, Change Control, Configuration Audit, Configuration Management for Web Engineering.	18 Hours

Text Books:

1. Software Quality Assurance – From Theory to Implementation, Daniel Galin, Pearson Education
2. Software Testing Techniques, Boris Beizer, Dream Tech Press.

Reference Books:

1. Roger S. Pressman, Software Engineering, 8/e, McGraw Hill, 2014.
2. Effective Methods for Software Testing, Third edition, William E. Perry, Wiley India.
3. Software Testing – Principles and Practices, Naresh Chauhan, Oxford University Press Walker Royce, Software Project Management: A Unified Frame Work, Pearson Education.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1932
Course Name: Information Security and Cyber Law

Program: MCA	**L**:4 **T**:0 **P**:0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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	Acquire knowledge about various Information Systems.
CO2	Understand the key security requirements of Confidentiality, Integrity &Availability.
CO3	Demonstrate the concept of Intrusion Detection & Intrusion Prevention.
CO4	Apply Symmetric Encryption techniques.
CO5	Describe the concept of Security policies and Cyber Laws.

Detailed contents	Contact hours
Part A Introduction to Information System, classification and components of information system, Computer Security Concepts, CIA (Confidentiality, integrity and availability),Security Functional Requirements. User Authentication: Means of Authentication, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication. **Access Control:** Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, File Access Control, Role-Based Access Control. **Database Security:** The Need for Database Security, Database Access Control, Database Encryption.	22 Hours

Malicious Software: Types of Malicious Software (Malware)-Viruses, Worms,SPAM E-mail, Trojans, Zombie, Bots, Keyloggers, Phishing, Spyware, Backdoors, Rootkits, Preventive Measures.Denial-of-Service Attacks: Types of DoS attacks, Defenses Against Denial-of-Service Attacks.	
Part B **Intrusion Detection:** Intruders, Intrusion Detection, Host-Based Intrusion Detection, Distributed Host-Based Intrusion Detection, Network-Based Intrusion Detection, Honeypots. **Firewalls & Intrusion Prevention Systems:** The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Intrusion Prevention Systems. **Cryptographic Algorithms:** Symmetric Encryption Principles, Data Encryption Standards (DES) **Introduction to Internet Security Protocols & Standards:** SSL, TLS, HTTPS, IPv4 and IPv6 Security protocols. **Security Policies and Cyber Laws:** Concept of Information Security Policy, ISO Standards, various Indian Cyber Laws, Information Technology Act 2000, Electronic Record and E-Governance, Classification and Provisions of Cyber Crimes, Regulation of Certifying Authorities, Patent, Copyright, Digital signature, Introduction to Cyberspace.	22 Hours

Text Books:

1. William Stallings, Lawrie Brown, "Computer Security: Principles & Practice", 3rd Edition, Pearson, 2015.
2. Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla, "Introduction to Information Security and Cyber Laws", Wiley India, 2014.

Reference Books:

1. Christof Paar , Jan Pelzl, "Understanding Cryptography: A Textbook for Students and Practitioners", 1st Edition, Springer, 2010
2. William Stallings, "Cryptography and Network Security Principles and Practices", 4th Edition, Prentice Hall, 2006.
3. Darren Death, "Information Security Handbook", Packt Publishing, 2017

Course Code: PGCA1933
Course Name: Mobile Application Development

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**Elective status:** Elective II
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	Know the components and structure of mobile application development frameworks for Android and iOS based mobiles.
CO2	Understand how to work with various mobile application development frameworks.
CO3	Design and implement the user interfaces of mobile applications.
CO4	Develop useful mobile applications using Google Android and Eclipse simulator.

Detailed contents	Contact hours
Part A **Introduction**: Mobile Applications –Characteristics and Benefits – Frameworks and Tools, Types, Application Model. Profiles of Mobile devices. **Building Blocks of Mobile Applications:** User Interface Designing, Layout, User Interface elements, Functionality based user interface, Naïve Data Handling, Sprucing up Mobile applications **Testing Mobile Applications:** Debugging Applications, Testing Strategies, Test Automation of Applications.	22 Hours
Part B **Mobile Operating System --**Introduction to Mobile Operating Systems and why they are needed, Open Platforms, Mobile OS Features, Symbian, BlackBerry, Android, iOS, Windows, Tizen, Ubuntu, etc.	22 Hours

Android programming: Android toolkit, Components of an Android application, Android Software Development using Eclipse – Concepts, Terminology, Views and Perspectives, memory management, communication protocols, application development methods, deployment. **IOS:** Development environment, iOS Layers, Architecture, User Interface tool kit interfaces, Event handling, Graphics services, Layer Animation, Basic iPhone Styling, Advanced iPhone Styling.	

Text Books:

1. Anubhav Pradhan, Anil V Deshpande, " Mobile Apps Development" Edition: I
2. Jeff McWherter, Scott Gowell "Professional Mobile Application Development", John Wiley & Sons, 2012.

Reference Books:

1. Zigurd Mednieks, L. Dornin, G. Blake Meike, M. Nakamura," Programming Andriod, 1st Edition, O'Relly Publication, 2011.
2. A. Allan" Learning iPhone Programming", 1st Edition, O'Relly Publication, 2010.
3. Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons.
4. Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1934
Course Name: Mobile Application Development Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 4th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 30	**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	Understand how to work with various mobile application development frameworks.
CO2	Develop mobile applications using GUI and Layouts
CO3	Learn the basic and important design concepts and issues of development of mobile applications.
CO4	Analyze and discover own mobile app for simple needs.

List of Assignments	
Sr. No.	**Assignments**
1	Using emulator to deploy and run mobile apps
2	Create an Android application that shows Hello + name of the user and run it on an emulator.
3	Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button.
4	Develop an ANDRIOD application that uses GUI components, Font and Colors.
5	Write an application that draws basic graphical primitives on the screen.
	Develop an application that uses Layout Managers and event listeners.
7	Create and Login application as above. On successful login, open browser with any URL.
8	Testing mobile app - unit testing, black box testing and test automation.
9	Create an iOS application that can play audio and video files.
10	Write an iOS application that creates alarm clock.
11	Devise an iOS application that draws basic graphical primitives (rectangle, circle) on the screen.
12	Build an iOS mobile application that create, save, update and delete data in a database.

Text Books:

1. Anubhav Pradhan, Anil V Deshpande, " Mobile Apps Development" Edition: I
2. Jeff McWherter, Scott Gowell "Professional Mobile Application Development", John Wiley & Sons, 2012.

Reference Books:

1. Zigurd Mednieks, L. Dornin, G. Blake Meike, M. Nakamura," Programming Andriod, 1st Edition, O'Relly Publication, 2011.
2. A. Allan" Learning iPhone Programming", 1st Edition, O'Relly Publication, 2010.
3. Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons.
4. Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS.

Course Code: PGCA1935
Course Name: Simulation & Modelling

Program: MCA	**L**: 4 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 30	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 70	**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	Identify the paradigms and approaches used to design the simulation.
CO2	Understand the various types of simulation, techniques and methods.
CO3	Apply concepts of computer simulation for types of inputs, system models, output behavior and performance estimation
CO4	Test the goodness of a simulation by analyzing the simulated data.

Detailed contents	Contact hours
Part A	26 Hours

Inventory Concept: The technique of Simulation, Major application areas, concept of a System, Environment, Continuous and discrete systems, systems modeling types of models progress of a Simulation Study, Monte Carlo Method, Comparison of Simulation and Analytical Methods. Numerical Computation Technique for discrete and continuous models, Continuous System Simulation. **Input Modeling-** Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots.100 Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests applied to Simulation inputs: Chi-Square and Chi-Square with Equal Probabilities, Kolmogorov-Smirnov Tests, pValues and Best Fits. **Verification and Validation of Simulation Models-** Verification and Validation of Simulation Models. Calibration and Validation: Face Validity, Validation of Assumptions, Input-Out Transformation Validation. **Output Analysis of a Single Model-** Output analysis and types of simulation. Stochastic Nature of the Output Data. Measures of Performance and Estimation: Point Estimation and Confidence-Interval Estimation. Output Analysis for Terminating Simulations and Estimation of Probabilities. Output Analysis of Steady State Simulations: Initialization Bias, Error Estimation, Replications, Sample Size and Batch Means for Interval Estimation.	
Part B **Simulation of Queuing Systems:** Rudiments of queuing theory, Simulation of single-server queue, Simulation of two-server queue. **Simulation Software-** Integrated environments. Examples and review of some existing software popular and useful in the industry, e.g., Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc. Simulation using languages and environments like C++/Java/GPSS/SSF etc. Experimentation and Statistical-Analysis Tools: common features and relevant current products**.** **Simulation Languages:** Basic Introduction to Special Simulation Languages:-GPSS/ MATLAB/ Network Simulators.	18 Hours

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, New Delhi, 2005
2. Gordon, G: System Simulation, Prentice-Hall; 2 edition (1979).

Reference Books:

1. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009
2. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems, Academic Press, 2000.
3. Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons. Bhat, U. Narayan, An Introduction to Queueing Theory: Modeling and Analysis in Applications, Springer 2008 (Birkhäuser Boston).
4. James J. Nutaro, Building software for simulation: theory and algorithms, with applications in C++. Wiley, 2010.

Course Code: PGCA1936

Course Name: Simulation & Modelling Laboratory

Program: MCA	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 4th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** --
Internal max. marks: 70	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 30	**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	Understand the use of software tools for modelling and analysis of mathematical concepts for engineering application.
CO2	Know how to simulate any discrete system using queuing systems.
CO3	Model and analyze simple engineering concepts and its importance in engineering applications.
CO4	Develop skills to apply simulation software to construct and execute goal-driven system models.

Sr. No.	Assignments
1	Installation of MATLAB.
2	Write a program in MATLAB using different types of branching statements.

3	Write a program to perform basic matrix operations.
4	WAP to plot different types of graphs in MATLAB.
5	Write a MATLAB code to plot with the elements of its vector representation
6	Programs on simulation of real time systems for automation purpose.
7	Simulation of continuous and discrete systems.
8	Programs on testing the random number set for uniformity and independence – Kolmogorov-Smirnov test, Chisquare test, Runs test and Autocorrelation test.
9	Programs on simulation of single and two-server queuing systems..
10	Programs on simulation of an inventory system.

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, New Delhi, 2005
2. Gordon, G: System Simulation, Prentice-Hall; 2 edition (1979).

Reference Books:

1. Gabriel A. Wainer, Discrete-event modeling and simulation: a practitioner's approach, CRC Press, 2009
2. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems, Academic Press, 2000.

I. K. Gujral Punjab Technical University
Master of Computer Applications (MCA)

Course Code: PGCA1937
Course Name: Cloud Computing

Program: MCA	**L:**4 **T:**0 **P:**0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44
Theory/Practical: Theory	**Percentage of numerical/design problems:**
Internal max. marks: 30	**Duration of end semester exam (ESE):**
External max. marks: 70	**Elective status: core/elective** Elective
Total marks:100	

Prerequisite:
Co requisite:
Additional material required in ESE:
Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Understand the basic concept and importance of cloud computing.
CO2	Access the suitability of migrating to a cloud solution for different applications.
CO3	Compare and evaluate the virtualization technologies.
CO4	Monitor and manage the cloud resources, applications and data while addressing the security concerns.
CO5	Use cloud solutions offered by industry leaders for various applications.

Detailed contents	Contact hours
Part A **Overview of Computing Paradigm:** Recent trends in Computing -Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. **Introduction to Cloud Computing:** Vision of Cloud Computing, Defining a Cloud, Cloud Reference Model, Deployment Model, Characteristics, Benefits of Cloud Computing, Challenges ahead. Cloud computing vs. Cluster computing vs. Grid computing. **Migrating into a Cloud:** Introduction, Broad approaches to Migrating into the Cloud, The Seven-Step Model of Migration Into a Cloud. **Virtualization:** Introduction, Characteristics of Virtualized environment, Taxonomy of Virtualization techniques, Virtualization and Cloud Computing, Pros and Cons of	22 hours

Virtualization, Technology Examples- Xen, VMware, Microsoft Hyper-V. **Capacity Planning:** Introduction, Defining Baseline and Metrics-Baseline Measurements, System Metrics, Load Testing, Resource Ceilings, Server and Instance types; Network Capacity, Scaling.	
Part B **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. **Securing Cloud services:** Cloud Security, Securing Data-Brokered Cloud Storage Access, Storage location and tenancy, Encryption, Auditing and compliance. **Cloud Storage:** Provisioning Cloud Storage, Virtual storage containers, Cloud Storage Interoperability (CDMI, OCCI), Database Storage, Resource Management, **Advance Topics in Cloud:** Energy Efficiency in cloud, Market Oriented Cloud Computing, Federated Cloud Computing, Mobile Cloud Computing, Fog computing, BigData Analytics, Basics of IoT. **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.	22 hours

Text Books:

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

Reference Books:

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

E Books/ Online learning material:

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

Course Code: PGCA 1938
Course Name: Cloud Computing Laboratory

Program: MCA	**L:** 0 **T:**0 **P:**4
Branch: Computer Applications	**Credits:** 2
Semester:4th	**Contact hours:**4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: -**
Internal max. marks: 70	**Duration of end semester exam (ESE): -**
External max. marks: 30	**Elective status: core/elective** Elective
Total marks: 100	

Prerequisite: Working Knowledge of Linux Operating system
Co requisite:
Additional material required in ESE:
Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Learn the use of cloud computing tools offered by industry leaders.
CO2	Develop and deploy cloud applications using popular cloud platforms.
CO3	Configuration of the virtual machines on the cloud and building of a private cloud.

Sr. No.	Experiment Name
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.	Interact with Cloud Storage and conduct typical management tasks such as bucket creation, file transfers, Access Control Lists (ACL) permissions and Identity and Access Management (IAM) configuration.

6.	Setting up a private cloud using open source tools (Eucalyptus/Open Stack etc.).
