



## **Curriculum and Syllabus**

**(Applicable to students admitted during AY 2022 – 25)**

**BSc Computer Science (Hons.)**

**BSc Computer Science (Research)**

**BSc Computer Science (Hons. & Research)**

**School of Engineering and Sciences**

**Department of BSc Computer Science**  
**SRM UNIVERSITY – AP, Andhra Pradesh**

<b>S.No</b>	<b>Component</b>	<b>No of Required Credits</b>	<b>No.of Courses</b>	<b>in %</b>
1	Foundation Courses (FC)	28	7	25
2	Core Course (CC)	48	12 (Courses)	41
3	Minor Courses (MC)	16	4	14
5	Open Elective (OE)	6	2	5
6	Dissertation / Project (P)	4	1	5
7	Skill Enhancement Courses (SEC)	10	6	10
	<b>Total (BSC CS)</b>	<b>112</b>		<b>100</b>
8	Honours (AI&ML or Data Science)	17	4	
	<b>Total (BSC CS with Honours)</b>	<b>129</b>		
9	Research, Design and Industry Practice (RDIP)	38		
	<b>Total (BSC CS with Research)</b>	<b>150</b>		
	<b>Total (BSC CS Honours with Research)</b>	<b>167</b>		

**SRM UNIVERSITY – AP, ANDHRA PRADESH**  
**CURRICULUM FRAMEWORK**  
**PROGRAM: BSC Computers Honors**  
**(For students admitted from the academic year 2022-25)**

**SEMESTER I**

Course Type	Course Code	Course Name	L	T	P	C
FC	CSE 108	Introduction to Computer Science and Programming Using C	3	0	0	3
	CSE 108 L	Introduction to Computer Science and Programming Using C Lab	0	0	2	1
FC	PHY 103	Introduction to Physics	3	0	2	4
FC	CHE 115	Introduction to Chemistry	3	1	0	4
FC	BIO 103	A primer to Biology	3	0	2	4
FC	MAT 104	Introduction to Mathematics	4	0	0	4
SEC	ISES 101	Industry Specific Employability Skills-I	3	0	0	1
		<b>TOTAL</b>	<b>16</b>	<b>1</b>	<b>11</b>	<b>21</b>

**SEMESTER II**

Course Type	Course Code	Course Name	L	T	P	C
FC	ENV 100	Introduction to Environmental Sciences	4	0	0	4
FC	EGL100	Introduction to Communicative English	3	1	0	4
CC	CSC 107	Data Structures	3	0	0	3
	CSC 107L	Data Structures Lab	0	0	2	1
CC	MAT 221	Probability and Statistics for Engineers	3	1	0	4
CC	MAT252	Discrete Mathematics	4	0	0	4
SEC	CSC 130	Industry Standard Coding Practice-I	0	0	4	2
SEC	ISES 102	Industry Specific Employability Skills-II	3	0	0	1
		<b>TOTAL</b>	<b>19</b>	<b>3</b>	<b>8</b>	<b>23</b>

**SEMESTER III**

Course Type	Course Code	Course Name	L	T	P	C
CC	CSC201	Design and Analysis of Algorithms	3	0	0	3
	CSC201L	Design and Analysis of Algorithms Lab	0	0	2	1
CC	CSC 206	Object oriented Programming with C++	3	0	0	3
	CSC 206L	Object oriented Programming with C++ Lab	0	0	2	1
MC	MC1	Minor 1	3	1	0	4
SEC	CSC231	Industrial Standard Coding Practice-II	0	0	4	2
SEC	ISES 211	Industry Specific Employability Skills-III	3	0	0	1

Honours	CSC 102	Introduction to Programming Using Python	3	0	0	3
	CSC 102L	Introduction to Programming Using Python Lab	0	0	3	2
		<b>TOTAL</b>	<b>15</b>	<b>1</b>	<b>11</b>	<b>20</b>

#### SEMESTER IV

Course Type	Course Code	Course Name	L	T	P	C
CC	CSC 203	Operating Systems	3	0	0	3
	CSC 203L	Operating Systems Lab	0	0	2	1
CC	CSC 207	Java Programming	3	0	0	3
	CSC 207 L	Java Programming Lab	0	0	2	1
MC	MC2	Minor 2	3	1	0	4
CC	CSC 204	Computer Organization and Architecture	3	0	0	3
	CSC 204L	Computer Organization and Architecture Lab	0	0	2	1
Honors	CSC 336/ CSC 338	Machine Learning/Applied Data Science	3	0	0	3
	CSC 336L/ CSC 338L	Machine Learning Lab/Applied Data Science Lab	0	0	2	1
SEC	CSC 233	Industry Standard Coding Practice-III	0	0	4	2
SEC	ISES 212	Industry Specific Employability Skills-IV	3	0	0	1
		<b>TOTAL</b>	<b>18</b>	<b>1</b>	<b>12</b>	<b>23</b>

#### SEMESTER V

Course Type	Course Code	Course Name	L	T	P	C
CC	CSC 304	Database Management System	3	0	0	3
	CSC 304 L	Database Management System Lab	0	0	2	1
MC	MC3	Minor 3	3	1	0	4
CC	CSC E	CSC Elective 1	4	0	0	4
Honors	CSC 413/ CSC 310L	Artificial Intelligence/Data Warehousing and Mining	3	0	0	3
	CSC 413 L/ CSC 310 L	Artificial Intelligence Lab/Data Warehousing and Mining Lab	0	0	2	1
OE	OE1	Open Elective 1	3	0	0	3
		<b>TOTAL</b>	<b>16</b>	<b>1</b>	<b>4</b>	<b>19</b>

### SEMESTER VI

Course Type	Course Code	Course Name	L	T	P	C
Honors	CSC412/ CSC 419	Principles of Soft Computing/Information Retrieval	3	0	0	3
	CSC412L/ CSC 419 L	Principles of Soft Computing Lab/Information Retrieval Lab	0	0	2	1
OE	OE2	Open Elective 2	3	0	0	3
CC	CSEE	CSE Elective 2	4	0	0	4
CC	CSEE	CSE Elective 3	4	0	0	4
MC	MC4	Minor 4	3	1	0	4
RDIP	CSC 340	Project	0	0	8	4
		<b>TOTAL</b>	<b>17</b>	<b>1</b>	<b>10</b>	<b>23</b>

**General BSC Total Credits: 21+23+15+19+15+19=112 credits**

**BSC Honors Total Credits: 21 + 23 + 20 + 23 + 19 + 23 = 129 credits**

### SEMESTER VII

Course Type	Course Code	Course Name	L	T	P	C
CC	CSEE	CSE Elective 4	4	0	0	4
CC	CSEE	CSE Elective 5	4	0	0	4
CC	RM101	Research Methodology	2	0	0	2
CC	EGL102	Technical Writing	2	0	0	2
RDIP	CSC 440	Project	0	0	20	10
		<b>TOTAL</b>	<b>12</b>	<b>1</b>	<b>16</b>	<b>22</b>

### SEMESTER VIII

Course Type	Course Code	Course Name	L	T	P	C
RDIP	CSC 441	Project	0	0	32	16
		<b>TOTAL</b>	<b>12</b>	<b>1</b>	<b>16</b>	<b>16</b>

**General BSC + Research Total Credits: 21+23+15+19+15+19+ 22 + 16 =150 credits**

**BSC Honors + Research Total Credits: 21 + 23 + 20 + 23 + 19 + 23 +22+16 = 167 credits**

### Honours in AI & ML

Students who would like to take Honours in AI and ML are recommended to take four domain specific specializations

Course Code	Course Name	L	T	P	C
CSC 102	Introduction to Programming Using Python	3	0	0	3
CSC 102L	Introduction to Programming Using Python Lab	0	0	3	2
CSC 413	Artificial Intelligence	3	0	0	3
CSC 413 L	Artificial Intelligence Lab	0	0	2	1
CSC 336	Machine Learning	3	0	0	3
CSC 336L	Machine Learning Lab	0	0	2	1
CSC 314	Digital Image Processing	3	0	0	3
CSC 314L	Digital Image Processing Lab	0	0	2	1
CSC412	Principles of Soft Computing	3	0	0	3
CSC412 L	Principles of Soft Computing Lab	0	0	2	1

### Honours in Data Science

Students who would like to take Honours in Data Science are recommended to take four domain specific specializations

Course Code	Course Name	L	T	P	C
CSC 102	Introduction to Programming Using Python	3	0	0	3
CSC 102L	Introduction to Programming Using Python Lab	0	0	3	2
CSC 310L	Data Warehousing and Mining	3	0	0	3
CSC 301L	Data Warehousing and Mining Lab	0	0	2	1
CSC 338	Applied Data Science	3	0	0	3
CSC 338L	Applied Data Science Lab	0	0	2	1
CSC 417	Principles of Bigdata Management	3	0	0	3
CSC 417L	Principles of Bigdata Management Lab	0	0	2	1
CSC 419	Information Retrieval	3	0	0	3
CSC 419 L	Information Retrieval Lab	0	0	2	1

### List of Electives

Students who would like to take specializations are recommended to take two general electives and five domain specific specializations.

Students who would like to pursue elective in general discipline can take any of the electives listed below provided offered in the particular semester.

## Computer Science Department General Electives

Course Code	Course Name	L	T	P	C
CSC 320	Web Programming	3	0	0	3
CSC 321	Human Computer Interaction	3	0	0	3
CSC 322	Advanced Computer Architecture	3	0	0	3
CSC 323	Natural Language Processing	3	0	0	3
CSC 324	Computer Graphics	3	0	0	3
CSC 325	Advanced Data Structures and Algorithms	3	0	0	3
CSC 326	Distributed Operating Systems	3	0	0	3
CSC 420	Data and Web Mining	3	0	0	3
CSC 421	Complexity Theory	3	0	0	3
CSC 422	Software Project Management	3	0	0	3
CSC 423	Multimedia	3	0	0	3
CSC 424	Deep Learning	3	0	0	3
CSC 425	Advanced Database Management Systems	3	0	0	3
CSC 426	Fog Computing	3	0	0	3
CSC 427	Parallel Algorithms	3	0	0	3
CSC 428	Web Services	3	0	0	3
CSC 429	Advances in Data Mining	3	0	0	3
CSC 303	Computer Networks	3	0	0	3
CSC 303 L	Computer Networks Lab	0	0	2	1
CSC 305	Software Engineering	3	0	0	3
CSC 305 L	Software Engineering-Lab	0	0	2	1
CSC 337	Cryptography	3	0	0	3
CSC 337 L	Cryptography Lab	0	0	2	1
CSC 315	Network Security	3	0	0	3
CSC 315 L	Network Security Lab	0	0	2	1
CSC 316	Distributed Systems	3	0	0	3
CSC 316 L	Distributed Systems Lab	0	0	2	1
CSC 318	Cloud Computing	3	0	0	3
CSC 318 L	Cloud Computing Lab	0	0	2	1
CSC 317	Embedded Systems	3	0	0	3
CSC 317 L	Embedded Systems Lab	0	0	2	1
CSC 424	Deep Learning	3	0	0	3
CSC 420	Data and Web Mining	3	0	0	3
CSC 323	Natural Language Processing	3	0	0	3

# **SEMESTER -I**



## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 108	Introduction to Computer Science and Programming Using C	FC	3	0	0	3

### UNIT I: INTRODUCTION TO COMPUTER SCIENCE

Fundamentals of Computing, Historical perspective, Early computers. Computing machine. Basic organization of a computer: ALU, input-output units, memory, program counter - variables and addresses - instructions: store, arithmetic, input and output. Problem solving: Algorithm / Pseudo code, flowchart, program development steps Computer languages: Machine, symbolic and high-level languages Creating and Running Programs: Writing, editing (any editor), compiling (gcc), linking, and executing in Linux environment

### UNIT II

#### C PROGRAMMING BASICS

Structure of a C program, identifiers Basic data types and sizes. Constants, Variables Arithmetic, relational and logical operators, increment and decrement operator's Conditional operator, assignment operator, expressions Type conversions, Conditional Expressions Precedence and order of evaluation, Sample Programs.

**SELECTION & DECISION MAKING:** if-else, null else, nested if, examples, multi-way selection: switch, else-if, examples.

**ITERATION:** Loops - while, do-while and for, break, continue, initialization and updating, event and counter controlled loops and examples.

### UNIT III: FUNCTIONS AND ARRAYS

**FUNCTIONS:** User defined functions, standard library functions, Passing 1-D arrays, 2-D arrays to functions. Recursive functions - Recursive solutions for fibonacci series, towers of hanoi. C Pre-processor and header files.

**ARRAYS:** Concepts, declaration, definition, storing and accessing elements, one dimensional, two dimensional and multidimensional arrays, array operations and examples. Character arrays and string manipulations.

### UNIT IV: POINTERS

Concepts, initialization of pointer variables, pointers as function arguments, passing by address, dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments.

### UNIT V: ENUMERATED, STRUCTURE AND UNION TYPES

Structures - Declaration, definition, and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures. Unions, typedef, bit-fields, program applications. Bit-wise operators: logical, shift, rotation, masks.

**FILE HANDLING:** Concept of a file, text files and binary files, formatted I/O, file I/O operations and example programs.

**TEXTBOOKS**

1. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
2. The C programming Language by Brian Kernighan and Dennis Richie.

**REFERENCES**

1. Problem Solving and Program Design in C, Hanly, Koffman, 7<sup>th</sup> edition, PEARSON 2013.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Programming in C, A practical approach Ajay Mittal PEARSON.
4. Programming in C, B. L. Juneja, Anith Seth, First Edition, Cengage Learning.

## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 108 L	Introduction to Computer Science and Programming Using C Lab	FC	0	0	2	1

### LIST OR PRACTICAL EXPERIMENTS

1. **Week-1: Basic C programs**

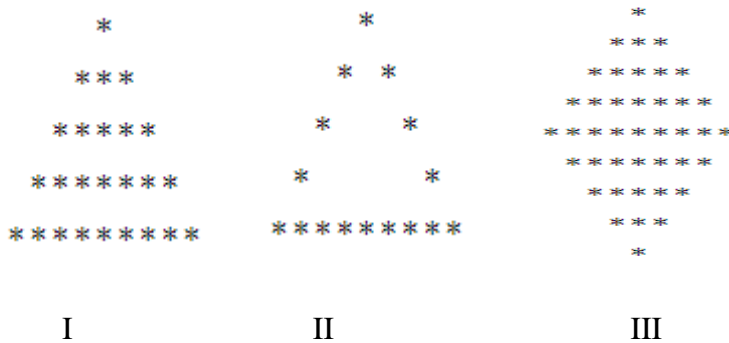
- a. Calculation of the area of triangle.
- b. Swap two numbers without using a temporary variable.
- c. Find the roots of a quadratic equation.
- d. Takes two integer operands and one operator from the user, performs the operation and then prints the result.

2. **Week-2: Loops**

- a. Find the sum of individual digits of a positive integer and find the reverse of the given number.
- b. Generate the first n terms of Fibonacci sequence.
- c. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.
- d. Print the multiplication table of a given number n up to a given value, where n is entered by the user.

3. **Week-3: Loops**

- a. Decimal number to binary conversion.
- b. Check whether the given number is Armstrong number or not.
- c. Triangle star patterns



4. **Week-4: Arrays**

- a. Interchange the largest and smallest numbers in the array.
- b. Searching an element in an array
- c. Sorting array elements.

5. **Week-5: Matrix**

- a. Transpose of a matrix.
- b. Addition and multiplication of 2 matrices.

6. **Week-6: Functions**

- a. (nCr) and (nPr) of the given numbers
- b.  $1+x+x^2+x^3+...+x^n$

7. **Week-7:** Functions and array

- a. Function to find both the largest and smallest number of an array of integers.
- b. Linear search.
- c. Replace a character of string either from beginning or ending or at a specified location.

8. **Week-8:** Pre-processor directives

- a. If Def
- b. Undef
- c. Pragma

9. **Week-9:** Structures

- a. Reading a complex number
- b. Writing a complex number.
- c. Addition of two complex numbers
- d. Multiplication of two complex numbers

10. **Week-10:** String operations without using the built-in functions

- a. Concatenate two strings
- b. Append a string to another string.
- c. Compare two strings
- d. Length of a string
- e. Find whether a given string is palindrome or not

11. **Week-11:** Pointers

- a. Illustrate call by value and call by reference.
- b. Reverse a string using pointers
- c. Compare two arrays using pointers

12. **Week-12:** Pointers and array

- a. Array of Int and Char Pointers.
- b. Array with Malloc(), calloc() and realloc().

13. **Week-13:** Recursion

- a. To find the factorial of a given integer.
- b. To find the GCD (greatest common divisor) of two given integers.
- c. Towers of Hanoi

14. **Week-14:** File Operations

- a. File copy
- b. Word, line and character count in a file.

15. **Week-15:** Command line arguments

- a. Merge two files using command line arguments.

## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
PHY 103	Introduction to Physics	FC	3	0	0	3

### UNIT I: Great Discoveries in Physics

Max Planck – Black body Radiation, Radioactivity – Uranium fission, Niels Bohr – Various models of atoms, Edwin Hubble – Galaxies, Expansion of Universe, C. V. Raman – Raman effect and applications, James Chadwick – Discovery of Neutron, Ernst Ruska – Invention of Electron microscope, Charles Townes – Invention of MASER and LASER, Discovery of elementary particles – LHC, Concept of Ether: Michelson-Morley experiment, Gravitational Waves – LIGO Experiments Quantum resistance and superconductivity

### UNIT II: Mechanics

Scalars and vectors, their various products, Newton's Laws of motion and kinematics, Free body force diagrams and applications on Inclined plane motion and Simple Pulley system, Impulse, Impulse momentum theorem, Conservation of momentum, momentum diagram, worked examples Centre of Mass of rigid systems and motion of CM, Projectile motion and applications, Work Energy conservation, and application in bullet's motion, Conservative and non-conservative forces, path integrals, Work-Energy motion on friction surface, Collisions in 1D and 2D with work examples Circular motion and applications

### UNIT III: Electricity and magnetism

Atoms, types of charge carriers and quantization, Force between charges, electric field and electric lines of force, Concept of electric potential and potential difference, Current through a conductor and Ohm's law, Atomic polarizability, Polarization in dielectrics, capacitors, Biot-Savart law, Ampere Law, Concept of magnetic monopole, magnetic current density, Force on a charge due to electric and magnetic field, Force between two current carrying conductors, Cyclotron motion, Accelerated charged particles and electromagnetic wave (concept)

### UNIT IV: Modern Physics

Longitudinal and transverse waves, travelling wave, Superposition of waves, Electromagnetic waves and EM spectrum, Propagation EM waves in free space, Poynting vector, Radiation of EM waves, Blackbody radiation, classical interpretation, and Planck's hypothesis, Photoelectric effect and particle nature of wave, Wave properties of particles and de-Broglie hypothesis, Concept of Wave function, Probability, physical significance of wavefunction, Wavefunction, probability and energy of particle in a box with infinite potential (concept only), Heisenberg's uncertainty principle

### UNIT IV: Modern Physics

Crystalline, amorphous and glassy phases, Concept of lattice and basis, Primitive unit cell, Bravais lattice, Symmetry elements and operations: rotation, reflection, inversion, Lattice planes and Miller indices, Packing factor of face and body centred crystals, Bragg's law of X-Ray diffraction in crystal

Electron and Neutron diffraction, Group activities on X-Ray diffraction methods, Application of Diffraction in solid state physics, Origin of Energy band in crystal structure, Energy Band of metals, insulators, and semiconductors

**TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL**

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill
3. Introduction to Solid State Physics, 8th Edition Charles Kittel 8th edition Wiley India Pvt Ltd

## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
PHY 103L	Introduction to Physics Lab	FC	3	0	0	3

### Experiment:

1. Compound Pendulum: Acceleration due to gravity and radius of gyration of the given pendulum
2. Hooke's law and determination of spring constant for a given spring
3. Biot-savart law: Dependence of magnetic field on the current and magnetic field variation along the axis of a current carrying circular loop
4. Faraday law & Induced E.M.F: Measurement of the induced voltage and calculation of the magnetic flux induced by a falling magnet
5. Verification of Stefan's Law of blackbody radiation
6. Measurement of dielectric constant of air and a given object using parallel plate capacitor
7. Photoelectric effect and Planck's Constant determination
8. Spectral lines from Hydrogen discharge lamp: Balmer Series and Rydberg constant
9. Powder X-Ray diffraction patterns of NaCl and

### Recommended Resources

1. Laboratory manuals, SRM University – AP
2. R.K. Shukla and Anchal Srivastava, "Practical Physics" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9].

### Other Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited  
Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill

## SEMESTER-I

Course Code	Course Name	Core / Elective	Credits			
			L	T	P	C
CHE 115	Introduction to Chemistry	FC	3	1	0	4

### UNIT I – CHEMICAL BONDING AND MOLECULAR STRUCTURE

Importance and scope of chemistry (Central Science), Valence electrons, ionic bond, covalent bond, Hydrogen bond, Valence bond theory, the geometry of covalent molecules, VSEPR theory, the concept of hybridization involving *s*, *p*, and *d* orbitals, Shapes of some simple molecules, Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only)

### UNIT II – STATES OF MATTER

Three states of matter, intermolecular interactions Gases: The behavior of gases, changes in the volume of a gas with pressure; Boyle's law, Change in volume of a gas with temperature; Charles's law

Gay Lussac's law, Avogadro's law, Ideal gas law, Empirical derivation of gas equation, Kinetic molecular theory, Deviation from ideal gas law, Liquids – Liquid State – Vapour pressure, viscosity, and surface tension, Introduction to solutions, different types of solutions, Raoult's Law (change of state), Constant boiling mixtures (azeotropic mixtures (distillation)), Nature and different types of solids including covalent, non-covalent ionic, and metallic solids, Solids and their bonding, Band theory, Application of crystalline materials in electronic devices.

### UNIT III – REDOX REACTIONS

Concept of oxidation and reduction, redox reactions, redox reactions, Oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers, Applications of redox reactions, Nomenclature applicable to electrochemical cells, viz., electromotive force, electrochemical series, Evolution of electrochemical cells: from voltaic cells to Li-ion battery

### UNIT IV: BASIC PRINCIPLES OF ORGANIC CHEMISTRY

General introduction, classification, IUPAC nomenclature of organic compounds, electronic displacements in a covalent bond, Inductive effect, electrometric effect, resonance, and hyperconjugation, Homolytic and heterolytic fission of a covalent bond, Free radicals, carbocations, carbanions, Electrophiles and nucleophiles, Types of organic reactions, Purification methods: Qualitative and quantitative analysis

### UNIT V: CHEMISTRY OF LIFE

Carbohydrates, Amino acids, peptide bonds, Secondary and tertiary structures of proteins, enzymes, vitamins, Nucleic acids, bioinorganic chemistry, Toxicity of heavy metals (Cu, Fe, As, Pb, Hg, Co, Cr, Cd, etc.),

### Recommended Resources

1. Peter Atkins, & Paula, J. de. Elements of Physical Chemistry 7th Ed., Oxford University Press (2014).



2. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
3. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).  
Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

### **Course Designers**

- a. Dr Mahesh Kumar Ravva and Dr Pardha Saradhi Maram.
- b. Expert Reviewers from Institutes of National Importance / Institutes of International Repute.
- c. Expert Reviewers from Industry.

## SEMESTER-I

Course Code	Course Name	Core / Elective	Credits			
			L	T	P	C
BIO 103	A primer to Biology	FC	3	0	0	3

### Unit I

**Life: Origin, composition, and chemistry:** Origin of complex biomolecules and primitive cells. Chemical basis of life- carbon-based life, Importance of water, Selectively permeable membranes, Synthesis by polymerization, Importance of self-assembly.

### Unit II

**Cell Biology:** Eukaryotes and prokaryotes; Virus- lysogenic and lytic cycles; Bacteria- typical bacterial cells and antibiotic resistance; Bacterial gene transfer- conjugation, transformation, and transduction. Cell organelles; Microbiome. Cell cycle, Mitosis and meiosis.

### Unit III

**Energy harvesting reactions by life forms:** The importance of energy, Gibbs free energy ( $\Delta G$ ) and Enzymes and their equilibrium constants in biological reactions ( $K_{eq}$ ), Fate of food in cellular energy cycle. Energy harvesting: Chemotrophic, Phototrophic; Metabolism: Glycolysis, anaerobic and aerobic cellular respiration.

### Unit IV

**Molecular Biology:** Structure of DNA and organization of chromosomes; Central dogma- replication, transcription, and translation in prokaryotes. Mutations and genetic diseases. Introduction to genetic manipulation- Concepts of restriction digestion, cloning.

### Unit V

#### **Bioinformatics:**

Biological sequences and evolution of sequencing technologies. Utilization of sequence information in personalized medicine and disease detection. Structural Biology: Protein and biomolecular structures and their databases.

#### **Reference books:**

1. Becker's World of the Cell, Global Edition, 9th Edition (2017). Jeff Hardin, Gregory Paul Lewis J. Kleinsmith. Pearson
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. SINAUER ASSOCIATES MACMILLAN.

## SEMESTER-I

Course Code	Course Name	Core / Elective	Credits			
			L	T	P	C
BIO 103L	Practical Biology	FC	0	0	2	1

1. Preparation of growth media for yeast culture, Methods of sterilization, Yeast cell culture and estimate the growth curve (sigmoid), Emphasize different phases of yeast cell growth.
2. Principles of spectrophotometry. Adapting spectrophotometer to record yeast cell growth;
3. Cell count using hemocytometer. Single colony selection using streak plate technique.
4. Principles of thin layer chromatography (TLC), isolation of triglycerides from yeast cells and running TLC to spot the triglycerides. Quantification using ImageJ software.
5. Antibiotic sensitivity test using cell culture.
6. Concept of chi square and Student's t-test. Application of chi square and t-test to test hypothesis. Construction of null hypothesis using hypothetical experiments and testing the validity of results using different statistical methods.

## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
MAT 104	Introduction to Mathematics	FC	4	0	0	4

### UNIT-I: Set Theory Functions & Basic Algebra

What is Set, why should we study sets? Various properties of sets ideas. definitions and graphs, Translation. scaling. The function of a function, Inverse functions Power laws. exponential and logarithmic functions Arithmetic, Formulae. identities. Equations, Proportionality, Factorization, Simple inequalities Arithmetic and geometric progressions, Polynomials Complex Numbers, Factor and remainder theorems, Elementary rational function,

### UNIT-2: Straight lines, Quadratics, and Cubic, Geometry

Graphs and plotting, the straight line, Intersection of two lines, Linear inequalities, Reduction to linear form The quadratic curve, Quadratic equations, and roots, Common problems involving quadratics, Features of Cubic's, Shapes in two dimensions, Congruence and similarity, Circles, Shapes in three dimensions Coordinate geometry, Conic Sections, Distances and areas in two dimensions, Loci, and simple curves, Circles Polar coordinates, Three-dimensional geometry

### UNIT 3: Trigonometry

Tangent. sine and cosine, Solution of triangles, Distances and angles in solids, Ratios of any angle, and periodic modeling

### UNIT 4: Differentiation &Integration

Rates of change, Simple differentiation, Tangents, and stationary points, second derivatives and stationary points Reversing differentiation, Definite integration and area, Applications to the area, volume and mean values, Centers of gravity

### UNIT 5: Differential equation &Mathematical Modelling

what is a differential equation? Why should we study differential equations? How to solve differential equations?

What is Mathematical modeling? How to construct mathematical modeling of a system? Applications of Mathematical Modeling?

#### Texts:

- (1) An Introduction to Mathematics by A. N. Whitehead, Williams and Norgate Henry Holt and Co., New York.
- (2) Introduction to The Foundations of Mathematics, By Raymond L. Wilder, Dover Publications, Inc. Mineola, New York.
- (3) Foundations and Fundamental Concepts of Mathematics by Howard Eves, Dover Publications, Inc, Mineola, New York.
- (4) Foundation Mathematics for Engineers by John Berry and Patrick Wainwright, Macmillan Education UK (1991).
- (5) Foundation of Mathematics by L R Mustoe and M D J Barry, John Wiley, and Sons.
- (6) Foundation Mathematics For Non-Mathematicians by Milo Shott by Open University Press

## SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
ISES 101	Industry Specific Employability Skills-I	SEC	3	0	0	1

### UNIT I: QUANTITATIVE APTITUDE

Speed calculations, Time and Distance, Problems on Trains, Boats and Streams, Races and Games, Escalator Problems, Time and Work, Chain Rule, Pipes and cistern, Simplification, surds and indices, Square roots and cube roots, Functions.

### UNIT II: LOGICAL REASONING

Number Series, Alphabet series, Odd Man Out, Missing number, Wrong number, Analogies, Mathematical Operations, Calendars, Clocks.

### UNIT III: DATA INTERPRETATION

Cryptarithmetics, Identification of cross variable relations, Sudoku.

### UNIT IV: VERBAL ABILITY

Basic sentence structure: Nouns, Pronouns, Adjectives. Parts of speech. Degree of comparison. Articles, conditionals, and sentences (kinds). Verb tense. Sentence formation. Paragraph formation, change of voice, Change of speech, Synonyms, Antonyms.

### UNIT V: SOFT SKILLS

Self-Introduction, Presentations, Nonverbal communication, Email Etiquette.

### TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. Mastering Soft skills – Julian Vyner.
6. Soft skills – Key to success in workplace and life – Meenakshi Raman, Shalini Upadhyay.
7. English grammar and composition – S.C.Gupta.

# **SEMESTER -II**

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
ENV 100	Introduction to Environmental Sciences	FC	4	0	0	4

### UNIT I: Fundamental Concepts in Environmental Science

Human population and environment, Environmental education and awareness, Environmental ethics Evolution of Environmental ethics – Leopold’s land ethics, Silent Spring, Population growth, Ecological overshoot, and Ecological Footprint, Defining global sustainability, Garret Hardin’s “Tragedy of the Commons”, Brundtland commission report, Principles of sustainable development, Sustainable Development Goals (SDGs), Triple bottom line of sustainable development, Technology and Society: Information Technology - Human health & Environmental health, Environmental misconception, Sustainable ethics: Overcoming the obstacles of sustainability Individualizing Responsibility for a sustainable future - Consumption and its impact on sustainable development.

### UNIT II:

Frontierism, Biological Imperialism, and Natural rights, Significance of Human rights; Human rights and environment Wastewater reclamation, Water conservation, Rainwater harvesting, Watershed management, Urban problems related to energy, Nuclear accidents, Global Environmental Policy, Environmental acts and laws, Water Act 1974, Environmental Protection Act 1986.

### UNIT III: Global Climate Change

Differentiating Climate and Weather, Interconnection of Earth systems (Hydrosphere, Geosphere, Cryosphere, Atmosphere, and Biosphere), Climate change through data (global temperature, and CO<sub>2</sub> – Mauna Lao Earth observatory), Climate change: Impacts - Extreme weather events, Sea-level rise, Food and water security, and Human health & well-being, Biodiversity loss, Climate change: Adaptation – local to global scales, Synthesis, Disaster management – landslides, Tsunamis floods, earthquakes, anthropogenic disasters, Bhopal tragedy.

### UNIT IV: Energy and Environment

Renewable Energy: Global Status and trends, Global Renewable Energy Applications, Technical Issues, Challenges & Opportunities, Solar, tidal, hydropower, Bioenergy, nuclear, Renewable Energy Markets.

### UNIT V: Environmental Pollution and Management

Pollution: Air pollution, Noise pollution, Water pollution, Soil pollution, Solid waste management: Collection, Handling, and solid waste management rules, E-waste and hazardous waste management, biomedical waste management, Wastewater treatment systems: Industrial and sewage treatment.

### TEXTBOOKS

1. Recommended Resources
2. Daniel D. Chiras (2012), Environmental Science 9th Edition. Jones & Barlet Publishers
3. Carson, R. (2002). Silent spring. Houghton Mifflin Harcourt.

4. Rajagopalan, R (2015). Environmental Science – from crisis to cure, 3rd Edition. Oxford Higher Education.
5. Walter K Dodds (2018). Humanity's Footprint: Momentum, Impact, and Our Global Environment. Columbia University Press
6. Hayley Stevenson (2018). Global Environmental Politics Problems, Policy and Practice. Cambridge University Press
7. Garette Hardin (1968). The Tragedy of the Commons. Science 162 (3859), 1243-1248. DOI: 10.1126/science.162.3859.1243
8. Brutland Commission Report, 1987. Oxford University Press
9. TRANSFORMING OUR WORLD: The 2030 Agenda for Sustainable Development
10. Shastri, S.C. (2015) Environmental Law by 5th edition, EBC Publications.
11. Intergovernmental Panel on Climate Change (IPCC) Synthesis Report, 2014.
12. C.S. Rao (2018) Environmental Pollution Control Engineering, New Age International Publishers.

### **Other Resources**

1. W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill
2. Divan Shyam (2002). Environmental Law and Policy in India, OUP India
3. Jonathan Cowie, (2002). Climate change: Biological and Human Aspects, 2nd Edition. Cambridge University Press
4. Hanjalic, Kemo, Roel Van de Krol, and Alija Lekic, eds. (2017). Sustainable energy technologies: options and prospects. Springer Science & Business Media



## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
EGL 100	Introduction to Communicative English	FC	4	0	0	4

### UNIT I

Course Introduction and Overview, Tenses, Principles of Sentence Structure & Paragraph Writing (S+V+O)

### UNIT II

The Fundamentals of Speech (*Ethos, Pathos & Logos*) Verbal & Nonverbal Communication, Fundamentals of Personal, Informative, and Scientific Speech.

### UNIT III

Listening Skills: Definition, Barriers, steps to Overcome. Listening to Influence, Negotiate, Note taking & Making while Listening.

### UNIT IV

Read to Skim, and Scan, Read to Comprehend (Predict, Answer Questions & Summarize). Read to Understand.

### UNIT V

Write to Inform - I News, Emails. Write to Inform- II Notice, Agenda & Minutes. Write to Define (Definitions & Essays).

### TEXTBOOKS/REFERENCES

1. Shoba, Lourdes. (2017). Communicative English: A Workbook. U.K: Cambridge University Press.
2. Steven, Susan, Diana. (2015). Communication: Principles for a Lifetime. U.S.A: Pearson 6th Ed.
3. Publication Manual of the American Psychological Association, (2010). 6th Ed.
4. Kosslyn, S.M. "Understanding Charts and Graphs", Applied Cognitive Psychology, vol. 3, pp. 185-226, 1989.

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 107	Data Structures	DC	3	0	0	3

### UNIT I: INTRODUCTION TO C PROGRAMMING

Basic elements of C: identifiers, basic data types, constants, variables, keywords, operators: arithmetic, relational and logical, increment and decrement operators, conditional operator, assignment operators, Instruction: type declaration, Input-output, conditional, loop control, Arrays, Functions, pointers, dynamic memory management functions Derived types- structures- declaration, definition and initialization of structures, accessing member of structure, arrays of structures, structures and functions, pointers to structures, self-referential structures.

### UNIT II: INTRODUCTION TO DATA STRUCTURES

Stacks and Queues: representation and application, implementation of stack and queue operations using C. Linked lists: Single linked lists, implementation of link list and various operation using C, Double linked list, circular list.

### UNIT III: TREES

Tree terminology, Binary tree, Binary search tree, infix to post fix conversion, postfix expression evaluation. General tree, AVL Tree, Complete Binary Tree representation.

### UNIT IV: GRAPHS

Graph terminology, Representation of graphs, Path matrix, BFS (breadth first search), DFS (depth first search), topological sorting, Shortest path algorithms.

### UNIT V: SORTING AND SEARCHING TECHNIQUES

Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort, implementation using C. Linear and binary search methods, implementation using C, Hashing techniques and hash functions.

### TEXTBOOKS

13. "Data structure using C", Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
14. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson publications, Second Edition Programming in C. P. Dey and M Ghosh, Second Edition, Oxford University Press.
15. Programming with C, Byron Gottfried, McGraw hill Education, Fourteenth reprint, 2016.

### REFERENCES

1. "Fundamentals of data structure in C" Horowitz, Sahani & Anderson Freed, Computer Science Press.
2. "Fundamental of Data Structures", (Schaums Series) Tata-McGraw-Hill.
3. G. A. V. Pai: "Data Structures & Algorithms; Concepts, Techniques &";

Algorithms” Tata McGraw Hill.

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 107 L	Data Structures Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Write a C program to find the factorial of the given number (Example:  $5! = 5*4*3*2*1 = 120$ ).
2. Write a C program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until “-10” is encountered.
3. Write a C program for implementation of Stack operations using arrays.
4. Write a C program for implementation of Queue operations using arrays.
5. Write a C program for Linked list implementations and problems related to linked list such as inverting list, concatenation, etc.
6. Write a C program for Linked list-based implementation of stack and queue operations.
7. Write a C program for Evaluation of expressions.
8. Write a C program for implementation of Binary tree traversals techniques.
9. Write a C program for implementation of Graph traversals techniques (BFS and DFS).
10. Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?
11. Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm?
12. Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
13. Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?
14. Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?
15. Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
MAT 221	Probability and Statistics for Engineers	FC	3	1	0	4

### UNIT I: INTRODUCTION TO PROBABILITY

Introduction, counting and set, terminologies and examples, conditional probability, independence and Bayes' theorem.

### UNIT II: PARTIAL DERIVATIVES

Discrete random variables, variance of discrete random variables, continuous random variables, Expectation, variance and standard deviation of continuous random variables, central limit theorem and law of large numbers, joint distributions and independence, covariance and correlation.

### UNIT III: BAYESIAN INFERENCE

Introduction to statistics, Maximum likelihood estimate, Bayesian updating: discrete priors, probabilistic prediction, odds, continuous priors; Beta distribution, conjugate priors, probability intervals.

### UNIT IV: NULL HYPOTHESIS SIGNIFICANCE TESTING

The frequentist school of statistics, Null hypothesis significant testing, comparison between frequentist and Bayesian inference

### UNIT V: CONFIDENCE INTERVALS AND REGRESSIONS

Confidence intervals: normal data, three views, mean of the non-normal data; Bootstrap confidence intervals, linear regression.

### TEXTBOOKS

1. J. Jacod and P. Protter, Probability Essentials, Springer, 2004.
2. K. S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley India, 2008.

### REFERENCES

1. S. Ross, A First Course in Probability, 6th Edn., Pearson, 2002.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
MAT 252	Discrete Mathematics	CC	4	0	0	4

### SEMESTER-II

#### **UNIT I - The Foundations: Logic and Proofs**

Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

#### **UNIT II- Set Theory**

Laws of set theory, Set Operations, Functions, Sequences and Summations, Matrices.

#### **UNIT III – Elementary number theory, Induction and Recursion**

Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences; Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction.

#### **UNIT IV – Counting principles**

The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide and Conquer Algorithms and Recurrence Relations.

#### **UNIT V – Introduction to Graph Theory**

Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Trees, Spanning trees, Minimal spanning trees, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems.

\*\* Apart from the regular lectures, the allotted lecture hours can be used for tutorial and problem solving sessions.

#### **Books of Study:**

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGraw-Hill, 2012.
2. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.

#### **Books of Reference:**

1. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 3rd Ed., Tata McGraw-Hill, 1999.

- M. K. Venkataraman, N. Sridharan, and N. Chandrasekaran, Discrete Mathematics, National Publishing Company, 2003.

### **SEMESTER-II**

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSC 130	Industry Standard Coding Practice -1	DC	0	0	4	2

#### **UNIT I**

Problem Solving with - Basic coding practices, Expression Evaluation, Operators Usage, Expressions, Control Structures, Loop & Iterations for all test case scenarios.

#### **UNIT II**

Problem Solving using time efficient logics, linear list data, Array problems, 2D Arrays and Matrix Data for all test case scenarios.

#### **UNIT III**

Problem Solving with - Pointers & Memory referencing, String Handling, functions for all test case scenarios.

#### **UNIT IV**

Problem Solving with - parameter passing, Recursions, Recursion Analysis, Structures and unions, Enumerations & Memory allocation for all test case scenarios.

#### **UNIT V**

Problem solving with - String manipulations. Lists, display patterns, strings, matrix, tuples, dictionaries, modules, packages, exception handling using Python.

#### **TEXTBOOKS**

- Problem solving with C++ -9e- Walter Savitch – Pearson.
- The complete Reference C, Fourth R Edition – Herbert Schildt – MC Graw Hill.
- Programming in Python 3, A complete introduction to Python language - 2e – Mark Summerfield Addison-Wiley.

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
ISES 102	Industry Specific Employability Skills-II	HS	3	0	0	1

### UNIT I: QUANTITATIVE APTITUDE

Average, Alligation or Mixture, Alligation or Mixture, Percentage, Profit and Loss, True discount, Partnership, Height and distance, Algebra.

### UNIT II: LOGICAL REASONING

Logical deductions, Syllogism, Image based problems, Coding and Decoding, Cubes and Cuboids, Inequalities, Input output tracing.

### UNIT III: VERBAL ABILITY

Ordering of sentences, Comprehension, Verbal Analogies, Letter and Symbol series, One word substitutes, Cause and Effect, Syllogism, Synonyms and Antonyms, Idioms and Idiomatic expressions.

### UNIT IV: COMMUNICATION SKILLS

Critical thinking topics, Team activity, Problem solving/ Out of the box thinking.

### UNIT V: SOFT SKILLS

Sentence formation (Practical), Word group categorization, Casual conversation (Practical), Formal conversation (interpersonal, Meeting).

### TEXTBOOKS/REFERENCES

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. Mastering Soft skills – Julian Vynar.
6. Soft skills – Key to success in workplace and life – Meenakshi Raman, Shalini Upadhyay.
7. English grammar and composition – S.C.Gupta..

# SEMESTER -III

## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 201	Design and Analysis of Algorithms	CC	3	0	0	3



## UNIT I: INTRODUCTION

Algorithmic thinking & motivation with examples, Reinforcing the concepts of Data Structures with examples. Complexity analysis of algorithms: big O, omega, and theta notation, Analysis of Sorting and Searching, Hash table, Recursive and non-recursive algorithms.

## UNIT II: GENERAL PROBLEM SOLVING (GPS) TECHNIQUES

Divide and conquer: Merge sort, Quicksort, BST, Master method for Complexity analysis  
Greedy method: Fractional Knapsack, Minimum spanning trees (Prim's & Kruskal's), Shortest paths: Dijkstra's algorithm, Huffman coding  
Dynamic Programming: 0/1 Knapsack, All-to-all shortest paths.

## UNIT III

BFS & DFS, Backtracking: 8-Queens problem, Knights tour, Travelling Salesman Problem (TSP), Branch-and-bound: 16-puzzle problem, TSSP, Randomized algorithms: Playing Cards, Scheduling algorithms.

## UNIT IV

Pattern matching algorithms: Brute-force, Boyer Moore, KMP algorithms. Algorithm analysis: Probabilistic Analysis, Amortized analysis, Competitive analysis.

## UNIT V

Non-polynomial complexity: examples and analysis, Vertex cover, set cover, TSP, 3-SAT  
Approximation Algorithms: Vertex cover, TSP, Set cover.

## TEXTBOOKS

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms", 3rd Edition, MIT press, 2009.
2. Parag Dave & Himanshu Dave, "Design and Analysis of Algorithms", Pearson Education, 2008.

## REFERENCES

1. Michel Goodrich, Roberto Tamassia, "Algorithm design-foundation, analysis & internet examples", Wiley., 2006.
2. A V Aho, J E Hopcroft, J D Ullman, "Design and Analysis of Algorithms", Addison-Wesley Publishing.
3. Algorithm Design, by J. Kleinberg and E. Tardos, Addison-Wesley, 2005.
4. Algorithms, by S. Dasgupta, C. Papadimitriou, and U. Vazirani, McGraw-Hill, 2006.

## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 201 L	Design and Analysis of Algorithms Lab	CC	0	0	2	1

## LIST OF PRACTICAL EXPERIMENTS

1. Selection sort, Insertion sort, Heap sort.
2. Creating singly linked list + Hash table as a set of linked lists.
3. Towers of Hanoi (Recursive& Non-recursive).
4. Merge sort.
5. Quicksort.
6. Fractional Knapsack.
7. Minimum-spanning tree.
8. One-to all shortest paths.
9. All-to-all shortest paths.
10. 0/1 knapsack.
11. Transitive closure/ Reachability problem.
12. Eight queens' problem.
13. 16-puzzle.
14. TSP approximation algorithm.
15. Vertex cover: Approximate algorithm.

## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 206	Object Oriented Programming with C++	CC	3	0	0	3

## **UNIT I: INTRODUCTION**

What is object-oriented programming? Comparison of procedural programming and Object-Oriented Programming - Characteristics of Object-Oriented Languages - C++ Programming Basics: Basic Program Construction - Data Types, Variables, Constants - Type Conversion, Operators, Library Functions - Loops and Decisions, Structures - Functions: Simple Functions, passing arguments, Returning values, Reference Arguments. - Recursion, Inline Functions, Default Arguments - Storage Classes - Arrays, Strings, Addresses, and pointers. Dynamic Memory management. Linked lists in C++.

## **UNIT II: FEATURES OF OBJECT-ORIENTED PROGRAMMING**

Introduction to Classes and Objects, Making sense of core object concepts (Encapsulation, Abstraction, Polymorphism, Classes, Messages Association, Interfaces). Constructors and its types, Destructors - Passing Objects as Function arguments and Returning Objects from Functions.

## **UNIT III: POLYMORPHISM**

Concept of Polymorphism, Function overloading, examples and advantages of function overloading, pitfalls of function overloading, Operator overloading, Overloading unary operations. Overloading binary operators, pitfalls of operators overloading.

## **UNIT IV: INHERITANCE**

Concept of inheritance. Derived class and based class. Derived class constructors, member function, inheritance in the English distance class, class hierarchies, inheritance and graphics shapes, public and private inheritance, aggregation: Classes within classes, inheritance, and program.

## **UNIT V: TEMPLATES AND EXCEPTIONS**

Templates: Function templates, Class templates - Exceptions: Need of Exceptions, keywords, Simple and Multiple Exceptions - Re-throwing Exception and Exception Specifications, Custom Exception.

Standard Template Library: Containers, Algorithms, iterators - potential problems with STL - Algorithms: find (), count (), sort (), search (), merge () - Function Objects: for each (), transform () - Sequence Containers: vectors, Lists, Dequeues - Iterators and specialized.

## **TEXTBOOKS**

1. C++ Primer, Stanley B. Lippman, Stanley Lippman and Barbara Moo, Addison-Wesley Professional, Fifth edition, 2012.
2. C++: The complete reference, Schildt, Herbert. McGraw-Hill/Osborne, Fourth edition, 2017.

## **REFERENCES**

1. Thinking in C++, Bruce, Eckel, Pearson, Second edition, Volume 1, 2002.
2. Object-oriented programming in C++, Robert Lafore, Course Sams Publishing, Fourth edition, 2001.
3. Lischner, Ray. STL Pocket Reference: Containers, Iterators, and Algorithms. " O'Reilly Media, Inc.", 2003.

### SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 206 L	Object Oriented Programming with C++ Lab	CC	0	0	2	1

#### LIST OF PRACTICAL EXPERIMENTS

Week-1:

1. Takes two integer operands and one operator from the user, performs the operation and then prints the result.
2. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.
3. Searching an element in an array.
4. To find the factorial of a given integer.

**Week-2:**

1. Write a program to demonstrate the Inline functions.
1. Programs to understand different function call mechanism.
  - a. call by reference
  - b. call by value
1. Programs to understand storage specifiers

**Week-3:**

1. Write a Program to design a class having static member function named showcount() which has the property of displaying the number of objects created of the class.
1. Write a Program using class to process Shopping List for a Departmental Store. The list include details such as the Code No and Price of each item and perform the operations like Adding, Deleting Items to the list and Printing the Total value of a Order.

**Week-4:**

1. Write a Program which creates & uses array of object of a class.( for eg. implementing the list of Managers of a Company having details such as Name, Age, etc..).
1. Write a Program to find Maximum out of Two Numbers using friend function. Note: Here one number is a member of one class and the other number is member of some other class.

**Week-5:**

1. Write a Program to swap private data members of classes named as class\_1, class\_2 using friend function.
1. Write a Program to design a class complex to represent complex numbers. The complex class should use an external function (use it as a friend function) to add two complex numbers. The function should return an object of type complex representing the sum of two complex numbers.

**Week-6:**

1. Write a Program using copy constructor to copy data of an object to another object.
1. Write a Program to allocate memory dynamically for an object of a given class using class's constructor.

**Week-7:**

1. Write a Program to design a class to represent a matrix. The class should have the functionality to insert and retrieve the elements of the matrix
1. Write a program to design a class representing complex numbers and having the functionality of performing addition & multiplication of two complex numbers using operator overloading.

**Week-8:**

1. Write a Program to overload operators like \*, <<, >> using friend function. The following overloaded operators should work for a class vector.
1. Write a program for developing a matrix class which can handle integer matrices of different dimensions. Also overload the operator for addition, multiplication & comparison of matrices.

**Week-9:**

1. Write a program to overload new/delete operators in a class.
1. Write a program in C++ to highlight the difference between overloaded assignment operator and copy construct.

**Week-10:**

1. Write a Program illustrating how the constructors are implemented and the order in which they are called when the classes are inherited. Use three classes named alpha, beta, gamma such that alpha, beta are base class and gamma is derived class inheriting alpha & beta

1. Write a Program to design a student class representing student roll no. and a test class (derived class of student) representing the scores of the student in various subjects and sports class representing the score in sports. The sports and test class should be inherited by a result class having the functionality to add the scores and display the final result for a student.

**Week-11:**

1. Write a program to maintain the records of person with details (Name and Age) and find the eldest among them. The program must use this pointer to return the result.

1. Write a Program to illustrate the use of pointers to objects which are related by inheritance.

**Week-12:**

1. Write a program illustrating the use of virtual functions in class.

1. Write a program to design a class representing the information regarding digital library (books, tape: book & tape should be separate classes having the base class as media). The class should have the functionality for adding new item, issuing, deposit etc. the program should use the runtime polymorphism.

**Week-13:**

1. Write a program to show conversion from string to int and vice-versa.

1. Write a program showing data conversion between objects of different classes.

**Week-14:**

1. Write a program showing data conversion between objects of different classes and conversion routine should reside in destination class.

1. Write a program to copy the contents of one file to another.

**Week-15:**

1. Write a program to implement the exception handling.

1. Write a program to maintain the elementary database of employee using file concepts.

**SEMESTER-III**

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 231	Industry Standard Coding Practice -II	SEC	0	0	4	2

**UNIT I**

Problems Solving with: Structure Pointers, formation of links, Operations on Linked lists, Operations on a circular linked list, Operations on a double linked list & Industry Standard Practice Questions.

## **UNIT II**

Problem Solving with - Stack Operations, Queue data structure Implementation, Linear / Binary Search Algorithms, Sorting Algorithms, Industry Standard Practice Questions.

## **UNIT III**

Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.

## **UNIT IV**

Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms & Industry Standard Practice Questions.

## **UNIT V**

Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.

## **TEXTBOOKS**

1. Fundamentals of Data Structures in C++ - 2e- Sahni Horowitz - Universities Press.
2. Algorithms -4e- Robert Sedgewick & Kevin Wayne - Addison-Wesley Professional.
3. C++ Standard Library A Tutorial and Reference – 2e - Nicolai M. Josuttis - Addison Wesley Longman.
4. An Introduction to Database Systems – 8e - C.J. Date – Pearson.  
Competitive Programming – 3e – Steven Halim, Felix Halim

## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
ISES 211	Industry Specific Employability Skills-III	SEC	3	0	0	1

### UNIT I: QUANTITATIVE APTITUDE

Numbers, Problems on numbers (Divisibility, power cycle, remainder cycle), Problems on ages,

### UNIT II: QUANTITATIVE APTITUDE

Problems on HCF and LCM, Simple interest, Compound interest, Data interpretation (Charts, tables, pie charts, lines).

### UNIT III: LOGICAL REASONING

Direction sense, Blood Relations, Logical order, Analytical reasoning, Passage and inference, Selection decision table, Attention to details, Seating arrangement (Circular & table)

### UNIT IV: VERBAL ABILITY

Active listening, Word group categorization, Sentence formation.

### UNIT V: SOFT SKILLS

Self-image and self-presentation (grooming etiquettes), Public speaking skills, Extempore, FAQ's.

### TEXTBOOKS/REFERENCES

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. English grammar and composition – S.C.Gupta.



## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102	Introduction to Programming Using Python	HC	3	0	0	3

### UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages, Types, Variables Operators and Branching — Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

### UNIT II: FUNCTIONS

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numeric, Files.

### UNIT III: TUPLES AND LISTS

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – Dictionaries: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions, Assertions, Exceptions, Exception Examples.

### UNIT IV: CLASSES AND INHERITANCE

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – An Extended Example: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators.

### UNIT V: COMPUTATIONAL COMPLEXITY

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort.

### TEXTBOOKS

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).

### REFERENCES

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10June2017),ISBN-10: 0199480173.
2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016).
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition (6th February 2009).

## SEMESTER-III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102 L	Introduction to Programming Using Python Lab	HC	0	0	3	2

### LIST OF PRACTICAL EXPERIMENTS

1. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3. Write a Python program to find the factorial of the given number (Example:  $5! = 5*4*3*2*1 = 120$ ).
4. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until “-10” is encountered.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9. Define inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

### TEXTBOOKS

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
3. Data Structures and Algorithms in Python by Michael T Goodrich and Roberto Tamassia, Micheal S Goldwasser, Wiley Publisher (2016).

# **SEMESTER –IV**

## SEMESTER – IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 203	Operating Systems	CC	3	0	0	3

### UNIT I: INTRODUCTION TO OPERATING SYSTEM

What is an Operating System? Simple Batch Systems, Multiprogramming and Time-Sharing systems. Personal Computer Systems, Parallel Systems, Distributed Systems and Real Time Systems.

Operating System Structures: Operating System Services, System components, Protection system, Operating System Services, system calls.

### UNIT II: PROCESS MANAGEMENT

Process Concept, Process Scheduling, Operation on Processes, inter process communication, Examples of IPC Systems, Multithreading Models, Threading Issues, Process Scheduling Basic concepts, scheduling criteria, scheduling algorithms, Thread Scheduling.

### UNIT III: PROCESS COORDINATION

Synchronization: The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classical problems of synchronization, Monitors.

Deadlocks: System model, Deadlock Characterization Methods for Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, recovery from Deadlock.

### UNIT IV: MEMORY MANAGEMENT

Memory Management strategies, Logical versus Physical Address space, swapping, contiguous Allocation, Paging, Segmentation. Virtual Memory: Background, Demand paging, performance of Demand paging, Page Replacement, Page Replacement Algorithms. Allocation of frames, Thrashing, Demand Segmentation.

### UNIT V: STORAGE MANAGEMENT

File System Concept, Access Methods, File System Structure, File System Structure, File System Implementation, Directory implementation, Efficiency and Performance, Recovery, Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, I/O System Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Request to Hardware Operation.

### TEXTBOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc.
2. Operating System, Harvey M. Dietel, Paul J. Deitel and David R. Choffnes, Pearson Publications, Third Edition.
3. William Stallings, "Operating Systems – Internals and Design Principles", 9th Edition, Pearson publications.
4. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson publications.
5. Mastering Unix Shell scripting, Randal K. Michael, Wiley Publications, Second Edition.
6. Linux system programming, Robert Love, O'Reilly Publications, First Edition, 2007.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 203 L	Operating Systems Lab	CC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Shell Programming exercises.
2. Implementing Linux system commands using system calls.
3. CPU Scheduling Algorithms.
4. Computing page faults for various page replacement algorithms.
5. Simulation of Demand Paging System.
6. Implement producer, consumer problem using semaphores.
7. Implement deadlock avoidance and detections algorithms.
8. Project Development.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 207	Java Programming	CC	3	0	0	3

### UNIT I: INTRODUCTION TO JAVA

An Overview of Java - Data types, Variables and Arrays, operators, expressions, Control statements, Classes, Objects, Constructor, Methods, this reference, static keyword, and final keyword; String handling, Compiling using command line argument; Inheritance - Concept, Member access, Abstract Class, Interface, Creating Multilevel hierarchy- super uses, Packages-access specifiers, using final with inheritance; Polymorphism - Compile time Polymorphism, Method overloading, Constructor overloading; Run time polymorphism, Method overriding, Dynamic method dispatch.

### UNIT II: EXCEPTION HANDLING & MULTITHREADING

Fundamentals of exception handling, Uncaught exceptions, using try and catch, multiple catch blocks, Exception types - Introduction to Object class, Exception class hierarchy, Termination or presumptive models, Built-in exceptions, User defined exceptions, Nested try statements, Throw, Throws, and Finally. Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, Thread life cycle, Creating threads – Thread class, Runnable interface, Thread priorities, Synchronizing threads, Inter-thread communication.

### UNIT III: STREAM BASED I/O (JAVA.IO)

Java API, The Stream Classes-Byte streams and Character streams, reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics.

### UNIT IV: THE COLLECTIONS FRAMEWORK (JAVA.UTIL) & JDBC

Collection's overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque, and other utility classes. Accessing a Collection via an Iterator, using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, String Tokenizer. JDBC – What is database, Table, SQL Syntax-Create, Insert, Select, Drop, Alter, Update, Delete, what is JDBC, JDBC Architecture and Components, JDBC Driver Types, Connections, Statements, Result Set.

### UNIT V: GUI PROGRAMMING WITH SWING

Introduction - AWT & Swings, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout. Event Handling- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes. A Simple Swing Application, Applets – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets. Creating a Swing Applet, painting in Swing, A Paint example, Exploring Swing Controls- J Label and Image Icon, J Text Field, The Swing Buttons- J Button, J Toggle Button, J Check Box, J Radio Button, J Tabbed Pane, J Scroll Pane, J List, J Combo Box, Swing Menus, Dialogs.

**TEXTBOOKS**

1. Java The complete reference, 11th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.

**REFERENCES**

1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
3. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
4. Object Oriented Programming through Java, P. Radha Krishna, and Universities Press.
5. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
6. Java Programming and Object-Oriented Application Development, R. A. Johnson, Cengage Learning.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 207 L	Java Programming Lab	CC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Declare a class Named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Write a function to read the values of the class variables. The values of the variable will be stored in a FILE (text file). The values will be stored in a structured format of your own choice.

Further, read the content of the FILE and display the content in an ordered form (First Name, Last Name).

Concept Learning:

1. FILE manipulation
  2. Use try catch blocks
  3. Use multiple try catch block
  4. Finally statement
- Try to have your own Exception

2. Create three classes Named Student, Teacher, Parents. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized. Similarly, the other two classes should have run methods with few valid statements under synchronized.

3. Create two classes Named Student and Teacher with required data members. Assume that the information about the Student and Teacher is stored in a text file. Read n and m number of Student and Teacher information from the File. Store the information in Array list of type Student and Teacher Array List<Student> and Array List<Teacher>. Print the information of Teacher who taught OOPS and Maths. Use Iterator and other functions of util in your program.

4. Watch any of the favorite movie of your choice (any language is fine, preferably English). Create a Text file to store at least 10 meaningful dialogs from the movie and store it in a text file. Process the file to remove the stop words (eg. the, is, was, ..... ) and create another file to have clean text (word).

5. Write a java program to create Hashtable to act as a dictionary for the word collection. The dictionary meaning of the words, including synonyms, etc., has to be displayed.

6. Declare two classes Student and Teacher. The classes will have the data members and constructors as per your convenience. Write a JAVA program, (i) where the Teacher will enter the marks of the all the students in the database. (ii) Once the marks are entered, the student can view the marks.

7. Create GUI for the above program to upload the dialog FILE, clean the FILE. The GUI should take input from the user for invoking the dictionary for displaying dictionary meaning.

8. Declare a class Named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the



keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.

Have an option in the GUI to search the Name of the students by roll number and display the content in the text field.

9. Create two classes Named Student and Teacher with required data members. Read the information about the student and teacher using text fields. Use checkbox to choose the option to feed either teacher information or student information. Store the information about the Student and Teacher in a text file. Read n and m number of Student and Teacher information from the File. Show in the GUI about a Teacher who taught two subjects to a section. Develop at least one of the applications (AWT problem) using swing package.

10. Create a Window based applications using various controls to handle subject registration for exams. Have a List Box to display the subject of semesters. Have one more List box having subject codes. Have a combo box to select the Semester, which will change the list of course and code in the list boxes. Display the subject registered for the examination on the right side of the window.

11. Declare a class Named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.

Have an option in the GUI to search the Name of the students by roll number and display the content in the text field. Develop at least one of the applications (AWT problem) using swing package.

12. Create a Window based application for displaying your photo album. Create a Frame and Canvas. Change the border, foreground and background colors of canvas and other controls. Have buttons to start the image show, pause the image show and end the image show. Explore the options to play background music.

13. Create a Window application with menu bar and menu. The frame will also have a text area with scroll bar. In the menu, have File related options. Open a file and its content has to be displayed in the text area.

14. Create a GUI using various controls: (i) to upload the marks of all the students presented in a marks.csv or marks.txt file into the database. (ii) to show the marks of the respective student after uploading the marks into the database. Note: Handle the exception, if the file is not present (or) if the marks are not uploaded in the database.

15. Individual Project. Every student should do a project to achieve all the course outcomes. Based on the course outcomes, the project will be evaluated.

## SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 204	Computer Organization and Architecture	CC	3	0	0	3

### UNIT I: BASIC STRUCTURE OF COMPUTERS

Functional units – Bus structures – Instruction set architecture: Instruction formats - addressing modes - Architecture and instruction set of 8086/8088 microprocessor- Assembly language programming - Fixed point and floating-point operations – ALU design.

### UNIT II: BASIC PROCESSING UNIT

Fundamental concepts – Execution of a complete instruction – Hardwired control – Micro programmed control design- Nano programming- CISC-RISC- principles.

### UNIT III: PIPELINE PROCESSING

Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Pipeline optimization techniques: Compiler techniques for improving performance.

### UNIT IV: MEMORY SYSTEM

Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache memories – Improving cache performance – Virtual memory – Memory management requirements– Associative Memories-Secondary-storage-devices.

### UNIT V: I/O ORGANIZATION

Accessing I/O devices – Programmed Input/output - Interrupts – Direct Memory Access– Interface circuits – Standard I/O Interfaces - I/ O devices and Processors.

### TEXTBOOKS

1. Computer System Architecture, Morris Mano, Third edition, Pearson publications.
2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, V Edition, McGraw-Hill publications.
3. “Computer Organization and Architecture – Designing for Performance”, William Stallings, Ninth edition, Pearson publications.

### REFERENCES

1. Andrew S. Tanenbaum, “Structured Computer Organization”.
2. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”.
3. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill.
4. An Introduction to 8086/8088 Assembly Language Programming, Thomas P. Skinner, John Wiley & Sons, 1985.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSE 204 L	Computer Organization and Architecture Lab	C	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Write Assembly language program to print the numbers from 0 to 9.
2. Write Assembly language programs to find average of numbers stored in an array.
3. Write Assembly language programs to find the largest number in an array.
4. Write Assembly language programs to sort the numbers in ascending order.
5. Write Assembly language programs to find L.C.M of two numbers.
6. Write Assembly language programs to find G.C.D of two numbers.
7. Write Assembly language programs to display nth term Fibonacci number.
8. Write Assembly language programs to find the factorial of a number.
9. Programs for 16-bit Arithmetic Operations for 8086 (Using Microprocessor trainer kit 8086).
10. Program for String Manipulations for 8086 (Using Microprocessor trainer kit 8086).
11. Develop an assembler to convert the given assembly language program into machine language program by considering 8086/88 microprocessor.
12. Develop a simulator for 8086/88 microprocessor.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 336	Machine Learning		3	0	0	3

### UNIT I

Introduction: Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance

Linear Regression: Introduction, Linear regression, Simple and Multiple Linear regression, Polynomial regression, evaluating regression fit.

### UNIT II

Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, over fitting in decision tree and methods to avoid over fitting.

Instance based Learning: K nearest neighbour, the Curse of Dimensionality, Feature Selection: univariate, multivariate feature selection approach, missing values ratio, high correlation filter, low variance filter, feature selection using decision tree, Feature reduction Techniques: Principal Component Analysis, Linear Discriminate Analysis

Recommender System: Content based system, Collaborative filtering based

### UNIT III

Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes, Logistic Regression

Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem.

### UNIT IV

Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm.

### UNIT V

Ensembles: Introduction, Bagging and boosting, Random forest, Discussion on some research papers.

Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering.

### TEXTBOOKS

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

### REFERENCES

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 336 L	Machine Learning Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib
2. Python exercise on Feature engineering, data visualisation
3. Programs on Covariance, Correlation, Covariance Matrix and Correlation Matrix
4. Implement Linear Regression and calculate sum of residual error
5. Program to implement different distance functions
6. Program to implement decision tree learning
7. Program to implement K nearest neighbour classifier
8. Program to implement Principle Component Analysis
9. Program to implement perceptron for different learning task
10. Programs to implement ADALINE and MADALINE for given learning task
11. Program to implement classification task using Support Vector machine
12. Programs to implement different Clustering algorithms

### REFERENCES

1. Swamynathan, Manohar. Mastering machine learning with python in six steps: A practical implementation guide to predictive data analytics using python. Apress, 2019.
2. Raschka, Sebastian. Python machine learning. Packt publishing ltd, 2015.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 338	Applied Data Science	DC	3	0	0	3

### UNIT I: INTRODUCTION

Introduction to Data Science, Data vs. Big Data, Statistical Inference - Populations and samples, Statistical modeling, probability distributions, fitting a model. Data Science Process, Exploratory Data Analysis, Basic tools - plots, graphs and summary statistics of EDA. Introduction to R Programming.

### UNIT II

Basic Machine Learning Algorithms - Linear Regression - K-Nearest Neighbors (K-NN) - K-means, K-Medoids, Naive Bayes. Case Study: Real Direct (online real estate firm), Filtering Spam - Linear Regression and K-NN and Naive Bayes for Filtering Spam. Data Wrangling: APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning from Data) - Motivating Application and Case Study: User (customer) retention - Feature Generation - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

### UNIT III

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis.

### UNIT IV

Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs.

### UNIT V

Data Visualization - Basic principles, ideas and tools for data visualization – Case Study 1 on industry projects – Case Study 2: Create Complex visualization dataset - Data Science and Ethical Issues - Discussions on privacy, security, ethics - Next-generation data scientists.

### TEXTBOOKS

1. Sinan Ozdemir, Sunil Kakade. Principles of Data Science - Second Edition Released December 2018 Publisher(s): Packt Publishing ISBN: 9781789804546.
2. Cathy O’Neil and Rachel Schutt Doing Data Science, Straight Talk from The Frontline. O’Reilly. 2014.

### REFERENCES

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman Mining of Massive Datasets v2.1, Cambridge University Press 2014 (free online).
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
4. Trevor Hastie, Robert Tibshirani and Jerome Friedman Elements of Statistical Learning, Second Edition ISBN 0387952845 2009 (free online).

5. Avrim Blum, John Hopcroft and Ravindran Kannan Foundations of Data Science (Note: this is a book currently being written by the three authors. The authors have made the first draft of their notes for the book available online. The material is intended for a modern theoretical course in computer science.)
6. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.
7. Jiawei Han, Micheline Kamber and Jian Pei Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790 2011.

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 338 L	Applied Data Science Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Write a python program to apply datafication concepts of friendship network of your face book account.
2. Write python program to calculate the central tendency of any popular data set. The inbuilt functions in the python should not be used.
3. Write R – Programming to plot various charts and graphs. You have to consider minimum two popular data sets and draw all the statistical observations.
4. Write a python Program to apply EDA on any two popular data sets and provided your analysis and interpretations. Use matplotlib library of python along with other libraries for the analysis and interpretation.
5. Write Python program to implement Linear Regression using inbuilt python Library. Also, write your own program to implement Linear Regression without using the inbuilt function. Compare and contrast the results.
6. Write Python program to implement K-Nearest Neighbors using inbuilt python Library. Also, write your own program to implement K-Nearest Neighbors without using the inbuilt function. Compare and contrast the results.
7. Write Python program to implement K-Means using inbuilt python Library. Also, write your own program to implement K-Means without using the inbuilt function. Compare and contrast the results.
8. Write a python program to implement a Spam Filter using Linear Regression and K-NN. Use a popular dataset.
9. Write a Python Program to Scrapping the Web using suitable API. Create a usable dataset for classification and clustering purpose.
10. Write a python program to generate the features from the data set created by you for exercise 9.
11. Write a Python Program to implement Filter and Wrappers.
12. Write a Python Program to implement Decision Trees, Random Forests – The inbuilt functions should not be used for the implementation.
13. Write a python Program to implement Singular Value Decomposition and Principal Component Analysis. Use any popular data set.
14. Write a python Program to extract the friendship details of your face book account as Social network Graph and represent in various visual forms.
15. Write a python program to extend the above exercise to discover the communities in the graph, partition the graph and extracting the neighbor hood properties of the graphs.
16. Write Python Program using Bokeh 2.1.1 realize the all the basic principles of data visualization.
17. Consider any popular dataset and present complex visualization principle using Bokeh 2.1.1.



## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 233	Industry Standard Coding Practice -III	SEC	0	0	4	2

### UNIT I

Problem solving with - Descriptive statistics, Mean/median/mode, Measures of dispersion/range variance, deviations, mean/median/mode problems, Random variables, Univariate & Bivariate random variables.

### UNIT II

Problem solving with - Graphs, Handshaking Lemma, Simple Graphs, DFS/BFS, connected components, coloring, Introduction to DAGs, Spanning Trees, Articulation Points/ Connected points.

### UNIT III

Problem solving with - Greedy Methods: Coin change, Fractional Knapsack, Activity Selections/ Job sequencing with Deadlines, Spanning Trees, Dynamic Programming: 0/1 Knapsack, Substructures, Longest common substring/subsequence, Longest Increasing sub sequence, Grid based Problems.

### UNIT IV

Problem solving with - Divide & Conquer Strategies: Quick/Merge Sort, Min/Power functions, Backtracking, N Queens problem, Finding the path & Grid based problems, iterative/loop free approaches.

### UNIT V

R Language Constructs, calculations, Operators, vectors, lists, Practice problems implementing R language, Matrices and data frame, Conditional statements and loops, Problem Solving on R language examples.

### TEXTBOOKS

1. An Introduction to Statistical Learning: with Applications in R - Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.
2. Introduction to Algorithms by Thomas H. Corman, The MIT Press, 3rd Edition.
3. Introduction to Algorithms: A Creative Approach by Udi Mander, Pearson.
4. R Cookbook - Paul Teetor, O'reilly.
5. Competitive Programming – 3e – Steven Halim, Felix Halim

## SEMESTER-IV

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
ISES 212	Industry Specific Employability Skills-IV	SEC	3	0	0	1

### UNIT I: QUANTITATIVE APTITUDE

Logarithms. Permutations and combinations. Probability. Progressions, Geometry and Mensuration, Data sufficiency.

### UNIT II: LOGICAL REASONING

Statement and conclusions, Most logical choice, Inferred meaning, Data arrangements, Venn diagram, Flow charts and logical gates, Puzzles, Case lets, Ordering, Ranking, Grouping.

### UNIT III: VERBAL ABILITY

Arguments, Verification of truth, Matching definitions, Theme detection, Idioms and phrases, Synonyms and Antonyms.

### UNIT IV: SOFT SKILLS

Active listening, Word group categorization, Self-image, self-presentation (grooming etiquette), Resume.

### UNIT V: SOFT SKILLS

Public speaking skills, Extempore, FAQ's.

### TEXTBOOKS/REFERENCES

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. English grammar and composition – S.C.Gupta.
6. Ramachandran and Karthik from campus to corporate India, Pearson Publication, 2016.

# **SEMESTER –V**

## SEMESTER - V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 304	Database Management System	CC	3	0	0	3

### **UNIT I: INTRODUCTION TO DBMS AND RELATIONAL MODEL**

File Processing System, Advantages of DBMS over File Processing System, Database System Applications DBMS Architecture: The three-schema architecture, Data Independence: Logical and Physical Data Models: Hierarchical, network and relation models, Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values. Database constraints (Domain, Key constraints, integrity constraints) and their importance.

### **UNIT II: QUERY PROCESSING: RELATIONAL ALGEBRA**

Relational Calculus, Introduction to SQL: Database Objects- DDL Schema definitions. DML- Insert, select, update, delete. Views, exercise on SQL queries. Transaction support in SQL: Aggregate Functions, Null Values, Views, Complex Integrity Constraints in SQL, Assertions, Triggers.

### **UNIT III: CONCEPTUAL MODEL AND DATABASE DESIGN**

Entity Relationship Model Entity types, Entity Sets, Attributes, and Keys Relationships, Relationship types and constraints, Weak Entity Types Enhanced ER (EER) Modeling: Super/Sub Classes Specialization and Generalization. Constraints and characteristics of Specialization and Generalization Example EER Schema Basics of Normalization, Normal Forms: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), BCNF, 4NF.

### **UNIT IV: TRANSACTION PROCESSING, CONCURRENCY CONTROL AND RECOVERY**

Introduction of transaction processing, advantages, and disadvantages of transaction processing system, Serializability and Recoverability of transaction, Concurrency Control, lock based Protocols, Timestamp Based Protocols – Validation based Protocols - Multiple Granularity Locking, Recovery techniques.

### **UNIT V: OVERVIEW OF STORAGE AND INDEXING**

Data on External Storage, File Organization, and Indexing - Clustered Indexes, Primary and Secondary Indexes. Indexed Sequential Access Methods (ISAM) B+ Trees: Tree Structure, Search, Insert, Delete. Hash Based Indexing: Static Hashing, Extendable hashing, Linear Hashing, Extendable vs. Linear Hashing.

### **TEXTBOOKS**

1. Ramez Elmasri and Shamkant Navathe. 2010. Fundamentals of Database Systems (6th ed.). Addison-Wesley Publishing Company, USA.
2. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.

### **REFERENCES**

1. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

2. Database system Implementation: Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom, Prentice Hall, 2000.
3. C.J. Date. 2003. An Introduction to Database Systems (8 ed.). Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA.

## SEMESTER-V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 304 L	Database Management System Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Implementation of data storage and indexing methods using files.
2. DML queries on single table.
3. Queries on Joining tables and Aggregate Functions.
4. Nested queries, Queries on creation of views, indexes, sequences and access privileges.
5. Triggers, Assertions.
6. SQL Transactions.
7. PL/SQL, Stored Procedures.
8. Design and Develop Applications.

## SEMESTER-V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 413	Artificial Intelligence	DC	3	0	0	3

### UNIT I: INTRODUCTION

What is Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents.

### UNIT II: SEARCH

Introduction to Search, Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, current-best-hypothesis search, least commitment search.

### UNIT III: KNOWLEDGE REPRESENTATION AND REASONING

Inference, Propositional Logic, Predicate Logic (first order logic), Logical Reasoning, Forward & Backward Chaining, Resolution; AI languages and tools - Lisp, Prolog, CLIPS.

### UNIT IV: PROBLEM SOLVING

Formulating problems, problem types, Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods.

### UNIT V: LEARNING

Overview of different forms of learning, decision trees, rule-based learning, neural networks, reinforcement learning.

Game playing: Perfect decision game, imperfect decision game, evaluation function, minimax, alpha-beta pruning.

### TEXTBOOKS

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, Third Edition, Pearson Education, 2008.

### REFERENCES

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill, 3<sup>rd</sup> edition, 2017.
2. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson.

## SEMESTER-V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 413 L	Artificial Intelligence Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Week 1: Artificial Intelligence Problem identification and PEAS description.
2. Week 2: Introduction to AI programming Language PROLOG.
3. Week 3: Study of facts, objects, predicates and variables in PROLOG.
4. Week 4: Study of arithmetic operators, simple input/output and compound goals in PROLOG.
5. Week 5: Study of string operations in PROLOG. Implement string operations like substring,
  6. string position, palindrome etc.
7. Week 6: Write a prolog program to implement all set operations (Union, intersection,
  8. complement etc.
9. Week 7: Write a program for Usage of rules in Prolog.

Create a family tree program to include following rules 1. M is the mother of P *if* she is a parent of P and is female 2. F is the father of P *if* he is a parent of P and is male 3. X is a sibling of Y *if* they both have the same parent. 4. Then add rules for grandparents, uncle-aunt, sister and brother. Based on the facts, define goals to answer questions related to
10. Week 8: Write programs for studying Usage of arithmetic operators in Prolog.

Accept name of the student, roll no, his/her subject name, maximum marks and obtained marks in the subject. (Take marks of at least 6 subjects). Compute the percentage of a student. Display his result with other information.

Accept department, designation, name, age, basic salary, house rent allowance (HRA) of an employee. Compute dearness allowance (DA) which is 15% of basic salary. Determine the gross salary (basic salary+HRA+DA) of the employee. Display all information of the employee (Generate Payslip).
11. Week 9: Implement a program for recursion and list in PROLOG.
12. Week 10: WAP for studying usage of compound object and list in Prolog.

Write a program to maintain inventory items using a compound object:
  - (i) Accept from user the details of at least 10 objects. (ii) Display from user the details of objects entered by user (2) Find and display odd and even numbers from a given input list.
13. Week 11: Write a prolog program to solve “Water Jug Problem”.
14. Week 12: Write a program to implement a monkey banana problem.
15. Week 13: Write a program to implement 8 Queens Problem.
16. Week 14: Write a program to solve traveling salesman problem.
17. Week 15: Write a program to solve water jug problem using LISP.



## SEMESTER-V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 310	Data Warehousing and Mining	DC	3	0	0	3

### UNIT I

Data warehousing and Online Analytical Processing: Basic concepts of Data Warehouse – Data Warehouse Modelling – Data Warehouse Design and Usage – Data Warehouse Implementation – Data Generalization by Attribute-oriented Induction.

### UNIT II

Data Mining: Knowledge Discovery from Data – Types of Data - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration – Data Reduction – Data Transformation and Data Discretization. Association Rule Mining – Frequent Itemset Mining methods – Pattern Evaluation Methods.

### UNIT III

Classification – Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule based Classification – Model Evaluation and Selection – Techniques to improve Classification Accuracy

### UNIT IV

Clustering – Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid Based Methods – Evaluation of Clustering.

### UNIT V

Data Mining Trends and Research Frontiers - Mining Complex Data types – Other Methodologies of Data Mining – Data Mining Applications – Data Mining and Society – Data Mining trends.

### TEXTBOOKS

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

### REFERENCES

1. G. K. Gupta “Introduction to Data Mining with Case Studies”, Third Edition, Prentice Hall of India, 2014.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2016.
3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
4. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.

## SEMESTER-V

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 310 L	Data Warehousing and Data Mining Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. **Week 1:** Implementation of OLAP operations.
2. **Week 2:** Data pre-processing techniques.
3. **Week 3:** Write a program in any programming language to generate at least 10,000 transactions in a text file with at least three items.
4. **Week 4 & 5:** Write a program to implement the APRIORI algorithm.
5. **Week 6 & 7:** Write a program for FP-Growth algorithm.
6. **Week 8 & 9:** Write a program to implement Decision tree-based classification.
7. **Week 10 & 11:** Write a program to implement Bayesian classification.
8. **Week 12:** Write a program to implement K-means clustering.
9. **Week 13:** Write a program to implement Divisive clustering.
10. **Week 14:** Write a program to implement Agglomerative clustering.
11. **Week 15:** Write a program to implement DBSCAN clustering.

### TEXTBOOKS

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

### REFERENCES

1. G. K. Gupta “Introduction to Data Mining with Case Studies”, Third Edition, Prentice Hall of India, 2014.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2016.
3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
4. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.

# **SEMESTER - VI**

## SEMESTER-VI

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 412	Principles of Soft Computing	DC	3	0	0	3

### UNIT I: INTRODUCTION TO SOFT COMPUTING, ARTIFICIAL NEURAL NETWORK (ANN)

Fundamentals of ANN, Basic Models of an artificial Neuron, Neural Network Architecture, learning methods, Terminologies of ANN, Hebb network, Supervised Learning Networks: Perceptron, Adaline, Madeline, Multi-Layer Perceptron, Feed forward Back Propagation Network: back propagation learning, Learning Effect of Tuning parameters of the Back propagation.

### UNIT II: RBF NETWORK, ASSOCIATIVE MEMORY

Auto, hetero and linear associative memory, network, Adaptive Resonance Theory: ART1, ART2, Introduction to Computer vision, Introduction to Convolutional neural network, Popular architectures: AlexNet, GoogleNet, VGG Net.

### UNIT III: FUZZY LOGIC

Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods, Fuzzy rule-based reasoning.

### UNIT IV: GENETIC ALGORITHMS

Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction. Genetic Modeling: Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm. Applications, Real life Problems. Particle Swarm Optimization and its variants.

### UNIT V

Hybrid Soft Computing Techniques Hybrid system, neural Networks, fuzzy logic and Genetic algorithms hybrids. Genetic Algorithm based Back Propagation Networks: GA based weight determination applications: Fuzzy logic controlled genetic Algorithms soft computing tools, Applications.

### TEXTBOOKS

1. Principles of Soft Computing- S.N.Sivanandan and S.N.Deepa, Wiley India, 2nd Edition,2011

### REFERENCES

1. Fuzzy and Soft Computing, J. S. R. JANG, C.T. Sun, E. Mizutani, PHI.
2. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application) S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI.

## SEMESTER-VI

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 412 L	Principles of Soft Computing Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Write a Python Program to implement a perceptron. The input is your semester marks.
2. Write a python program to extend the exercise given above to implement Feed Forward Network. The inbuilt function should not be used.
3. Write a python program to implement Hebb Network. The inbuilt function should not be used.
4. Write a python program to implement Multilayer Perceptron. The inbuilt function should not be used.
5. Write a python program to implement any ANN with back propagation learning Algorithm.
6. Write a Python Program to implement ART1 and ART 2.
7. Write a python program to implement CNN.
8. Write a python Programming to realize the working principles of popular architectures such as Alex Net, Google Net and VGG Net.
9. Write python Program to realize Fuzzy Sets arithmetic.
10. Write a python Program to realize fuzzy relations.
11. Write a python program to realize a fuzzy rule of any popular problem(s).
12. Write a python program to realize a defuzzification scheme for the above exercise.
13. Write a python Program to reason the fuzzy rules in exercises 12 and 13.
14. Write a python program to realize various steps of Genetic Algorithms.
15. Write a Python Program to realize GA based back propagation Networks.
16. Write a Python Program to realize Fuzzy Controlled Genetic Algorithms.

## SEMESTER-VI

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 419	Information Retrieval	DC	3	0	0	3

### UNIT I

Introduction to information retrieval, IR problem, IR system, The Web, Search interface, Visualizing search interface, Inverted index and boolean queries, Tokenization, Stemming, Stop words, Phrases, Phrases queries, Index construction, Index compression, k-gram indexes

### UNIT II

Retrieval models: Boolean, Vector space model, TF-IDF, The cosine measure, Document length normalization, Probabilistic models, Binary Independence Model, Okapi, Language modeling,

Evaluating IR system: User happiness, Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems

### UNIT III

Relevance feedback and Query expansion: Explicit relevance feedback, Explicit relevance feedback through clicks, Implicit feedback through local analysis, Implicit feedback through global analysis

Document format, Markup language, Text properties, Document processing, Document organization, Text compression, Query languages, Query properties

### UNIT IV

Text/Document classification, Clustering and LSI: Introduction to classification, Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting, Choosing right classifier

Introduction to clustering, Evaluation of clustering, k-means clustering, Hierarchical agglomerative clustering, Divisive clustering; Low-rank approximations, Latent semantic indexing

### UNIT V

Web IR: Hypertext, Web crawling, Indexes, Search engines, Ranking, Link analysis, Page Rank, HITS

### TEXTBOOKS/REFERENCES

1. Modern Information Retrieval: The Concepts and Technology Behind Search, by Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Second Edition (Pearson Education India, 2010)
2. Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze (Cambridge University Press, 2008)
3. Mining the Web, by S. Chakrabarti (Morgan-Kaufmann, 2002)
4. Natural Language Processing And Information Retrieval, by Tanveer Siddiqui and U. S. Tiwary, First Edition (Oxford University Press, 2008)

## SEMESTER-VI

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 419 L	Information Retrieval Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Tokenization, Stemming, Stop words removal, Inverted index construction - Token sequence, Sort, Dictionary & Postings, Implementation of Boolean queries.
2. Ranked retrieval - Implementation of TF-IDF, Vector space model, Cosine similarity.
3. Ranked retrieval - Implementation of Binary Independence Model, Okapi BM25.
4. Implementation of Text/Document classification algorithms - Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting.
5. Implementation of Text/Document clustering algorithms - k-means clustering, Hierarchical agglomerative clustering, Divisive clustering.
6. Implementation of Low-rank approximations, Latent semantic indexing.
7. Sort-based index construction.
8. Implementation of External memory indexing - BSBI, SPIMI.
9. Implementations of Dynamic indexing - Logarithmic merge.
10. Dictionary compression - Implementation of Blocking, Posting Compression - Implementation of Gamma codes.
11. Development of a Web Crawler and a small-scale web search engine - Ranking, PageRank, HITS.

## SEMESTER-VI

Course Code	Course Name	Core/ Elective	L-T-P	Credits
CSC 340	Project		0-0-8	4

### General Guidelines for project report and Research work

These guidelines explain briefly the mechanics of writing a research paper in Computer Science and Engineering. These guidelines are generic and can be customized to fit most of the research works

The writing can start with the abstract, which can be approximately one page 10–20 sentences. The abstract will be refined and updated as a continuous process. The abstract can concisely (1) identify the research topic, (2) identify the benefits and advantages that result (3) and if there is novelty, describe the novelty of the presented work.

**Section 1: Introduction (Motivation)** Although the title of the starting section is “Introduction” it should really be Motivation. In one or two paragraphs, the topic has to be introduced. This is followed with useful of the work, including possible applications of the work. Possible points to mention include:

1. Does the research work describe the state-of-the-art in that research domain?
2. What is the relevance of this work in filling any research gap?
3. Who will potentially benefit from the work?
4. Does the presented work provide a new technique of some sort?
5. Does this research work provide any new insight in some way?
6. Is it a review work which give an insight to the current research in a particular domain?

Words like, contribute, benefit, advantageous, and possibly novel are used in this list. The presented work often builds on a previous system or algorithm. If so, your work may inherit benefits from the previous work. Those inherited advantages may also be listed. The introduction section then concludes with how the rest of the research paper is organized.

**Section 2: Related works:** presents review of the previous work on this topic

The related work section demonstrates to the reader that you have done your homework (research), reviewed the previous literature, and now are ready to present your contribution based what has been previously published. The review is confined to relevant and recent research



works in the domain of the proposed research. One of the difficult aspects of the related work section is choosing the proper scope. There is some subjectivity in choosing which books or papers to refer to and also importantly, which previous literature not to refer to. This is something an advisor is able to help with.

**Section 3:** presents the proposed work/experimental/simulation specifications.

**Section 4:** presents any algorithms or procedures used.

**Next section** can represent an evaluation of the results and the

**Last section** may present conclusions and future work.

### **Citations**

Any figure, image, or equation that is taken from another source must be cited. Content and terminology from other sources must also be cited. For more information about citations and their use, see:

<http://www.plagiarism.org/>. Click on the “How to cite sources” link.

References should be accurate and complete, i.e., with page numbers etc. A paper without complete and correct references can leave a bad impression on the reader and detract from a paper’s credibility.

Mark Distribution: (As per the original plan. May be reviewed)

- |  |          |
|--|----------|
| 1. Internal evaluation by Guide:   | 50 marks |
| 2. External evaluation by a Committee:<br>(Project Report, Demonstration and Presentation) | 50 marks |

# **SEMESTER - VII**

## SEMESTER-VII

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
RM101	Research Methodology	CC	2	0	0	2

### UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

### UNIT II

Effective literature studies approaches, analysis Plagiarism, Research ethics,

### UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

### UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

### UNIT V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

### UNIT VI

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

### TEXTBOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

### REFERENCES

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
7. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
EGL102	Technical Writing	CC	2	0	0	2

### **UNIT I**

Sentence Structure (English), Paragraph Writing, Coherence, Cohesion, and Unity, Construction of an Argument and Counter-argument, Deducing a Conclusion

### **UNIT II**

The Concept of 'BASIC' (Brief, Appropriate, Simple, Intelligible, and Complete), Writing Vs Drafting, The process of 'Technical' writing, Difference between 'General' and 'Technical' writing (the nuances of technical writing)

### **UNIT III**

What is a Definition? The process / structure of a Definition, What is a Description?, The process / structure of a Scientific Description, Describing an Object, Describing a Process, What is an Explanation?, The mechanism of writing an 'Explanation'

### **UNIT IV**

Synopsis, Research Proposal, Abstract Vs Summary, Referencing and Citations, Bibliography

### **UNIT V**

Planning a Research Write-up, Structure of a Paper, Designing an effective Abstract, Introduction Section, Discussion, Conclusion

### **TEXTBOOKS**

1. Dudley Evans, T. (1998). Developments in English for Specific Purposes: A multidisciplinary approach. U.K: Cambridge University Press
2. Hutchinson, T., & Waters, A. (1987). English for Specific Purposes: A learner-centered approach. U.K: Cambridge University Press
3. Jain, A. K. (2001). Professional Communication Skills. New Delhi: S. Chand & Company Limited
4. Raman, Meenakshi, and Sangeetha Sharma. (2008). Technical Communication: English Skills for Engineers. New Delhi: Oxford University Press
5. Raman, Meenakshi, and Sangeetha Sharma. (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press
6. Trimble, Louis. English for Science and Technology - A Discourse Approach. (1985). Cambridge: Cambridge University Press.

7. Williams, Phil. *Advanced Writing Skills for Students of English*. (2018). Brighton: Rumian Publishing.
8. Wilson, Paige and Teresa Ferster Glazier. (2013). *The Least You Should Know About English: Writing Skills, Form C* (11th Edition). Boston: Cengage Learning.

Course Code	Course Name	Core/ Elective	L-T-P	Credits
CSC 441	Project		0-0-20	10

### **Introduction**

These guidelines are conceived as a set of procedures stating broad expectations from both students and mentors of the project which is part of the B.Sc CS curriculum. These guidelines are intended to make the project work evaluation process easier, formal and more authentic. The Project spans 2 semesters which are the 7<sup>th</sup> and 8<sup>th</sup> semesters. The total number of Credits offered for the project is 26. The total credit is split into 10+16 for 7<sup>th</sup> and 8<sup>th</sup> semesters respectively. The project has to be sufficiently complex and feasible so as to be considered for 26 Credits. The evaluation of the project is done by a review panel comprising department faculty members and the review process is continuous. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

### **Project Selection**

Project may be an in-campus project or can be mapped with internship carried out in the industry or the research internship carried out in the other premier Universities in India/Abroad.

**In campus project:** The idea for student's Project may be a proposal from a faculty member or student's own, or perhaps a combination of the two. The project has to be sufficiently complex and feasible. Students are advised to choose a project that involves a combination of sound background research, a solid implementation, or piece of theoretical work, and a thorough evaluation of the Project's output. Interdisciplinary Project proposals and innovative Projects are encouraged and more appreciable.

### **Mapping with any Internship:**

- Any type of internships can be carried out by the students in the 7<sup>th</sup> and 8<sup>th</sup> semester after getting the due approval from the Project coordinator and the Head of the department.
- The internship period has to be a minimum of 10 weeks of duration in each semester and the students could have carried out the practical work for at least 180 hrs during this period.
- The internship has to involve some Software/Hardware design and implementation component and/or research component and the complexity of this work is expected to match the requirements of the Project work.

**Mentor allocation process:** Students can form a batch of 4 (5 may be allowed in exceptional cases on the discretion of the project coordinators) and select their mentor provided the Faculty member accepts them and the faculty member has less than the specified number projects under his/her mentorship.

**Project Equipment:** In case of deserving projects for limited financing of equipment, the students can approach the concerned university authorities following due procedure.

### **Meetings with Your Supervisor:**

Instructions to students: You must make sure that you arrange regular meetings with your Mentor. The meetings may be brief once your project is under way, but your Mentor needs to know that your work

is progressing. You are also expected to be contactable throughout the project. You should inform the Mentor your contact details and keep these updated if these change.

Instructions to Mentors: Mentors are advised to maintain a project diary depicting attendance of student and progress of project.

**Legal and Ethical Considerations:** If a student want to do some project with some company where their relatives or friends work, the details need to be disclosed to their mentor. The mentor has to report the same to the project coordinators for permission. Again, if a student doing internship with a company, the data, procedures/algorithms and software developed may be classified and may not be allowed to submit in the report. The students need to consider that before requesting mapping.

**Project Report format:** Format of the report is similar to the format of standard Journal papers published. (Abstract-Literature survey-Methodology-Algorithms-Simulation-Results-explanation of results-Future work etc)

### **Project milestones and Assessment**

Starting date of the project to be taken as the commencement date of 7th semester. A student is expected to finish first two stages in 7<sup>th</sup> semester and remaining in 8<sup>th</sup>. The students are expected to plan from the beginning for at least one research publication in a reputed journal.

Stage 1: Title, Scope of the project and Literature survey to be submitted within 4 weeks from the commencement of the project. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

Stage 2: Methodology, Requirement analysis and Deliverables to be submitted within 8 weeks from the commencement of the project.

Stage 3: Algorithms, project design and implementation plan have to be submitted within 12 weeks of the commencement of the 8<sup>th</sup> semester. Internal review will be conducted by the Mentor and this review has a weightage of 50%.

Stage 4: Project implementation to be done and demonstrate that the project meets the requirements and expectations.

Stage 5: The results need to be analyzed and if any fine tuning required is to be done.

**Final evaluation** by expert committee at the end of the 14<sup>th</sup> week and this evaluation has a weightage of 50%.



# **SEMESTER - VIII**

Course Code	Course Name	Core/ Elective	L-T-P	Credits
CSC 441	Project		0-0-32	16

### **Introduction**

These guidelines are conceived as a set of procedures stating broad expectations from both students and mentors of the project which is part of the B.Sc CS curriculum. These guidelines are intended to make the project work evaluation process easier, formal and more authentic. The Project spans 2 semesters which are the 7<sup>th</sup> and 8<sup>th</sup> semesters. The total number of Credits offered for the project is 26. The total credit is split into 10+16 for 7<sup>th</sup> and 8<sup>th</sup> semesters respectively. The project has to be sufficiently complex and feasible so as to be considered for 26 Credits. The evaluation of the project is done by a review panel comprising department faculty members and the review process is continuous. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

### **Project Selection**

Project may be an in-campus project or can be mapped with internship carried out in the industry or the research internship carried out in the other premier Universities in India/Abroad.

**In campus project:** The idea for student's Project may be a proposal from a faculty member or student's own, or perhaps a combination of the two. The project has to be sufficiently complex and feasible. Students are advised to choose a project that involves a combination of sound background research, a solid implementation, or piece of theoretical work, and a thorough evaluation of the Project's output. Interdisciplinary Project proposals and innovative Projects are encouraged and more appreciable.

### **Mapping with any Internship:**

- d. Any type of internships can be carried out by the students in the 7<sup>th</sup> and 8<sup>th</sup> semester after getting the due approval from the Project coordinator and the Head of the department.
- e. The internship period has to be a minimum of 10 weeks of duration in each semester and the students could have carried out the practical work for at least 180 hrs during this period.
- f. The internship has to involve some Software/Hardware design and implementation component and/or research component and the complexity of this work is expected to match the requirements of the Project work.

**Mentor allocation process:** Students can form a batch of 4 (5 may be allowed in exceptional cases on the discretion of the project coordinators) and select their mentor provided the Faculty member accepts them and the faculty member has less than the specified number projects under his/her mentorship.

**Project Equipment:** In case of deserving projects for limited financing of equipment, the students can approach the concerned university authorities following due procedure.

### **Meetings with Your Supervisor:**

Instructions to students: You must make sure that you arrange regular meetings with your Mentor. The meetings may be brief once your project is under way, but your Mentor needs to know that your work

is progressing. You are also expected to be contactable throughout the project. You should inform the Mentor your contact details and keep these updated if these change.

Instructions to Mentors: Mentors are advised to maintain a project diary depicting attendance of student and progress of project.

**Legal and Ethical Considerations:** If a student want to do some project with some company where their relatives or friends work, the details need to be disclosed to their mentor. The mentor has to report the same to the project coordinators for permission. Again, if a student doing internship with a company, the data, procedures/algorithms and software developed may be classified and may not be allowed to submit in the report. The students need to consider that before requesting mapping.

**Project Report format:** Format of the report is similar to the format of standard Journal papers published. (Abstract-Literature survey-Methodology-Algorithms-Simulation-Results-explanation of results-Future work etc)

### **Project milestones and Assessment**

Starting date of the project to be taken as the commencement date of 7th semester. A student is expected to finish first two stages in 7<sup>th</sup> semester and remaining in 8<sup>th</sup>. The students are expected to plan from the beginning for at least one research publication in a reputed journal.

Stage 1: Title, Scope of the project and Literature survey to be submitted within 4 weeks from the commencement of the project. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

Stage 2: Methodology, Requirement analysis and Deliverables to be submitted within 8 weeks from the commencement of the project.

Stage 3: Algorithms, project design and implementation plan have to be submitted within 12 weeks of the commencement of the 8<sup>th</sup> semester. Internal review will be conducted by the Mentor and this review has a weightage of 50%.

Stage 4: Project implementation to be done and demonstrate that the project meets the requirements and expectations.

Stage 5: The results need to be analyzed and if any fine tuning required is to be done.

**Final evaluation** by expert committee at the end of the 14<sup>th</sup> week and this evaluation has a weightage of 50%.

## Honors in AI & ML

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102	Introduction to Programming Using Python	HC	3	0	0	3

### UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages, Types, Variables Operators and Branching — Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

### UNIT II: FUNCTIONS

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numeric, Files.

### UNIT III: TUPLES AND LISTS

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – Dictionaries: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions, Assertions, Exceptions, Exception Examples.

### UNIT IV: CLASSES AND INHERITANCE

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – An Extended Example: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators.

### UNIT V: COMPUTATIONAL COMPLEXITY

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort.

### TEXTBOOKS

2. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).

### REFERENCES

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10June2017),ISBN-10: 0199480173.
2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016).
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition (6th February 2009).

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102 L	Introduction to Programming Using Python Lab	HC	0	0	3	2

### LIST OF PRACTICAL EXPERIMENTS

11. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
12. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
13. Write a Python program to find the factorial of the given number (Example:  $5! = 5*4*3*2*1 = 120$ ).
14. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until “-10” is encountered.
15. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
16. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
17. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
18. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
19. Define inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
20. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

### TEXTBOOKS

4. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).
5. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
6. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016).

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 413	Artificial Intelligence	HC	3	0	0	3

### UNIT I

Introduction: What is Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents.

### UNIT II

Search: Introduction to Search, Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, current-best-hypothesis search, least commitment search

### UNIT III

Knowledge Representation and Reasoning: Inference, Propositional Logic, Predicate Logic (first order logic), Logical Reasoning, Forward & Backward Chaining, Resolution; AI languages and tools - Lisp, Prolog, CLIPS

### UNIT IV

Problem Solving: Formulating problems, problem types, Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods.

### UNIT V

Learning: Overview of different forms of learning, decision trees, rule based learning, neural networks, reinforcement learning.

Game playing: Perfect decision game, imperfect decision game, evaluation function, minimax, alpha-beta pruning.

### TEXTBOOKS

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 413 L	Artificial Intelligence Lab	HC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Week 1: Artificial Intelligence Problem identification and PEAS description.
2. Week 2: Introduction to AI programming Language PROLOG.
3. Week 3: Study of facts, objects, predicates and variables in PROLOG.
4. Week 4: Study of arithmetic operators, simple input/output and compound goals in PROLOG.
5. Week 5: Study of string operations in PROLOG. Implement string operations like substring, string position, palindrome etc.
7. Week 6: Write a prolog program to implement all set operations (Union, intersection, complement etc).
9. Week 7: Write a program for Usage of rules in Prolog.  
Create a family tree program to include following rules 1. M is the mother of P *if* she is a parent of P and is female 2. F is the father of P *if* he is a parent of P and is male 3. X is a sibling of Y *if* they both have the same parent. 4. Then add rules for grandparents, uncle-aunt, sister and brother. Based on the facts, define goals to answer questions related to
10. Week 8: Write programs for studying Usage of arithmetic operators in Prolog.  
Accept name of the student, roll no, his/her subject name, maximum marks and obtained marks in the subject. (Take marks of at least 6 subjects). Compute the percentage of a student. Display his result with other information.  
Accept department, designation, name, age, basic salary, house rent allowance (HRA) of an employee. Compute dearness allowance (DA) which is 15% of basic salary. Determine the gross salary (basic salary+HRA+DA) of the employee. Display all information of the employee (Generate Payslip).
11. Week 9: Implement a program for recursion and list in PROLOG.
12. Week 10: WAP for studying usage of compound object and list in Prolog.  
Write a program to maintain inventory items using a compound object:  
(i) Accept from user the details of at least 10 objects. (ii) Display from user the details of objects entered by user (2) Find and display odd and even numbers from a given input list.
13. Week 11: Write a prolog program to solve “Water Jug Problem”.
14. Week 12: Write a program to implement a monkey banana problem.
15. Week 13: Write a program to implement 8 Queens Problem.
16. Week 14: Write a program to solve traveling salesman problem.
17. Week 15: Write a program to solve water jug problem using LISP.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 336	Machine Learning	HC	3	0	0	3

### UNIT I

Introduction: Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance

Linear Regression: Introduction, Linear regression, Simple and Multiple Linear regression, Polynomial regression, evaluating regression fit.

### UNIT II

Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, over fitting in decision tree and methods to avoid over fitting.

Instance based Learning: K nearest neighbour, the Curse of Dimensionality, Feature Selection: univariate, multivariate feature selection approach, missing values ratio, high correlation filter, low variance filter, feature selection using decision tree, Feature reduction Techniques: Principal Component Analysis, Linear Discriminate Analysis

Recommender System: Content based system, Collaborative filtering based

### UNIT III

Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes, Logistic Regression

Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem.

### UNIT IV

Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm.

### UNIT V

Ensembles: Introduction, Bagging and boosting, Random forest, Discussion on some research papers.

Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering.

### TEXTBOOKS

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.



## REFERENCES

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 336 L	Machine Learning Lab	HC	0	0	2	1

## LIST OF PRACTICAL EXPERIMENTS

1. Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib
2. Python exercise on Feature engineering, data visualisation
3. Programs on Covariance, Correlation, Covariance Matrix and Correlation Matrix
4. Implement Linear Regression and calculate sum of residual error
5. Program to implement different distance functions
6. Program to implement decision tree learning
7. Program to implement K nearest neighbour classifier
8. Program to implement Principle Component Analysis
9. Program to implement perceptron for different learning task
10. Programs to implement ADALINE and MADALINE for given learning task
11. Program to implement classification task using Support Vector machine
12. Programs to implement different Clustering algorithms

## REFERENCES

1. Swamynathan, Manohar. Mastering machine learning with python in six steps: A practical implementation guide to predictive data analytics using python. Apress, 2019.
2. Raschka, Sebastian. Python machine learning. Packt publishing ltd, 2015.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 314	Digital Image Processing	HC	3	0	0	3

### UNIT I

Introduction: Digital Image fundamentals: Image sampling and quantization, relationship between pixels, Image acquisition and Pre-processing: Intensity transformations and spatial filtering, some basic intensity transformation functions, Histogram processing, spatial filters for smoothing and sharpening.

### UNIT II

Filtering in the Frequency Domain: basic filtering in the frequency domain, image smoothing and sharpening Image Restoration: Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function.

### UNIT III

Image segmentation: Fundamentals, point, line detection, basic edge detection techniques, Hough transform, Thresholding, basic global thresholding, optimal thresholding using Otsu's method, multi-spectral thresholding, Region based segmentation, region growing, region splitting and merging.

### UNIT IV

Color Image Processing: color models, Color transformation Image Compression: Fundamentals, Some basic compression methods Morphological Image Processing: Erosion and Dilation, opening and closing, thinning, skeletonisation.

### UNIT V

Image Representation: Shape features (Region-based representation and descriptors), area, Euler's number, eccentricity, elongatedness, rectangularity, direction, compactness, moments, convex hull, texture features, color features. Object and Pattern Recognition: Pattern and pattern classes, Matching, minimum distance or nearest neighbor classifier, matching by correlation, Optimum statistical classifier, Neural network classifier.

### TEXTBOOKS

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education

### REFERENCES

1. S. Sridhar, Digital Image Processing, Oxford University Press, 2011.
2. Milan Sonka, Vaclav Hlavac and Roger Boyele, Image processing, analysis, and machine vision. 3e, Cengage Learning, 2014.
3. Computer Vision A modern approach, David A. Forsyth and Jean Ponce, Pearson Education.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 314 L	Digital Image Processing Lab	HC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Perform the following operations using library functions
  - a. Read, Display and write any color image in other formats.
  - b. Find RED, GREEN and BLUE plane of the color image.
  - c. Convert color image into gray scale image and binary image.
  - d. Resize the image by one half and one quarter.
  - e. Image rotates by 45, 90 and 180 degrees.
2. Create black and white images (A) of size 1024x1024. Which consists of alternative horizontal lines of black and white? Each line is of size 128.  
Create black and white images (B) of size 1024x1024. Which consists of alternative vertical lines of black and white? Each line is of size 128. Perform the following operations on Image A and Image B.
  - a. Image addition of A and B
  - b. Subtraction of A and B
  - c. Multiplying Images of A and B
  - a. Create a grayscale image of size 256x1024. Intensity of image should vary sinusoidal.
  - b. Create a white image of size 256x256, with black box of size 58x58 at centre.
3. Develop programs for following intensity transformation operation on a gray scale image. Collect any gray scale image from any source. Process that image using these operations.
  - a. Image negative
  - b. Log transformation and inverse log transform:  $s = c \log(1+r)$ ,  $c$  is a const,  $r \geq 0$ .  $s$  is pixel intensity of output image;  $r$  is the pixel intensity of input image. Study the effect of constant  $c$  on the quality of output image.
  - c. Power law transformation: Study the effect of different values of Gamma used in this transformation.
  - d. Contrast stretching
  - e. Gray level slicing
4. Develop programs for following spatial filtering operations on a gray scale image.
  - a. Averaging: Implement averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.
  - b. Weighted averaging: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.

- c. Median filtering: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.
  - d. Max filtering
  - e. Min filtering
- 5. Take a gray scale image and add salt and pepper noise. Write programs for following operations and observe their outputs
  - a. Linear smoothing or Image averaging
  - b. Weighted averaging
  - c. Median filtering. Compare the output quality among Image averaging and median filtering.
  - d. Max filtering
  - e. Min filtering
- 6. Write programs to perform following sharpening operations on a gray scale image
  - a. Laplacian filter
  - b. Filtering using composite mask
  - c. Unsharp masking
  - d. High boost filtering
  - e. Filtering using first order derivative operators such as sobel and prewitt mask.
- 7. Write a program to improve contrast of an image using histogram equalization. The prototype of the function is as below:
 

```
histogram_equalisation (input_Image, no_of_bins);
```

 The function should return the enhanced image. Consider two low contrast input images. Study the nature of the output image quality in each case by varying the number of bins.
- 8. Take a low contrast gray scale image (A) and a high contrast gray scale image (B). Write a program to improve the contrast of A with the help of image B using histogram specification or matching. The prototype of the function is as below:
 

```
Histogram_sp(input_Image, specified_Iage, no_of_bins);
```

 The function should return the enhanced image.
- 9. Develop programs to implement frequency domain smoothing filters (Ideal, Butterworth and Gaussian) and apply these filters on a gray scale image.
  - a. Compare/comment on the output of Ideal, Butterworth and Gaussian Low pass Filters having the same radii (cutoff frequency) value.
  - b. Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal low pass frequency domain filter.
  - c. Compare the output of Butterworth low pass filters (order  $n=2$ ) for different cut-off frequencies (5, 15, 30, 90, 120).
  - d. Compare the output of Gaussian low pass filters for different cut-off frequencies (5, 15, 30, 90, and 120).
- 10. Develop programs to implement frequency domain sharpening/High pass filters (Ideal, Butterworth and Gaussian) and apply these filters on a gray scale image.
  - a. Compare/comment on the output of Ideal, Butterworth and Gaussian High pass Filters having the same radii (cutoff frequency) value.
  - b. Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal high pass frequency domain filter.
  - c. Compare the output of Butterworth high pass filters (order  $n=2$ ) for different cut-off frequencies (5, 15, 30, 90, 120).

- d. Compare the output of Gaussian high pass filters for different cut-off frequencies (5, 15, 30, 90, and 120).
11. Develop program to add different types of noise in a gray scale image and write functions to implement following filters for image restoration in presence of these noises.
  - a. Remove Salt and Pepper Noise
  - b. Minimize Gaussian noise
  - c. Median filter and Weiner filter
12. Write and execute program for image morphological operations erosion and dilation.
13. Implement Morphological smoothing using opening and closing
14. Develop program to implement point and line detection masks. Detect points and lines using these masks for a given gray scale image.
15. Develop programs for edge detection using different edge detection mask.
16. Develop programs to achieve image segmentation using
17. Basic Global thresholding
18. Optimal global thresholding or Otsu's thresholding
19. Given a set of coordinates as boundary pixels in an image. Write a program to implement Hough Transform for joining the points using different lines.
20. Given a MXN image. Write a program to find the Co-occurrence matrix for a given angle and distance. Compute the Co-occurrence matrix features.
21. Given a MXN image. Write a program to find the Local Binary Pattern profile of the given image.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 412	Principles of Soft Computing	HC	3	0	0	3

### **UNIT I: INTRODUCTION TO SOFT COMPUTING, ARTIFICIAL NEURAL NETWORK (ANN)**

Fundamentals of ANN, Basic Models of an artificial Neuron, Neural Network Architecture, learning methods, Terminologies of ANN, Hebb network, Supervised Learning Networks: Perceptron, Adaline, Madeline, Multi-Layer Perceptron, Feed forward Back Propagation Network: back propagation learning, Learning Effect of Tuning parameters of the Back propagation.

### **UNIT II: RBF NETWORK, ASSOCIATIVE MEMORY**

Auto, hetero and linear associative memory, network, Adaptive Resonance Theory: ART1, ART2, Introduction to Computer vision, Introduction to Convolutional neural network, Popular architectures: AlexNet, GoogleNet, VGG Net.

### **UNIT III: FUZZY LOGIC**

Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods, Fuzzy rule-based reasoning.

### **UNIT IV: GENETIC ALGORITHMS**

Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction. Genetic Modeling: Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm. Applications, Real life Problems. Particle Swarm Optimization and its variants.

### **UNIT V**

Hybrid Soft Computing Techniques Hybrid system, neural Networks, fuzzy logic and Genetic algorithms hybrids. Genetic Algorithm based Back Propagation Networks: GA based weight determination applications: Fuzzy logic controlled genetic Algorithms soft computing tools, Applications.

### **TEXTBOOKS**

2. Principles of Soft Computing- S.N.Sivanandan and S.N.Deepa, Wiley India, 2nd Edition,2011

## REFERENCES

3. Fuzzy and Soft Computing, J. S. R. JANG, C.T. Sun, E. Mitzutani, PHI.
4. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application) S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 412 L	Principles of Soft Computing Lab	HC	0	0	2	1

## LIST OF PRACTICAL EXPERIMENTS

17. Write a Python Program to implement a perceptron. The input is your semester marks.
18. Write a python program to extend the exercise given above to implement Feed Forward Network. The inbuilt function should not be used.
19. Write a python program to implement Hebb Network. The inbuilt function should not be used.
20. Write a python program to implement Multilayer Perceptron. The inbuilt function should not be used.
21. Write a python program to implement any ANN with back propagation learning Algorithm.
22. Write a Python Program to implement ART1 and ART 2.
23. Write a python program to implement CNN.
24. Write a python Programming to realize the working principles of popular architectures such as Alex Net, Google Net and VGG Net.
25. Write python Program to realize Fuzzy Sets arithmetic.
26. Write a python Program to realize fuzzy relations.
27. Write a python program to realize a fuzzy rule of any popular problem(s).
28. Write a python program to realize a defuzzification scheme for the above exercise.
29. Write a python Program to reason the fuzzy rules in exercises 12 and 13.
30. Write a python program to realize various steps of Genetic Algorithms.
31. Write a Python Program to realize GA based back propagation Networks.  
Write a Python Program to realize Fuzzy Controlled Genetic Algorithms

## Honours in Data Science

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102	Introduction to Programming Using Python	HC	3	0	0	3

### UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages, Types, Variables Operators and Branching -- Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

### UNIT II: FUNCTIONS

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numeric, Files.

### UNIT III: TUPLES AND LISTS

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – Dictionaries: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions, Assertions, Exceptions, Exception Examples.

### UNIT IV: CLASSES AND INHERITANCE

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – An Extended Example: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators.

### UNIT V: COMPUTATIONAL COMPLEXITY

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort.

### TEXTBOOKS

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).

### REFERENCES

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10June2017), ISBN-10: 0199480173.



2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016).
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1<sup>st</sup>edition (6<sup>th</sup> February 2009).

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 102 L	Introduction to Programming Python Lab	HC	0	0	3	2

### LIST OF PRACTICAL EXPERIMENTS

1. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3. Write a Python program to find the factorial of the given number (Example:  $5! = 5*4*3*2*1 = 120$ ).
4. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until “-10” is encountered.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9. Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

### TEXTBOOKS

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.

- Data Structures and Algorithms in Python by Michael T Goodrich and Roberto Tamassia, Micheal S Goldwasser, Wiley Publisher (2016).

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSE 310	Data Warehousing and Mining	HC	3	0	0	3

#### **UNIT I**

Data warehousing and Online Analytical Processing: Basic concepts of Data Warehouse – Data Warehouse Modelling – Data Warehouse Design and Usage – Data Warehouse Implementation – Data Generalization by Attribute-oriented Induction.

#### **UNIT II**

Data Mining: Knowledge Discovery from Data – Types of Data - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration – Data Reduction – Data Transformation and Data Discretization. Association Rule Mining – Frequent Itemset Mining methods – Pattern Evaluation Methods.

#### **UNIT III**

Classification – Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule based Classification – Model Evaluation and Selection – Techniques to improve Classification Accuracy

#### **UNIT IV**

Clustering – Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid Based Methods – Evaluation of Clustering.

#### **UNIT V**

Data Mining Trends and Research Frontiers - Mining Complex Data types – Other Methodologies of Data Mining – Data Mining Applications – Data Mining and Society – Data Mining trends.

#### **TEXTBOOKS**

- Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

#### **REFERENCES**

- G. K. Gupta “Introduction to Data Mining with Case Studies”, Third Edition, Prentice Hall of India, 2014.
- Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2016.
- K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

4. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSE 310 L	Data Warehousing and Data Mining Lab	HC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. **Week 1:** Implementation of OLAP operations.
2. **Week 2:** Data pre-processing techniques.
3. **Week 3:** Write a program in any programming language to generate at least 10,000 transactions in a text file with at least three items.
4. **Week 4 & 5:** Write a program to implement the APRIORI algorithm.
5. **Week 6 & 7:** Write a program for FP-Growth algorithm.
6. **Week 8 & 9:** Write a program to implement Decision tree-based classification.
7. **Week 10 & 11:** Write a program to implement Bayesian classification.
8. **Week 12:** Write a program to implement K-means clustering.
9. **Week 13:** Write a program to implement Divisive clustering.
10. **Week 14:** Write a program to implement Agglomerative clustering.
11. **Week 15:** Write a program to implement DBSCAN clustering.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 338	Applied Data Science	HC	3	0	0	3

### UNIT I: INTRODUCTION

Introduction to Data Science, Data vs. Big Data, Statistical Inference - Populations and samples, Statistical modeling, probability distributions, fitting a model. Data Science Process, Exploratory Data Analysis, Basic tools - plots, graphs and summary statistics of EDA. Introduction to R Programming.

### UNIT II

Basic Machine Learning Algorithms - Linear Regression - K-Nearest Neighbors (K-NN) - K-means, K-Medoids, Naive Bayes. Case Study: Real Direct (online real estate firm), Filtering Spam - Linear Regression and K-NN and Naive Bayes for Filtering Spam. Data Wrangling: APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning from Data) - Motivating Application and Case Study: User (customer) retention - Feature Generation - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

### UNIT III

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis.

### UNIT IV

Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs.

### UNIT V

Data Visualization - Basic principles, ideas and tools for data visualization – Case Study 1 on industry projects – Case Study 2: Create Complex visualization dataset - Data Science and Ethical Issues - Discussions on privacy, security, ethics - Next-generation data scientists.

### TEXTBOOKS

3. Sinan Ozdemir, Sunil Kakade. Principles of Data Science - Second Edition Released December 2018 Publisher(s): Packt Publishing ISBN: 9781789804546.
4. Cathy O’Neil and Rachel Schutt Doing Data Science, Straight Talk from The Frontline. O’Reilly. 2014.

## REFERENCES

8. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman Mining of Massive Datasets v2.1, Cambridge University Press 2014 (free online).
9. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
10. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
11. Trevor Hastie, Robert Tibshirani and Jerome Friedman Elements of Statistical Learning, Second Edition ISBN 0387952845 2009 (free online).
12. Avrim Blum, John Hopcroft and Ravindran Kannan Foundations of Data Science (Note: this is a book currently being written by the three authors. The authors have made the first draft of their notes for the book available online. The material is intended for a modern theoretical course in computer science.)
13. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.
14. Jiawei Han, Micheline Kamber and Jian Pei Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790 2011.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 338 L	Applied Data Science Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

18. Write a python program to apply datafication concepts of friendship network of your face book account.
19. Write python program to calculate the central tendency of any popular data set. The inbuilt functions in the python should not be used.
20. Write R – Programming to plot various charts and graphs. You have to consider minimum two popular data sets and draw all the statistical observations.
21. Write a python Program to apply EDA on any two popular data sets and provided your analysis and interpretations. Use matplotlib library of python along with other libraries for the analysis and interpretation.
22. Write Python program to implement Linear Regression using inbuilt python Library. Also, write your own program to implement Linear Regression without using the inbuilt function. Compare and contrast the results.
23. Write Python program to implement K-Nearest Neighbors using inbuilt python Library. Also, write your own program to implement K-Nearest Neighbors without using the inbuilt function. Compare and contrast the results.
24. Write Python program to implement K-Means using inbuilt python Library. Also, write your own program to implement K-Means without using the inbuilt function. Compare and contrast the results.
25. Write a python program to implement a Spam Filter using Linear Regression and K-NN. Use a popular dataset.
26. Write a Python Program to Scrapping the Web using suitable API. Create a usable dataset for classification and clustering purpose.
27. Write a python program to generate the features from the data set created by you for exercise 9.
28. Write a Python Program to implement Filter and Wrappers.
29. Write a Python Program to implement Decision Trees, Random Forests – The inbuilt functions should not be used for the implementation.
30. Write a python Program to implement Singular Value Decomposition and Principal Component Analysis. Use any popular data set.
31. Write a python Program to extract the friendship details of your face book account as Social network Graph and represent in various visual forms.

32. Write a python program to extend the above exercise to discover the communities in the graph, partition the graph and extracting the neighborhood properties of the graphs.
33. Write Python Program using Bokeh 2.1.1 realize the all the basic principles of data visualization.
34. Consider any popular dataset and present complex visualization principle using Bokeh 2.1.1.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 417	Principles of Big Data Management	HC	3	0	0	3

### UNIT I

Understanding Big Data – Concepts and Terminology – Big Data Characteristics – Different types of Data – Big Data Storage concepts – Clusters – File systems and distributed file systems – NoSQL – Sharding – Replication – CAP theorem – BASE - Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

### UNIT II

Big Data Processing Concepts – Parallel Data Processing – Distributed Data Processing – Hadoop – Processing workloads – Batch processing with MapReduce – Map and Reduce Tasks – MapReduce Example

### UNIT III

Hadoop ecosystem and its components– Flume - Sqoop - Pig - Spark - Hbase.

### UNIT IV

Querying big data with Hive: Introduction to Hive QL - Hive QL: data definition- data manipulation – Hive QL Queries.

### UNIT V

Data Analytics using R: Introduction to R, Creating a dataset, Getting started with graphs, Basic data management, Advanced data management.

### TEXTBOOKS/REFERENCES

1. Big Data Fundamentals: concepts, Drivers and Techniques: Person Education, 2016
2. Hadoop The Definitive Guide, IV edition, O'Reilly publications
3. Hadoop in Action, Chuck lam, Manning publications
4. Programming, Hive, O'Reily publications,
5. Apache Hive Cookbook, PACKT publications
6. R in Action, Robert I. Kabacoff, Manning publications
7. Practical Data Science with R, Nina Zumel John Mount, Manning publications.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 417 L	Principles of Big Data Management Lab	HC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

- 1.a. Hadoop Installation
- b. Hadoop Shell Commands
- 2.a. Writing a file from local file system to Hadoop Distributed file system (HDFS)
- b. Reading a file from HDFS to the local file system.
- 3.a. Implementation of Word Count program using MapReduce without combiner logic.
- b. Implementation of Word Count program using MapReduce with combiner logic.
4. Weather data analysis for analyzing hot and cold days using MapReduce.
5. Implementation of MapReduce algorithm for Matrix Multiplication.
6. Implement a MapReduce program to identify “common friends” among all pairs of users.
7. Transfer data between Hadoop and relational database servers using Sqoop.
8. Read a text file from HDFS into RDD using Spark.
9. Use HiveQL to analyze the stock exchange dataset and calculate the covariance between the stocks for each month. This will help a stock-broker in recommending the stocks to his customers.
10. Implement JOINS using HIVE
  - a. Inner Join
  - b. Left outer join
  - c. Right outer Join
  - d. Full outer join
11. Write a R program to create a student record using the Vector concept.
12. Write a R program to create medical patients status using data frame
  - i) Patient age ii) Gender iii) Symptoms iv) Patient Status
13. Write a R program to visualize student marks of various subjects using Bar-chart and Scatter plot.



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 419	Information Retrieval	HC	3	0	0	3

### UNIT I

Introduction to information retrieval, IR problem, IR system, The Web, Search interface, Visualizing search interface, Inverted index and boolean queries, Tokenization, Stemming, Stop words, Phrases, Phrases queries, Index construction, Index compression, k-gram indexes

### UNIT II

Retrieval models: Boolean, Vector space model, TF-IDF, The cosine measure, Document length normalization, Probabilistic models, Binary Independence Model, Okapi, Language modeling,

Evaluating IR system: User happiness, Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems

### UNIT III

Relevance feedback and Query expansion: Explicit relevance feedback, Explicit relevance feedback through clicks, Implicit feedback through local analysis, Implicit feedback through global analysis

Document format, Markup language, Text properties, Document processing, Document organization, Text compression, Query languages, Query properties

### UNIT IV

Text/Document classification, Clustering and LSI: Introduction to classification, Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting, Choosing right classifier

Introduction to clustering, Evaluation of clustering, k-means clustering, Hierarchical agglomerative clustering, Divisive clustering; Low-rank approximations, Latent semantic indexing

### UNIT V

Web IR: Hypertext, Web crawling, Indexes, Search engines, Ranking, Link analysis, Page Rank, HITS

### TEXTBOOKS/REFERENCES

5. Modern Information Retrieval: The Concepts and Technology Behind Search, by Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Second Edition (Pearson Education India, 2010)
6. Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze (Cambridge University Press, 2008)
7. Mining the Web, by S. Chakrabarti (Morgan-Kaufmann, 2002)
8. Natural Language Processing And Information Retrieval, by Tanveer Siddiqui and U. S. Tiwary, First Edition (Oxford University Press, 2008)

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 419 L	Information Retrieval Lab	DC	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

12. Tokenization, Stemming, Stop words removal, Inverted index construction - Token sequence, Sort, Dictionary & Postings, Implementation of Boolean queries.
13. Ranked retrieval - Implementation of TF-IDF, Vector space model, Cosine similarity.
14. Ranked retrieval - Implementation of Binary Independence Model, Okapi BM25.
15. Implementation of Text/Document classification algorithms - Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting.
16. Implementation of Text/Document clustering algorithms - k-means clustering, Hierarchical agglomerative clustering, Divisive clustering.
17. Implementation of Low-rank approximations, Latent semantic indexing.
18. Sort-based index construction.
19. Implementation of External memory indexing - BSBI, SPIMI.
20. Implementations of Dynamic indexing - Logarithmic merge.
21. Dictionary compression - Implementation of Blocking, Posting Compression - Implementation of Gamma codes.
22. Development of a Web Crawler and a small-scale web search engine - Ranking, PageRank, HITS.

## Computer Science General Elective

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 320	Web Programming	E	3	0	0	3

### UNIT I

Introduction to internet-Introduction to World Wide Web (WWW)-Web browsers-Web servers-Uniform Resource Locator (URL)- Introduction to Hyper Text Markup Language (HTML)-Standard HTML document structure-Text and Paragraph formatting- Lists in HTML-Handling of images in web pages-Hyperlinks- -Tables-Iframes in HTML-Forms in HTML-HTML Graphics-HTML Media

### UNIT II

Introduction to Cascading Style Sheets (CSS)-CSS versions-The specification of CSS-Applying style to a document-Media types-Document structure and CSS inheritance-Selectors in CSS-Major themes of CSS-Style inclusion methods-CSS strings and keywords-CSS color values-Background attachment-border in CSS-Counter in CSS-Basics of Web fonts-CSS animations- CSS tool tips-CSS Image reflections-CSS grid container.

### UNIT III

Overview of JavaScript-General syntactic characteristics of JavaScript-Primitives, Operations and Expressions-Control statements-Arrays-Functions-Constructors-Pattern matching using regular expressions-Error handling in JavaScript-Events and event handling-Document Object Model (DOM)- Dynamic documents with JavaScript-Positioning elements-moving elements-Changing colors and font-Dynamic content management-stacking elements-Locating mouse cursor and Reacting to mouse click-Dragging and dropping elements

### UNIT IV

Introduction to Hypertext Preprocessor (PHP)-General syntactic characteristics-Primitives, operations and expressions-Control statements-Arrays-Functions-Pattern matching in PHP-Form handling-Cookies and Session tracking-MySQL connectivity and various database operations with PHP

### UNIT V

Introduction to Ajax-Ajax technology-Implementing Ajax-Applications-Ajax request-Ajax response-Ajax XML-Introduction to JSON-JSON syntax-JSON data types-JSON arrays-Introduction to Web APIs- Types of Web APIs-Examples of web APIs.

### TEXTBOOKS

1. Thomas A. Powell, The Complete Reference HTML & CSS, Mc Graw Hill Publishers, Fifth Edition, 2017
2. Robert W. Sebesta, Programming the World Wide Web, Pearson Publishers, Eighth Edition, 2014.

### REFERENCES

1. Richard Blum, PHP, MySQL & JavaScript All-in-one, Wiley, 2018.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 321	Human Computer Interaction	E	3	0	0	3

### **UNIT I: FOUNDATIONS OF HCI**

The Human: I/O channels – Memory – Reasoning and problem solving - The computer: Devices – Memory – Processing and networks - Interaction: Models – frameworks – Ergonomics – styles – elements – Interactivity- Paradigms.

### **UNIT II: DESIGN AND SOFTWARE PROCESS**

Interactive design basics – Process – Scenarios – Navigation – Screen design – Iteration and prototyping - HCI in software process – Software life cycle – Usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

### **UNIT III: MODELS AND THEORIES**

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration Models-Hypertext, Multimedia and WWW.

### **UNIT IV: MOBILE HCI**

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

### **UNIT V: WEB INTERFACE DESIGN**

Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

### **TEXTBOOKS**

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Pearson Education.
2. Brian Fling, “Mobile Design and Development”, O’Reilly Media Inc. Bill Scott and Theresa Neil, “Designing Web Interfaces”, O’Reilly.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 322	Advanced Computer Architecture	E	3	0	0	3

### UNIT I: INSTRUCTION LEVEL PARALLELISM

ILP – Concepts and challenges – Hardware and software approaches – Dynamic scheduling – Speculation – Compiler techniques for exposing ILP – Branch prediction.

### UNIT II: MULTIPLE ISSUE PROCESSORS

VLIW & EPIC – Advanced compiler support – Hardware support for exposing parallelism– Hardware versus software speculation mechanisms – IA 64 and Itanium processors–Limits on ILP.

### UNIT III: MULTIPROCESSORS AND THREAD LEVEL PARALLELISM

Symmetric and distributed shared memory architectures – Performance issues – Synchronization – Models of memory consistency – Introduction to Multithreading.

### UNIT IV: MEMORY AND I/O

Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology. Types of storage devices – Buses – RAID – Reliability, availability and dependability – I/O performance measures – Designing an I/O system.

### UNIT V: MULTI-CORE ARCHITECTURES

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture – heterogeneous multi-core processors – case study: IBM Cell Processor.

### TEXTBOOKS

1. John L. Hennessey and David A. Patterson, “Computer architecture – A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 4th. edition, 2007.

### REFERENCES

1. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann /Elsevier Publishers, 1999.
2. Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 200

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 323	Natural Language Processing	E	3	0	0	3

### UNIT I: INTRODUCTION

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues – Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.

### UNIT II: WORD LEVEL AND SYNTACTIC ANALYSIS

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and Correction-Words and Word Classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

### UNIT III: SEMANTIC ANALYSIS AND DISCOURSE PROCESSING

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: Cohesion-Reference Resolution- Discourse Coherence and Structure.

### UNIT IV: NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

### UNIT V: INFORMATION RETRIEVAL AND LEXICAL RESOURCES

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame Net-Stemmers-POS Tagger- Research Corpora.

### TEXTBOOKS

1. Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications.
2. James Allen, Natural Language Understanding. The Benajmins/Cummings Publishing Company Inc. 1994. ISBN 0-8053-0334-0
3. Bird, Steven, Ewan Klein, and Edward Loper, Natural language processing with Python: Analyzing text with the natural language toolkit, O'Reilly Media, Inc, 2009.
4. Manning, Christopher, and Hinrich Schutze. Foundations of statistical natural language processing. MIT press, 1999.

### REFERENCES

1. Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog”, Springer.
2. Cover, T. M. and J. A. Thomas, Elements of Information Theory, Wiley, 1991. ISBN 0-471-06259-6.
3. Charniak, E.: Statistical Language Learning. The MIT Press. 1996. ISBN 0-262-531410.
4. Tom Mitchell, Machine Learning. McGraw Hill, 1997. ISBN 00704280

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 324	Computer Graphics	E	3	0	0	3

### UNIT I: INTRODUCTION

Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors, and workstations and input devices  
 Output primitives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms.  
 Filled area primitives: Scan line polygon fill algorithm, boundary-fill, and flood-fill algorithms.

### UNIT II: 2-D GEOMETRICAL TRANSFORMS

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.  
 2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

### UNIT III: 3-D OBJECT REPRESENTATION

Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces. Basic illumination models, polygon rendering methods.  
 3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

### UNIT IV: VISIBLE SURFACE DETECTION METHODS

Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods.

### UNIT V: COMPUTER ANIMATION

Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

### TEXTBOOKS

1. Computer Graphics with Virtual Reality System, Rajesh K. Maurya, Wiley Dreamtech.
2. Computer Graphics, D. Hearn and M.P. Baker (C Version), Pearson Education

### REFERENCES

1. Computer Graphics Principle and Practice, J.D. Foley, A.Dam, S.K. Feiner, Addison, Wesley
2. “Procedural elements for Computer Graphics”, David F Rogers, Tata Mc Graw hill, 2nd edition.
3. “Principles of Interactive Computer Graphics”, Neuman and Sproul, TMH.
4. Principles of Computer Graphics”, Shalini, Govil-Pai, Springer.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSE 325	Advanced Data Structures and Algorithms	E	3	0	0	3

### UNIT I: ADVANCED DATA STRUCTURES

Strategies for choosing the appropriate data structures-Heaps, AVL Trees (Search, Insertion, Deletion), Red-Black Trees (Search, Insertion and Deletion), Splay Trees (Search, Insertion and Deletion), B-trees, B+ Trees (Search, Insertion and Deletion), Fibonacci heaps, Data Structures for Disjoint Sets, Augmented Data Structures.

### UNIT II: GRAPHS & ALGORITHMS

Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning, Topological sort, Max flow: Ford Fulkerson algorithm, max flow – min cut, Dynamic Graphs, Few Algorithms for Dynamic Graphs, Union-Find Algorithms.

### UNIT III: GEOMETRIC ALGORITHMS

Point location, Convex hulls and Voronoi diagrams, Arrangements, graph connectivity, Network Flow and Matching: Flow Algorithms - Maximum Flow – Cuts - Maximum Bipartite Matching - Graph partitioning via multi-commodity flow, Karger's Min Cut Algorithm, String matching and document processing algorithms.

### UNIT IV: APPROXIMATION ALGORITHMS

Approximation algorithms for known NP hard problems - Analysis of Approximation Algorithms. Use of Linear programming and primal dual, Local search heuristics. Parallel algorithms: Basic techniques for sorting, searching, merging, list ranking in PRAMs and Interconnection.

### UNIT V: RANDOMIZED ALGORITHMS

Introduction, Type of Randomized Algorithms, Min- Cut, 2-SAT, Game Theoretic Techniques, Random Walks. Online Algorithms: Introduction, Online Paging Problem, Adversary Models, k-server Problem

### TEXTBOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.

### REFERENCES

1. Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, MIT Press (2005)
2. Roger Sedgewick and Kevin Wayne, Algorithms, Addison-Wesley Professional 2011.
3. Allan Borodin and Ran El-Yaniv: Online Computation and Competitive Analysis, Cambridge University Press, 2005.
4. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009.
5. RK Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and Applications", Prentice Hall Englewood Cliffs, NJ 1993.
6. Rajeev Motwani, Prabhakar Raghavan: Randomized Algorithms, Cambridge University Press, 1995.
7. Jiri Matousek and Bernd Gärtner: Understanding and Using Linear Programming, 2006.



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 326	Distributed Operating Systems	E	3	0	0	3

### UNIT I: FUNDAMENTALS

What is distributed operating system, issues in designing distributed operating system, Computer networks: Lan, WAN technologies, communication protocols, internetworking, Message passing: Issues in IPC by message passing, synchronization, buffering group communication, case study.

### UNIT II: REMOTE PROCEDURE CALLS

The RPC model, Implementing RPC, RPCs in heterogeneous environment, lightweight RPC, case study. Distributed shared memory: General architecture of DSM systems, Design and implementation issues of DSM, Consistency models, Replacement strategies, Advantages of DSM.

### UNIT III: PROCESS MANAGEMENT

Introduction, Process migration, Threads. Synchronization: Clock synchronization, event ordering, Mutual exclusion, deadlock, Election Algorithms. Resource management: Global scheduling algorithm, Task assignment, Load sharing and balancing approaches.

### UNIT IV: DISTRIBUTED FILE SYSTEM

Desirable features of a good DFS, file models, file accessing models, file sharing semantics, file caching schemes, file replication, fault tolerance, atomic transactions, Design principles, Case study: Google DFS and Hadoop DFS.

### UNIT V: NAMING

Desirable features of a good naming system, system-oriented names, object locating mechanisms, human oriented names, name caches, naming and security. Security: potential attacks, cryptography, authentication, access control, digital signatures, design principles.

### TEXTBOOKS/REFERENCES

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Advanced Concepts in Operating Systems, Mukesh Singhal and Niranjana Shrivastava, Mc Graw hill publications, 2017.
3. Andrew S. Tanenbaum, Maarten Van Steen, Distributed Systems, Principles and Paradigms, Pearson publications, 2nd edition.

Course Code	Course name	Course Category	Credits			
			L	T	P	C
CSC 420	Data and Web Mining	E	3	0	0	3

### **UNIT I: INTRODUCTION TO DATA MINING**

What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics. Data Mining Goals. Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods. Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations.

### **UNIT II: DATA PRE-PROCESSING**

Data cleaning. Data transformation, Data reduction. Data mining knowledge representation, Attribute-oriented analysis. Data mining algorithms: Association rules: Motivation and terminology, Basic idea: item sets, generating item sets and rules efficiently, Correlation analysis.

### **UNIT III: DATA MINING ALGORITHMS**

Classification, Basic learning/mining tasks, inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules. Data mining algorithms: Prediction, The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbour), Linear models.

### **UNIT IV: WEB CRAWLING**

Basic crawler algorithm, Focused crawlers, Topical crawlers, Web search: Web page pre-processing, Inverted index, HITS algorithm, Page ranking algorithm, Leadership algorithm.

### **UNIT V: SOCIAL NETWORK ANALYSIS**

Co-citation and bibliographic coupling, Community discovery. Web usage mining: Recommender systems. Mining Twitter, Mining Face book, Mining Instagram.

### **TEXTBOOKS/REFERENCES**

1. Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann publications.
2. Introduction to Data Mining, Vipin kumar, Michael Steinbach, Pang-Ning Tan, Person publications, 2016
3. Mining the Web, Soumen Chakrabarti, Elseier publications, 2002
4. Web Data Mining, Bing Liu, Second Edition, Springer publications, 2011.
5. Mining the Social Web, Mathew A. Russel, Mikhail Klassen, Third edition, Oreily publications, 2018.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 421	Complexity Theory	E	3	0	0	3

### **UNIT I: COMPUTABILITY**

A recap of automata theory and the Church-Turing Thesis Computational models: Lambda calculus, Turing machine Decidability Reducibility. The PCP problem & Mapping reducibility The Recursion Theorem Definition of Information.

### **UNIT II: TIME COMPLEXITY**

Measuring Complexity, Big-O and small-o notation, Analyzing algorithms. Complexity relationships among computational models The Class-P, Examples The Class-NP, Examples The P versus NP question NP-completeness The Cook-Levin Theorem Additional NP-completeness Problems.

### **UNIT III: SPACE COMPLEXITY**

Space complexity. Savitch's Theorem and NL. NL-completeness and log-space reductions. From P-completeness to PSPACE-completeness. The Classes L and NL NL completeness, NL equals coNL.

### **UNIT IV: INTERACTABILITY**

Hierarchy Theorems Relativization Circuit Complexity.

### **UNIT V: ADVANCED TOPICS IN COMPLEXITY THEORY**

Approximation Algorithms Probabilistic Algorithms Alternation Interactive Proof Systems.

### **TEXTBOOKS**

1. Introduction to the Theory of Computation - Michael Sipser (Primary Textbook).
2. Computational Complexity - Arora Barak (Reference).

Course Code	Course name	Course Category	Credits			
			L	T	P	C
CSC 422	Software Project Management	E	3	0	0	3

### **UNIT I: SOFTWARE MANAGEMENT & ECONOMICS**

SDLC -waterfall model Conventional Software Management Performance Evolution of Software Economics – Software economics Pragmatic software cost estimation Reducing software product size Improving software processes Improving team effectiveness Improving automation through software environment.

### **UNIT II: THE OLD AND THE NEW WAY OF PROJECT MANAGEMENT**

The principles of conventional software engineering Principles of modern software management, Transitioning to an iterative process Basics of Software estimation – Effort and Cost estimation techniques COSMIC Full function points COCOMO-I COCOMO II A Parametric Productivity Model - Staffing Pattern.

### **UNIT III: SOFTWARE MANAGEMENT PROCESS FRAMEWORK**

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts Model based software architectures: A Management perspective. Model based software architectures: Technical perspective Work Flows of the process: Software process workflows Iteration workflows Checkpoints of the process: Major milestones, Minor Milestones, Periodic status assessment.

### **UNIT IV: PROJECT ORGANIZATION AND PLANNING**

Work breakdown structures Planning guidelines. The cost and schedule estimating process The iteration planning process Pragmatic planning Line-of-Business organizations Project organizations, Evolution of organizations Process automation - Automation building Blocks The project environment.

### **UNIT V: PROJECT CONTROL AND PROCESS INSTRUMENTATION**

The Seven-Core metrics: Management indicators The Seven-Core metrics: Quality indicators Life-Cycle expectations, Pragmatic software metrics, Metrics automation Modern project profiles Next generation software economics Modern process transitions.

### **TEXBOOKS/REFERENCES**

1. Walker Royce, “Software Project Management”, 1st Edition, Pearson Education, 2006.
2. Bob huges, Mike cotterell, Rajib Mall “Software Project Management”, 6th Edition, Tata McGraw Hill, 2017.
3. SA Kelkar, Software Project Management: A Concise Study, 3rd Edition, PHI, 2013.
4. Joel Henry, Software Project Management: A Real-World Guide to Success, Pearson Education, 2009.
5. Pankaj Jalote, Software Project Management in Practice, Pearson Education, 2015.
6. <https://ocw.mit.edu/courses/engineering-systems-division/esd-36-system-project-management-fall-2012/>
7. <https://uit.stanford.edu/pmo/pm-life-cycle>

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 423	Multimedia	TE	3	0	0	3

### UNIT I: INTRODUCTION TO MULTIMEDIA

What is Multimedia, Multimedia and Hypermedia, Overview of Multimedia Software Tools Graphics and Multimedia Data Representations: Graphics Image Data Types, File Formats, and representation (image, video, and sound).

### UNIT II: COLOUR IN IMAGE AND VIDEO

Color Science, Color Models in Images, Color Models in Video, Fundamental Concepts in Video, Analog Video, Digital Video Basics of Digital Audio: Digitization of Sound, MIDI: Musical Instrument Digital Interface Quantization and Transmission of Audi.

### UNIT III: LOSSLESS COMPRESSION ALGORITHMS

Basics of Information Theory, Run-Length Coding, Variable-Length Coding, Dictionary-Based Coding, Arithmetic Coding, Lossless Image Compression Lossy Compression Algorithms: Distortion Measures, The Rate-Distortion Theory Quantization, Transform Coding, Wavelet-Based Coding, Embedded Zerotree of Wavelet Coefficients.

### UNIT IV: IMAGE COMPRESSION STANDARDS

The JPEG Standard, The JPEG2000 Standard, The JPEG-LS Standard, Bilevel Image Compression Standards.

Basic Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261, H.263.

Basic Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders.

### UNIT V: MPEG Video Coding I - MPEG-1 and 2

MPEG-1, MPEG-2 MPEG Video Coding 11- MPEG-4, 7, and Beyond: Overview of MPEG-4, Object-Based Visual Coding in MPEG-4, Synthetic Object Coding in MPEG-4, MPEG-4 Part10/H.264, MPEG-7, H.265 MPEG Audio Compression: MPEG Audio, Commercial Audio codes.

### TEXTBOOKS

1. Fundamentals of Multimedia (FM), Ze-Nian Li, Mark S. Drew, in Prentice Hall, 2004 (Springer 2nd Edition, 2014 with additional author of Dr. Jiangchuan Liu).
2. Digital Multimedia by Chapman (DM), Nigel P./ Chapman, Jenny, in John Wiley & Sons Inc, 2000 (3rd Edition, 2009).

### REFERENCES

1. Multimedia: Making It Work, 9 Edition by Vaughan, Tay in McGraw-Hill, 2014.
2. Multimedia: Computing, Communications and Applications by Ralf Steinmetz in Pearson Education, 2012.
3. Recent articles about multimedia (recommended at classes).

Course Code	Course name	Course Category	Credits			
			L	T	P	C
CSC 424	Deep Learning	TE	3	0	0	3

### UNIT I: INTRODUCTION

Overview of machine learning, linear classifiers, loss functions.

Introduction to Tensor Flow: Computational Graph, Key highlights, creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras.

### UNIT II: ACTIVATION FUNCTIONS

Sigmoid, ReLU, Hyperbolic Fns, Softmax Perceptrons: What is a Perceptron, XOR Gate.

Artificial Neural Networks: Introduction, Perceptron Training Rule, Gradient Descent Rule, vanishing gradient problem and solution.

### UNIT III: CONVOLUTIONAL NEURAL NETWORKS

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem, and solution of under fitting and over fitting.

### UNIT IV: RECURRENT NEURAL NETWORKS

Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architectures.

### UNIT V: DEEP LEARNING APPLICATIONS

Image segmentation, Self-Driving Cars, News Aggregation and Fraud News Detection Natural Language Processing, Virtual Assistants, Entertainment, Visual Recognition Fraud Detection, Healthcare.

### TEXTBOOKS

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.
3. Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.
4. Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next-generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017.

### REFERENCES

1. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G., H., and Van Loan, C. F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 425	Advanced Database Management Systems	TE	3	0	0	3

### UNIT I

Overview of the DBMS Introduction to DBMS implementation using Megatron 2000 database system Data storage using main memory and hard disks Disk failures Recovery from disk crashes Representing data elements: Record, Representing block and record address Variable length data and records Record modifications.

### UNIT II

Index structures: Indexes on sequential files Secondary indexes B-Trees Hash tables Multidimensional indexes: Hash and tree like structures for multidimensional data Bitmap indexes.

### UNIT III

Query execution: Algebra for queries Introduction to Physical-Query-Plan Operators One-Pass Algorithms for Database Operations Nested-Loop Joins Two-Pass Algorithms Based on Sorting Two-Pass Algorithms Based on Hashing Index-Based Algorithms Buffer Management Algorithms Using More Than Two Passes Parallel Algorithms for Relational Operations.

### UNIT IV

The query compiler: Parsing Algebraic Laws for Improving Query Plans from Parse Trees to Logical Query Plans Estimating the Cost of Operations Introduction to Cost-Based Plan Selection Choosing an Order for Joins Completing the Physical-Query-Plan Selection.

### UNIT V

Concurrency control: Conflict-Serializability View serializability Enforcing Serializability by Locks Locking Systems with Several Lock Modes. An Architecture for a Locking Scheduler Concurrency control by timestamps and validation Transactions that Read Uncommitted Data Coping with system failures: Undo/Redo logging Protecting media failures

### TEXTBOOKS

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.
2. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

### REFERENCES

1. K. V. Iyer, Lecture notes available as PDF file for classroom use.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 426	Fog Computing	E	3	0	0	3

### **UNIT I: FOG COMPUTING**

Limitation of Cloud computing, Differences between Cloud and Fog computing, what is Fog? Advantages of Fog computing, Business Models, Architecture of Fog computing, Opportunities and Challenges.

### **UNIT II: ADDRESSING THE CHALLENGES IN FOG RESOURCES**

Introduction, Taxonomy and Characteristics, Resource Management Challenge, Optimisation challenges, Miscellaneous Challenges, IoT and Fog: Introduction. Programming paradigms for IoT+ Fog, Research challenges and Future Research Directions.

### **UNIT III: MANAGEMENT AND ORCHESTRATION OF NETWORK**

#### **SLICES IN 5G, FOG, EDGE, AND CLOUDS**

Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Future Research Directions: Middleware for Fog and Edge Computing: Design Issues, Introduction. Need for Fog and Edge Computing Middleware: Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Clusters for Lightweight Edge Clouds, Architecture Management – Storage and Orchestration, IoT Integration, Security Management for Edge Cloud Architectures, Future Research Directions.

### **UNIT IV: DATA MANAGEMENT AND ANALYSIS IN FOG COMPUTING**

Introduction, Background, Fog Data Management, Future Research and Direction Motivating Example: Smart Building, Predictive Analysis with Fog Torch, Survey of ML Techniques for Defending IoT Devices, Machine Learning in Fog Computing, Future Research Directions.

### **UNIT V: CASE STUDIES**

Case Study 1: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection.

Case Study 2: Introduction, Data-Driven Intelligent Transportation Systems, Mission-Critical Computing Requirements of Smart Transportation Applications, Fog Computing for Smart Transportation Applications, Case Study 3: Intelligent Traffic Lights Management (ITLM) System, Testing Perspectives.

### **TEXTBOOKS**

1. Fog and Edge Computing, Rajkumar Buyya, Satish Narayana Srirama, Wiley Publications, 2019.
2. Fog computing in the Internet of Things: Springer publications, 2018.

### **REFERENCES**

1. Research papers from IEEE, ACM, Springer and Elsevier)



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 427	Parallel Algorithms	E	3	0	0	3

### UNIT I

Sequential model need of alternative model, parallel computational 8 models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.

### UNIT II

Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Cost-optimality, an example of illustrate Cost- optimal algorithms- such as summation, Min/Max on various models.

### UNIT III

Parallel Sorting Networks, Parallel Merging Algorithms on on 8 CREW/EREW/MCC, Parallel Sorting Networks CREW/EREW/MCC/, linear array.

### UNIT IV

Parallel Searching Algorithm, Kth element, Kth element in X+Y on 8 PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding.

### UNIT V

Graph Algorithms - Connected Graphs, search and traversal, 8 Combinatorial Algorithms- Permutation, Combinations, Derangements.

### TEXTBOOKS

1. M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer", Mc Graw Hill.
2. S.G. Akl, "Design and Analysis of Parallel Algorithms" 3. S.G. Akl, "Parallel Sorting Algorithm" by Academic Press.

Course Code	Course name	Course Category	CREDITS			
			L	T	P	C
CSC 428	Web Services	E	3	0	0	3

### UNIT I

Introduction to Service Oriented Architecture-Goals of service oriented architecture- Introduction to services-The SOA Architectural Stack-Service Composition and Data Flow-Data-Flow Paradigms-Composition Techniques.

### UNIT II

Introduction to web services- History of webservices-Web services: communication stack-Simple Object Access Protocol (SOAP)-Web Services Description Language (WSDL)-WSDL Main Elements-Message Communication Model in SOAP/WSDL.

### UNIT III

Web Services: REST or Restful Services-REST Design Principles-Web API Design for RESTful Services-Data Services-Implementation of Data Services-XML Transformation and Query Techniques-Consuming data via direct data access to the sources.

### UNIT IV

Web Service Composition: Overview-Service Orchestration vs. Service Choreography-Benefits of Web Service Composition-Web Service Composition Environment-Web Service Composition: Control Flows-BPEL (Business Process Execution Language)-BPMN (Business Process Model and Notation)-Web Service Composition: Data Flows-Data-Flow Paradigms.

### UNIT V

Introduction to Service Component Architecture (SCA)-The SOA Integration Problem-Overview of SCA-High-level overview of the assembly model-Application of SCA to Use Case-SCA Runtime-Benefits of SCA.

### TEXTBOOKS

1. Paik, Hye-young, et al. Web Service Implementation and Composition Techniques. Vol. 256. Springer International Publishing, 2017.
2. Martin Kalin, Java Web Services: Up and Running, O'Reilly publishers, Second edition, 2013.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 429	Advances in Data Mining	E	3	0	0	3

### UNIT I

What is Data Mining, Compiling need of Data Mining, Business Data Mining, Data Mining Tools. Data Mining Process, CRISP-DM, Business Understanding, Data Understanding, Data Preparation, Modelling, Evaluation, Deployment. SEMMA, Steps in SEMMA Process, Comparison of CRISP & SEMMA, Handling Data.

### UNIT II

Association Rules in Knowledge Discovery, Market-Basket Analysis, Mining Frequent Patterns, Associations, and Correlations, Apriori Algorithm, Pattern-Growth Approach for Mining Frequent Itemsets, Mining Frequent Itemsets using Vertical Data Format, Mining Closed and Max Patterns. Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns, Mining Compressed or Approximate Patterns.

### UNIT III

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods: Bayes' Theorem, Naïve Bayesian Classification, Rule-Based Classification. Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Bagging, Boosting and AdaBoost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data. Other Classification Methods: Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches.

### UNIT IV

Cluster Analysis, Partitioning Methods: k-Means: A Centroid-Based Technique, k-Medoids: A Representative Object-Based Technique. Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, BIRCH: Multiphase Hierarchical Clustering Using Clustering, Feature Trees, Chameleon: Multiphase Hierarchical Clustering Using Dynamic Modelling, Probabilistic Hierarchical Clustering. Density-Based Methods, Grid-Based Methods.

### UNIT V

Outliers and Outlier Analysis, Outlier Detection Methods: Supervised, Semi-Supervised, and Unsupervised Methods, Statistical Methods, Proximity-Based Methods, and Clustering-Based Methods, Mining Contextual and Collective Outliers, Outlier Detection in High-Dimensional Data. Mining Complex Data Types, Data Mining Applications, Social Impacts of Data Mining.

### TEXTBOOKS

1. Data Mining Concepts and Techniques, Third Edition, by Jiawei Han, Micheline Kamber, and Jian Pei.
2. Olson DL, Delen D. Advanced data mining techniques. Springer Science & Business Media.

### REFERENCES

1. Aggarwal CC. Data mining: the textbook. Springer. William.
2. Machine Learning, 2nd edition, by Ethem Alpaydi.

Course Code	Course name	Course Category	Credits			
			L	T	P	C
CSC 303	Computer Networks	E	3	0	0	3

### **UNIT I: OVERVIEW OF THE INTERNET (PHYSICAL LAYER AND DATA LINK LAYER)**

Basic Computer Network concepts, Protocol, Layering Scenario. Layer Architecture: OSI Model, TCP/IP model. Internet history standards and administration; Comparison of the OSI and TCP/IP reference model. Guided transmission media, wireless transmission media. Different LAN topologies: BUS, RING and STAR topology. Data Link layer design issues: Error detection techniques. Error Correction Techniques, Flow control. Sliding Window protocols. Go back N and selective Repeat protocols. Difference between single bit sliding window and n-bit sliding window protocols.

### **UNIT II: MEDIUM ACCESS CONTROL**

Static and Dynamic Channel Allocations. Shared channel Access: Pure ALOHA and slotted ALOHA. Persistent CSMA protocols: 1, P and Non-persistent CSMA protocols. CSMA with collision detection. Comparison of different CSMA protocols. Collision free protocols: Bit-map protocol, Token Ring and Binary Count down protocols. Limited Contention protocols: Adaptive tree walk protocol. Shared medium for wireless networks: CSMA/CA or MACA. Interconnecting LANs: HUBS, Repeaters and Switches and bridges. Spanning tree algorithm for bridges.

### **UNIT III: NETWORK LAYER**

Overview: Connection oriented and connection less services. Comparison of packet switched, and circuit switched networks. Routing: proactive routing and reactive routing protocols, static and dynamic routing protocols. Dijkstra Algorithm, Distance vector routing and Link state routing protocols. Routing in wireless networks: AODV and DSR routing protocols. Overview of IP header and IP addressing. Classful IP addressing: Class A, B, C, D and E. Limitations of classful Addressing, Introduction to Subnet. Overview of Congestion: Warning Bit, Choke packets, Load Shedding, RED (Random Early Detection).

### **UNIT IV: INTERNETWORKING AND TRANSPORT LAYER**

IP Encapsulation and Tunneling. IP packet fragmentation, ICMP, ARP. ICMP, DHCP, Introduction to Transport layer. Different end-to-end transport layer protocols: TCP and UDP. Brief explanation of TCP protocol. Packet formats for TCP and UDP protocol.

### **UNIT V: TRANSPORT AND APPLICATION PROTOCOLS**

TCP Connection Management Modeling. TCP Sliding Window. TCP congestion control. Introduction to application layer paradigms. Client Server model. Introduction and overview of HTTP protocol. Overview of FTP protocol. Operation of Electronic Mail. Introduction to peer-to-peer communication models. Introduction and overview of TELNET. Importance of Security in computer Networks.

### **TEXTBOOKS**

1. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
2. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.

## **REFERENCES**

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.
2. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 303 L	Computer Networks Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1.	Explain about wire shark and display how to send packets or packets from one layer another.
2.	Write a Java program to implement Error Detection Technique using CRC Algorithm.
3.	Write a Java program to implement Error Correction Technique using Hamming code.
4.	Write a Java program to implement TCP Client Server programming.
5.	Write a Java program to implement UDP Client Server Programming.
6.	Write a Java program to implement 1-bit Stop and Wait Protocol at data link layer.
7.	Write a Java program to implement N-bit Sliding Window Protocol at data link layer.
8.	Write a Java program to implement Dijkstra Shortest path routing protocol.
9.	Write a Java program to implement Distance Vector Routing.
10.	Write a Java program to implement echo command in client server socket programming
11.	Write a Java program to implement Trace-route command.
12.	Write a Java program to implement Ping command.
13.	Write a Java program to display the class of IP address, network mask and generate t subnet IP address based on the subnet bits entered from the keyboard.
14.	Write a Java program to implement sliding window protocol at the transport layer.
15.	Write a Java program to transfer file using TCP?

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 305	Software Engineering	E	3	0	0	3

### **UNIT I: SOFTWARE PROCESS AND AGILE DEVELOPMENT**

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile Process-Extreme programming-XP Process.

### **UNIT II: REQUIREMENTS ANALYSIS AND SPECIFICATION**

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirement’s elicitation and analysis, requirements validation, requirements Management-Classical analysis: Structured system Analysis, Petri Nets-Data Dictionary.

### **UNIT III: SOFTWARE DESIGN**

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

### **UNIT IV: TESTING AND MAINTENANCE**

Software testing Fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging –Software Implementation Techniques: Coding Practices-Refactoring-Maintenance and Reengineering-BPR Model-Reengineering Process Model-Reverse and Forward Engineering.

### **UNIT V: PROJECT MANAGEMENT**

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS.

### **TEXTBOOKS**

1. Roger S. Pressman, Software Engineering – A Practitioner’s Approach, Ninth Edition, Mc Graw-Hill International Edition, 2020.
2. Ian Sommerville, Software Engineering, Tenth Edition, Pearson Education Asia, 2015.

### **REFERENCES**

1. Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, PHI Learning Private Limited, 2018.
2. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, 2010.

3. Kelkar S.A., Software Engineering, Third Edition, Prentice Hall of India Pvt Ltd, 2013.
4. Stephen R. Schach, Object-oriented Software Engineering, Tata McGraw-Hill Publishing Company Limited, 2008.

#### **WEB RESOURCES**

1. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-355j-software-engineering-concepts-fall-2005/lecture-notes/>
2. <https://web.stanford.edu/class/archive/cs/cs295/cs295.1086/>



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 305 L	Software Engineering Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

Week 1: Software Requirement Specification

1. Develop requirements specification for a given problem

Week 2: Data Flow Diagram (DFD)

2. Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem

Week 3: DFD and Structured chart

3. To perform the function-oriented diagram: DFD and Structured chart

Week 4: Use case Diagram

4. To perform the user's view analysis: Use case diagram

Week 5: Class Diagram

5. To draw the structural view diagram: Class diagram

Week 6: Object Diagram

6. To draw the structural view diagram: Class diagram, object diagram

Week 7: Package Diagram

7. To draw the structural view diagram: Package Diagram

Week 8: Sequence Diagram

8. To draw the structural view diagram: Sequence Diagram

Week 9: Interaction Overview Diagram

9. To draw the structural view diagram: Interaction Overview Diagram

Week 10: State-chart Diagram

10. To draw the behavioral view diagram: State-chart diagram

Week 11: Activity diagram

11. To draw the behavioral view diagram: Activity diagram

Week 12: Component diagram

12. To draw the implementation view diagram: Component diagram

Week 13: Deployment diagram

13. To draw the environmental view diagram: Deployment diagram

Week 14: Unit Testing

14. To perform various testing using the testing tool -unit testing

Week 15: Integration Testing

15. To perform various testing using the testing tool -integration testing

## TEXTBOOKS

1. Roger S. Pressman, Software Engineering – A Practitioner’s Approach, Ninth Edition, McGraw-Hill International Edition, 2020.
2. Ian Sommerville, Software Engineering, Tenth Edition, Pearson Education Asia, 2015.
3. Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, PHI Learning Private Limited, 2018.
4. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, 2010.
5. Kelkar S.A., Software Engineering, Third Edition, Prentice Hall of India Pvt Ltd, 2013.
6. Stephen R. Schach, Object-oriented Software Engineering, Tata McGraw-Hill Publishing Company Limited, 2008
7. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-355j-software-engineering-concepts-fall-2005/lecture-notes/>
8. <https://web.stanford.edu/class/archive/cs/cs295/cs295.1086/>
9. Grady Booch, James Rumbaugh, Ivar Jacobson, Unified Modeling Language User Guide, The, 2nd Edition, 2016.
10. Dr.K.V.N.S. Prasad, “Software Testing Tools”, 1st Edition, Dream tech, 2011.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 337	Cryptography	E	3	0	0	3

#### **UNIT I**

History and overview of cryptography, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, And Steganography.

#### **UNIT II**

Stream Ciphers and Block Ciphers, Attacks on block ciphers, Block Cipher Principles, The Data Encryption Standard (DES), Block Cipher Design Principles, Group, Rings, Field, Polynomial Arithmetic, The Euclidean Algorithm, Finite Fields of the Form  $GF(2^n)$ .

#### **UNIT III**

Advanced Encryption Standard (AES), Stream Ciphers, RC4, The Chinese Remainder Theorem, Public Key Cryptography and RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.

#### **UNIT IV**

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA), SHA-3.

#### **UNIT V**

Introduction to Block Chain, Bitcoin basics, Smart Contracts, Blockchain development platforms and APIs, Blockchain Ecosystems, Ethereum, Distributed Consensus, Blockchain Applications.

#### **TEXTBOOKS/REFERENCES**

1. Stallings, William. Cryptography and network security, Principle and Practice. Pearson Education India, 2017.
2. R. Stinson Cryptography, Theory and Practice (Fourth Edition Edition).
3. Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone.
4. Melanie Swan, Blockchain, Blueprint for a new Economy, OReilly.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 337 L	Cryptography Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

- Write a program take text file as an input and print word, character count and ascii value of each characters as output. (Hint: Use open(), read() and split()).
- Write a encryption program: Input: computerscienceengineeringssrmuniversity Output: gsqtyxivwgmirgiirkmriivmrkwvqyrmzivwmx Hint: key =4 (play with ascii value).
- Raju send an encrypted message (cipher text) “PHHW PH DIWHU WKH WRJD SDUWB” to Rani. Can you build decryption process and find out what is the message (plain text) send to Rani? Hint: try all keys.
- Raju send encrypted message “ZICVTWQNGKZEIIGASXSTSLVWLA” to Rani. Can you build decryption process and find out what is the message send to Rani. Hint: try all keys for each character.
- Kohli have plain text “wewishtoreplaceplayer”. Can you build encryption process and find out what is the cipher text he needs send to BCCI. Help him out by using monoalphabetic cipher. Hint: use any one-to-one mapping between alphabets.

One to one

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	N	D	R	E	W	I	C	K	S	O	H	T	B	F	G	J	L	M	P	Q	U	V	X	Y	Z

mapping

- Kohli sent encrypted message (Cipher text) “SEEMSEAOMEDSAMHL” to Anushka. Can you build decryption process and find out what is the message (plain text) send to Anushka. Hint: use above one to one mapping between alphabets.
- Raju want to build encrypted and decryption algorithms of Playfair Cipher. Help him to build a key matrix using the key “srmapuniversity”
- By using key matrix Raju want to send message “we are discovered save yourself” to Rani. Can you build encryption process and find out what is the cipher text message send to Rani by using palyfaircipher.

<b>s</b>	<b>r</b>	<b>m</b>	<b>a</b>	<b>p</b>
<b>u</b>	<b>n</b>	<b>i/j</b>	<b>v</b>	<b>e</b>
<b>t</b>	<b>y</b>	<b>b</b>	<b>c</b>	<b>d</b>
<b>f</b>	<b>g</b>	<b>h</b>	<b>k</b>	<b>l</b>
<b>o</b>	<b>q</b>	<b>w</b>	<b>x</b>	<b>z</b>

- By using key “CBDE” Raju would like send message (plain text)“HELLO WORLD” to Rani. Can you build encryption process and find out what is the encrypted message (cipher text) to Raju by using Hill Cipher.Also Can you build decryption process and find out what is the decrypted message (plain text) of cipher text "SLHZYATGZT" by using Hill Cipher.
- Implementation of Encryption and Decryption of Vigenère Cipher  
keyword *deceptive*  
key:           deceptivedeceptivedeceptive  
plaintext:     wearediscoveredsaveyourself  
ciphertext:    ZICVTWQNGRZGVTWAVZHCQYGLMGJ

11. Implement the Encryption and Decryption of Row Transposition.

Key: 4 3 1 2 5 6 7

Plaintext: a t t a c k p

o s t p o n e

d u n t i l t

w o a m x y z

Ciphertext: TTNAAPTMTSUOAODWCOIXKNLYPETZ

12. Implement the Euclidean Algorithm for integers and polynomials.

13. Implement AES Key Expansion.

14. Implementation of AES encryption and decryption

15. Implementation of Simplified DES Encryption and decryption

16. Implementation of RC4

17. Implementation of RSA algorithm

18. Implementation of Diffie-Helman key exchanges

19. Implementation of elliptic-curve cryptography

20. Implementation of Hash functions

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 315	Network Security	E	3	0	0	3

### UNIT I: NEED FOR SECURITY

**Need for Security:** Security Attack, Security Services, Information Security, Methods of Protection.

**Network Concepts:** Basic Concepts of Computer Networks

**Threats in Networks:** Threat Precursors, Threats in Transit, Protocol Flaws, Message Confidentiality Threats, Nonexistent and Well-Known Authentication, Spoofing, DoS, DDoS

**Network Security Controls:** Segmentation, Redundancy, Single Points of Failure, Encryption, Link and End-to-End Encryption, Virtual Private Networks, VPN & Firewall, PKI and Certificates, SSL and SSH Encryption, Kerberos, Onion Routing

### UNIT II: AUTHENTICATION

**Message Authentication Codes (MAC):** Message Authentication Requirements, Message Authentication Functions, Security of MACs, MACs Based on Hash Functions: HMAC.

**Digital Signature:** Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

**Overview of Authentication Systems:** Password-Based Authentication, Address-Based Authentication, Cryptographic Authentication Protocols, Trusted Intermediaries, KDCs, Certification Authorities (CAs), Session Key Establishment.

**Security Handshake Pitfalls:** Login, Mutual Authentication, Integrity/Encryption for Data, Two-Way Public Key Based Authentication, One-Way Public Key Based Authentication, Mediated Authentication (with KDC), Needham-Schroeder, Expanded Needham-Schroeder, Otway-Rees, Nonce Types.

**Strong Password Protocols:** Lamport's Hash, Strong Password Protocols, Strong Password Credentials Download Protocols.

### UNIT III: IPSEC

**IPSec:** Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Comparison of Encodings.

**Internet Key Exchange (IKE):** Photuris, SKIP, History of IKE, IKE Phases, Phase 1 IKE - Aggressive Mode and Main Mode, Phase 2/Quick Mode, Traffic Selectors, The IKE Phase 1 Protocols, Phase-2 IKE: Setting up IPsec SAs, ISAKMP/IKE Encoding - Fixed Header, Payload Portion of ISAKMP Messages, SA Payload, SA Payload Fields.

### UNIT IV: WEB SECURITY

**Web Security Requirements:** Web Security threats, Web traffic Security Approaches.

**SSL/TLS:** Secure Socket Layer (SSL), Transport Layer Security (TLS), TLS Architecture, TLS record protocol, change cipher spec protocol, Alert Protocol, Handshake Protocol, Https, SSH.

**Secure Electronic Transaction (SET):** SET functionalities, Dual Signature, Roles & Operations, Purchase Request Generation, Purchase Request Validation, Payment Authorization and Payment Capture.

**SNMP:** Basic concepts of SNMP, SNMP basic components and their functionalities, Basic commands of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.

## **UNIT V: FIREWALL & EMAIL SECURITY**

**Firewalls:** Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations.

**Electronic Mail Security:** Pretty Good Privacy, S/MIME, DNSSEC, Domain Keys Identified Mail.

### **TEXTBOOKS**

1. Perlman, Radia, Charlie Kaufman, and Mike Speciner. Network security: private communication in a public world. Pearson Education India, 2016.
2. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition.

### **REFERENCES**

1. Network Security and Cryptography, Bernard Menezes, CENGAGE Learning.
2. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
3. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 315 L	Network Security Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Packet assembler/analyzer: Wireshark.
2. Packet assembler/analyzer: hPing3.
3. Encrypted communication over socket using AES.
4. Message Authentication Code: MAC.
5. MAC Based on Hash Function: HMAC.
6. Session Key establishment using RSA.
7. Handcraft a TCP handshake.
8. Diffie-Hellman Algorithm.
9. DH Key exchange.
10. Network Mapper: Nmap Basics.
11. Penetration Testing: Metasploit Basics.
12. Key tool & OpenSSL.
13. One Way SSL to a Web App.
14. SNMP: net SNMP – MIB.
15. Firewall with UFW.



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 316	Distributed Systems	E	3	0	0	3

### UNIT I: INTRODUCTION AND ARCHITECTURES

Introduction: Definition of a distributed system, Goals, types of distributed systems Architectures: Architecture styles, System architectures, Architectures versus middleware, Self-management in distributed systems.

### UNIT II: PROCESSES AND COMMUNICATION

Processes: Threads, Virtualization, Clients, Servers, Code Migration. Communication: Fundamentals, Remote Procedure Call, Message and Stream oriented communication, Multicast communication.

### UNIT III: NAMING AND SYNCHRONIZATION

Naming: Flat naming, Structured naming, Attribute-based naming. Synchronization: Clock synchronization, Logical clocks, Mutual exclusion, Election algorithms.

### UNIT IV: CONSISTENCY AND REPLICATION

Replication as Scaling Technique, Data-Centric Consistency Models: Continuous Consistency, Data-Centric Consistency Models: Consistent Ordering of Operations, Data-Centric Consistency Models: Consistent Ordering Of Operations, Replica-Server Placement, Replica-Server Placement, Content Distribution, Continuous Consistency, Primary-Based Protocols, Replicated-Write Protocols, Cache-Coherence Protocols.

### UNIT V: FAULT TOLERANCE AND SECURITTY

Fault tolerance: Introduction, Process Resilience, Reliable client server communication, Reliable group communication, Distributed Commit, Recovery. Security: Secure channels, Access control, Security Management.

### TEXTBOOKS/REFERENCES

1. Andrew S. Tanenbaul, Maarten Van Steen, Distributed Systems, Principles and Paradigms, Pearson publications, 2<sup>nd</sup> edition.
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
4. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 316 L	Distributed Systems Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Experiment-1: Implement concurrent echo client-server application.
2. Experiment -2: Implement concurrent day-time client-server application.
3. Experiment-3: Configure following options on server socket and tests them: SO\_KEEPALIVE, SO\_LINGER, SO\_SNDBUF, SO\_RCVBUF, TCP\_NODELAY
4. Experiment -4: Simulate the functioning of Lamport's Logical Clock in C.
5. Experiment -5: Simulate the Distributed Mutual Exclusion in C.
6. Experiment -6: Implement Java RMI mechanism for accessing methods of remote systems.
7. Experiment -7: Simulate Balanced Sliding Window Protocol in C.
8. Experiment -8: Incrementing a counter in shared memory.
9. Experiment -9: Create CORBA based server-client application.
10. Experiment -10: Design XML Schema and XML instance document.
11. Experiment -11: SOAP based: Implement Arithmetic Service that implements add and subtract operations /Java based: Implement Trigonometric Service that implements sin, and cos operations.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 318	Cloud Computing	E	3	0	0	3

### UNIT I

Distributed system models: Scalable computing over the internet, Technologies for network-based systems, System models and software environments for distributed and cloud computing, performance, security and Energy Efficiency Computer clusters for Scalable parallel computing: Clustering for Massive parallelism, Computer clusters and MPP Architectures, Design principles of computer clusters, Cluster job and resource management.

### UNIT II

Virtual Machines and Virtualization of Data Centres: Implementation levels of virtualization, Virtualization structures, tools and mechanisms, Virtualization of CPU, Memory and I/O devices, Virtual clusters and resource management, Virtualization for Data center automation.

### UNIT III: NAMING AND SYNCHRONIZATION

Cloud computing and service models, Data center design and interconnection networks, Architectural design of Compute and storage clouds, Public cloud platforms, Inter-cloud resource management, Cloud security and trust management.

### UNIT IV: CONSISTENCY AND REPLICATION

Services and service-oriented architecture, Message oriented middleware, Portals and science gateways, Discovery, Registries, Meta data and databases. Workflow in service-oriented architectures,

### UNIT V: FAULT TOLERANCE AND SECURITY

Features of cloud and Grid platforms, Parallel and distributed programming paradigms, Programming support for Google application engine, Programming on Amazon AWS and Microsoft Azure, Emerging cloud software environments.

### TEXTBOOKS

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
2. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley.

### REFERENCES

1. Distributed and Cloud Computing. Kal Hwang. Geoffeiy C. Fox. Jack J. Dongarra. Elsevier. 2012.
2. Cloud computing, Black book. Deven Shah, Kailash Jayaswal, Donald J. Houde, Jagannath Kallakurchi.
3. Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl) 1st Edition, Thomas Erl (Author), Ricardo Puttini , Zaigham Mahmood.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSE 318 L	Cloud Computing Lab	E	0	0	2	1

#### **LIST OF PRACTICAL EXPERIMENTS**

1. Basics of Virtualization: VMM, Example of VMM (virtualbox), Creation of a VM, Networking and communication between VMs.
2. Introduction to CloudSim: Installation and Execution, Cloud Datacenter, Network Topology.
3. Simulation of a Cloud Framework: Creating a DC, Creation of Tasks, Creation of VMs, Defining task and VM characteristics, execution of tasks on VMs.
4. Scalable and dynamic Cloud systems: Creation of scalable cloud entities, creation of dynamic entities.
5. Resource Allocation in Cloud Datacenter: Experimenting and understanding various resource allocation policies, Changing the resource allocation policy, effects of resource allocation policies.
6. Power Management in Cloud Datacenters: Creation of a power datacenter, understanding various power saving techniques.
7. Understanding Commercial Cloud Frameworks: Amazon AWS, Elastic Cloud, Amazon Load Balancer, creating VMs, Allocation of Resources.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 317	Embedded Systems	E	3	0	0	3

### UNIT I: INTRODUCTION TO EMBEDDED SYSTEMS

Introduction, characteristics of embedding computing applications, concept of real time systems, designing of hardware and software components, challenges in embedded system design, Safety and Security of an Embedded System, Performance of Embedded Systems.

### UNIT II: INSTRUCTION SET OF PROCESSORS

Overview of various features of Computer Architecture, Instruction-set of ARM family of processors, Instruction-set of PIC family of Processors, Digital Signal Processor, Instruction set of TI C55X DSP. Programmed I/O, Interrupts (supported by Arm, PIC , TI C55x family of processors), Supervisor mode, exceptions, traps, co-processors, memory system, CPU power management.

### UNIT III: INPUT-OUTPUT SUB-SYSTEM

I/O sub-system: busy-wait I/O, DMA, interrupt driven I/O, co-processors and hardware accelerators, Timers and counters, watchdog timers, interrupt controllers, DMA controllers, A/D and D/A converters. Component interfacing, interfacing protocols, Firewire, USB, IrDA. Sensors and Actuators.

### UNIT IV: PROGRAM DESIGN AND ANALYSIS

State machine, circular buffer, stream-oriented programming, data flow graph (DFG), control flow graph (CFG), Compilation techniques, performance analysis, performance optimization, power analysis and power optimization, program validation and testing.

### UNIT V: OPERATING SYSTEMS

Basic features of an operating system, Kernel features, polled loops system, co-routines, interrupt-driven system, multi-rate system, processes and threads, context switching, scheduling, task assignment, inter-process communication, Real-time Memory Management: Process stack management, dynamic allocation, synchronous and asynchronous I/O, Interrupt handling, device drivers, example real-time OS: VxWorks, RT-Linux, PSOS.

### TEXTBOOKS

1. Wolf, Marilyn. Computers as components: principles of embedded computing system design. Elsevier, 2017 (4<sup>th</sup> Ed.).
2. Marwedel, Peter. Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things. Springer, 2017. (3<sup>rd</sup> Ed.)

### REFERENCES

1. Manish Patel, The 8051 Microcontroller based Embedded System, McGraw Hill 2014 (1<sup>st</sup> edn.).
2. Mall, Rajib. Real-time systems: theory and practice. Pearson Education India, 2009. (1<sup>st</sup> edn)

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 317 L	Embedded Systems Lab	E	0	0	2	1

### LIST OF PRACTICAL EXPERIMENTS

1. Introduction to Software tool (preferably kiel MDK Microcontroller Development Kit) used in the lab. (2 hrs)
2. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller. (1 hour)
3. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller. (1 hour)
4. Implementation of Serial Communication by using 8051 serial ports. (1 hour)
5. Interfacing of individual LEDs and program them to blink after a fixed time interval. (1 hour)
6. Interfacing of 16\*2 LCD panel with 8051 Microcontroller. (1 hour)
7. Interfacing of stepper motor with 8051 Microcontroller. (1 Hour)
8. A minor project is given to student to implement (7 hrs)

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 424	Deep Learning	E	3	0	0	3

### UNIT I: INTRODUCTION

Overview of machine learning, linear classifiers, loss functions.

**Introduction to Tensor Flow:** Computational Graph, Key highlights, creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras.

### UNIT II: Activation Functions

Sigmoid, ReLU, Hyperbolic Fns, Softmax Perceptrons: What is a Perceptron, XOR Gate.

Artificial Neural Networks: Introduction, Perceptron Training Rule, Gradient Descent Rule, vanishing gradient problem and solution.

### UNIT-III: Convolutional Neural Networks

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem, and solution of under fitting and over fitting.

### UNIT IV: Recurrent Neural Networks

Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architectures.

### UNIT V: Deep Learning applications

Image segmentation, Self-Driving Cars, News Aggregation and Fraud News Detection Natural Language Processing, Virtual Assistants, Entertainment, Visual Recognition Fraud Detection, Healthcare.

### TEXTBOOKS

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.
3. Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.
4. Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next-generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017.

### REFERENCES

1. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G., H., and Van Loan, C. F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 420	Data and Web Mining	E	3	0	0	3

### UNIT I: INTRODUCTION TO DATA MINING

What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics. Data Mining Goals. Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods. Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations .

### UNIT II: DATA PRE-PROCESSING

Data cleaning. Data transformation, Data reduction. Data mining knowledge representation, Attribute-oriented analysis. Data mining algorithms: Association rules: Motivation and terminology, Basic idea: item sets, generating item sets and rules efficiently, Correlation analysis.

### UNIT III: DATA MINING ALGORITHMS

Classification, Basic learning/mining tasks, inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules. Data mining algorithms: Prediction, The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbour), Linear models.

### UNIT IV: WEB CRAWLING

Basic crawler algorithm, Focused crawlers, Topical crawlers, Web search: Web page pre-processing, Inverted index, HITS algorithm, Page ranking algorithm, Leadership algorithm.

### UNIT V: SOCIAL NETWORK ANALYSIS

Co-citation and bibliographic coupling, Community discovery. Web usage mining: Recommender systems. Mining Twitter, Mining Face book, Mining Instagram.

### TEXTBOOKS/REFERENCES

1. Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann publications.
2. Introduction to Data Mining, Vipin kumar, Michael Steinbach, Pang-Ning Tan, Person publications,2016
3. Mining the Web, Soumen Chakrabarti, Elseier publications, 2002
4. Web Data Mining, Bing Liu, Second Edition, Springer publications, 2011.
5. Mining the Social Web, Mathew A. Russel, Mikhail Klassen, Third edition, Oreily publications, 2018.



Course Code	Course Name	Course Category	Credits			
			L	T	P	C
CSC 323	Natural Language Processing	E	4	0	0	4

### UNIT I: Introduction

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues – Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.

### UNIT II: Word Level and Syntactic Analysis

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

### UNIT III: Semantic Analysis and Discourse Processing

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

### UNIT IV: Natural Language Generation and Machine Translation

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

### UNIT V: Information Retrieval and Lexical Resources

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame Net-Stemmers-POS Tagger- Research Corpora.

### Text Books:

1. Daniel Jurafsky , James H. Martin , “Speech & language processing”, Pearson publications.
2. Allen, James. Natural language understanding. Pearson, 1995.

### References:

1. Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog” , Springer.

# Minors

Department of Biological Sciences								
Semest	Course C	Course Name	Course Cate					Total
III	BIO315	Cell Biology	M					16
IV	BIO410	Introductory Biophysics	M					
V	BIO518	Genetic Engineering	M					
VI	BIO614	Bioinformatics	M					

Department of Physics								
Semest	Course C	Course Name	Course Cate					Total
III	PHY 202	Quantum Mechanics	M					16
IV	PHY 311	Statistical Physics	M					
V	PHY 301	Solid-state Physics	M					
VI	PHY 307	Special Theory of Relativity	M					
	PHY 221	Introduction to Quantum Computat	M					
	PHY 231	Introduction to Soft Matter Physic	M					
	PHY 311	Introduction to Astrophysics	M					
	PHY 306	Electronic Materials & Device Phys	M					

Department of Chemistry								
Semest	Course C	Course Name	Course Cate					Total
II	CHE111	Physical Chemistry-1	M					16
III	CHE122	Organic Chemistry 1	M					
IV	CHE111	Inorganic Chemistry I	M					
V	CHE321	Molecular modeling and drug desi	M					

Department of Mathematics								
Semest	Course C	Course Name	Course Cate					Total
III	MAT 161	An Introduction to Mathematical lo	M					16
IV	MAT 162	Linear Algebra and its Applicatio	M					
V	MAT 163	Discrete Mathematics	M					
VI	MAT 164	An Introduction to probability and Sta	M					

Department of Computer Science ( AI & ML )								
Semest	Course C	Course Name	Course Cate					Total
	CSE 413	Artificial Intelligence	M					16
	CSE 413 L	Artificial Intelligence Lab	M					
	CSE 336	Machine Learning	M					
	CSE 336 L	Machine Learning Lab	M					
	CSE 314	Digital Image Processing	M					

	CSE 314 L	Digital Image Processing Lab	M					
	CSE 412	Principles of Soft Computing	M					
	CSE 412 L	Principles of Soft Computing Lab	M					

B.Sc Computer Science								
Semest	Course C	Course Name	Course Cate					Total
	CSE 201	Design and Analysis of Algorithms	M					16
	CSE 201L	Design and Analysis of Algorithms Lab	M					
	CSE 202	Java Programming	M					
	CSE 202L	Java Programming Lab	M					
	CSE 304	Database Management Systems	M					
	CSE 304L	Database Management Systems Lab	M					
	CSE 305	Software Engineering	M					
	CSE 305L	Software Engineering Lab	M					

Department of EVS								
Semest	Course C	Course Name	Course Cate					Total
Mandate	ENV M-1	Environmental Sustainability (M)	M					16
Mandate	ENV M-1	Natural Resources (M)	M					
Optiona	ENV M-1	Land cover and Legislation (O1)	M					
	ENV M-1	Environmental Pollution (O1)	M					
Optiona	ENV M-1	Resource Recovery (O2)	M					
	ENV M-1	Urban Forestry (O2)	M					