PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, PRAYAGRAJ

Department of Higher Education

U.P. Government, Lucknow

National Education Policy-2020

Common Minimum Syllabus for all U.P. State Universities

Year wise Structure of B.Sc. (Computer Science)

Year	Paper	Course Code	Paper Title	Theory/Practical	Credits
1	I	B070101T	Problem Solving using Computer	Theory	4
	II	B070102P	Software Lab using Python	Practical	2
	III	B070201T	Database Management Systems	Theory	4
	IV	B070202P	Database Management Systems Lab	Practical	2
2	I	B070301T	Operating Systems	Theory	4
	II	B070302P	Operating Systems Lab	Practical	2
	III	B070401T	Computer System Architecture	Theory	4
	IV	B070402P	Computer System Architecture Lab	Practical	2
3	I	B070501T	Analysis of Algorithms and Data Structures	Theory	4
	II	B070502T	Soft Computing	Theory	4
	III	B070503P	Lab on Algorithms and Data Structures with C++	Practical	2
	IV	B070504R	Research Project-I	Project	Qualifying
	V	B070601T	Data Communication and Computer Networks	Theory	4
	VI	B070602T	Cyber Security & Cyber Laws	Theory	4
	VII	B070603P	Lab on Computer Networks	Practical	2
	VIII	B070604R	Research Project-II	Project	Qualifying

Name	Designation	Affiliation
Steering Committee		
Mrs. Monika S. Garg, (I.A.S.) Chairperson Steering Committee	Additional Chief Secretary	Dept. of Higher Education U.P., Lucknow
Prof. Poonam Tandan	Professor, Dept. of Physics	Lucknow University, U.P.
Prof. Hare Krishna	Professor, Dept. of Statistics	CCS University Meerut, U.P.
Dr. Dinesh C. Sharma	Associate Professor, Dept. of Zoology	K.M. Govt. Girls P.G. College Badalpur, G.B. Nagar, U.P.
Supervisory Committee-Science Faculty		
Dr. Vijay Kumar Singh	Associate Professor, Dept. of Zoology	Agra College, Agra
Dr. Santosh Singh	Dean, Dept. of Agriculture	Mahatma Gandhi Kashi Vidhyapeeth, Varanasi
Dr. Baby Tabussam	Associate Professor, Dept. of Zoology	Govt. Raza P.G. College Rampur, U.P.
Dr. Sanjay Jain	Associate Professor, Dept. of Statistics	St. John's College, Agra

Syllabus Developed by:

S.No.	Name	Designation	Department	College/University
1.	Prof. Ashutosh Gupta	Director/Professor	School of Science	U.P.Rajarshi Tandon Open University, Prayagraj
2.	Prof. Manu Pratap Singh	Professor	Computer Science	Dr. B. R. Ambedkar University, Agra
3.	Dr. Brajesh Kumar	Associate Professor	Computer Science and Info. Tech.	MJP Rohilkhand University, Bareilly

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, PRAYAGRAJ

Year wise Structure
of
B.Sc. (Computer Science)

Subject prerequisites To study the Computer Science, a student must have had the subject(s) computer science OR Mathematics in class/12th.	
Programme outcomes (POs): Students taking admission to B.Sc. program are expected to get prepared with following outcomes:	
PO 1	Explaining the basic scientific principles and methods.
PO 2	Inculcating scientific thinking and awareness among the student.
Programme specific outcomes (PSOs)	
PEO 1	To prepare students for career in computer science and its applications in professional career
PEO 2	To develop the student to cope up with the advancements in respective science field
PEO 3	The student will determine the appropriate level of technology for use in: a) experimental design and implementation, b) analysis of experimental data, and c) numerical and mathematical methods in problem solutions.
PEO 4	Investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry, and illustrate these solutions using symbolic, numeric, or graphical methods

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, PRAYAGRAJ

Year wise Structure of B.Sc. for subject Computer Science

Type of Award	Subject: **Computer Science**										Total Credits of the subject
	Year		Paper 1 Theory	credit	Paper 2 Theory		Paper 3 Practical	credit	Research Project	credit	
Certificate in Computer	1		Problem Solving using Computer	4	--		Software Lab using Python	2	Nil	Nil	6
			Database Management Systems	4	--		Database Management Systems Lab	2	Nil	Nil	6
Diploma in Computer	2		Operating Systems	4	--		Operating Systems Lab	2	Nil	Nil	6
			Computer System Architecture	4	--		Computer System Architecture Lab	2	Nil	Nil	6
Bachelor of Science	3		Analysis of Algorithms and Data Structures	4	Soft **Computing**	4	Lab on Algorithms and Data Structures with C++	2	Research Project-I	0	10
			Data Communication and Computer Networks	4	Cyber Security & Cyber Laws	4	Lab on Computer Networks	2	Research Project-II	0	10
									Total Credits:		**44**

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, PRAYAGRAJ

Syllabus for B.Sc.: Subject: Computer Science

Programme/Class: **Certificate**	Year: **First**	Paper: **First**
Subject: **Computer Science**		
Course Code: B070101T	Course Title: **Problem Solving using Computer**	

Course outcomes:

CO 1: Understand hardware components of computer system such as memory system organization, input/output devices, aware of software components of computer system, and windows operating system concepts.

CO 2: Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

CO3: Develops the ability to analyze a problem, develop an algorithm to solve it.

CO4: Develops the use of the Python programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.

CO5: Introduces the more advanced features of the Python language

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Computer Fundamentals:** Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers.	7
II	**Basic Computer Organization -** Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices. **Planning the Computer Program:** Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation.	8
III	**Techniques of Problem Solving:** Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.	7
IV	**Overview of Programming:** Structure of a Python Program, Elements of Python, IDEs for python, Python Interpreter, Using Python as calculator, Python shell, Indentation.	8
V	**Introduction to Python:** Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).	8

VI	**Creating Python Programs:** Input and Output Statements, Control statements (Looping- while Loop, for Loop, Loop Control, Conditional Statement- if...else, Difference between break, continue and pass).	7
VII	**Structures**: Numbers, Strings, Lists, Tuples, Dictionary, Date & Time, Modules, Defining Functions, Exit function, default arguments. File handling in python.	7
VIII	**Introduction to Advanced Python:** Objects and Classes, Inheritance, Regular Expressions, Event Driven Programming, GUI Programming. Basic concepts of concepts of Package and modules	8

Suggested Readings:

1. P. K. Sinha & Priti Sinha , "Computer Fundamentals", BPB Publications, 2007.
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.
3. T. Budd, Exploring Python, TMH, 1st Ed, 2011
4. Python Tutorial/Documentation www.python.or 2010
5. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012
6. Rober Sedgewick, K Wayne -Introduction to Programming in Python: An interdisciplinary Approach" Pearson India

Suggestive digital platforms web links-

https://www.pearsoned.co.in/prc/book/anita-goel-computer-fundamentals-1e-1/9788131733097

http://docs.python.org/3/tutorial/index.html
http://interactivepython.org/courselib/static/pythonds
http://www.ibiblio.org/g2swap/byteofpython/read/

This course can be opted as an elective by the students of following subjects:

"Skill Based Elective"
"Elective"

Suggested Continuous Evaluation Methods: **Max. Marks: 25**

1. **Assessment Type: Class Tests (Max. Marks 14)**
   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.

If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be "End of the class quiz".

3. **Assessment Type: Assignments (Max Marks: 4)**
   Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge.

4. **Assessment Type: Class Interaction (Max. marks: 2)**

Course prerequisites: None

Suggested equivalent online courses:

Further Suggestions:
None

Programme/Class: **Certificate**	Year: **First**	Paper: **Second**
Subject: Computer Science		
Course Code: B070102P	**Course Title: Software Lab using Python**	

Course outcomes:

1. To learn and understand Python programming basics.
2. To learn and understand python looping, control statements and string manipulations.
3. Students should be made familiar with the concepts of GUI controls and designing GUI applications.
4. To learn and know the concepts of file handling, exception handling and database connectivity.

Credits**: 2**	Max. Marks: **25+75**	Min. Passing Marks: 35
Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-4**		

Suggested Readings:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
4. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :
   Grade A: Percentage >=80
   Grade B: Percentage>=70 and <80
   Grade C: Percentage>=60 and <70
   Grade D: Percentage>=40 and <60
   Grade E: Percentage<40
3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. WAP to display the first n terms of Fibonacci series.
5. WAP to find factorial of the given number.
6. WAP to find sum of the following series for n terms: 1 – 2/2! + 3/3!----------n/n!

7. WAP to calculate the sum and product of two compatible matrices.

Section: B (Visual Python)

All the programs should be written using user defined functions, wherever possible.

1. Write a menu-driven program to create mathematical 3D objects
   I. curve
   II. sphere
   III. cone
   IV. arrow
   V. ring
   VI. Cylinder.

2. WAP to read n integers and display them as a histogram.
3. WAP to display sine, cosine, polynomial and exponential curves.
4. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
5. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.
6. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

   P(t) = (15000(1+t))/(15+ *e)*

   where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

7. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:
   I. velocity wrt time (v=u+at)
   II. distance wrt time (s=u*t+0.5*a*t*t)
   III. distance wrt velocity (s=(v*v-u*u)/2*a)

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Programme/Class: **Certificate**	Year: **First**	Paper: **Third**
Subject: **Computer Science**		
Course Code: B070201T	Course Title: **Database Management System**	

Course outcomes:

After the completion of the course the students will be able to:

1. Understands the basic concepts of data base management systems.
2. Design E-R diagrams for real world applications.
3. Formulate relational algebraic expressions using relational data models and languages.
4. Apply normalization transaction properties and concurrency control to design database.
5. Analyze the security algorithms for database protection.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction:** Database System Concepts, File system vs. database system, Database system architecture, Data models and their types, Data base scheme and instances, Data independence, Database Languages and Interfaces.	7
II	**Data Modeling Concepts** ER model concepts: Notations for ER diagram, Extended E-R diagram, Extended E-R model, E-R model design issues, constraints, and keys: Weak entity set strong entity set, Relationships of higher degree.	8
III	**Relational model concepts:** code rules, constraints, Relational Algebra operations, Extended relational algebra operations, Relational Calculus, Tuple and Domain relational calculus.	7
IV	**Database Design** Functional dependencies, Normal forms, First, second, and third normal forms, BCNF, Multi-valued dependencies and Fourth Normal form, Join Dependencies and Fifth Normal form.	8
V	**Transaction, Query Processing** Transaction and system concepts: transaction states, ACID properties of transactions, concurrent execution schedules and Recoverability, Serializability of schedules.Query Processing and Optimization: Measures of Query cost, Cost, Evaluation of expression.Optimization: Transformation of relational expression, Choice of evaluation plan.	7
VI	**Concurrency Control**: Concurrency Control Techniques: Two phase Locking Techniques for Concurrency Control; Time stamping in Concurrency control.	8
VII	**Introduction to SQL** Basic Structure of SQL Query, Set operators, SELECT, UNION, INTERSECT, and EXCEPT, Nested queries, Aggregate function, Null values, Derived Relations, Modification of the Database, Joined relations and up-dates in SQL.	8
VIII	**Database Security**	

	Importance of data, Threats and risks, Users and database privileges, Access Control, Security for Internet Applications, Role of Database Administrator.	7

Suggested Readings:

1. Henry F. Korth and Abraham Silberschatz, "Database System Concepts," Second Edition, McGraw Hill, 1991.
2. AtulKahate, "Introduction to Database Management Systems," Pearson India, 2004.
3. Raghu Ramakrishnan and Johannes Gehrike, "Database Management Systems," Third McGraw Hill, Edition, 2003.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6 Edition, Pearson Education,2013.
5. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
6. C.J Date " An Introduction to Database Systems", Addison Wesley

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering and BCA

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be “End of the class quiz”.

3. **Assessment Type: Assignments (Max Marks: 4)**
   Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge.

4. **Assessment Type: Class Interaction (Max. marks: 2)**

Course prerequisites: To study this course, a student must have had the subject Mathematics in class 12th and Problem solving using computers.
Suggested equivalent online courses:
Further Suggestions:

Programme/Class: **Certificate**	Year: **First**	Paper: **Fourth**
Subject: Computer Science		
Course Code: B070202P	Course Title: Database Management Systems Lab	

Course outcomes:

Ability to:

1. Understand, analyze and apply common SQL statements including DDL, DML and DCL statements to perform different operations.
2. Design and implement a database schema for a given problem.
3. Do connectivity of PHP and MySQL to develop applications.

Credits**: 2**	Max. Marks: **25+75**	Min. Passing Marks: 35

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

Suggested Readings:

1. Paul DuBois, "MySQL Cookbook: Solutions for Database Developers and Administrators," Third Edition, O'Reilly Media, 2014.
2. Frank M. Kromann, "Beginning PHP and MySQL: From Novice to Professional," Fifth Edition, Apress, 2018.
3. Joel Murach and Ray Harris, "Murach's PHP and MySQL," First Edition, Mike Murach & Associates, 2010.
4. Luke Welling, Laura Thomson, "PHP and MySQL Web Development," Fourth Edition, Addison-Wesley, 2008.

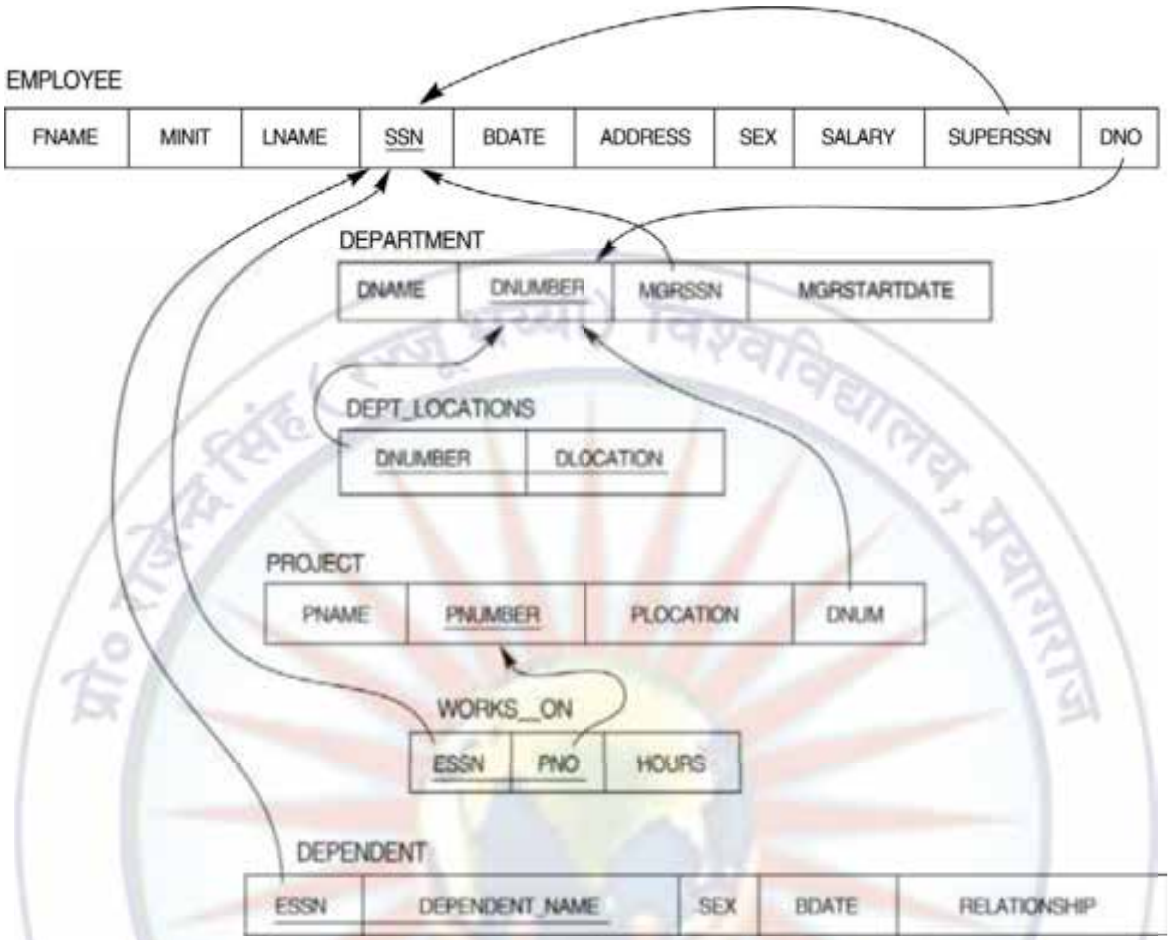
Software Lab based on Database Management Systems

Note: PHP/MySQL may be used

List of Experiments

1. Creation of databases and execution of SQL queries.
2. Creation of Tables using MySQL: Data types, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables.
3. Practicing DML commands- Insert, Select, Update, Delete.
4. Practicing Queries using ANY, ALL, IN, EXISTS, NOT, EXISTS, UNION, INTERSECT, and CONSTRAINTS, etc.
5. Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.
6. Use of COMMIT, ROLLBACK and SAVEPOINT.
7. Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger.
8. To remove the redundancies and anomalies in the above relational tables, Normalize up to Third Normal Form.

Relational Database Schema - COMPANY



Questions to be performed on above schema

1. Create tables with relevant foreign key constraints
2. Populate the tables with data
3. Perform the following queries on the database :
    1. Display all the details of all employees working in the company.
    2. Display ssn, lname, fname, address of employees who work in department no 7.
    3. Retrieve the birthdate and address of the employee whose name is 'Franklin T. Wong'
    4. Retrieve the name and salary of every employee
    5. Retrieve all distinct salary values
    6. Retrieve all employee names whose address is in ‘Bellaire’

7. Retrieve all employees who were born during the 1950s
8. Retrieve all employees in department 5 whose salary is between 50,000 and 60,000(inclusive)
9. Retrieve the names of all employees who do not have supervisors
10. Retrieve SSN and department name for all employees
11. Retrieve the name and address of all employees who work for the 'Research' department
12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate.
13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
14. Retrieve all combinations of Employee Name and Department Name
15. Make a list of all project numbers for projects that involve an employee whose last name is 'Narayan' either as a worker or as a manager of the department that controls the project.
16. Increase the salary of all employees working on the 'ProductX' project by 15%. Retrieve employee name and increased salary of these employees.
17. Retrieve a list of employees and the project name each works in, ordered by the employee's department, and within each department ordered alphabetically by employee first name.
18. Select the names of employees whose salary does not match with salary of any employee in department 10.
19. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee.
20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.
21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.
22. Find the sum of the salaries and number of employees of all employees of the 'Marketing' department, as well as the maximum salary, the minimum salary, and the average salary in this department.
23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.
24. For each department, retrieve the department number, the number of employees in the department, and their average salary.
25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.

26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively.
27. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.
28. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.

29. Delete all dependents of employee whose ssn is '123456789'.

30. Delete an employee from Employee table with ssn = '12345'(make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL

31. Perform a query using alter command to drop/add field and a constraint in Employee table.

Note: The instructors should design detailed experiments based on above suggested experiments.

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Programme/Class: **Diploma**	Year: **Second**	Paper: **First**
Subject: **Computer Science**		
Course Code: B070301T	Course Title: **Operating System**	

Course outcomes:

After the completion of the course the students will be able:

1. Understand role, responsibilities, features, and design of operating system.
2. Analyze memory management schemes and process scheduling algorithms.
3. Apply process synchronization techniques to formulate solution for critical section problems.
4. Illustrate concept of disk scheduling.
5. Evaluate process deadlock handling techniques.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction** Operating system and functions, Classification of Operating systems: Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multithreaded Systems, Operating System Structure, System Components, Operating System Services, Kernels, Monolithic and Microkernel Systems.	7
II	**Process Management** Process Concept, Process States, Process Synchronization, Critical Section, Mutual Exclusion, Classical Synchronization Problems, Process Scheduling, Process States, Process Transitions, Scheduling Algorithms Interprocess Communication, Threads and their management, Security Issues.	8
III	**CPU Scheduling** Scheduling Concepts, Techniques of Scheduling, Preemptive and Non-Preemptive Scheduling: First-Come-First-Serve, Shortest Request Next, Highest Response Ration Next, Round Robin, Least Complete Next, Shortest Time to Go, Long, Medium, Short Scheduling, Priority Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.	8
IV	**Memory Management** Memory allocation, Relocation, Protection, Sharing, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing.	7
V	**I/O Management and Disk Scheduling** I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID.	8

VI	**File System:** File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.	7
VII	**Shell introduction and Shell Scripting:** What is shell and various type of shell, Various editors present in linux, Different modes of operation in vi editor,	7
VIII	What is shell script, Writing and executing the shell script, Shell variable (user defined and system variables) System calls, Using system calls, Pipes and Filters, Decision making in Shell Scripts (If else, switch), Loops in shell, Functions, Utility programs (cut, paste, join, tr , uniq utilities), Pattern matching utility (grep)	8

Suggested Readings:

1. Andrew S. Tanenbaum and Herbert Bos,"Modern Operating Systems," Fourth Edition, Pearson, 2014.
2. Abraham Silberschatz, Greg Gagne, and Peter B. Galvin, "Operating System Concepts," Tenth Edition, Wiley, 2018.
3. William Stallings, "Operating Systems: Internals and Design Principles," Seventh Edition, Prentice Hall, 2011.
4. Dhanjay Dhamdhere, "Operating Systems," First Edition, McGraw-Hill, 2008
5. Milan Milankovic "Operating systems, Concepts and Design" McGraw Hill

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering and BCA

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase**

Answers (Max Marks: 5) **Suggested Usage:** Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be "End of the class quiz". 3. **Assessment Type: Assignments (Max Marks: 4)** **Suggested Usage:** Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge. **4. Assessment Type: Class Interaction (Max. marks: 2)**
Course prerequisites: To study this course, a student must have had the subject Mathematics in class 12th and Problem solving using computers r.
Suggested equivalent online courses:
Further Suggestions:

Programme/Class: **Diploma**	Year: **Second**	Paper: **Second**
Subject: Computer Science		
Course Code: B070302P	Course Title: Operating Systems Lab	

Course outcomes:

Ability to:

1. Use of Linux operating system and able to write shell programs.
2. Simulate and demonstrate the concepts of operating systems.

Credits**: 2**	Max. Marks: **25+75**	Min. Passing Marks: 35
Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-4**		

Suggested Readings:

1. Sumitabh Das, "Your Unix/Linux: The Ultimate Guide," McGraw Hill, 2012.
2. Richard Blum and Christine Bresnahan, "Linux Command Line and Shell Scripting Bible," Wiley, 2015.
3. Stroustrup, Bjarne, Programming: Principles and Practice Using C++, Addison Wesley, USA, 2014, 2nd ed.
4. E Balagurusamy, Object Oriented Programming with C++, McGraw Hill Education (India) Pvt. Ltd., India, 2013, 6th ed.

Lab on Operating Systems

Note: Following exercises can be performed using Linux or Unix

1. Usage of following commands:
   ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.
2. Usage of following commands:
   cal, cat(append), cat(concatenate), mv, cp, man, date.
3. Usage of following
   commands: chmod, grep, tput
   (clear, highlight), bc.
4. Write a shell script to check if the number entered at the command line is prime or not.
5. Write a shell script to modify "cal" command to display calendars of the specified months.
6. Write a shell script to modify "cal" command to display calendars of the specified range of months.
7. Write a shell script to accept a login name. If not a valid login name display message – "Entered login name is invalid".
8. Write a shell script to display date in the mm/dd/yy format.
9. Write a shell script to display on the screen sorted output of "who" command along with the total number of users .
10. Write a shell script to display the multiplication table any number,

11. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
12. Write a shell script to check whether the file have all the permissions or not.
13. Simulate FCFS CPU scheduling algorithm in C++.
14. Simulate SJF CPU scheduling algorithm in C++.
15. Simulate Priority CPU scheduling algorithm in C++.
16. Simulate Round Robin CPU scheduling algorithm in C++.
17. Simulate FIFO page replacement algorithm in C++.
18. Simulate LRU page replacement algorithm in C++.

Programme/Class: **Diploma**	Year: **Second**	Paper: **Third**
Subject: **Computer Science**		
Course Code: B070401T	Course Title: **Computer System Architecture**	

Course outcomes:

The student will be able to understand the basic arithmetic of a Computer System; how the data is represented, how the various operation are performed on the data, the basic circuits to perform these operations, how instructions are formatted and how these instructions are executed to accomplish a particular operation. Student can also learn the organization of the peripheral devices, the interface between these devices to the system. Student can also understand the architecture of a basic computer, its registers, bus system and the interaction flow among them.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Data Representation and basic Computer Arithmetic:** Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison.	7
II	**Logic gates and circuits:** logic gates, boolean algebra, combinational circuits, circuit simplification, introduction to flip-flops and sequential circuits, decoders, multiplexers, registers, counters.	8
III	**Basic Computer Organization and Design:** Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt.	7
IV	**Central Processing Unit:** Register organization, arithmetic and logical micro-operations, stack organization, Hardwired vs. micro programmed control. Pipeline control: Instruction pipelines, pipeline performance, super scalar processing, Pipelining, RISC & CISC	8
V	**Programming the Basic Computer:** Instruction formats, addressing modes, instruction codes, assembly language	7
VI	**Memory Organization:** Memory device characteristics, random access memories, serial access memories, Multilevel memories, address translation, memory allocation, Main features, address mapping, structure versus performance.	8
VII	**Input-output Organization:** Peripheral devices, I/O interface, Modes of data transfer: Programmed, Interrupt Driven and Direct Memory Access.	8

VIII	**Parallel processing:** Processor-level parallelism, multiprocessor architecture	7

Suggested Readings:

1. M. Mano, "Computer System Architecture", Pearson Education, New Jersey, 2017,Third Edition.
2. W. Stallings, "Computer Organization and Architecture Designing for Performance",Prentice Hall of India, 2015, Tenth Edition.
3. M. Mano, "Digital Design", Pearson Education, New Jersey, 2018, Sixth Edition.
4. Vranasic and Hamacher, Computer Organization, TMH"

This course can be opted as an elective by the students of following subjects:
B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Engineering, BCA, B.E, B.Tech.

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**
   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be "End of the class quiz".

3. **Assessment Type: Assignments (Max Marks: 4)**
   Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge.

4. **Assessment Type: Class Interaction (Max. marks: 2)**

Course prerequisites: To study this course, a student must have had the subject Mathematics in class12th and Operating system.

Suggested equivalent online courses: 1. https://onlinecourses.nptel.ac.in/noc20_cs64;
Further Suggestions: None

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Programme/Class: **Diploma**	Year: **Second**	Paper: **Fourth**
Subject: **Computer Science**		
Course Code: B070402P	Course Title: Computer System Architecture Lab	

Course outcomes:
An ability to understand:

CO1 The functions of various hardware components and their building blocks
CO2 Boolean algebraic expressions to digital design
CO3 And implementation of different sequential and Combinational circuits
CO4 computer buses and input/output peripherals
CO5 memory hierarchy and design of primary memory

Credits: **2**	Max. Marks: **25+75**	Min. Passing Marks: 35
Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-4**		

Practical: 60 Lab Periods

Memory	Instruction format
4096 words 16 bits per word	0 3 4 15 Opcode | Address

Basic Computer Instructions

Memory Reference	Register Reference	Input-Output

1. Create a machine based on the following architecture:
Register Set

IR	DR	AC	AR	PC	FGI	FGO	S	I	E
0 15	0 15	0 15	011	011	1 Bit	1 Bit	1 Bit	1 bit	1 Bit

Symbol	Hex		Symbol	Hex	Symbol	Hex
AND	0xxx		CLA	E800	INP	F80 0
ADD	2xxx		CLE	E400	OUT	F40 0
ISZ	Cxxx		INC	E020		

AND_I	1xxx	Indirect Addressing	SPA	E010		
ADD_I	3xxx		SNA	E008		
LDA_I	5xxx		SZA	E004		
STA_I	7xxx		SZE	E002		
BUN_I	9xxx		HLT	E001		
BSA_I	Bxxx					
ISZ_I	Dxxx					

Refer to Chapter-5 of Morris Mano for description of instructions.

ii) Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.

iii) Create a Fetch routine of the instruction cycle.

iv) Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

a. CLA
b. CLE
c. CMA
d. CME
e. CIR
f. CIL
g. INC
h. SPA
i. SNA
j. SZA
k. SZE
l. HLT

Initialize the contents of AC to $(A937)_{16}$, that of PC to $(022)_{16}$ and E to 1.

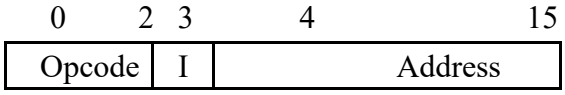
5. Simulate the machine for the following memory-reference instructions with I= 0 and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

a. ADD
b. AND
c. LDA
d. STA
e. BUN
f. BSA
g. ISZ

6. Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

7. Modify the machine created in Practical 1 according to the following instruction format:

Instruction format



a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12-bit address. There are only two addressing modes, I = 0 (direct addressing) and I = 1 (indirect addressing).

b. Create a new register I of 1 bit.

c. Create two new microinstructions as follows :

   i. Check the opcode of instruction to determine type of instruction (Memory Reference/Register Reference/Input-Output) and then jump accordingly.

   ii. Check the I bit to determine the addressing mode and then jump accordingly.

Programme/Class: **Bachelor in Science**	Year: **Third**	**Paper: First**
Subject: **Computer Science**		
Course Code: B070501T	Course Title: **Analysis of Algorithm and Data Structures**	

Course outcomes:

CO 1: Understand that various problem solving categories exist such as; iterative technique, divide and conquer, dynamic programming, greedy algorithms, and understand various searching and sorting algorithms

CO 2: Employ a deep knowledge of various data structures when constructing a program..

CO 3: Design and construct simple object-oriented software with an appreciation for data abstraction and information hiding.

CO 4: Effectively use software development tools including libraries, compilers, editors, linkers and debuggers to write and troubleshoot programs.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction**: Basic Design and Analysis techniques of Algorithms, time and space complexity, Correctness of Algorithm, Algorithm Design Techniques: Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.	7
II	**Sorting Techniques**: Elementary sorting techniques-Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques-Heap Sort, Quick Sort, Sorting in Linear Time-Bucket Sort, Radix Sort and Count Sort	8
III	**Searching Techniques and Complexity Analysis:** Linear and Binary search, Medians & Order Statistics.	7
IV	**Arrays** Arrays: Single and Multi-dimensional Arrays, Sparse Matrices;	7
V	**Stacks and Queues :** Implementing stack using array and linked list, Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Array and Linked representation of Queue, De-queue, Priority Queues	8
VI	**Linked Lists:** Singly, Doubly and Circular Lists, representation of Stack and Queue as Linked Lists.	8
VII	**Recursion**: Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion;	7
VIII	**Trees**: Introduction to Tree as a data structure; Binary Trees,	8

	Binary Search Tree, (Creation, and Traversals of Binary Search Trees)	

Suggested Readings:

1. Cormen T.H., Leiserson Charles E., Rivest Ronald L., Stein Clifford, Introduction to Algorithms, PHI Learning Pvt. Ltd., 2009, 3rd Edition.
2. Basse Sara & A.V. Gelder, Computer Algorithm: Introduction to Design and Analysis, Pearson, 2000, 3rd Edition.
3. Drozdek Adam, "Data Structures and algorithm in C++", Cengage Learning, 2012, Third Edition.
4. Tenenbaum Aaron M., Augenstein Moshe J., Langsam Yedidyah, "Data Structures Using C and C++, PHI, 2009, Second edition.
5. Kruse Robert L., "Data Structures and Program Design in C++", Pearson.
6. **Suggestive digital platforms web links or online course-**

   https://www.oercommons.org/authoring/14873-data-structure/view

   https://www.oercommons.org/courses/data-structure-and-algorithms

   https://onlinecourses.swayam2.ac.in/cec19_cs04/preview **(online course)**

This course can be opted as an elective by the students of following subjects:
B. Sc in Mathematics, Physics, Electronics, Statistics, Engineering and BCA

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be “End of the class quiz”.

3. **Assessment Type: Assignments (Max Marks: 4)** **Suggested Usage:** Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge. **4. Assessment Type: Class Interaction (Max. marks: 2)**
Course prerequisites: To study this course, a student must have had the subject Mathematics in class 12th and Computer Fundamental, and C++ and Object Oriented Programming in certificate
Suggested equivalent online courses: 1 https://nptel.ac.in/courses/106/102/106102064/
Further Suggestions:

Programme/Class: **Bachelor In Science**	Year: **Third**	Paper: **Second**
Subject: **Computer Science**		
Course Code: B070502T	Course Title: **Soft Computing**	

Course outcomes:

Upon the completion of this course the student will have the knowledge of soft computing concepts and he can apply them for practical applications. He would be able to choose and design suitable Neural Network for real time problems. He can appropriately use fuzzy rules and reasoning to develop decision making and expert systems. He would know the importance of optimization techniques and genetic programming.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction To Neural Networks**: Neural Networks Neuron, Nerve Structure And Synapse, Artificial Neuron And Its Model, Activation Functions.	7
II	**Neural Network Architecture**: Single Layer And Multilayer Feed Forward Networks, Recurrent Networks. Perception And Convergence Rule.Supervised Learning Network& Unsupervised Learning Network.	8
III	**Back Propogation Networks-I**: Perceptron Model, Solution, Single Layer, Multilayer Perception Model;	7
IV	**Back Propogation Networks**-II: Back Propogation Learning Methods, Effect Of Learning Rule Co-Efficient ;Back Propagation Algorithm, Applications.	8
V	**Fuzzy Logic Introduction-I**: Basic Concepts Of Fuzzy Logic, Fuzzy Sets And Crisp Sets, Fuzzy Set Theory And Operations, Properties Of Fuzzy Sets	7
VI	**Fuzzy Logic Introduction-II:** Fuzzy And Crisp Relations, Fuzzy To Crisp Conversion, Membership Functions, Interference In Fuzzy Logic, Fuzzy If-Then Rules, Fuzzyfications&Defuzzificataions.	8
VII	**Genetic Algorithm-I**: Basic Concepts, Working Principle, Procedures Of GA, Flow Chart Of GA	7

VIII	**Genetic Algorithm-II:** Genetic Representations, (Encoding), Genetic Operators, Mutation, Generational Cycle.	8

Suggested Readings:

1. S. Rajsekaran& G.A. VijayalakshmiPai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India,2003
2. Anderson, James, "Introduction to Neural Networks", PHI Publication, Delhi, India
3. N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press, USA, 2005.
4. Simon Haykin,"Neural Netowrks and Learning Machines "Prentice Hall of India, 2005, Third Edition.

This course can be opted as an elective by the students of following subjects:
B.Sc. in Electronics, B.Sc. in Physics, B.Sc. in Statistics, B.Sc. in Mathematics, B.Sc. in Engineering, B.Sc. Vocational, BCA, B.E. , B.Tech, B.A.(Maths)

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be "End of the class quiz".

3. **Assessment Type: Assignments (Max Marks: 4)**
   Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge.

4. Assessment Type: Class Interaction (Max. marks: 2)
Course prerequisites: To study this course, a student must have had the subject Mathematics
Suggested equivalent online courses: https://www.classcentral.com/course/swayam-introduction-to-soft-computing-10053
Further Suggestions: List of Programs in Soft Computing with Python:

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Programme/Class: **Bachelor of Science**	Year: **Third**	Paper: **Third**
Subject: **Computer Science**		
Course Code: B070503P	Course Title: **Lab on Algorithm and Data Structures with C++**	
Course outcomes: **CO 1:** Optimize the solution with respect to time complexity & memory usage **CO 2:** Assess how the choice of data structures and algorithm design methods impacts the performance of programs. **CO 3:** Choose the appropriate data structure and algorithm design method for a specified application. **CO 4:** Solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees and writing programs for these solutions		
Credits: **2**	Max. Marks: **25+75**	Min. Passing Marks: 35
Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-4**		

Practical List of on Analysis of Algorithms and Data Structures with C++:

1. Write a program that uses functions to perform the following:
   a) Create a singly linked list of integers.
   b) Delete a given integer from the above linked list.
   c) Display the contents of the above list after deletion.

2. Write a program that uses functions to perform the following:
   a) Create a doubly linked list of integers.
   b) Delete a given integer from the above doubly linked list.
   c) Display the contents of the above list after deletion.

3. Write a program that uses stack operations to convert a given infix expression into its postfix Equivalent, implement the stack using an array.

4. Write program to implement a double ended queue using
   i) array and
   ii) doubly linked list respectively.

5. Write a program that uses functions to perform the following:
   a) Create a binary search tree of characters.
   b) Traverse the above Binary search tree recursively in Postorder.

6. Write a program that uses functions to perform the following:
   a) Create a binary search tree of integers.
   b) Traverse the above Binary search tree non recursively in inorder.

7. Write program for implementing the following sorting methods to arrange a list of integers in ascending order:
    a) Insertion sort
    b) Merge sort
    c)
8. Write program for implementing the following sorting methods to arrange a list of integers in ascending order:
    a) Quick sort
    b) Selection sort

9. Write program to implement Insertion Sort (The program should report the number of comparisons)

10. Write program implement Merge Sort(The program should report the number of comparisons)

11. Write program implement Heap Sort (The program should report the number of comparisons)

12. Write program implement Randomized Quick sort (The program should report the number of comparisons)

13. Write program for creation and traversal of Binary Search Tree.

Programme/Class: **Bachelor of Science**	Year: **Third**	Paper: **Five**
Subject: **Computer Science**		
Course Code: B070601T	Course Title: **Data Communication and Computer Network**	

Course outcomes:

After the completion of the course the students will be able:

1. To develop understanding of computer networks and communication basics.
2. To understand design issues and services at different layers of reference models.
3. To learn various error detection/correction techniques, routing protocols, congestion control algorithms, and connection establishment/release.
4. To describe and analyze related technical, administrative, and social aspects of networking.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction to Signals** Data and Information, Data communication, Characteristics of data communication, Components of data communication, Data Representation, Data Flow, Simplex, Half Duplex, Full Duplex, Analog and Digital Signals, Periodic and Aperiodic signals, Time and Frequency Domain, Composite Signals	7
II	**Basic concepts of Networks:** Components of data communication, standards and organizations, Network Classification, Network Topologies ; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.	8
III	**Physical Layer** : Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway.	7
IV	**Data Link Layer** Designing issues, Framing and Data Link Control, Error detection schemes (parity, checksums, CRCs), Error correction schemes (Hamming codes, binary convolution codes), Data link layer protocols (Simplest, Stop & Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, Sliding Window), MAC sublayer (Ethernet, ALOHA, CSMA family, Contention-free access/Token Ring).	8
V	**Network Layer** Design issues, Switching, Routing algorithms (Shortest path, Link state, Flooding, Broadcast, Multicast), Packet Scheduling, Internetworking, Internet Protocol (IPv4, IPv6), IP addressing, Internet Control Protocols (IMCP, ARP, DHCP), Mobile IP.	8

VI	**Transport Layer** Transport layer services, Connection establishment and teardown, TCP, UDP, Congestion Control, Quality of Service, Domain Name System, World Wide Web.	8
VII	**Application Layer** : Application layer protocols and services – Domain name system, HTTP, WWW, telnet, FTP, SMTP	7
VIII	**Network Security** : Common Terms, Firewalls, Virtual Private Networks	7

Suggested Readings:

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks," Fifth Edition, Pearson, 2014.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson, 2013.
3. Behrouz A. Forouzan, "Data Communications and Networking," Fourth Edition, McGraw-Hill Higher Education, 2007

This course can be opted as an elective by the students of following subjects:
B. Sc in Engineering and BCA

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be "End of the class quiz".

3. **Assessment Type: Assignments (Max Marks: 4)**
   Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes,

but application analysis and synthesis of that knowledge. **4. Assessment Type: Class Interaction (Max. marks: 2)**
Course prerequisites: To study this course, a student must have had the subject Mathematics in class 12^{th}. In addition, the basic knowledge of DBMS, Operating System, Analysis of Algorithm and Data Structure is required.
Suggested equivalent online courses:
Further Suggestions:

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Programme/Class: **Bachelor In Science**	Year: **Third**	Paper: **Six**
Subject: **Computer Science**		
Course Code: B070602T	Course Title: **Cyber Security & Cyber Laws**	

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

1. Understand types of information, cyber threats, and national/international cyber security standards.
2. Do mathematical modeling and development of security techniques and information system.
3. Develop understanding of legal issues related to cyber security.
4. Apply ethical principles/responsibilities in cyber practices.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: 35

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

Unit	Topic	No. of Lectures
I	**Introduction:** Introduction to Information System, Type of information system, Development of information system, CIA model of Information Characteristics, Introduction to Information Security, Need of Information Security, Cyber Security, Business need, Ethical and Professional issues of security.	7
II	Information Security Model, Component of an Information security, Aspect of information security, Security attacks (Active and Passive Attacks), Security mechanism and Security Services (X.800).	8
III	Information Security Techniques, Introduction to Cryptography: Terminology, cryptanalysis, Security of algorithms, Substitution Cipher and Transposition Cipher, Single XOR , One-way Pad,	7
IV	Cryptographic Protocols-I: Arbitrated and Adjudicated Protocol, One- Way Hash function,	8
V	Cryptographic Protocols-II: Public key cryptography, Digital Signature, Digital Watermarking Technique: Characteristics and Types.	7
VI	Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies- Sample Security Policies.	8

VII	**Cyber Laws I:** Information Security Standards, IT act 2000 Provisions, Introduction to digital laws,	7
VIII	**Cyber Laws II:** cyber laws, intellectual property rights, copyright laws, patent laws, software license.	8

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security," Sixth Edition, Cengage Learning, 2017.
2. Douglas J. Landoll, "Information Security Policies, Procedure, and Standards: A Practitioner's Reference," CRC Press, 2016.
3. Harold F. Tipton, and Micki Krause, "Hand book of information security management," Sixth Edition, Archtech Publication, 2007.
4. William Stallings, "Cryptography and Network Security: Principles and Practice," Sixth Edition, Pearson, 2014.

This course can be opted as an elective by the students of following subjects:
B. Sc in Electronics, Physics, mathematics, Engineering, B.Sc. Vocational, BCA and MCA

Suggested Continuous Evaluation Methods:

1. **Assessment Type: Class Tests (Max. Marks 14)**

   Suggested Usage:
   Include all types of questions-essay, short answer, objective; Design to test all levels of domain; Exam Blue Print be prepared to ensure inclusion of all types & levels of questions and proper sampling of content; Marking Criteria made known to students; Teacher should provide written feedback selectively and discuss answers in the class; Only Role/Code numbers , not names be written to avoid bias in marking; Display of model answer copies.

   After Completion of Unit I and Unit II, a first class test of max. marks of 7 shall be conducted.
   After Completion of Unit III and IV, a second class test of max. marks of 7 shall be conducted.
   If any student does not appear in any one or both class test, a makeup test shall be conducted of max. marks of 5 instead of total 14 marks.

2. **Assessment Type: Quizzes/ Objective Tests / Recognition Type (such as MCQs; True or False; Matching; Classifying) /Recall Type -Filling Blanks; One word / Phrase Answers (Max Marks: 5)**

   Suggested Usage: Teachers be trained in construction, advantages, disadvantages and precautions while preparing different types of objective items; Go beyond factual information to High Order Thinking (HOT) Skills. It shall be “End of the class quiz”.

3. **Assessment Type: Assignments (Max Marks: 4)**

Suggested Usage: Some class assignments shall be given to students at the end of each Unit. Note making techniques be taught to students; Not just direct questions from notes, but application analysis and synthesis of that knowledge. **4. Assessment Type: Class Interaction (Max. marks: 2)**
Course prerequisites: To study this course, a student must have had the subject Mathematics in class 12th and Computer Fundamental.
Suggested equivalent online courses:
Further Suggestions:

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, PRAYAGRAJ

Programme/Class: **Bachelor of Science**	Year: **Third**	Paper: **Seven**
Subject: **Computer Science**		
Course Code: B070603P	Course Title: Lab on Computer Networks	

Course outcomes:

CO1	Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
CO2	Analyze and Set up protocol designing issues for Communication networks.
CO3	Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
CO4	Apply various network layer techniques for designing subnets and supernets and analyze packet flow on basis of routing protocols.
CO5	Estimate the congestion control mechanism to improve quality of service of networking application

Credits: **2**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-4**	

Software Lab based on Computer Networks:

Implement the concepts of Computer Networks such as:

1. Simulate Checksum Algorithm.
2. Simulate CRC Algorithm
3. Simulate Stop & Wait Protocol.
4. Simulate Go-Back-N Protocol.
5. Simulate Selective Repeat Protocol.

and so on....

Common Guidelines for Course Code: B070504P and Course Code: B070604P

Research Project Guidelines for Paper-IV and Paper-VIII of 3rd Year

1. Objectives of the Project

- To facilitate the student to independently formulate and solve a social, philosophical, commercial, or technological problem and present the results in written and oral form.
- To render students to the real life problems.
- To provide opportunities to students to interact with people and present them confidently.

2. Types of Project

The students are expected to work on:

(1) Application Oriented Project or
(2) Research Oriented Project.

However, it is not mandatory for a student to work on a real-life project. The student can formulate a project problem with the help of his Guide and submit the project proposal of the same. **Approval of the project proposal is mandatory.** If approved, the student can commence working on it, and complete it.

3. Software and Broad Ideas of Application

- **Languages -** C, C++, Java, VC++, C#, R,Python
- **Scripting Languages -** PHP,JSP, SHELL Scripts (Unix), TcL/TK
- **.NET Platform -** F#,C#. Net, Visual C#. Net, ASP.Net
- **Middle Ware(Component) Technologies -** COM/DCOM, Active-X, EJB
- **Front-End/GUI Tools -** .Net Technologies, Java
- **Back-End/DBMS -** Oracle, SQL Plus, MY SQL, SQL Server
- **UNIX Internals -** Device Drivers, RPC, Threads, Socket programming
- **Real time Operating Systems/Embedded Skills -** LINUX, Raspberry Pi, Arduino.
- **Application and Research Areas -** Financial / Insurance / Manufacturing / Multimedia / Computer Graphics / Instructional Design/ Database Management System/ Internet / Intranet / Computer Networking-Communication Software development/ E-Commerce/ ERP/ MRP/ TCP-IP programming / Routing protocols programming/ Socket programming

4. Eligibility of the Guide

Guide should be a regular teacher of the University/College/Higher Education Institute. Student can also do the project under the guidance of regular teacher of Institute of National Importance .

5. Introduction to the Project

The student should include the details in the project diary, in which they will record the progress of their project throughout the course. The project report should be documented with scientific approach to the solution of the problem that the students have sought to address. The project report should be prepared in order to solve the problem in a methodical and professional manner, making due references to appropriate techniques, technologies and professional standards. The project report should contain enough details to enable examiners to evaluate the work. The important points should be highlighted in the body of the report, with details often referred to appendices.

6. Structure and Format of the Project

Chapter 1 to 4 should be submitted in Paper IV in spiral binding and these chapters have also to be included in Paper VIII report if same project is carried from IV to VIII Paper . If different projects are taken than complete project report is to be submitted in each Paper . Paper VIII report has to be hard bound with golden embossing . Students will be evaluated based on the project in IV and VIII Paper independently.

(i) Title Page:

Sample format of Title page is given below. Students should follow the given format.

(All the text should be in Times New Roman)

<TITLE OF THE PROJECT>
(NOT EXCEEDING 2 LINES, 24 BOLD, ALL CAPS)

A Project Report (12 Bold)

Submited in partial fulfilliment of the
Requirement of the award of the Degree of (Size- 12)

BACHELOR OF SCINCE (14 BOLD, CAPS)

By (12 Bold)

Name of The Student (Size 15, title case)
Roll Number (Size- 15)

COLLEGE LOGO

DEPARTMENT NAME
FACULTY NAME (12 BOLD, CAPS)
UNIVERSITY/COLLEGE NAME (14 BOLD, CAPS)
Affiliated to University Name) (12, Title case, bold, talic)

CITY, PIN CODE(12 bold, CAPS)
UTTAR PRADESH (12 bold, CAPS)
YEAR (12 bold)

(ii) Original Copy of the Approval Proforma of the Project Proposal:
Sample Proforma of Project Proposal is given below. Students should follow the given format.

PROFORMA FOR THE APPROVAL OF PROJECT PROPOSAL

(Note: All entries of the proforma of approval should be filled up with appropriate and complete information. Incomplete proforma of approval in any respect will be rejected)

Roll no:……..

1. Name of the Student
……..
2. Title of the Project
……
3. Name of the Guide
……
4. Teaching experience of the Guide
……

Signature of the Student
Date……

Signature of the Guide
Date:……

Signature of the Project Coordinator
Date…….

(iii) Certificate of Authenticated work:
Sample format of Certificate of Authenticated work is given below. Students should follow the given format. Also, HEIs/Institutes/Colleges are required to give plagiarism report for the project work.

UNIVERSITY/COLLEGE NAME (14 BOLD, CAPS)
***(Affiliated to University Name)* (13, bold, italic)**
CITY NAME-PINCODE (13 bold, CAPS)

DEPARTMENT NAME (14 BOLD, CAPS)

College Logo

CERTIFICATE (14 BOLD, CAPS, underlined, centered)

This is to certify that the project entitled, "**Title ofThe Project**", is bonaficd work of **NAME OF THE STUDENT** bearing **Roll No.** submitted in partial fulfillment of the requirements for the award of degree of BACHELOR OF SCIENCE in COMPUTER SCIENCE from **University Name**. (12, times new roman, justified)

Name of Internal Guide (12 bold) Name of Coordinator

(Don't write names of lecturers or HOD)

External Examiner

Date: College Seal

(iv) **Certificate from other Institute of National Importance** (to be issued by the HEI and the photocopy of the certificate is to be attach)

(v) **Abstract**

This should be one/two short paragraphs (100-150 words total), summarizing the project work. It will not be a re-statement of the original project outline. A suggested flow is background, project aims and main achievements. From the abstract, a reader should be able to determine if the project is of interest to them and, it should present results of which they may wish to know more details.

(Project Abstract page format)

Abstract (20bold, caps, centered)

Content goes here (12, justified)

Note: Entire document should be with 1.5 line spacing and all paragraphs should start with 1 tab space.

(vi) **Acknowledgements**

This should express student's gratitude to those who have helped in the preparation of project.

ACKNOWLEDGEMENT (20, BOLD, ALL CAPS, CENTERED)

The acknowledgement should be in times new roman, 12 font with 1.5 line spacing, Justified.

(vii) **Declaration**

(Declaration page format)

DECLARATION (20 bold, centered, allcaps)

Content (12, justified)

I here by declare that the project entitled, "**Title of the Project'** done at **[name of place where projects is done]** has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other universiny.

The project is done in partial fulfilment of the requirements for the award of degree of **BACHELOR OF SCIENCE** to be submitted as **[IV OR VIII]** Paper project as part of our curriculum.

Name and Signature of the Student

(viii) Table of Contents

The table of contents gives the readers a view of the detailed structure of the report. The students would need to provide section and subsection headings with associated pages. The formatting details of these sections and subsections are given below.

TABLE OF CONTENTS (20bold, caps, centered)

Should be generated automatically using word processing software.

(ix) List of Tables

List of all the tables in the project along with their page numbers.

List of Tables (20 bold, centered, Title Case)

Should be generated automatically using word processing software.

(x) List of Figures

List of all the figures, graphs, charts etc. in the project along with their page numbers.

> **List of Figures (20 bold, centered, Title Case)**
>
> Should be generated automatically using word processing software.

Chapter 1: Introduction

The introduction has several parts as given below:

- Background: A brief detail of background and framework of project and its relation to work done in the area.
- Objectives: Point wise statement of the aims and objectives of the project
- Purpose, Scope and Applicability: The description of Purpose, Scope, and Applicability are given below:
  - Purpose: Describe the topic of the project on the basis of why this project is being done. How this project improve the existing system.
  - Scope: Describe methodology, assumptions and limitations.
  - Applicability: State the application of project.
- Achievements: Explain what kind of purpose is achieved after completion of project.
- Organization of Report: Summarize remaining chapters of the project report.

> (Project Introduction page format)
>
> **Chapter 1**
>
> **Introduction (20 Bold, centered)**
>
> Content or text (12, justified)
>
> Note: Introduction has to cover brief description of the project with minimum 4 pages.

Chapter 2: Literature Review OR Survey of Technologies

In this chapter survey of technologies for application oriented project should demonstrate the student awareness and understanding of available technologies OR literature survey is required for research oriented project. The student should give the detail of all the related literature/technologies that are necessary to complete the project. The student should present a comparative study of all those technologies/literature.

Chapter 3: Requirements and Analysis (For Application Oriented) OR [Title of Research Working Chapter]

Chapter 4: System Design (For Application Oriented) OR [Chapter related to Research Work]

Chapter 5: Implementation and Testing

- **Implementation Approaches:** Define the plan of implementation, and the standards or standard data sets used in the implementation.
- **Coding Details and Code Efficiency:** Students not need include full source code, instead, include only the important codes (design of new data structure, algorithms, applets code, forms code etc). The program code should contain comments needed for explaining the work a piece of code does. Comments may be needed to explain why it does it, or, why it does a particular way. The student can explain the function of the code with a shot of the output screen of that program code. The student should explain how the code is efficient and how the students have handled code optimization.
- **Testing Approach**
- **Modifications and Improvements**

Chapter 6: Results and Discussion

- **Test Reports:** Student should provide the test results and reports based on the test cases to show that it works fine in different conditions of input.
- **User Documentation:** In this section, working of the software should be explained; also explain its different functions with screen shots. The user document should be like a manual.

Chapter 7: Conclusions and Future Work

The conclusions shall be summarized with in 2 or 3 pages. This chapter mainly focuses on:

- Limitations of the Proposed System OR Research
- Future Scope describes new areas of investigation and parts of the current work that was not completed due to time constraints and/or problems encountered.

(xi) References

In this, students acknowledge the work of others that they have used or adapted in their own work. Student can follow the given standard for the references for books, journals, and online material. The citation is mandatory in both the reports.

Eg.

Lipson, Charles (2011). Cite right : A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more (2nd ed.). Chicago [u.a.]: University of Chicago Press. p. 187. ISBN 9780226484648.

(xii) Glossary

If any acronyms, abbreviations, symbols, or uncommon terms is used in the project report then their meaning should be explained where they first occur.

(xiii) Appendices

Appendix include some further details like results, mathematical derivations, certain illustrative parts of the program code (e.g., class interfaces), user documentation etc.

7. Evaluation

- During the project work, its progress will be monitored, on fortnightly/monthly basis, by the internal guide.
- 2 copies of Project Report to be submitted to department (1 copy to be retained by department, 1 copy for student)
- End Examination shall be based on Project Report, Presentation, Viva, and Demonstration of the software**.**
- Project carries 3 Credit Points.

Duration (for 1 group):

Evaluation		
Type of evaluation	**Total time**	**Max. Marks**
Presentation	10 minutes	25
Viva	10 minutes	20
Demonstration	5 minutes	20
Report checking	5 minutes	35
Total Time/Max. Marks	**30 minutes**	**100**

Format of Certificate of Evaluation

Certificate of Evaluation (14 point, Times, Bold)

This is to certify that the undersigned have assessed and evaluated the project work titled "……." submitted by the following student(s).

1.
2.
3.

The project report has been accepted/ rejected for the partial fulfillment of B.Sc. progarmme.

Signature of the examiner
Name of the examiner

Stamp of the Department

8. Project Viva Voice

Student may be asked to write code for some segment of the problem during VIVA to check his coding capabilities. The project can be done in group of at most two or three students. A big project can be modularized and different modules can be assigned as separate project to different students.

9. Plagiarism