Department of Computer Science
D.D.U. Gorakhpur University, Gorakhpur

Year wise Structure of B.Sc. Computer Science Subject

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	CSC101F	Basics of Computer Science	Theory	2
	I	CSC102F	Problem Solving using Computer	Theory	4
	I	CSC103F	Software Lab	Practical	2
	II	CSC104F	Database Management Systems	Theory	4
	II	CSC105F	Database Management Systems Lab	Practical	2
2	III	CSC201F	Operating Systems	Theory	4
	III	CSC202F	Operating Systems Lab	Practical	2
	IV	CSC203F	Computer System Architecture	Theory	4
	IV	CSC204F	Computer System Architecture Lab	Practical	2
3	V	CSC301F	Analysis of Algorithms and Data Structures	Theory	4
	V	CSC302F	Soft Computing	Theory	4
	V	CSC303F	Lab on Algorithms and Data Structures	Practical	2
	VI	CSC304F	Data Communication and Computer Networks	Theory	4
	VI	CSC305F	Cyber Security & Cyber Laws	Theory	4
	VI	CSC306F	Lab on Computer Networks	Practical	2

4	VII	CSC 401F	Linux and Shell Programming	Theory	4
	VII	CSC 402F	Advance Analysis and Design of Algorithm	Theory	4
	VII	CSC 403F	Programming using Python	Theory	4
	VII	CSC 404F	Software Engineering	Theory	4
	VII	CSC 405F	Linux, Algorithm and Python Lab	Practical	4
	VIII	CSC 406F	Advance Database Management System	Theory	4
	VIII	CSC 407F	Introduction to Data Science	Theory	4
	VIII	CSC 408F	Artificial Intelligence	Theory	4
	VIII	CSC 409F	Machine Learning & Soft Computing	Theory	4
	VIII	CSC 410F	DBMS,AI and ML lab	Practical	4

OR For Students who secured 75% Marks in First Six Semesters

4	VII	CSC 401F	Linux and Shell Programming	Theory	4
	VII	CSC 402F	Advance Analysis and Design of Algorithm	Theory	4
	VII	CSC 403F	Programming using Python	Theory	4
	VII	CSC 404F	Software Engineering	Theory	4
	VII	CSC 405F	Linux, Algorithm and Python Lab	Practical	4
	VIII	CSC 406F	Advance Database Management System	Theory	4
	VIII	CSC 407F	Introduction to Data Science	Theory	4
	VIII	CSC 411F	Research Project	Practical	12

Subject prerequisites To study the Computer Science, a student must have the subject(s) computer science OR Mathematics in class 12^{th}.	
Programme outcomes (POs): Students taking admission into B.Sc. program are expected to get Prepared with following outcomes:	
PO1	Explaining the basic scientific principles and methods.
PO2	Inculcating scientific thinking and awareness among the student.
Programme specific outcomes (PSOs)	
PSO1	To prepare students for career in computer science and its applications in professional Career
PSO2	To develop the student to cope up with the advancements in respective science field
PSO3	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.
PSO4	Investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry, and illustrate the solutions using symbolic, numeric, or graphical methods

Syllabus for B.Sc. ; Subject : Computer Science

Programme/Class : **B.Sc.**	Year : **First**	Semester : **First**
Subject : **Computer Science**		
Course Code: CSC101F	Course Title: **Basics of Computer Science**	

Course outcomes:

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

1: Demonstrate a basic understanding of computer hardware and software.
2: Demonstrate problem-solving skills.
3: Utilize web technologies.
4: Present conclusions effectively, orally and in writing.
5. To get employment opportunity in the basic computer area.

Credits:**2**

Unit	Topic
I	**KNOWING COMPUTER:** What is Computer, Basic Applications of Computer, Components of Computer System, Concept of Hardware and Software (Application Software Systems software), Concept of computing, data and information.
II	**OPERATING COMPUTER USING GUI BASED OPERATING SYSTEM:** Basics of Operating System, The User Interface (Task Bar, Icons, Menu, Running an Application), File and Directory Management (Creating and renaming of files and directories), Operating System Simple Setting (Changing System Date And Time, Changing Display Properties, To Add Or Remove A Windows Component, Changing Mouse Properties).
III	**UNDERSTANDING WORD PROCESSING AND SPREAD SHEET:** Word Processing Basics, Opening and closing Documents, Text Creation and manipulation, Formatting the Text, Elements of Electronic Spread Sheet, Manipulation of Cells
IV	**WWW AND WEB BROWSER:** Internet, World Wide Web (WWW), Popular Web Browsing Software, Search Engines, Understanding URL.

Suggested Readings:

1. P.K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 2007.
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.

Programme/Class : **B.Sc.**	Year : **First**	Semester : **First**
Subject : **Computer Science**		
Course Code: CSC102F	Course Title: **Problem Solving using Computer**	

Course outcomes:

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

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.

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

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

4: Develops the ability to get employment in programming field.

Credits:**4**

Unit	Topic
I	**Computer Fundamentals:** Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers, Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices. Concept of problem solving, Problem definition, Program design, Debugging.
II	**Techniques of Problem Solving:** Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.
III	**Introduction to Programming:** Compilation, Linking and Loading, Testing and Debugging, documentation. Character set, Variables, and Identifiers, Built-in Data Types. Arithmetic operators and Expressions, Constants and .Literals.
IV	**Conditional Statements and Loops:** Decision making within a program, Conditions, Relational Operators. If- statements. If-else statement, Switch case Statement. **Loops:** while loop, do- while, for loop, Nested loops.
V	**Arrays, Functions, Structures and Pointers::**One dimensional arrays: -Array manipulation; Insertion. Deletion of an element from an array; Prototype of a function: formal parameter list; Return Type, Function call, Passing arguments to a Function: call by reference. call by value. Structure variables, initialization, structure assignment, Address operators, pointer type declaration, pointer assignment, pointer initialization, Arrays and Pointers.

Suggested Readings:

1. Herbert Schildt, “C: The Complete Reference”, McGraw Hill Education India.
2. Kanetkar Yashavant, “Let Us C”, BPB Publications.

E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education India.

Programme/Class: **B.Sc.**	Year: **First**	Semester: **First**
Subject: Computer Science		
Course Code: CSC103F	**Course Title: Software Lab**	

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

1. To learn and understand C programming basics.
2. To learn and understand C looping, control statements and string manipulations.
3. To learn and know the concepts of arrays, strings, structures, pointers etc.
4. Develops the ability to get employment in programming field.

Credits**:2**

Suggested Readings:

1. Herbert Schildt, "C: The Complete Reference", McGraw Hill Education India.
2. Kanetkar Yashavant, "Let Us C", BPB Publications.
3. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India.

Sample 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 term so Fibonacci series.
5. WAP to find factorial of the given number.
6. WAP to find sum of the following series form terms: 1 – 2/2!+3/3! ----------n/n!

   Similar programs like it.

Programme / Class: **B.Sc.**	Year: **First**	Semester: **Second**
Subject: **Computer Science**		
Course Code: CSC104F	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 database management systems.
2. Develops the ability to get employment in Database field.
3. Formulate relation algebraic expression 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**

Unit	Topic
I	**Introduction:** Database System Concepts, File system vs. database system, Database system architecture, Data models and their types, Database scheme and instances, Data independence, Database Languages and Interfaces.
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, Relationship as of higher degree.
III	**Database Design** Functional dependencies, Normal forms, First, second, and third normal forms, BCNF, Multi-value dependencies and Fourth Normal form, Join Dependencies and Fifth Normal form.
IV	**Transaction, Query Processing and Concurrency Control** 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, Concurrency Control Techniques: Two phase Locking Techniques for Concurrency Control
V	**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.

Suggested Readings:

1. Henry F. Korth and Abraham Silberschatz, "Database System Concepts," Second Edition, McGraw Hill, 1991.
2. AtulKahate,"IntroductiontoDatabaseManagementSystems,"PearsonIndia, 2004.
3. RaghuRamakrishnanandJohannesGehrike,"DatabaseManagementSystems,"ThirdMc Graw 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
6. 6th Edition, McGraw Hill, 2010.

Programme/ Class: **B.Sc.**	Year: **First**	Semester: **Second**
Subject: Computer Science		
Course Code: CSC105F	Course Title: Database Management Systems Lab	

Course outcomes:

After the completion of the course the students will be able 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.
4. Develops the ability to get employment in Database field.

Credits**:2**

Suggested Readings:

1. Paul Du Bois, "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, A press, 2018.
3. Joel Murachand Ray Harris, "Murach's PHP and MySQL", First Edition, Mike Murach & Associates, 2010.
4. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 4th Edition, Addison-Wesley, 2008.

List of Experiments

1. Creation of data bases 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, GROUPBY, HAVING, VIEWS Creation and Dropping.
6. Use of COMMIT, ROLL BACK and SAVE POINT.
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.

Programme /Class: **B.Sc.**	Year: **Second**	Semester: **Third**
Subject: **Computer Science**		
Course Code: CSC201F	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. Develops the ability to get employment in System Development field.
5. Evaluate process deadlock handling techniques.

Credits: **4**

Unit	Topic
I	**Introduction** Operating system and functions, Classification of Operating systems: Batch,Interactive,Timesharing,RealTimeSystem,MultiprocessorSystems,Multiuser Systems, Multithreaded Systems, Operating System Structure,SystemComponents,OperatingSystemServices,Kernels,MonolithicandMicrokernelSystems.
II	**Process Management** Process Concept, Process States, Process Synchronization, Critical Section, Mutual Exclusion, Classical Synchronization Problems, Process Scheduling, Process States, Process Transitions, Scheduling Algorithms Inter-process Communication, Threads and their management, Security Issues.
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.
IV	**Memory Management and Disk Scheduling** Memory allocation, Relocation, Protection, Sharing, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing, Disk storage and disk scheduling, RAID.
V	**File System:** File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

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," 7th Edition, Prentice Hall, 2011.
4. Dhanjay Dhamdhere, "Operating Systems, "First Edition, McGraw-Hill, 2008

Programme/Class: **B.Sc.**	Year: **Second**	Semester: **Third**
Subject: Computer Science		
Course Code: CSC202F	Course Title: Operating Systems Lab	

Course out comes:

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

1. Use of Linux operating system and able to write shell programs.
2. Simulate and demonstrate the concepts of operating systems.
3. Develops the ability to get employment in System Development field.

Credits**:2**

Suggested Readings:

1. Sumitabh Das, "Your Unix/Linux: The Ultimate Guide," McGrawHill, 2012.
2. Richard Blumand 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++, Mc Graw Hill Education(India)Pvt. Ltd., India, 2013, 6th ed.

Lab on Operating Systems

Note: Following exercises can be performed using Linux or UNIX: Usage of following commands: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.Usage of following commands: cal, cat(append), cat(concatenate), mv ,cp, man, date.Usage of following commands: chmod, grep, tput, (clear, highlight), bc. Write a shell script to check if the number entered at the command line is prime or not.

1. Write a shell script to modify "cal" comm. And to display calendar of the specified months.
2. Write a shell script to modify "cal" comm. and to display calendar of the specified range of months.
3. Write a shell script to accept a login name. If not a valid login name display message– "Entered login name is invalid".
4. Write a shell script to display date in the mm/dd/yy format.
5. Write a shell script to display on the screen sorted output of "who" command along with the total number of users.
6. Write a shell script to display the multiplication table any number,
7. Write as hell script to compare two files and if found equal asks the user to delete the duplicate file.
8. Write a shell script to check whether the file have all the permissions or not.
9. Simulate FCFS CPU scheduling algorithm.
10. Simulate SJF CPU scheduling algorithm.
11. Simulate Priority CPU scheduling algorithm.
12. Simulate Round Robin CPU scheduling algorithm.
13. Simulate FIFO page replacement algorithm.
14. Simulate LRU page replacement algorithm.

Programme/Class: **B.Sc.**	Year: **Second**	Semester: **Fourth**
Subject: **Computer Science**		
Course Code: CSC203F	Course Title: **Computer System Architecture**	

Course outcomes:

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

1. Understand the basic arithmetic of a Computer System
2. Understand the Architecture of a basic computer
3. Develops the ability to get employment in Computer hardware field.

Credits: **4**

Unit	Topic
I	**Data Representation and basic Computer Arithmetic:** Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison.
II	**Logic gates and circuits:** logic gates, Boolean algebra, combinational circuits, circuit simplification, introduction to flip-flops and sequential circuits, decoders, multiplexers, registers, counters.
III	**Basic Computer Organization and Design:** Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt.
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
V	**Memory Organization:** Memory device characteristics, random access memories, serial access memories, Multi level memories, address translation, memory allocation, Main features, address mapping, structure versus performance.

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"

Programme/ vClass: **B.Sc.**	Year: **Second**	Semester: **Fourth**
Subject: **Computer Science**		
Course Code: CSC204F	Course Title: Computer System Architecture Lab	

Course out comes:

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

1. The functions of various hardware components and their building blocks
2. computer buses and input/output peripherals
3. memory hierarchy and design of primary memory
4. Develops the ability to get employment in Computer hardware field

Credits:**2**

Practical:

Memory 4096 words 16 bits per word	Instruction format 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	1Bit	1Bit	1Bit	1 bit	1Bit

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

Refer to Chapter-5 of Morris Man of or 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	e.CIR	i. SNA
b.CLE	f.CIL	j.SZA
c.CMA	g.INC	k.SZE
d.CME	h.SPA	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 withA937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

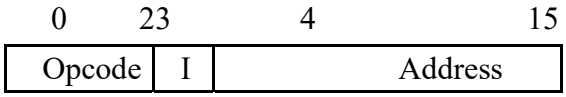
a. ADD
b. AND
c. LDA
d. STA
e. BUN
f. BSA
g. ISZ

6. Simulatethemachineforthememory-referenceinstructionsreferredinabovequestion 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 a12-bit address. There are only two addressing modes, I = 0 (direct addressing) and I=1 (indirect addressing).
   b. Create a new register Iof1bit.
   c. Create two new micro instructions 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: **B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Computer Science**		
Course Code: CSC301F	Course Title: **Analysis of Algorithm and Data Structures**	

Course out comes:

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

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

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

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

4: To get employment in the field of software development tools including libraries, compilers, editors, linkers and debuggers to write and troubleshoot programs.

Credits: **4**

Unit	Topic
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.
II	**Sorting Techniques**: Elementary sorting techniques-Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques-Heap Sort, Quick Sort.
III	**Arrays, Stacks and Queues:** Arrays: Single and Multi-dimensional Arrays, Prefix, Infix and Postfix expressions, Array and Linked representation of Queue, De-queue, Priority Queues.
IV	**Linked Lists:** Singly, Doubly and Circular Lists, representation of Stack and Queue as Linked Lists.
V	**Trees**: Introduction to Tree as a data structure; Binary Trees, 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, 3rd 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**(onlinecourse)**

Programme/Class: **B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Computer Science**		
Course Code: CSC302F	Course Title: **Soft Computing**	

Course outcomes:

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

1. To have the knowledge of soft computing concepts
2. To choose and design suitable Neural Network for real time problems.
3. To get employment in the field of soft Computing field.

Credits: **4**

Unit	Topic
I	**Introduction To Neural Networks**: Neural Networks Neuron, Nerve Structure And Synapse, Artificial Neuron And Its Model, Activation Functions.
II	**Neural Network Architecture**: Single Layer And Multilayer Feed Forward Networks, Recurrent Networks. Perception And Convergence Rule. Supervised Learning Network &Unsupervised Learning Network.
III	**Back Propagation Networks**: Perceptron Model, Solution, Single Layer, Multilayer Perception Model, Back Propagation Learning Methods, Effect Of Learning Rule Co-Efficient ;Back Propagation Algorithm, Applications.
IV	**Fuzzy Logic Introduction**: Basic Concepts Of Fuzzy Logic, Fuzzy Sets And Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion, Membership Functions, Interference In Fuzzy Logic, Fuzzy If-Then Rules, Fuzzyfications & Defuzzificataions.
V	**Genetic Algorithm**: Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding), Genetic Operators, Mutation, Generational Cycle.

Suggested Readings:

1. S. Rajsekaran & G. A. Vijayalakshmi Pai, "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 Networks and Learning Machines" Prentice Hall of India, 2005, 3rd Edition.

Programme/ Class: **B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Computer Science**		
Course Code: CSC303F	Course Title: **Lab on Algorithm and Data Structures**	

Course outcomes:

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

1:Optimize the solution with respect to time complexity & memory usage
2: Access how the choice of data structures and algorithm design methods impacts the performance of programs.
3: Choose the appropriate data structure and algorithm design method for a specified application.
4:To get opportunity of the employment in the field of programming and software development.

Credits:**2**

Practical List on Analysis of Algorithms and Data Structures:

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. ii) Doubly linked list.
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 Post order.
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 in order.
7. Write program for implementing the following sorting methods to arrange a list of integers in ascending order:
   a) Insertion sort b) Merge sort
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: **B.Sc.**	Year: **Third**	Semester: **Six**
Subject: **Computer Science**		
Course Code: CSC304F	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 get opportunity of employment in the field of Networks and communication.

Credits: **4**

Unit	Topic
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 A periodic signals, Time and Frequency Domain, Composite Signals.
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.
III	**Physical Layer and Data Link Layer**: Cabling, Network Interface Card, Transmission Media Devices-Repeater, Hub, Bridge, Switch, Router, Gateway, 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 sub layer (Ethernet, ALOHA, CSMA family, Contention-free access / Token Ring).
IV	**Network Layer and Transport 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, Transport layer services, Connection establishment and teardown, TCP, UDP, Congestion Control, Quality of Service, Domain Name System, World Wide Web.
V	**Network Security**: Common Terms, Firewalls, Virtual Private Networks

Suggested Readings:

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks, "5th Edition, Pearson, 2014.
2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson, 2013.
3. Behrouz A. Forouzan, "Data Communications and Networking," 4th Edition, McGraw-Hill Higher Education, 2007

Programme/ Class: **B.Sc.**	Year: **Third**	Semester: **Six**
Subject: **Computer Science**		
Course Code: CSC305F	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. To get opportunity of employment in the field of Cyber Security and Law.

Credits: **4**

Unit	Topic
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.
II	Information Security Techniques, Introduction to Cryptography: Terminology, Cryptanalysis, Security of Algorithms, Substitution Cipher and Transposition Cipher, Single XOR, One-way Pad**.**
III	Cryptographic Protocols: Arbitrated and Adjudicated Protocol, One-Way Hash function, Public key cryptography, Digital Signature, Digital Watermarking Technique: Characteristics and Types.
IV	Security Policies, Why Policies should be developed, WWW policies, Email Security policies and Policy Review Process-Corporate policies - Sample Security Policies.
V	Cyber Laws**:** Information Security Standards, IT Act 2000 Provisions, Introduction to digital laws, cyber laws, intellectual property rights, copyright laws, patent laws, software license.

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security, "6th 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, "6thArchtech Publication, 2007.
4. William Stallings, "Cryptography and Network Security: Principles and Practice," 6th Edition, Pearson, 2014.

Programme/ Class: **B.Sc.**	Year: **Third**	Semester: **Six**
Subject: **Computer Science**		
Course Code: CSC306F	Course Title: Lab on Computer Networks	

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 get opportunity of employment in the field of Networks and communication.

Credits: **2**

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.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Science**		
Course Code: CSC401F	Course Title: **Linux and Shell Programming**	

Course outcomes:

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

1. List the basic commands of unix operating system and use them in Linux environment (ubuntu, fedora etc.)
2. Understand commands related to process control and apply them to manage processes.
3. Understand the concepts of control structure, loops, case and functions in shell programming and apply them to create shell scripts.
4. Associate the concepts of arrays with Linux and apply them to create, compile and execute C programs in Linux terminal
5. Compare different editors (vi, gedit, nano) and use them to create shell script and C program for given problem.

Credits: **4**

Unit	Topic
I	Linux Utilities: File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities, Backup utilities Sed - Scripts, Operations, Addresses, Commands,,awk - Execution, Fields and Records, Scripts, Operations, Actions, Assocoative Array, Strings and Mathematical functions, System commands in awk, Applications. Shell programming with Bourne Again Shell (bash): Introduction, Shell responsibilities, Pipes and redirection, here documents, Running a shell script, Shell as a programming language, Shell meta characters, File-name substitution, Shell variables, Command substitution, Shell commands, The environment, Quoting, test command, Control structures, Arithmetic in shell, Shell script examples, Interrupt processing functions, Debugging shell scripts
II	Files and Directories: File concepts, File types File system structure,file metadata - Inodes, kernel support for files, System calls for the file I/O operations-open,create,read,wrirte,close,lseek,dup2,file status information-stat family, file and record locking-fcntl function, file permissions- chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links- symlink, link, unlink.
III	Process: Process concept, Layout of a C program image in main memory, Process environment – environment list, environment variables, getenv, setenv, Kernel support for process, Process identification, Process control - Process creation, replacing a process image, waiting for process, Process termination, Zombie process, Orphan process, ,system call interface for process management – fork, vfork, exit, wait, waitpid, exec family, process groups, sessions and controlling Terminal, differences between threads and processes.

IV	Inter process Communication: Introduction to IPC,IPC between processes on a single computer system, IPC between processes on different systems, Pipes-creationIPC between related processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions.
V	Sockets: Introduction to Berkley Sockets, IPC over a network, client – server model, Socket address structures (Unix domain and internet domain) , Socket system calls for connection oriented protocol and connectionless protocol, example- client/server programs- single server- client connection, multiple simultaneous clients, socket options setsockopt and fcntl system calls, comparison of IPC mechanisms.

Suggested Readings:

1. Begining Linux Programming, 4th Edition, N. Matthew, R.Stones, Wrox, Wiley India Edition.
2. Unix for Programmers 3rd Ed, Graham Glass & King Ables, Pearson Education.
3. System Programming with C and Unix, A.Hoover, Pearson.
4. Unix System Programming, communication, concurrency and Threads, K.A. Robbins and S.Robbins, Pearson Education.
5. Unix Shell Programming, S.G. Kochan and P.Wood, 3rd edition, Pearson Education.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Science**		
Course Code: CSC402F	Course Title: **Advance Analysis and Design of Algorithm**	

Course outcomes:

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

1. Given an algorithm, identify the problem it solves.
2. Write algorithms choosing the best one or a combination of two or more of the algorithm design techniques: Iterative, divide-n-conquer, Greedy, Dynamic Programming using appropriate data structures.
3. Write proofs for correctness of algorithms.
4. Re-write a given algorithm replacing the (algorithm design) technique used with a more appropriate/efficient (algorithm design) technique.

Credits: **4**

Unit	Topic
I	**Algorithmic Paradigms:** Dynamic Programming, Greedy, Branch-and-bound, Backtracking; Asymptotic complexity, Asymptotic notations and their significance, complexity analysis of algorithms, Amortized complexity analysis: Randomized algorithms, randomized selection, randomized min-cut.
II	**Complexity Classes and Approximation Algorithms:** Nondeterministic Algorithms, Fundamentals of NP-Hard and NP-Complete problems, different NP-complete problems, vertex cover, independent set, Hamiltonian cycle, knapsack, set cover, Constant ratio approximation algorithms.
III	**Tree and Graph Algorithms:** Tree, definition, traversal algorithms (pre, post, in), Applications of Trees, Graph, BFS, DFS, connected components, minimum spanning trees, shortest paths - single source and all pairs.
IV	**Searching & Sorting:** Searching, binary search trees, balanced binary, AVL trees and red-black trees, B-trees, skip lists, hashing. Priority queues, heaps, Interval trees, Sorting, comparison-based sorting, quick sort, heap sort, merge sort: worst and average case analysis, topological sort. Sorting in linear - radix sort, bucket sort, counting sort.
V	**Special Algorithmic Topics:** Queens problem, 0/1 Knapsack problem, Travelling Salesperson, Bin Packing, Probabilistic Algorithms; Numerical algorithms, matrix & polynomial multiplication, FFT, Euclid's algorithm, modular exponentiation, Recursion Technique, Tail recursion, String matching, Internet algorithms.

Suggested Readings:

1) Introduction to Algorithms, T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, 3rd Edition, Prentice-Hall of India Learning Pvt. Ltd.
2) Algorithm Design, J. Kleinberg and E. Tardos, 1st Edition, Pearson Education India,
3) Algorithms, Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, 1st Edition, Tata McGraw Hill.
4) Approximation Algorithms, Vijay V. Vazirani, Springer.
5) Introduction to Algorithms: A Creative Approach, Udi Manber, Addison-Wesley.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Science**		
Course Code: CSC403F	Course Title: **Programming Using Python**	

Course outcomes:

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

1.Create your first program in Python IDLE
2.Implement OOPs concepts in your programming
3.Use Arrays, and Data structures
Create an application with the 4.support of graphics in Python
5.Implement error handling

Credits: **4**

Unit	Topic
I	**Paradigms and Principles:** Overview of different programming paradigms e.g. imperative, object oriented, functional, logic and concurrent programming. Syntax and semantics- overview of syntax specification and semiformal semantic, specification using attribute grammar, Formal Semantics (languages with higher order constructs and types,

	recursive type and subtype).
II	**Programming Concepts in Python:** OOP, Keyword and Default Arguments, Scope Rules, Expressions, Conditionals, Loops, Functions etc; The Programming Cycle for Python, Python IDE, Strings-indexing and slicing of strings; Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries.
III	Higher Order Functions: Lambda Expressions; File I/O: File input and output operations in Python Programming Exceptions and Assertions Modules; Abstract Data Types: ADT interface; ***Classes:*** Class definition and other operations in the classes; Special Methods (such as _init_, _str_, comparison & Arithmetic methods); Modules and Packages.
IV	**Python in Web Development and Database Connection:** CGI in Python, Git tool, Django Framework, Styling with CSS, Django Forms, Sessions, SQL and Django models to Store and Access Data, Event-Driven Programming, APIs- JavaScript Objects, Applications with User Interfaces, Scalability-Hosting on the Cloud, Security-HTTPS; Database Connectivity.
V	**Python in Data Science:** Charting & Data Representation in Python, Usage of Numpy & Pandas, Applied Text Mining, Applied Social Network Analysis in Python, iPython for Interactive Computing, Data Wrangling:- Clean, Transform, Merge, Reshape; Usage of SciKit for Machine learning.

Suggested Readings:

1) A Formal Semantics of Programming Languages: An Introduction, Glynn Winskel, MIT Press.
2) Programming Languages: Concepts and Constructs, Ravi Sethi, Addison-Wesley.
3) Python for Data Analysis: Data Wrangling with Pandas, W. McKinney, NumPy and iPython, 2 nd Ed., O'Reilly, 2017.
4) Introduction to Data Mining, P. Tan, M. Steinbach, A Karpatne, and V. Kumar, 2nd Ed., Pearson Education, 2018.

5) Python Programming, Michael Urban and Joel Murach, Shroff/Murach,

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Science**		
Course Code: CSC404F	Course Title: **Software Engineering**	

Course outcomes:

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

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences.

Credits: **4**

Unit	Topic
I	**Fundamental Concepts:** Software life-cycle models, requirements specification, UML, design patterns, user interface design, coding and unit testing, integration and systems testing, debugging techniques, software quality - SEI CMM and ISO-9001. Reliability and fault-tolerance, planning, monitoring, control, and maintenance, Computer-Aided Software Engineering (CASE).
II	**Requirements Analysis and Specification:** Formal requirements specification, Development of requirements specification, SRS Building Process, Specification Languages, Validation of SRS, metrics, monitoring and control, Object Oriented analysis.

III	**Software Project Planning and Architecture:** Software Cost Estimation Techniques, Project Scheduling & Tracking, Project Team Standards, software configuration management. Role of Software Architecture, Architecture Views, Component and Connector View, Architecture Styles for C&C View, Architecture Evaluation.
IV	**Fundamental Issues in Software Design:** Goodness of design, cohesion, and coupling. Unified Modeling Language (UML), Unified design process. User interface design, Function oriented design using SA/SD, object-oriented design using UML, test case design, Design Strategies, Design specification and verification, Metrics, Design Translation Process.
V	**Software Testing and Reliability:** Strategies & Techniques, Debugging, Software Maintenance, Software Reliability and Availability Models, Software Reengineering, Cleanroom Approach, Software Reuse. Introduction to IEEE Standards, Case Studies.

Suggested Readings:

1) An Integrated Approach to Software Engineering, IIIrd Edition, Pankaj Jalote, Narosa Publishing House.
2) Software Engineering: Principles and Practices Waman S. Jawadekar, Tata McGraw-Hill.
3) Software Engineering: A Practitioner's approach, Roger S. Pressman, McGraw-Hill.
4) Software Engineering, Ian Sommerville, Pearson Education.
5) Fundamentals of Software Engineering, Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, PHI.
6) Fundamentals of Software Engineering, Rajib Mall, Prentice Hall India.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Seven**
Subject: **Computer Science**		
Course Code: CSC405F	Course Title: **Linux, Algorithm and Python Lab**	**Credit - 4**

1. Installation of Linux operating system using virtualization technique
2. Understanding and practice of various Linux commands
3. Creation/usage of various types of files supported by Linux
4. Practice of Computer networking commands
5. Write a shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. Whenever the argument is a file, the number of lines on it is also reported
6. Illustrate by writing script that will print, message "Hello World, in Bold and Blink effect, and in different colors like red, brown etc using echo commands?
7. Write a shell script that accepts a file name, starting and ending line numbers as arguments and displays all the lines between the given line numbers.
8. Illustrate by writing script using for loop to print the pyramid patterns?
9. Write a shell script that accepts a list of file names as its arguments, counts and reports the occurrence of each word that is present in the first argument file on other argument files.
10. Write a shell script to find factorial of a given number
11. Write other simple programs using shell programming

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC406F	Course Title: Advance Database Management System	

Course outcomes:

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

1. Explain and evaluate the fundamental theories for advanced database architectures and query operators.

2. Design and implement parallel database systems with evaluating different methods of storing, managing of parallel database.

3. Assess and apply database functions of distributed database.

4. Evaluate different database designs and architecture.

5. Administer and analyze database with query optimization techniques and developWeb interface with database.

6. Understand advanced querying and decision support system.

Credits: **4**

Unit	Topic
I	**Basic Concepts:** Object-oriented and object relational databases, logical databases, web databases, distributed databases, data warehousing and data mining.
II	**Database System Architecture and Selected Issues:** Data Abstraction, Data Independence, Data Definition and Data Manipulation Languages, Data Security, Transaction Management, Introduction to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques.
III	**Distributed DBMS:** Features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design – fragmentation, allocation criteria. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.
IV	**Partitioned Networks and Storage Mechanisms in Distributed DBMS**: Checkpoints & Cold Starts. Distributed Transactions Management, 2 Phase Protocols. Architectural Aspects. Node & Link Failure Recoveries. Translation of

	Global Queries. Global Query Optimization, Query Execution & Access, Concurrency Control, 2 Phases Locks. Distributed Deadlocks. Time based & quorum-based Protocols.
V	**Alternative Architecture in Distributed DBMS:** Development Tasks, Operation, Global task management. Client Server Databases, SQL Server, ODBC, Constructing an application.

Suggested Readings:

1) An Introduction to Database Systems, Vol I & II, C. J. Date, Addison Wesley.
2) Data Base System Concepts, Korth Silberschatz, McGraw Hill.
3) Principles of Database Systems, J. D. Ullman, Galgotia.
4) Database Design, Wiederhold, McGraw Hill.
5) Fundamentals of Database Systems, R. Elmasri and S. B. Navathe, Pearson Education Asia.
6) Database Management Systems, Raghu Ramakrishnan, McGraw-Hill Education.
7) Distributed Databases Principles & Systems, Tata McGraw-Hill Education.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC407F	Course Title: Introduction to Data Science	

Course outcomes:

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

1. The ability to manage large data sets in preparation for data science analysis.
2. A working knowledge of traditional statistical techniques and the ability to apply these methods to a wide array of real world problems.
3. The ability to perform data science analysis from beginning to end while adhering to the principles of reproducible research.

Credits: **4**

Unit	**Topic**

I	**Introduction:** Data Science Process, Data preparation & Management, Data Acquisition & Preprocessing Techniques, Data Cleaning, Selection, Integration, Transformation and Reduction, Mathematical Statistics & Probability, Statistical Inference- Event Space, Probability, Distributions and Hypothesis Testing; SciPy Stack (Python Programming Tools)- Jupyter, NumPy, scikit-learn, Pandas & Matplotlib;
II	**Data Modeling:** Statistical Inference, Exploratory Data Analysis and Visualization, Predictive Modeling, Decision Tree, Classification, Model Evaluation & Ensembles, Descriptive, Partitional, Hierarchical, Density Based Clustering, Outlier Detection, Clustering Performance Evaluation.
III	**Data Warehousing & Data Mining:** Dimensionality Reduction, Association Rules, Anomaly Detection, Data Analysis Techniques, Formulas, Statistics, Extracting Data & Information, Spatial Databases, Multimedia Databases, Time-series & Sequence, Text databases, Web Semantics. Big Data Technology & Computing, Big Data Architecture,
IV	**Machine Learning:** Explore New Data Sets, Implementing Machine Learning Comprehensive Set, Learning Algorithms from Scratch, Data Preprocessing, Scikit Learning, Library for Machine Learning, Feature Engineering, Model Selection, Performance Metrics, Hyper-parameter Optimization, Deep Learning,
V	**Exploratory Data Analysis:** Data Analysis, Descriptive Statistics, Univariate and Multivariate Exploratory Data Analysis, Data Engineering, Natural Language Processing, Web Scraping Applications, Real-Time Data, Streaming Data Analytics, Next Generation Databases, Genomics, Apache Spark, Research Modeling & Implementation.

Suggested Readings:

1) R for Data Science, G. Grolemund, H. Wickham, 1st Ed., O'Reilly.
2) Python Data Science Handbook, Jake VanderPlas, O'Reilly.
3) Introduction to Data Mining, P. Tan, M. Steinbach, A Karpatne, V. Kumar, 2nd Ed., Pearson Education, 2018.
4) Python for Data Analysis: Data Wrangling with Pandas, NumPy and iPython, W. McKinney, 2 nd Ed., O'Reilly.
5) Mining the Web: Discovering Knowledge from Hypertext Data, Soumen Chakrabar, Morgan-Kaufmann.
6) An Introduction to Statistical Learning with Applications in R, G James, D Witten, T Hastie and R Tibshirani, Springer Texts in Statistics, Springer.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC408F	Course Title: Artificial Intelligence	

Course outcomes:

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

1. Design user interfaces to improve human–AI interaction and real-time decision-making.
2. Evaluate the advantages, disadvantages, challenges, and ramifications of human–AI augmentation.
3. Design and develop symbiotic human–AI systems that balance the information processing power of computational systems with human intelligence and decision making.
4. Explain the benefits, limitations, and tradeoffs of designing engaging and ethical conversational user interactions, including those supported by chatbots, smart speakers, and other

Credits: **4**

Unit	Topic
I	**Introduction** Introduction to Artificial Intelligence, Simulation of Sophisticated & Intelligent Behavior, Uses of AI Different Area Problem Solving in Games, Natural Language, Automated Reasoning, Visual Perception.
II	**State Spaces, Production Systems and Search** State Space, Representation of Problems. Problem Solving as Search. Constraints. Production Systems, Heuristic Search techniques, Two Person Games.
III	**Knowledge Representation** First Order Predicate Calculus, Horn Clauses, Introduction to PROLOG, Partitioned Nets, Minskey Frames, Case Grammar Theory, Production Rules, Knowledge Base, Interface System, Forward & Backward Deduction.
IV	**Weak Slot and Filler Structure** Semantic Nets & Frames. Scripts for Representing, Prototypical Combinations, Events & Actions, Pattern Matching Algorithms. Control in Rule Based Systems, Rete Algorithm.
V	**Pattern Recognition** Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine Perception, Line Finding, Interception Semantic & Model, Object Identification, Speech Recognition, Text Recognition, Image Recognition.

Suggested Readings:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice Hall, 2nd edition.
2. The Sciences of the Artificial, Herbert A. Simon, MIT Press, 3rd Edition.
3. Common Lisp: The Language, Guy Steele, Digital Press, 2nd Edition.
4. Artificial Intelligence, Elaine Rich and Kevin Knight, Mc Graw Hill, 2nd Edition.

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC409F	Course Title: Machine Learning and Soft Computing	

Course outcomes:

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

1. Learn about soft computing techniques and their applications
2. Analyze various neural network architectures
3. Understand perceptrons and counter propagation networks.
4. Define the fuzzy systems
5. Analyze the genetic algorithms and their applications.

Credits: **4**

Unit	Topic
I	**Introduction:** Introduction to Soft Computing, Learning theory, Hypothesis and Target Cass, Inductive bias and Bias-variance Tradeoff, Occam's Razor, Limitations of Inference Machines, Approximation and Estimation errors. State Space Search, Traditional vs Heuristic Search, Review of Single State Methods: Hill Climbing, Simulated Annealing, Tabu Search, Iterated Local Search.
II	**Learning Process:** Supervised learning, Linear Separability, Decision Regions, Linear discriminants, Bayes optimal classifier, Linear Regression, Standard and Stochastic Gradient descent, Regression, Support Vector Machines, Decision Tree Induction, Overfitting,

	Pruning, Bagging and Boosting, Reduction & Feature Selection. Unsupervised Learning, Clustering, Mixture Models, Expectation Maximization, Spectral Clustering, Non-parametric, Density Estimation.
III	**Artificial Neural Networks:** Biological Neuron Networks, Mathematical Model of Neuron, Threshold and Activation Functions, ANN, ANN Topologies, Perceptron, Linear Separation & MLP, Feed-forward & Feed-backward Networks, Delta & Gradient Descent Learning, Hebbian & Back Propagation Learning, Hopfield Networks, Recurrent Networks, Self-Organizing Feature Maps.
IV	**Population-based Methods**: Genetic Algorithms, Representation & Encoding, Operators, Convergence, Steady State vs Generational GA, Differential Evolution Algorithm, Representation, Operators, Variants and Hybrids, Particle Swarm Optimization, Representation, Operation Algorithmic, Local and Global Best. Greedy Randomized Adaptive Search, Ant Colony Optimization.
V	**Learning and Applications**: ANN for Pattern Classification, Pattern Matching and Time Series Analysis. Deep Learning: Networks, Introduction to Deep Feedforward Networks, Convolutional Neural Networks, Stacking, Striding & Pooling.

Suggested Readings:

1. Introduction to Machine Learning, E. Alpaydin, 3rd Edition, Prentice Hall of India, 2014.
2. The Elements of Statistical Learning Data Mining, Inference, and Prediction, T Hastie, R Tibshirani and J Friedman, 2nd Edition, Springer.
3. Pattern Recognition and Machine Learning, C. M. Bishop, Springer.
4. Pattern Classification, R. O. Duda, P. E. Hart, and D.G. Stork, John Wiley and Sons.
5. Neural Networks and Learning Machines, Simon O. Haykin, Pearson Education, 2016

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC410F	Course Title: DBMS, AI and ML Lab	**Credit - 4**

1. Complete any at any 10 experiments as per the direction given by the instructor.
2. Designing and Implementation of some of the uninformed search algorithms.
3. Designing and Implementation of some of the informed search algorithms.
4. Designing and Implementation of A* search algorithms.
5. Designing and Implementation of A* search algorithms with different heuristic functions.
6. Designing and Implementation of some types of intelligent agents.
7. A simple linear regression attempts to draw a straight line that will best minimize the residual sum of squares between the observations and the predictions in python program language.
8. Linear Regression Logistic Regression used in python program language
9. Decision Tree in python program language.
10. SVM used in python program language.
11. Naive Bayes used in python program language.
12. KNN in python program language.
13. K-Means in python program language.
14. Random Forest in python program language.
15. Dimensionality Reduction Algorithms in python program language

Programme/ Class: **B.Sc.**	Year: **Four**	Semester: **Eight**
Subject: **Computer Science**		
Course Code: CSC411F	Course Title: Research Project	**Credit - 12**

The candidate can formulate and complete Research Project in the emerging areas of Computer science and allied discipline. The candidate has to complete Research Project related to his/her subject major. This course can be completed in the form of Research project work etc. It can be of interdisciplinary/ multi-disciplinary nature. This Research Project will be completed under the supervision of a faculty member of the concerned subject. A co-supervisor can be taken from research organization if needed**.**