DEPARTMENT OF HIGHER EDUCATION

RAJA MAHENDRA PRATAP SINGH UNIVERSITY ALIGARH

Syllabus for Fourth to Fifth Year of Higher Education (FYUP & P.G.)

According to-

National Education Policy-2020

U.G. (Honour's) or U.G. (Honour's with Research) / P.G.

in

COMPUTER SCIENCE

SYLLABUS DEVELOPED BY				
S.N.	**NAME**	**DESIGNATION**	**DEPARTMENT**	**COLLEGE/UNIVERSITY**
1	**PROF. SHUBHNESH KUMAR GOYAL**	Professor	Mathematics	**D.S.(P.G.) COLLEGE, ALIGARH**
2	**INDRA PAL GUPTA**	Assistant Professor	Computer Science	**S.V. COLLEGE, ALIGARH**
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PROPOSED STRUCTURE OF PG COMPUTER SCIENCE SYLLABUS AS PER NEP 2020 GUIDELINES

GENERAL OVERVIEW

SEMESTER WISE TITLES OF THE PAPER IN PG M.Sc (C.S.) COURSE

YEAR	SEM	COURSE CODE	PAPER TITLE	THEORY/ PRACTICAL	CREDIT	TOTAL
4TH YEAR	VII	RB070701T	Problem Solving using C	THEORY	4	20/16
		RB070702T	Discrete Mathematics	THEORY	4	
			Choose both for U.G. (Honour's) and One for U.G. (Honour's with Research)-			
		RB070703T	i. Digital Electronics	THEORY	4	
		RB070704T	ii. Artificial Intelligence	THEORY	4	
		RB070705P	PRACTICAL	PRACTICAL	4	
	VIII	RB070801T	Computer Organization and Architecture	THEORY	4	20/24
		RB070802T	Object-Oriented Programming Using C++	THEORY	4	
			Choose both for U.G. (Honour's) and One for U.G. (Honour's with Research)-	THEORY		
		RB070803T	I. Web development using Python		4	
		RB070804T	II. Operating System with the case study of UNIX		4	
		RB070805P	PRACTICAL	PRACTICAL	4	
		RB070806R	**Research Project (Submission and Evaluation)**		8	
5TH YEAR	IX	RB070901T	Data Structure using 'C'/'C++'	THEORY	4	16
		RB070902T	Software Engineering & Testing	THEORY	4	
		RB070903T	**Choose any one –**			
		RB070904T	I. Web Technologies II. Computer Networks & Security	THEORY	4	
		RB070905P	PRACTICAL	PRACTICAL	4	
	X	RB071001T	Object Oriented Programming with JAVA	THEORY	4	24
		RB071002T	Cloud Computing	THEORY	4	
			Choose any one –			
		RB071003T	I. Machine Learning			
		RB071004T	II. P.H.P Programming	THEORY	4	
		RB071005P	PRACTICAL	PRACTICAL	4	
		RB071006R	**Research Project (Submission and Evaluation)**		8	

U.G. (Honour's) or U.G. (Honour's with Research) / P.G.

Detailed Syllabus

OF

COMPUTER SCIENCE

PG COMPUTER SCIENCE

B.Sc. (Honours/Honours with Research) (SEMESTER-VII)
PAPER-I : Problem Solving using C

Programme B.Sc. (Honours/Honours with Research	**Year: FOURTH**	**Semester: SEVENTH**
Subject: Computer Science		
Course Code: RB070701T	**Course Title: Problem Solving using C**	

Course outcomes:

CO 1 Describe the functional components and fundamental concepts of a digital computer system including number systems.

CO 2 Construct flowchart and write algorithms for solving basic problems.

CO 3 Write 'C' programs that incorporate use of variables, operators and expressions along with data types.

CO 4 Write simple programs using the basic elements like control statements, functions, arrays and strings.

CO 5 Write advanced programs using the concepts of pointers, structures, unions and enumerated data types.

CO 6 Apply pre-processor directives and basic file handling and graphics operations in advanced programming.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Problem Solving using C

Unit	Topics	No. of Lectures
I	**Basics of programming:** Approaches to problem solving, Use of high level programming language for systematic development of programs, Concept of algorithm and flowchart, Concept and role of structured programming. **Basics of C**: History of C, Salient features of C, Structure of C Program, Compiling C Program, Link and Run C Program, Character set, Tokens, Keywords, Identifiers, Constants, Variables, Instructions, Data types, Standard Input/Output, Operators and expressions.	**15**
II	**Conditional Program Execution:** if, if-else, and nested if-else statements, Switch statements, Restrictions on switch values, Use of break and default with switch, Comparison of switch and if-else. **Loops and Iteration:** for, while and do-while loops, Multiple loop variables, Nested loops, Assignment operators, break and continue statement. **Functions:** Introduction, Types, Declaration of a Function, Function calls, Defining functions, Function Prototypes, Passing arguments to a function Return values and their types, Writing multifunction program, Calling function by value, Recursive functions.	**15**
III	**Arrays:** Array notation and representation, Declaring one-dimensional array, Initializing arrays, Accessing array elements, Manipulating array elements, Arrays of unknown or varying size, Two-dimensional arrays, Multidimensional arrays. **Pointers:** Introduction, Characteristics, * and & operators, Pointer type declaration and assignment, Pointer arithmetic, Call by reference, Passing pointers to functions, arrayof pointers, Pointers to functions, Pointer to pointer, Array of pointers. **Strings:** Introduction, Initializing strings, Accessing string elements, Array of strings, Passing strings to functions, String functions.	**15**

IV	**Structure:** Introduction, Initializing, defining and declaring structure, Accessing members, Operations on individual members, Operations on structures, Structure within structure, Array of structure, Pointers to structure. **Union:** Introduction, Declaring union, Usage of unions, Operations on union. Enumerated data types **Storage classes**: Introduction, Types- automatic, register, static and external. **Searching and Sorting:** Introduction to searching and sorting, Linear search, Binary search, Selection sort, Bubble sort. **Dynamic Memory Allocation**: Introduction, Library functions – malloc, calloc, realloc and free. **File Handling:** Basics, File types, File operations, File pointer, File opening modes, File handling functions, File handling through command line argument, Record I/O in files.	**15**

Suggested Readings:

1. Kanetkar Y., "Let us C", BPB Publications.
2. Balagurusamy E., "Programming with ANSI-C", Tata McGraw Hill.
3. Hanly J.R. and Koffman E.B., "Problem Solving and Program Design in C", Pearson Education.
4. Gottfried B.S., "Programming with C Language, Schaum Series, Tata McGraw Hill.
5. Goyal K. K. and Pandey H.M., Trouble Free C", University Science Press.
6. Kernighan and Richie, "C Programming", Prentice Hall of India.
7. Forouzan B.A. and Gilberg R.F., "A Structured Programming Approach Using C, Cengage Learning.
8. Goyal K. K., Sharma M. K. and Thapliyal M. P. "Concept of Computer and C
9. Programming", University Science Press.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

B.Sc. (Honours/Honours with Research) (SEMESTER-VII)
PAPER-II : Discrete Mathematics

Programme: B.Sc. (Honours/Honours with Research	**Year: FOURTH**	**Semester: SEVENTH**
Subject: Computer Science		
Course Code: RB070702T	**Course Title: Discrete mathematics**	

Course outcomes:

CO 1 Use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations and Functions

CO 2 Apply mathematical arguments using logical connectives and quantifiers

to check the validity of an argument through truth tables and propositional and predicate logic

CO 3 Identify and prove properties of Algebraic Structures like Groups, Rings and Fields

CO 4 Formulate and solve recurrences and recursive functions

CO 5 Apply the concept of combinatorics to solve basic problems in discrete mathematics

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Discrete mathematics

Unit	Topics	No. of Lectures
I	**Set Theory:** Definition of sets, Venn Diagrams, proofs of some general identities on sets. **Relation:** Definition, types of relation, composition of relations, Pictorial representation of relation, equivalence relation, partial ordering relation. **Function:** Definition, type of functions, one to one, into and onto function, inverse function, composition of functions, recursively defined functions.	**15**
II	**Algebraic Structures:** Properties, Semi group, Monoid, Group, Abelian group, Properties of group, Subgroup, Cyclic group, Cosets, Permutation groups, Homomorphism, Isomorphism and Automorphism of groups.	**15**
III	**Propositional Logic:** Preposition, First order logic, Basic logical operations, Tautologies, Contradictions, Algebra of Proposition, Logical implication, Logical equivalence, Normal forms, Inference Theory, Predicates and quantifiers.	**15**
IV	**Posets, Hasse Diagram and Lattices:** Introduction, Ordered set, Hasse diagram of partially ordered set, Isomorphic ordered set, Well ordered set, Properties of Lattices and complemented lattices.	**15**

Suggested Readings:

1. Tremblay J.P. and Manohar R., "Discrete Mathematical Structures with Application to Computer Science", Tata McGraw Hill.
2. Lipschutz S. and Lipson M., "Discrete Mathematics", Tata McGraw Hill.
3. Rosen K.H., "Discrete Mathematics and its Applications", Tata McGraw Hill.
4. Sarkar S.K., "A Textbook of Discrete Mathematics", S. Chand Publishing.
5. Sharma J.K., "Discrete Mathematics', Trinity Press.
6. Gupta S.B., "Discrete Mathematics and Structures", University Science Press.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

B.Sc. (Honours/Honours with Research) (SEMESTER-VII)
PAPER-III : Digital Electronics

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: seventh**
Subject: Computer Science		
Course Code: RB070703T	**Course Title: Digital Electronics**	

Course outcomes:

CO 1 Apply concepts of Digital Binary System, complements and Binary codes.

CO 2 Apply the concepts of Boolean Algebra and logic gates.

CO 3 Understand and implementation of gates.

CO 4 Analyze and Design of Combinational logic circuits.

CO 5 Analysis and design sequential logic circuits with their applications. Implement the design procedure of synchronous and asynchronous sequential circuits.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Digital Electronics

Unit	Topics	No. of Lectures
I	**Number Systems**: Number System: Binary, Octal, Decimal, Hexadecimal, Conversion of Number System, Binary Arithmetic &Complement, Binary Codes: Weighted & Non Weighted, Gray Code, Excess-3 Code. Error Detection Codes, Hamming Code	**15**
II	**Boolean Algebra and Logic Gates**: Basic definitions, Boolean Function, Boolean Postulates, De-Morgan's Theorem ,Boolean Expressions: Sum of Product, Product of Sum, Minimization of Boolean Expressions using K-Map, Logic Gates: AND, OR, NOT,NAND, NOR, XOR, XNOR, Implementations of Logic Functions using Gates, NAND, NOR Implementations, Multilevel gate Implementations.	**15**
III	**Combinational Logic:** Design procedure, Adders, Subtractors, Code conversion, Analysis procedure, Multilevel NAND and NOR circuits, Exclusive-OR and Equivalence Functions, Binary Parallel Adder, Decimal Adder, Magnitude comparator, Decoders, Multiplexers.	**15**
IV	**Sequential Logic:** Flip-flops, Types of flip-flop, RS (NAND and NOR) flip-flop, Edge triggered D flip-flop, Edge triggered T flip-flop, Edge triggered JK flip-flop, Master-Slave flip-flop, Triggering, propagation delay time, setup time, hold time. Memories, ROM, RAM, EPROM, EEPROM, Volatile and non-volatile – Static and dynamic RAM.	**15**

Suggested Readings:

1. Mano M., “Digital Logic and Computer Design”, Pearson.
2. Mano M., “Digital Design”, Prentice-Hall of India.
3. Gaur R.K., “Digital Electronics and Micro-computers”, Dhanpat Rai Publications.
4. Jain R.P. “Modern Digital Electronics”, McGraw-Hill Education.
5. Malvino A.P. and Leach D.P., “Digital Principles and Applications”, McGraw-Hill Education.
6. Rajaraman V. and Radhakrishanan T., “An Introduction to Digital Computer Design”, Prentice-Hall India Pvt. Ltd.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

B.Sc. (Honours/Honours with Research) (SEMESTER-VII)
PAPER-IV : Artificial Intelligence

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: Seventh**
Subject: Computer Science		
Course Code: RB070704T	**Course Title: Artificial Intelligence**	

Course outcomes:

CO 1 Define the meaning of intelligence and study various intelligent agents.

CO 2 Understand, analyze and apply AI searching algorithms in different problem domains.

CO 3 Study and analyze various models for knowledge representation.

CO 4 Understand the basic concepts of machine learning to analyze and implement widely used learning methods and algorithms.

CO 5 Understand the concept of pattern recognition and evaluate various classification and clustering techniques

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Artificial Intelligence

Unit	Topics	No. of Lectures
I	**Artificial Intelligence**: Introduction to artificial intelligence, Historical development and foundation areas of artificial intelligence, Tasks and application areas of artificial intelligence. Introduction, types and structure of intelligent agents, Computer Vision, Natural language processing.	**15**
II	**Searching Techniques:** Introduction, Problem solving by searching, Searching for solutions, Uniformed searching techniques, Informed searching techniques, Local search algorithms, Adversarial search methods, Search techniques used in games, Alpha-Beta pruning.	**15**
III	**Knowledge Representation and Reasoning:** Propositional logic, Predicate logic, First order logic, Inference in first order logic, Clause form conversion, Resolution. Chaining- concept, forward chaining and backward chaining, Utility theory and Probabilistic reasoning, Hidden Markov model, Bayesian networks.	**15**
IV	**Machine Learning:** Introduction, types and application areas, Decision trees, Statistical learning methods, Learning with complete data - concept and Naïve Bayes models, Learning with hidden data- concept and EM algorithm, Reinforcement learning. **Pattern Recognition:** Introduction and design principles, Statistical pattern recognition, Parameter estimation methods - Principle component analysis and Linear discrimination analysis, Classification techniques - Nearest neighbor rule and Bayes classifier, K-means clustering, Support vector machine.	**15**

Suggested Readings:

1. Russell S. and Norvig P., "Artificial Intelligence – A Modern Approach", Pearson Education.
2. Rich E. and Knight K., "Artificial Intelligence", McGraw Hill Publications.
3. Charnik E. and McDermott D., "Introduction to Artificial Intelligence", Pearson Education.
4. Patterson D. W., "Artificial Intelligence and Expert Systems", Prentice Hall of India Publications.
5. Khemani D., "A First Course in Artificial Intelligence", McGraw Hill.
6. Winston P. H., "Artificial Intelligence", Pearson Education.
7. Thornton C. and Boulay B.," Artificial Intelligence- Strategies, Applications and Models through Search", New Age International Publishers.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

B.Sc. (Honours/Honours with Research) (SEMESTER-VIII)
PAPER-I : Computer Organization and Architecture

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: Eighth**
Subject: Computer Science		
Course Code: RB070801T	**Course Title: Computer Organization and Architecture**	

Course outcomes:

CO 1 Identify various components of computer and their interconnection

CO 2 Identify basic components and design of the CPU: the ALU and control unit.

CO 3 Compare and select various Memory devices as per requirement.

CO 4 Compare various types of IO mapping techniques

CO Critique the performance issues of cache memory and virtual memory

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Computer Organization and Architecture

Unit	Topics	No. of Lectures
I	**STRUCTURE OF COMPUTERS:** Computer types, Functional units, Basic operational concepts, Von Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes. **COMPUTER ARITHMETIC:** Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations	15
II	**BASIC COMPUTER ORGANIZATION AND DESIGN:** Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC	15
III	**REGISTER TRANSFER AND MICRO-OPERATIONS:** Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. MICRO-PROGRAMMED CONTROL: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.	15
IV	**MEMORY SYSTEM:** Memory Hierarchy, Semiconductor Memories, RAM(Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.	15

Suggested Readings:

TEXT BOOKS:

1. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,
4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:




B.Sc. (Honours/Honours with Research) (SEMESTER-VIII)
PAPER-II : Object-Oriented Programming Using C++

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: 8th**
Subject: Computer Science		
Course Code: RB070802T	**Course Title: Object-Oriented Programming Using C++**	

Course outcomes:

CO1: Understand the Basic concept of Object Orientation, object identity and Encapsulation.

CO2: Understand the Basic concept of Basic Structural Modeling.

CO3: Know the knowledge of Object oriented design, Object design.

CO4: Know the knowledge of C++ Basics.

CO5: Understand the Basics of object and class in C++.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Object-Oriented Programming Using C++

Unit	Topics	No. of Lectures
I	**Principles of Objective Oriented Programming:** Introduction to object-oriented programming, user defined types, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.	**15**
II	**Functions in C++, Classes & Objects:** The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend and Virtual Functions. Specifying a class, Member Functions, Arrays within a class, Static Member Functions, Arrays of Objects, Friendly Functions. Constructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, Defining Operator Overloading, Overloading Operators, Rules for Overloading Operators, Type Conversions	**15**
III	**Pointers, Virtual Functions & Polymorphism,** Pointers, Declaration , Pointers to Objects, this pointer, Pointer to Derived Classes, Virtual Functions, Pointer operator, Address operator, Pointer arithmetic, Pointer to derived class, Introduction of Polymorphism, Types of polymorphism , Compile time Polymorphism: Function overloading, Revision of constructor overloading, Operator overloading: Rules for operator overloading, Overloading of unary and binary operators, Run time polymorphism: Virtual function, Rules for virtual function, Pure virtual function.	**15**
IV	**Working with Files, Exception handling :** Opening and Closing a File, File Modes, File Pointers, Input Output Operations, Updating a File, Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions, resource capture and release.	**15**

Suggested Readings:

1. Object Oriented Design by Rumbaugh (Pearson publication)
2. Object-oriented programming in Turbo C++ By Robert Lafore, Galgotia Publication.
3. Object-oriented programming with C++ by E.Balagurusamy, 2nd Edition, TMH.
4. Object Oriented Programming in C++ by Robert Lafore Techmedia Publication.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

B.Sc. (Honours/Honours with Research) (SEMESTER-VIII)
PAPER-III : Web development using Python

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: 8th**
Subject: Computer Science		
Course Code: RB070803T	**Course Title: Web development using Python**	

Course outcomes:

- To introduce students to the fundamentals of web technologies.
- To enable students to develop dynamic web applications using Python.
- To impart practical knowledge of Flask and Django frameworks.
- To develop, test, and deploy full-stack web applications.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Web development using Python

Unit	Topics	No. of Lectures
I	**Web Fundamentals and Python Programming Basics:** Introduction to the Internet, Web Servers, HTTP/HTTPS, Client-server architecture, Static vs Dynamic websites, HTML5: Elements, Forms, Tables, Multimedia, CSS3: Styling, Selectors, Layouts (Flexbox), Responsive Design, JavaScript (Basic Concepts): DOM manipulation, Form Validation, Python Basics: Data types, Conditional statements, Loops, Functions, Python modules, File handling, Exception handling, Virtual Environment (venv), Package Management (pip)	15
II	**Web Development Using Flask :** Introduction to Flask and Setup, Application structure and Routing, Templates and Jinja2 engine, Handling Forms (GET/POST methods), Working with sessions and cookies, Connecting Flask with databases (SQLite/MySQL), CRUD operations using Flask, Introduction to RESTful APIs in Flask	15
III	**Web Development Using Django,** Django installation and project setup, Django architecture: Models, Views, Templates (MVT), Creating Django Apps, URL Routing, Working with Django Models and ORM, Django Templates and Static files, Django Forms and Model Forms, Authentication system: Login, Logout, Registration, Admin interface customization	15
IV	**Advanced Topics and Project Development:** Django REST Framework: Basic API creation, Security in Web Applications: CSRF, XSS, SQL Injection prevention, Deployment: Version control using Git and GitHub, Hosting on Heroku / PythonAnywhere / Render, Using .env files and managing secrets, Capstone Project: Design and develop a full-stack application, Documentation, Testing, and Deployment.	15

Suggested Readings:

1. **Flask Web Development by Miguel Grinberg (O'Reilly)**
2. **Django for Beginners by William S. Vincent**
3. **Learning Web Development with Python by Fabrizio Romano**
4. **MDN Web Docs: https://developer.mozilla.org**
5. **Official Flask Documentation: https://flask.palletsprojects.com**
6. **Official Django Documentation: https://docs.djangoproject.com**

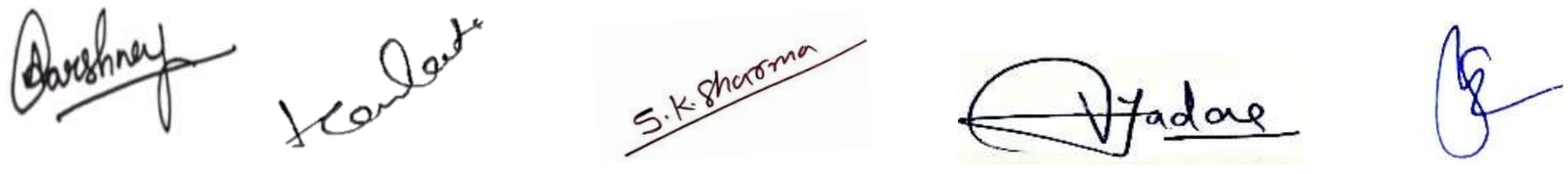
Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:



B.Sc. (Honours/Honours with Research) (SEMESTER-VIII)
PAPER-IV : Operating System with the case study of UNIX

Programme: B.Sc. (Honours/Honours with Research)	**Year: Fourth**	**Semester: 8th**
Subject: Computer Science		
Course Code: RB070804T	**Course Title: Operating System with the case study of UNIX**	

Course outcomes:

CO 1 Explain main components, services, types and structure of Operating Systems.

CO 2 Apply the various algorithms and techniques to handle the various concurrency control issues.

CO 3 Compare and apply various CPU scheduling algorithms for process execution.

CO 4 Identify occurrence of deadlock and describe ways to handle it.

CO 5 Explain and apply various memory, I/O and disk management techniques.

Credits: 4	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Operating System with the case study of UNIX

Unit	Topics	No. of Lectures
I	**Introduction**: Concept of Operating Systems, Generations of Operating systems, Types of pirating Systems, OS Services, System Calls, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	15
II	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	15
III	**Deadlocks & Scheduling Algorithm:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation and Compaction; Paging: Principle of operation, Page allocation, Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault, Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)..	15
IV	**Unix/Linux Operating System:** Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration. Case study: Linux, Windows Operating System	15

Suggested Readings:

1. **Operating System Concepts Essentials, 9th Edition by Abraham Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.**
2. **Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.**
3. **Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing**
4. **Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley**
5. **Design of the UNIX Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India**
6. **Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates**

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-IX)
PAPER-I : Data Structure using 'C'/'C++'

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 9TH**
Subject: Computer Science		
Course Code: RB070901T	**Course Title: Data Structure using 'C'/'C++'**	

Course outcomes:

CO 1 Explain the concept of data structure, abstract data types, algorithms, analysis of algorithms and basic data organization schemes such as arrays and linked lists.

CO 2 Describe the applications of stacks and queues and implement various operations on them using arrays and linked lists.

CO 3 Describe the properties of graphs and trees and implement various operations such as searching and traversal on them.

CO 4 Compare incremental and divide-and-conquer approaches of designing algorithms for problems such as sorting and searching

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 33 (With 25 mandatories in External Examination)**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Data Structure using 'C'/'C++'

Unit	Topics	No. of Lectures
I	**Fundamentals:** Introduction to Data Structures, Definition and importance of data structures. Classification of data structures (linear vs. non-linear, static vs. dynamic). Abstract Data Types (ADTs). C/C++ Programming Review: Basic syntax, control structures, and functions. Pointers and dynamic memory allocation. Structures and classes (for C++). Algorithm Analysis: Time and space complexity, Big O notation, Best, average, and worst-case analysis.	**15**
II	**Linear Data Structures:** Arrays, Basic array operations (insertion, deletion, traversal), Multi-dimensional arrays, Dynamic arrays (using dynamic memory allocation), Stack operations (push, pop, peek), Applications of stacks (function calls, expression evaluation), Queues: Queue implementation using arrays and linked lists. Queue operations (enqueue, dequeue). Types of queues (circular queue, priority queue). Applications of queues (scheduling, buffering). Linked Lists: Singly linked lists, doubly linked lists, circular linked lists, Linked list operations (insertion, deletion, traversal, searching), Applications of linked lists, Stack implementation using arrays and linked lists,	**15**
III	**Non-Linear Data Structures:** Trees, Tree terminology (root, node, leaf, etc.), Binary trees, binary search trees (BST), Tree traversals (inorder, preorder, postorder), BST operations (insertion, deletion, searching), Balanced trees (AVL trees, red-black trees). Graph terminology (vertices, edges, directed vs. undirected). Graph representations (adjacency matrix, adjacency list). Graph traversals (breadth-first search (BFS), depth-first search (DFS)), Applications of graphs (network analysis, shortest path algorithms).	**15**
IV	**Sorting and Searching:** Bubble sort, insertion sort, selection sort, Merge sort, quicksort, Heap sort, Linear search, Binary search. Advanced Topics: Hash functions, Collision resolution techniques, Hash table implementation, Basic concepts of dynamic programming, Memorization and tabulation techniques.	**15**

Suggested Readings:

1. Gilberg and Forouzan: “Data Structure- A Pseudo code approach with C” by Thomson publication.
2. “Data structure in C” by Tanenbaum, PHI publication / Pearson publication.
3. Pai:” Data Structures & Algorithms; Concepts, Techniques & Algorithms” Tata McGraw Hill.
4. “Fundamentals of data structure in C” Horowitz, Sahani & Freed, Computer Science Press.
5. “Fundamental of Data Structure” (Schaums Series) Tata-McGraw-Hill.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:





M.Sc. (Computer Science) (SEMESTER-IX)
PAPER-II : Software Engineering & Testing

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 9th**
Subject: Computer Science		
Course Code: RB070902T	**Course Title : Software Engineering & Testing**	

Course outcomes:

CO 1 Explain various software characteristics and analyze different software Development Models.

CO 2 Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.

CO 3 Compare and contrast various methods for software design.

CO 4 Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.

CO 5 Manage software development process independently as well as in teams and make use of various software management tools for development, maintenance and analysis.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Software Engineering & Testing

Unit	Topics	No. of Lectures
I	**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	**15**
II	**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model. **Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.	**15**
III	**Software Testing:** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top Down and Bottom- Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.	**15**

IV	**Software Maintenance and Software Project Management:** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.	**15**

Suggested Readings:

. R S Pressman, “Software Engineering: A Practitioners Approach”, McGraw Hill.

2. Pankaj Jalote, “Software Engineering”, Wiley

3. Rajib Mall, “Fundamentals of Software Engineering”, PHI Publication.

4. K K Aggarwal and Yogesh Singh, “Software Engineering”, New Age International Publishers.

5. Ghezzi, M. Jarayeri, D. Manodrioli, “Fundamentals of Software Engineering”, PHI Publication.

6. Ian Sommerville, “Software Engineering”, Addison Wesley.

7. Kassem Saleh, “Software Engineering”, Cengage Learning

8. Pfleeger, “Software Engineering”, Macmillan Publication

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-IX)
PAPER-III : Web Technologies

Class:M.Sc C.S.	**Year:Fifth**	**Semester: 9th**
Subject: Computer Science		
Course Code: RB070903T	**Course Title - : Web Technologies**	

Course outcomes:

CO 1 Apply the knowledge of HTML and CSS to develop web application and analyze the insights of internet programming to implement complete application over the web.
CO 2 Understand, analyze and apply the role of JavaScript in the workings of the web and web applications.
CO 3 Understand, analyze and build dynamic web applications using servlet and JSP.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Web Technologies

Unit	Topics	No. of Lectures
I	**Introduction**: Introduction and Web Development Strategies, History of Web and Internet, Protocols Governing Web, Writing Web Projects, Connecting to Internet, Introduction to Internet services and tools, Introduction to client-server computing. HTML-Introduction, HTML Tags, HTML-Grouping Using Div & Span, HTML-Lists, HTML-Images, HTML-Hyperlink, HTML Table, HTML-Iframe, HTML-Form,	**15**
II	**CSS:** Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) **CSS Advanced** (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Color, Creating page Layout and Site Designs.	**15**
III	**Scripting:** Introduction to JavaScript, Creating Variables in JavaScript, Creating Functions in JavaScript, UI Events, Returning Data from Functions, Working with Conditions, looping in JavaScript, Block Scope Variables, Working with Objects, Creating Object using Object Literals, Manipulating DOM Elements with JavaScript	**15**
IV	**Web Application development using JSP & Servlets:** Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resources, Session Tracking, Cookies, Session Tracking with Http Session. Java Server Pages (JSP): Introduction, Java Server Pages Overview, A First Java Server Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries.	**15**

Suggested Readings:

1. Burdman J., “Collaborative Web Development – Strategies and Best practices for Web Teams”, Addison-Wesley.
2. Bayross I., “Web Technologies”, BPB Publications.
3. Schieldth H., “The Complete Reference – HTML & CSS”,
4. Bergsten H., “Java Server Pages”, SPD O’ Reilly.

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Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-IX)
PAPER-IV : Computer Networks & Security

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 9th**
Subject: Computer Science		
Course Code: RB070904T	**Course Title - Computer Networks & Security**	

Course outcomes:

CO 1 Explain various software characteristics and analyze different software Development Models.

CO 2 Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.

CO 3 Compare and contrast various methods for software design.

CO 4 Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.

CO 5 Manage software development process independently as well as in teams and make use of various software management tools for development, maintenance and analysis.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Computer Networks & Security

Unit	Topics	No. of Lectures
I	**Application Layer:** Principles of Network Applications: Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols. The Web and HTTP: Overview of HTTP, Non-persistent and Persistent Connections, HTTP Message Format, User-Server Interaction: Cookies, Web Caching, The Conditional GET, File Transfer: FTP Commands & Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Message Format, Mail Access Protocols, DNS; The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages, Peer-to-Peer Applications: P2P File Distribution, Distributed Hash Tables, Socket Programming: creating Network Applications: Socket Programming with UDP, Socket Programming with TCP.	**15**
II	**Transport Layer :** Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing: Connectionless Transport: UDP,UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N, Selective repeat, Connection-Oriented Transport TCP: The TCP Connection, TCP Segment Structure, Round Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control: The Causes and the Costs of Congestion, Approaches to Congestion Control, Network-assisted congestion-control example, ATM ABR Congestion control, TCP Congestion Control: Fairness.	**15**
III	**The Network layer:** What's Inside a Router?: Input Processing, Switching, Output Processing, Where Does Queuing Occur? Routing control plane, IPv6,A Brief foray into IP Security, Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing, Routing in the Internet, Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter/AS Routing: BGP, Broadcast Routing Algorithms and Multicast.	**15**

IV	**Network Security:** Overview of Network Security:Elements of Network Security , Classification of Network Attacks ,Security Methods ,Symmetric-Key Cryptography :Data Encryption Standard (DES),Advanced Encryption Standard (AES) , Public-Key Cryptography :RSA Algorithm ,Diffie-Hellman Key-Exchange Protocol , Authentication :Hash Function , Secure Hash Algorithm (SHA) , Digital Signatures , Firewalls and Packet Filtering ,Packet Filtering , Proxy Server .	**15**

Suggested Readings:

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill, Indian Edition
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER
3. Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson
4. Mayank Dave, Computer Networks, Second edition, Cengage Learning

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-X)
PAPER-I : Object Oriented Programming with JAVA

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 10th**
Subject: Computer Science		
Course Code RB071001T	**Course Title - Object Oriented Programming with JAVA**	

Course outcomes:

CO 1 List the significance and key features of object oriented programming and modeling using UML

CO 2 Construct basic structural, behavioral and architectural models using object oriented software engineering approach.

CO 3 Integrate object oriented modeling techniques for analysis and design of a system.

CO 4 Use the basic features of data abstraction and encapsulation in Java programs.

CO 5 Use the advanced features such as Inheritance, polymorphism and virtual function in java programs.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Object Oriented Programming with JAVA

Unit	Topics	No. of Lectures
I	**Introduction:** Object Oriented Programming: objects, classes, Abstraction, Encapsulation, Inheritance, Polymorphism, OOP in Java, Characteristics of Java, The Java Environment, Java Source File Structure, and Compilation. Fundamental Programming Structures in Java: Defining classes in Java, constructors, methods, access specifies, static members, Comments, Data Types, Variables, Operators, Control Flow, Arrays.	15
II	**Inheritance, Interfaces, and Packages:** Inheritance: Super classes, sub classes, Protected members, constructors in sub classes, Object class, abstract classes and methods. Interfaces: defining an interface, implementing interface, differences between classes and interfaces and extending interfaces, Object cloning, inner classes. Packages: Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages, Import and Static Import Naming Convention For Packages, Networking java.net package.	15
III	**Exception Handling, I/O: Exceptions:** exception hierarchy, throwing and catching exceptions, built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics: Byte streams and Character streams, Reading and Writing, Console Reading and Writing Files. **Multithreading and Generic Programming:** Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming: Generic classes, generic methods, Bounded Types: Restrictions and Limitations.	15
IV	**Event Driven Programming:** Graphics programming: Frame, Components, working with 2D shapes,Using colors, fonts, and images. Basics of event handling: event handlers, adapter classes, actions, mouse events, AWT event hierarchy. Introduction to Swing: layout management, Swing Components: Text Fields, Text Areas, Buttons, Check Boxes, Radio Buttons, Lists, choices, Scrollbars, Windows Menus and Dialog Boxes.	15

Suggested Readings:

1. Herbert Schildt, "Java The complete reference‖", McGraw Hill Education, 8th Edition, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java Volume –I Fundamentals", Prentice Hall, 9th Edition,2013.
3. Steven Holzner, “Java Black Book”, Dreamtech.
4. Balagurusamy E, “ Programming in Java”, McGraw Hill
5. Naughton, Schildt, “The Complete reference java2”, McGraw Hill
6. Khalid Mughal, “A Programmer’s Guide to Java SE 8 Oracle Certified Associate (OCA)”, Addison Wesley.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-X)
PAPER-II : Cloud Computing

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 10th**
Subject: Computer Science		
Course Code RB071002T	**Course Title : Cloud Computing**	

Course outcomes:

CO 1 Understand the concepts of Cloud Computing, key technologies, strengths and limitations of cloud computing.

CO 2 Develop the ability to understand and use the architecture to compute and storage cloud, service and models.

CO 3 Understand the application in cloud computing.

CO 4 Learn the key and enabling technologies that help in the development of cloud.

CO 5 Explain the core issues of cloud computing such as resource management and security.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Cloud Computing

Unit	Topics	No. of Lectures
I	**Introduction:** Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing- issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.	**15**
II	**Cloud Services:** Types of Cloud services: Software as a Service Platform as a Service –Infrastructure as a Service - Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force. **Collaborating Using Cloud Services**: Email Communication over the Cloud - CRM Management – Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.	**15**
III	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System VM, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - supervisors – Xen, KVM, VMware, Virtual Box, Hyper-V.	**15**
IV	**Security, Standards and Applications:** Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud. Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine	**15**

Suggested Readings:

1. David E.Y. Sarna, "Implementing and Developing Cloud Application", CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing : A Practical Approach", Tata McGraw-Hill 2010.
4. Haley Beard, "Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008.
5. G. J. Popek, R.P. Goldberg, "Formal requirements for virtualizable third generation Architectures, Communications of the ACM", No.7 Vol.17, July 1974

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-X)
PAPER-III : Machine Learning

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 10th**
Subject: Computer Science		
Course Code RB071003T	**Course Title - Machine Learning**	

Course outcomes:

CO 1 To understand the need for machine learning for various problem solving

CO 2 To understand a wide variety of learning algorithms and how to evaluate models generated from data

CO 3 To understand the latest trends in machine learning

CO 4 To design appropriate machine learning algorithms and apply the algorithms to a real-world problems

CO 5 To optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Machine Learning

Unit	Topics	No. of Lectures
I	**INTRODUCTION –** Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, Genetic Algorithm), Issues in Machine Learning and Data Science Vs Machine Learning;	**15**
II	**REGRESSION:** Linear Regression and Logistic Regression **BAYESIAN LEARNING -** Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. **SUPPORT VECTOR MACHINE**: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel,and Gaussian kernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.	**15**
III	**DECISION TREE LEARNING -** Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. **INSTANCE-BASED LEARNING** – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	**15**
IV	**ARTIFICIAL NEURAL NETWORKS –** Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; **DEEP LEARNING -** Introduction, concept of convolutional neural network , Types of layers – (Convolutional Layers , Activation function , pooling , fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.	**15**

Suggested Readings:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.
5. M. Gopal, "Applied Machine Learning", McGraw Hill Education

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions:

M.Sc. (Computer Science) (SEMESTER-X)
PAPER-IV : P.H.P Programming

Class:M.Sc C.S.	**Year: Fifth**	**Semester: 10th**
Subject: Computer Science		
Course Code RB071004T	**Course Title - P.H.P Programming**	

Course outcomes:

1. Discover how the web works. what makes web sites work.
2. Implement simple and impressive design techniques, limo basics to advanced - so as to focus on goal oriented and user centric designs.
3. Use Server Side Scripting.
4. Implement concept of data persistence.
5. Apply skills to program logic using PHP and handle data using MySQL.
6. Develop dynamic websites using PHP & MySQL.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	**Min. Passing Marks: 40 (With 30 mandatories in External Examination)**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

P.H.P Programming

Unit	Topics	No. of Lectures
I	**BASICS OF PHP:** Introduction to PHP. PHP l'eatures, installation of XAMPP/WAMP, Benefits of using PHP MYSQL, Server Client Environment. Web Browser, Web SeNer Installation & Configumtion Files. OOPS with PHP, language basics, syntax, comments, variables, constants and data types, expressions and operators, flow control statements, looping structurcs, Arays Including html code in PHP, Embedding PHP in web pages.	**15**
II	**FUNCTIONS & STRINGS in PHP:** Defining a function, Calling a function, variable scope, l'unction parameters, return values, User Defined Function, System Defined Function, Parameterized Function. Date & Time Function, Hash Function. Mail Function, predefined functions. Strings: Creating & accessing string, searching and replacing strings, encoding and escaping, comparing st ngs, fomatting strings, regular expression.	**15**
III	**Data & File Handling**: PHP Forms: $ GET,$ POST,$ REQUEST, $_FILES, $ SERVER, $CLOBALS, $_ENV, input/output cortrols, validation, Cookies and Sessions. File Handling: File and directory. open, close. read, write. append, delete, uploading and downloading files. File exists. File Size, Rename. Reading and display all/selected files present in a dircctory.	**15**
IV	**MySQL an Overview:** lntroduction. What is a Database. Understanding an RDUMS. Tables. Record & Fields. SQI Language. **Working with phpmyadmin:** Creating and using a database. Selecting a database. creating/dropping a table. loading data into a table, Retrieving inlbnnation tiom a table. selecting all data. selecting particular rows. selecling pafiicular columns, writing queries. sorting. date, calculations, working with NIJLL values, pattern matohing, counting ro\\s. using more than one tables, usillg table and column aliases. **MySQL DATABASES IN PHP:** lntroduction. connecting to a MySQL database, querying the database, Retrieving and displaying the results, modifying data and deleting data thlough fiont end. Designing applications using PHP & MvSQL.	**15**

Suggested Readings:

1. Head First PHP & MySQL, Lynn Beighley & Michael Monison, O'Reilly
2. PHP: A Beginner's Guide, Vikram Vaswani, McGraw-Hill Edition
3. Learning PHP, MySQl. Javascript, & CSS: A Step-by-Step Guide to Creating Dynamic Websites, Robin Nixon, O'Reilly
4. PHP and MySQL Web Development, Luke Welling. Addison-Wesley
5. The Joy of PHP Alan Forbes BeakCheck LLC
6. o Leaming PHP, MySQL, Javascript & CSS: A Step-by-Step Guide to Creating Dynamic Websites, Robin Nixon, O'Reilly.

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation/** Research Orientation assignment	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have subject Mathematics in class 12th

Suggested equivalent online courses:

Further Suggestions: