



## Scheme and Syllabus for B.Tech. in Computer Science & Engineering (applicable for academic session 2023-24)

Semester-I						
S.No.	Code	Course Name	L	T	P	C
1.	MAL101	Engineering Mathematics-I	3	1	0	4
2.	SAP102	Health, Sports & Safety	2	0	0	2
3.	BEL103	Fundamental of Electrical and Electronics Engineering	3	0	0	3
4.	BSL104	Applied Science	3	0	0	3
5.	UCS001	Computer Programming	3	0	3	3
6.	ECL106	Analog Electronics	3	0	0	3
7.	HUL107	Environmental Studies	2	0	0	2
8.	BEL108	Fundamental of Electrical and Electronics Engineering Lab	0	0	2	1
9.	BSL109	Applied Science Lab	0	0	2	1
10.	UCS051	Computer Programming Lab	0	0	2	1
11.	ECL111	Analog Electronics Lab	0	0	2	1
Total Credits					24	

Semester-II						
S.No.	Code	Course Name	L	T	P	C
1.	MAL201	Engineering Mathematics-II	3	1	0	4
2.	ECL202	Digital Electronics	3	0	0	3
3.	UCS002	Data Structure	3	0	0	3
4.	HUL204	Communication Skills	2	0	0	2
5.	UCS003	Web Designing	3	0	0	3
6.	UCS004	Object Oriented Programming using C++	3	0	0	3
7.	ECL207	Digital Electronics Lab	0	0	2	1
8.	UCS052	Data Structure Lab	0	0	2	1
9.	HUL209	Communication Skills Lab	0	0	2	1
10.	UCS053	Web Designing Lab	0	0	2	1
11.	UCS054	Object Oriented Programming using C++ Lab	0	0	2	1
Total Credits					23	



# INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SONEPAT

## भारतीय सूचना प्रौद्योगिकी संस्थान सोनीपत

(An Autonomous Institute of National Importance under Act of Parliament)

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Semester-III						
S. No	Code	Course Name	L	T	P	C
1.	UCS005	Discrete Mathematics	3	1	0	4
2.	UCS006	Design and Analysis of Algorithms	3	0	0	3
3.	UCS007	Computer Organization	3	0	0	3
4.	UCS008	Object Oriented Programming using Java	3	0	0	3
5.	UCS009	Automata and Formal Languages	3	1	0	4
6.	UCS010	Database Management Systems	3	0	0	3
7.	UCS056	Design and Analysis of Algorithms Lab	0	0	2	1
8.	UCS057	Computer Organization Lab	0	0	2	1
9.	UCS058	Object Oriented Programming using Java lab	0	0	2	1
10.	UCS060	Database Management Systems Lab	0	0	2	1
Total Credits						24

Semester-IV						
S. No	Code	Course Name	L	T	P	C
1.	UCS011	Software Engineering	3	0	0	3
2.	UCS012	Probability and Statistical & Numerical Methods	3	1	0	4
3.	UCS013	Operating System	3	0	0	3
4.	UCS014	Computer Networks	3	0	0	3
5.	UCS015	Microprocessor and Interfacing	3	0	0	3
6.	UCS016	Compiler Design	3	0	0	3
7.	UCS061	Software Engineering Lab	0	0	2	1
8.	UCS063	Operating System Lab	0	0	2	1
9.	UCS064	Computer Networks Lab	0	0	2	1
10.	UCS065	Microprocessor and Interfacing Lab	0	0	2	1
11.	UCS066	Compiler Design Lab	0	0	2	1
Total Credits						24

Semester-V						
S. No	Code	Course Name	L	T	P	C
1	UCS017	Enterprise Java	3	0	0	3
2	UCS018	Information Security	3	0	0	3
3	UCS019	Mathematics for Data Science	3	1	0	4
4	XXXXX	Elective-V-I	3	0	0	3
5	UCS020	Professional Communication and Soft Skills	3	0	0	3
6	UCS021	Machine Learning	3	0	0	3
7	UCS067	Enterprise Java Lab	0	0	2	1
8	UCS068	Information Security Lab	0	0	2	1
9	UCS071	Machine Learning Lab	0	0	2	1
10	UCS201	Summer Internship	0	0	0	0
11	XXXXX	Elective-V-II Lab	0	0	2	1
Total credits						23



Semester-VI						
S. No	Code	Course Name	L	T	P	C
1	UCS022	Artificial Intelligence	3	0	0	3
2	XXXXX	Management Elective -VI-I	3	0	0	3
3	XXXXX	Elective II	3	0	0	3
4	XXXXX	Elective III	3	0	0	3
5	UCS023	Distributed Database and Cloud Computing	3	0	0	3
6	UCS072	Artificial Intelligence Lab	0	0	2	1
7	XXXXX	Elective II Lab	0	0	2	1
8	XXXXX	Elective III Lab	0	0	2	1
9	UCS202	Minor Project-I	0	0	4	2
<b>Total credits</b>					<b>20</b>	

Semester-VII						
S.No	Code	Course Name	L	T	P	C
1.	UCS203/UCS204	Industry Internship Project / In House Internship	0	0	42	21
Total Credits					21	
OR						
(Main Course Subjects)						
1	UCS205	Major Project	0	0	10	5
2.	XXXXXX	Elective I	3	0	0	3
3.	XXXXXX	Elective II	3	0	0	3
4.	XXXXXX	Elective III	3	0	0	3
6.	UCS024	Data Analytics &Visualization	3	0	2	3
7.	XXXXXX	Elective IV	3	0	0	3
8.	UCS074	Data Analytics &Visualization Lab	0	0	2	1
Total Credits					21	

Semester-VIII						
(Main Course Subjects)						
S. No	Code	Course Name	L	T	P	C
1	UCS206	Major Project	0	0	10	5
2.	XXXXXX	Elective I	3	0	0	3
3.	XXXXXX	Elective II	3	0	0	4
4.	XXXXXX	Elective III	3	0	0	3
6.	UCS024	Data Analytics &Visualization	3	0	0	3
7.	XXXXXX	Elective IV	3	0	0	3
8.	UCS074	Data Analytics &Visualization Lab	0	0	2	1
Total Credits					21	
OR						
1.	UCS207/ UCS208	Industry Internship Project / In House Internship	0	0	42	21
Total Credits					21	



**List of Electives in V<sup>th</sup> Semester**

Electives List	Course Code	Name
<b>Elective -V-I</b>	UCS101	Data Warehousing and Data Mining
	UCS102	Big Data
	UCS151	Data Warehousing and Data Mining Lab
	UCS152	Big Data Lab

**List of Electives in VI<sup>th</sup> Semester**

<b>Management Elective Elective-VI-I</b>	UCS103	Organizational Behavior
	UCS104	Professional Ethics
<b>Elective-VI-II</b>	UCS105	Forecasting methods and applications
	UCS155	Forecasting methods and applications Lab
	UCS106	Full Stack Development
	UCS156	Full Stack Development Lab
	UCS107	Object Oriented Analysis and Design
	UCS157	Object Oriented Analysis and Design Lab
<b>Elective-VI-III</b>	UCS108	Internet of Things
	UCS158	Internet of Things Lab
	UCS109	Advanced Software Engineering
	UCS159	Advanced Software Engineering Lab

**List of Electives in VII<sup>th</sup> & VIII<sup>th</sup> Semester**

<b>Elective VII-I</b>	UCS110	Soft Computing
	UCS111	Signal and Image Processing
	UCS112	Sensors Technology
<b>Elective VII-II</b>	UCS113	GPU Computing
	UCS114	Deep Learning
<b>Elective VII-III</b>	UCS115	Blockchain Technologies
	UCS116	Security & Privacy
	UCS117	Software Project Management
<b>Elective VII- IV</b>	UCS118	Operational Research
	UCS119	Research Methodology

**MAL101 : Engineering Mathematics-I****Credit Assigned:**

L	T	P	C
3	1	0	4

**Course objective:** This course is designed to understand the importance of calculus and applications of calculus. At the end of this course, the students will be able to model the engineering problem mathematically using theory of calculus and matrices.

**Course content:****Unit I- Matrices:**

Rank of Matrix, consistency of a system of equations. Linear dependence and independence. Linear and orthogonal transformations. Eigen values and Eigen vectors. Cayley Hamilton's Theorem, Reduction of Diagonal form, Quadratic form and their reduction to canonical form. Gaussian elimination rank, nullity, projection, LU decomposition on, singular value decomposition with applications

**Unit II -Differential Calculus:**

Calculus of functions of single variable: Limit, Continuity and differentiability. Mean value theorems: Rolle's theorem. Langrange's Theorem. Cauchy's theorem. Taylor's theorem with remainders, indeterminate forms, curvature.

**Unit III- Calculus of functions of several variables-I:**

Limit, Continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation. Tangent plane and normal line.

**Unit IV- Calculus of functions of several variables-II**

Euler's Theorem on homogeneous functions, total differentiation, chain rules, Jacobian, Taylor's formula, Maxima and minima Langrange's Method of Undetermined multipliers.

**Unit V- Integral calculus:**

Fundamental theorem of Integral calculus, mean value theorems, evaluation of definite integrals. Applications in Area, Length. Volumes and surface of solids of revolutions, Improper integrals: Beta Gamma functions

**Text Books:**

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons.
2. Piskunov, N., Differential and Integral Calculus, Mir publishers Moscow (vol.1, Vol.2)

**Reference Books:**

1. Thomas, G.B. and Finney, R.L, Calculus and Analytic Geometry, Addison Wesley Longman.
2. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education Pvt. Ltd.
3. Jain R.K., Iyengar S.R.K, Advanced Engineering Mathematics, Narosa Publishers.

**SAP102 : Health, Sports & Safety****Credit Assigned:**

L	T	P	C
2	0	0	2

**Course objective:** This course is designed to increase awareness about Physical Fitness, Health, first aid techniques & sports injuries and to provide information about Food and Nutrition.

**Course content:****Unit 1: Physical Fitness & Health**

Physical fitness, components of physical fitness, methods to improve components of physical fitness, health, components of health, health related fitness components, factors affecting overall health. Respiratory rate, Breathing rate, Body Mass Index.

**Physical Fitness Testing:** Cooper's test, Push-up test, Squat test, Sit & Reach Test, Isometric Back strength test, Standing Broad jump test, Shuttle run test, 100 metre sprint test, one minute Sit-up test.

**Unit 2: Yoga & its Elements**

Yoga, elements of Yoga, Asanas, Pranayama, Surya Namaskar.

**Unit 3: First Aid & Sports Injuries**

First aid, aim of first aid, techniques of first aid, CPR technique, Recovery position, introduction to sports injuries.

**Unit 4: Nutrition & Balanced Diet**

Nutrition, component of Nutrition, Balanced diet.

**Unit 5: Sports & Psychology**

Psychology, Sports Psychology, Motivation, Anxiety, Leadership, The Big 5 personality Test.

**Text Books:**

1. Health & Physical education, Saraswati publications.
2. Indian First Aid Manual 2016, 7<sup>th</sup> edition by Red cross society.
3. Certificate of Yoga Professionals: Official Guidebook, Excel books 1<sup>st</sup> edition 2016.

**BEL103 : Fundamentals of Electrical and Electronics Engineering****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to learn the concepts of D.C. and A.C. circuits, magnetic circuits, semiconductor devices, and also the working of single-phase transformers.

**Course Contents:****Unit-I: D.C. Circuits:**

Ohm's law, Kirchhoff's laws, Nodal Analysis, Mesh Analysis, Supernode, Super mesh, Source Transformations, Star-to-Delta & Delta-to-Star transformations, Thevenin Theorem, Norton Theorem, Superposition Theorem, and Maximum power transfer theorem.

**Unit II- A.C. Fundamentals:**

AC fundamentals, Complex analysis, Phasor diagrams of series and parallel RL, RC, and RLC circuits, Power factor, Resonance in series and parallel RLC circuits, Steady state analysis for sinusoidal excitation.

**Unit-III- Magnetic Circuits and Transformers:**

MMF, Magnetizing force, Magnetic flux and flux density, permeability, Reluctance and permeance, B-H curve, Simple magnetic circuits, Hysteresis and Eddy current losses.

**Transformers:** Construction of single-phase transformer, Operating principle, EMF equation, Phasor diagram on no-load and full-load, Losses and Efficiency, Open and short circuit test.

**Unit-IV- Semiconductor Diodes**

Introduction to Semiconductors, Intrinsic and Extrinsic semiconductor, Drift and Diffusion Currents, P-N junction diodes and its working, Diode current equations, Types of diodes: Photodiode, Light emitting diode, Varactor Diode and Tunnel diode.

**Unit-V- BJT and MOSFET**

Bipolar Junction Transistor: Simplified structure, Operation of n-p-n and p-n-p transistors, Input and Output characteristics of CE, CB, and CC configurations. Metal oxide semiconductor field effect transistor: Structure, Basic operation, Drain and Transfer characteristics, Comparison between BJTs and MOSFETs.

**Text Books:**

1. Charles, K.A. and Sadiku, N.O., "Fundamental of Electric Circuits", Tata Mc-Graw Hill, Sixth Edition, 2018.
2. Hayt, W. H. and Kemmerly, J., "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013.

**Reference Books:**

1. Sudhakar, A. and Palli, S. S., "Circuits and Networks: Analysis and Synthesis", McGrawHill Education, 2017.
2. Sedra and Smith K. C., "Microelectronics Circuits", 5th Edition, Oxford University, 2009.



**BSL104 : Applied Science****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to understand the fundamentals of Quantum Mechanics, formation of electronic bands, the structure and properties of materials and current trends & application of materials.

**Course Contents:****Unit I- Basics of Quantum Mechanics**

Dual nature of matter, de-Broglie hypothesis, Phase and group velocity and their relations (Numerical Problems), Wave function & its physical significance, Probability density, Eigen function, Operators, Wave function Normalization, 1-D and 3-D Schrodinger wave equations, Application-Particle in a potential box.

**Unit II- Electronic Conduction in Solids**

Classical free electron theory-Drude-Lorentz Model, Drift velocity, Relaxation time, Mean collision time, Mean free path, Quantum free electron theory, Band theory of solids-Kronig-Penny model (Qualitative), Energy bands in solids, E-k diagram, Types of electronic materials-metals, semiconductors, insulators, Concept of effective mass.

**Unit III- Semiconductors & Materials Structure**

Density of energy states, Fermi energy, Occupation probability. Intrinsic & extrinsic semiconductors, Dependence of Fermi level on carrier concentration & temperature (Numerical Problems). Crystal Structure- FCC, BCC, HCP structures and their atomic packing factors, Crystal systems-Bravais Lattice, Miller Indices, Inter planar spacing (Numerical Problems).

**Unit IV- Smart Materials & Current Trends in Engineering Applications**

Transforming materials-Shape memory alloys and their applications, Metallic glasses, Composite materials, Nanotechnology-Properties of nanomaterials and synthesis approaches, Quantum dots, CNT's, Graphene. Elementary ideas on Nanorobotics, Quantum computers, MEMS

**Text Books:**

1. Resnick, Walker and Halliday, Fundamental of Physics, John Willey and Sons. Inc, 6th Edition, 2005.
2. Streetman B. G., Solid State Electronics, Prentice Hall India (2nd Edition) 1986.
3. Avadhanulu M. N. and P.G. Kshirsagar, A text Book of Engineering Physics, (7th Edition) 2004.
4. Dekker A.J.; Electrical Engineering Materials; Prentice Hall of India Publication, 1992.
5. Kenneth Krane; Modern Physics; (2nd Edition); John Wiley Eastern, 1998.
6. Malik, H.K., Engineering Physics, Mc Graw Hill Education (2nd Edition), 2017.

**Reference Books:**

1. John A. Pelesko, David H. Bernstein, "Modeling MEMS and NEMS" CRC Press, 2002



**UCS001 : Computer Programming****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to explore computing and to show the art of computer programming. Students will learn some of the design principles for writing good programs.

**Course content:****Unit I- Introduction**

Flow charts, data types and storage classes, scope of variables, arithmetic operators, assignment, conditional, arithmetic expressions, enumerated data types, decision making, branching, looping, Switch and Goto Statements.

**Unit II- Basic programming algorithms**

Programs to illustrate basic language constructs in C like - Factorial, Fibonacci series, calculating square root of a number, calculating GCD of 2 integers (Euclid's method and otherwise), Calculating LCM of 2 integers and similar such programs.

**Unit III- Arrays and applications**

Introduction to one dimensional and 2-D array with examples. Representing a polynomial using 1-D array and polynomial operations, Use of 2-D array to represent a matrix and matrix operations. Character arrays (strings): String related functions (strlen, strcpy, strcat, strcmp, itoa, reverse, strstr etc.) and their function definitions.

**Unit IV- Searching and Sorting methods**

Selection sort, Bubble sort, Insertion sort, Linear search, merging of 2 sorted arrays. Structures and Unions: Basic concept, array of structures and its applications.

**Unit V- Pointers**

Introduction (declaration and initialization), pointers and arrays, concept of dynamic memory allocation, use of pointers to represent variable-sized 1-D and 2-D arrays, pointers to structures.

Function and parameter passing, recursive functions, macros.

**File Management in C:** Open, close, read and write operations, Sequential and text files.

**Text Books:**

1. Brian W. Kernighan Dennis M. Ritchie, C Programming Language, 2nd ed, 2012.
2. Balagurusamy G., Programming in ANSI C, 8<sup>th</sup> ed., 2019

**Reference Books:**

1. Kanetkar Y., Let Us C, 16th ed., 2017

**ECL106 : Analog Electronics**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objective:** This course is designed to explore the operations and applications of various semiconductor devices such as Diodes, BJTs, MOSFETs and OP-Amps and also to learn the concept of feedback mechanism in Oscillators circuits.

**Course Contents:****Unit-I: Semiconductor diodes**

P & N types Semiconductors, working and V-I characteristics of P-N junction diode, Power Supply, Rectifier circuits: Half-wave, Center-tapped and Bridge Full wave rectifiers, filters, ripple-factor, Applications of various diodes such as Zener as a voltage regulator.

**Unit II- Bipolar Junction Transistors**

Theory and operation of BJT, Transistor current components, Current amplification factors, Transistor circuit configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC), Transistor as an amplifier, Transistor load lines, Transistor as a diode, Transistor biasing and stabilization, Thermal runaway, BJT Small-signal model analysis, DC and AC analysis of a single stage transistor amplifiers circuits using h-parameters, Miller's theorem.

**Unit-III- Oscillators**

Feedback in amplifiers, Introduction to Oscillators, operation of oscillators, L-C oscillator, Colpitt's oscillator, Hartley oscillator, Crystal oscillator, Phase-shift oscillator, and Wein-bridge oscillator.

**Unit-IV- Metal Oxide Semiconductor Field Effect Transistors**

Theory and operation of MOSFETs, MOSFET small-signal model, MOS capacitor, MOSFET resistor, Applications of MOSFETs, DC and AC analysis of Common source (CS), Common Drain (CD), Common Gate (CG) MOSFET amplifiers.

**Unit-V- Operational Amplifiers**

Introduction, Block diagram of a typical Op-Amp, Schematic diagram of IC-741 operation amplifier, Ideal Op-Amp, Equivalent circuit of Op-Amp, Inverting and Non-inverting amplifiers, Common -Mode Rejection ratio (CMRR), Practical Op-Amp parameters, Op-Amp characteristics, Applications: Adder, Subtractor, Comparator, Integrator, and Differentiator.

**Text Books:**

1. Boylestad, R. L. and Nashelsky, L., "Electronic Devices and Circuits theory", 10th Edition, Pearson Education, 2013.
2. Streetman, B. G., & Banerjee, S., "Solid State Electronic Devices", 7th Edition, Upper Saddle River: Pearson/Prentice Hall, 2016.

**Reference Books:**

1. Neamen, D. A., "Semiconductor physics and devices: basic principles", 4th edition, McGraw- Hill, 2003.
2. Sedra, A. S., Smith, K. C., Carusone, T. C., and Gaudet, V. Microelectronic Circuits. Vol. 4. New York: Oxford University Press, 2004.

**HUL107: Environmental Studies****Credit Assigned:**

L	T	P	C
2	0	0	2

**Course objective:** Introduction to various natural resources and its importance, the concepts of ecosystem and its structure & functions along with biodiversity conservation & environmental pollution and its consequences, methods of prevention.

**Course content:****Unit I- Natural resources**

Forest resources, Water resources, Mineral resources, Food resources, Energy Resources, Land resources. Ecosystem: Concept of an ecosystem, Structure and functions of an ecosystem, Producers, consumers and Decomposers, Ecological succession, Food chain, food webs and pyramids.

**Unit II- Biodiversity and its conservation**

Introduction, definitions: genetics, species and diversity, Value of biodiversity, Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threat to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Conservation of biodiversity: in-situ and ex-situ conservation.

**Unit III- Environmental pollution**

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid Waste management: Causes, effects and control measures of urban and industrial wastes.

**Unit IV- Social issues and environment**

Sustainable development, Water conservation, Rain water harvesting, Watershed management, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear Accident, Holocaust, Environmental rules and regulations.

**Unit V- Human population and environment**

Population growth, Environment and human health, Human rights, Value education, Role of information technology in environment and human health.

**Text Books:**

1. Rajgopalan R., Environmental Studies.

**Reference Books:**

1. Benny Joseph, Environmental Studies, McGraw-Hill.
2. Erach Barucha Environmental Studies University press (UGC).

**BEL108 : Fundamentals of Electrical and Electronics Engineering Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**LAB objectives:** This lab is designed to discuss various hardware components used in electrical and electronic circuits, to learn the concepts of different network theorems to solve the electrical and electronics circuits, to analyze the frequency response of series and parallel RLC circuits and to discuss about the characteristics of various semiconductor devices.

**List of Experiments**

1. To study DSO, Function generator, Multimeter, and DC power supply.
2. To verify the Kirchhoff's laws (KCL and KVL).
3. To verify Superposition theorem.
4. To verify Thevenin's and Norton's theorems.
5. To verify Maximum power transfer theorem in DC circuits.
6. To study frequency response of series RLC circuit and determine resonant frequency and quality factor for various values of R, L, and C.
7. To study frequency response of parallel RLC circuit and determine resonant frequency and quality factor for various values of R, L, and C.
8. To observe the V-I characteristics of P-N Junction and Zener diode.
9. To study Half-wave and Full wave Rectifier circuits.
10. To perform open circuit and short circuit test on a single-phase transformer.

**Text Books:**

1. Charles, K.A. and Sadiku, N.O., "Fundamental of Electric Circuits", Tata Mc-Graw Hill, Sixth Edition, 2018.
2. Hayt, W. H. and Kemmerly, J., "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013.

**Reference Books:**

1. Sudhakar, A. and Palli, S. S., "Circuits and Networks: Analysis and Synthesis", McGrawHill Education, 2017.
2. Sedra and Smith K. C., "Microelectronics Circuits", 5th Edition, Oxford University, 2009.

**BSL109 : Applied Science Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** This course is designed to understand the fundamentals of Quantum Mechanics, formation of electronic bands, the structure and properties of materials and current trends & application of materials.

**List of Experiments**

1. To calibrate an electromagnet and study the dependence of Hall voltage on magnetic field and current through the sample.
2. To determine the band gap of a semiconductor by Four-probe method.
3. To study the Photoelectric effect and measure the work function of a given material.
4. To measure the dispersive power of a prism.
5. To measure the grating element of a diffraction grating and calculate the wavelength of prominent lines.
6. To calculate the wavelength of light by Newton Rings.
7. To determine the refractive index of a given liquid by Newton rings.
8. To determine the rigidity modulus of the suspension wire using torsion pendulum.
9. To study the V-I characteristics of p-n junction diode.
10. To study the V-I characteristics of a Zener diode.

**Text Books:**

1. Resnick, Walker and Halliday, Fundamental of Physics, John Wiley and Sons. Inc, 6th Edition, 2005.
2. Streetman B. G., Solid State Electronics, Prentice Hall India (2nd Edition) 1986.
3. Avadhanulu M. N. and P.G. Kshirsagar, A text Book of Engineering Physics, (7th Edition) 2004.
4. Dekker A.J.; Electrical Engineering Materials; Prentice Hall of India Publication, 1992.
5. Kenneth Krane; Modern Physics; (2nd Edition); John Wiley Eastern, 1998.
6. Malik, H.K., Engineering Physics, Mc Graw Hill Education (2nd Edition), 2017.

**Reference Books:**

1. John A. Pelesko, David H. Bernstein, "Modeling MEMS and NEMS" CRC Press, 2002

**UCS051 : Computer Programming Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Lab objective:** This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs

**List of Experiments**

1. Write a program to find sum of n natural number using for loop.
2. Write a program to calculate GCD of two numbers.
3. Write a program to calculate the Factorial of a number.
4. Write programs using elements of an array to:
5. Print position of smallest number in array.
6. Insert an element.
7. Delete a given element.
8. Find a given element.
9. Write a program to calculate Power (x, y) (Using Recursion).
10. Write a program to solve TOH (Tower of Hanoi).
11. Write a program for Swapping of two numbers using call by value and call by reference.
12. Write a program to store variable and array in pointer. Also implement array pointer and pointer to an array.
13. Write a program for String Comparison.
14. Write a program for finding Substring from given string.
15. Write a program for finding Reverse of string.
16. Write a program to create dynamic array using malloc and calloc function.
17. Write a program to reallocation of an array using realloc function.
18. Write program to read any string from and close a file using fgets and fclose respectively

**Text Books:**

1. Brian W. Kernighan Dennis M. Ritchie, C Programming Language, 2nd ed, 2012.
2. Balagurusamy G., Programming in ANSI C, 8<sup>th</sup> ed., 2019

**Reference Books:**

1. Kanetkar Y., Let Us C, 16th ed., 2017

**ECL111 : Analog Electronics Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Lab objectives:** The objectives of this lab are to discuss about various equipments such as CRO, Multimeter, function generator, bread-board, regulated power suppl, and to analyze the V-I characteristics of various semiconductor devices such as diodes, BJT, and MOSFETs.

**List of Experiments**

1. To get familiar with working knowledge of the following equipment
  - a) CRO b) Multimeter c) Function generator d) Regulated power supply e) Bread Board f) Active & passive components.
2. To study V-I characteristics of P-N junction diode.
3. To study Zener diode as a voltage regulator.
4. To study Half wave and center-tapped full wave rectifier circuits.
5. To study input and output characteristics of CE configuration of transistor.
6. To study input and output characteristics of CB configuration of transistor.
7. To study BJT fixed bias and voltage divider bias configurations.
8. To study transfer and Drain Characteristics of MOSFET.
9. To Study MOSFET in common source configuration.
10. To study inverting and non-inverting Op-Amp circuits.

**Text Books:**

1. Boylestad, R. L. and Nashelsky, L., "Electronic Devices and Circuits theory", 10th Edition, Pearson Education, 2013.
2. Streetman, B. G., & Banerjee, S., "Solid State Electronic Devices", 7th Edition, Upper Saddle River: Pearson/Prentice Hall, 2016.

**Reference Books:**

1. Neamen, D. A., "Semiconductor physics and devices: basic principles", 4th edition, McGraw- Hill, 2003.
2. Sedra, A. S., Smith, K. C., Carusone, T. C., and Gaudet, V. Microelectronic Circuits. Vol. 4. New York: Oxford University Press, 2004.



**UCS001 : Engineering Mathematics-II****Credit Assigned:**

L	T	P	C
3	1	0	4

**Course objective:** To introduce students the theory and concepts of differential equations, linear algebra and Laplace transformations which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

**Course content:****Unit I- Multiple Integrals**

Double and triple integrals, change of order of integration, Change of variables between Cartesian to polar coordinates, cylindrical coordinates and spherical polar coordinates Applications to area, volumes and Mass.

**Unit II- First Order Ordinary Differential Equations**

First order ordinary differential equations: Exact equation Integrating factors, reducible to exact differential equations, Linear and Bernoulli form, Orthogonal Trajectories, Existence and Uniqueness solutions, Picard's theorem, Picard's iteration method of solution (Statement only).

**Unit III- Higher Order Linear Differential equations**

Solutions of second and higher order linear equation with constant coefficients. Linear dependence and independence. Method of variation of Parameters. Equation reducible to linear equations with constant coefficients (Euler Cauchy and Legendre's linear differential equations). Simultaneous linear equations. System of linear differential equations with constant coefficients

**Unit IV- Partial Differential equations**

Formation of PDEs, Solution of standard four types of first order-PDEs and Lagrange's linear equations, linear PDEs of higher order with constant coefficients-homogeneous and non-homogeneous equations with their solution, Solution of PDEs by the method of separation of variables.

**Unit V- Laplace Transformation**

Laplace transform - Inverse Laplace transform - Properties of Laplace transforms - Laplace transforms of unit step function, impulse function, and periodic function - convolution theorem - Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform.

**Text Books:**

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons.
2. Piskunov, N., Differential and Integral Calculus, Mir publishers Moscow (vol.1, Vol.2)

**Reference Books:**

1. Thomas, G.B. and Finney, R.L, Calculus and Analytic Geometry, Addison Wesley Longman.
2. Michael D. Greenberg, Advanced Engineering Mathematics, Pearson Education Pvt. Ltd.
3. Jain R.K., Iyengar S.R.K, Advanced Engineering Mathematics, Narosa Publishers.

**ECL202 : Digital Electronics****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to understand the fundamentals of digital logic designs, Combinational and Sequential logic circuits, Analog-to-digital and digital-to-analog convertors.

**Course content:****Unit I: Number systems and Boolean Algebra**

Introduction to various number systems and their Conversions, Weighted and Non-weighted codes, r's and r-1's complements, Boolean Algebra and its laws, Minimization of Boolean expressions, Logic Gates: Basic, Universal and Special gates, Standard and Canonical forms, Karnaugh Maps.

**Unit-II: Combinational Logic Circuits**

Introduction, Design procedure, Adders, Subtractors, Binary parallel adder, Look-Ahead-carry adder, BCD adder, Code convertors, Comparators, Multiplexers and Demultiplexers, Encoders and Decoders, Priority Encoder.

**Unit-III: Sequential Logic Circuits**

Concept of a sequential circuits, Memory elements: Latches, Flip-flops: S-R, J-K, T, and D, Race around condition, Master-Slave Flip-Flops, Designing of synchronous and asynchronous counters, Shift registers: SISO, SIPO, PISO and PIPO registers.

**Unit-IV: Analog-to-digital and Digital-to-analog convertors**

Introduction to analog-to-digital and digital-to-analog convertors, DAC: Weighted-resistor type DAC, R-2R ladder type DAC, ADC: Counter type, Tracking-type, Flash-type, Dual-slope type ADCs.

**Unit-V: Memories**

Memory types and terminologies, Read only memory (ROM), Random Access memory (RAM), PAL, PLA, Semiconductor RAMs, Memory expansion, Non-volatile RAMs, Sequential memories, Magnetic memories.

**Text Books:**

1. Floyd T. L., "Digital Fundamentals" 11th Edition Pearson International Education, 2017.
2. Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, PHI, 2016.
3. Morris. M. Mano, "Digital Design", Pearson International Education.

**Reference Books:**

1. R P Jain, "Modern Digital Electronics", McGraw-Hill Education (India) Pvt Limited, 2003

**USC002 : Data Structure****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To become familiar with different types of data structures with applications and learn different types of algorithmic techniques and strategies.

**Course content:****Unit I-Introduction**

**Analyzing algorithms:** Basics of algorithm and its analysis, Complexity classes, order arithmetic, Time and space trade-off in algorithms.

**Linear Data Structures:** Arrays, Strings and string processing, Linked lists (Singly, Doubly, Circular), Abstract data types, their implementation and applications.

**Unit-II Searching and Sorting:**

Linear Search, Binary Search. Introduction to internal and external sort, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Counting Sort, Radix Sort.

**Unit III-Stack and Queues**

Stack Implementation using – Array and Linked List. Concept of recursion for various operations on Lined list such as – reversing list elements. Operations- PUSH & POP. Time Complexity of PUCH/POP using array & stack. Infix prefix and postfix conversion algorithms. Queue using Circular Array, its implementation using two stack, various Operations – Enqueue/Dequeues Doubly Linked List- various Operations on doubly Linked List .

**Unit IV- Trees**

Introduction of Non-Linear Data Structure. Properties of trees- height, Level, Depth, Binary Trees, Full trees, Complexity analysis for trees. Tree Traversing- Inorder, preorder, Post order, Implementation of traversing in trees using recursion methods. Count the number of trees using recursion Various Tree representation, recursive programs for counting the number of leaves, non-leaves, finding full nodes of trees. Binary search tree, AVL Tree and common operations on these trees. Heap, Heap Sort, Priority Queue using Heap.

**Unit V- Graphs and their applications:**

Graph Terminology and its representation, Depth and breadth first traversals, Shortest-path algorithms (Dijkstra and Floyd), Data Structures for Disjoint Sets, Minimum spanning tree (Prim and Kruskal).

**Text Books:**

1. Data Structures & Program Design in C: Robert Kruse, G. L. Tondo and B. Leung PHI-IEEE.
2. Fundamentals of Data Structures in C : E. Horowitz, S. Sahni, and S. Anderson - Freed, University Press.

**Reference Books:**

1. Aho, Hopcroft and Ullmann, -Data Structures and Algorithms, II Addison Wesley. 983.



**HUL204: Communication Skills**

**Credit Assigned:**

L	T	P	C
2	0	0	2

**Course objective:** To impart to the students, communication skills that they need in their academic, and later in the professional pursuit by enhancing their skills in Listening, Speaking, Reading, and Writing (LSRW).

**Course content:**

**Unit I Communication:**

Communication: meaning and its definition; modes of communication Listening, Speaking, Reading, and Writing. Types of communication: Oral communication and Written communication and visual communication.

**Unit II: Visual communication:**

Visual communication and its importance: Theories of visual communication: Gestalt Theory, Semiotic theory, Constructivism, Ecological Theory, Cognitive Theory, Huxley-Lester Model.

**Unit II Barriers to communication.**

Understanding pronunciations – issues and challenges to comprehension: Received Pronunciation, Indian English, American English. Language as connected speech – issues and challenges to comprehension: Intonation, liaison, juncture

**Unit III Reading comprehension:**

Types of reading: Skimming (general purpose), and Scanning (specific purpose). Comprehension by the use of Semantic markers and sign posting.

**Unit IV Writing skills:**

Structure and order: Understanding the Essay: Thesis statement and the topic sentences. Body of the Essay: Topic sentence, illustrations, supporting sentences: Types of essay writing: Narrative, Expository, Descriptive, Argumentative and cause and effect.

**Text Books:**

1. Orient Longman, A Textbook of English for Engineers and Technologists.
2. A Course in Phonetics and Spoken English by J Sethi & PV Dhamija PHI

**Reference Books:**

1. Quirk R. and Greenbaum S., A University Grammar of English.
2. Krishna swamv N., English Grammar (Longman publication) (Macmillan India Ltd)

**UCS003 : Web Designing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to understand the principle of Web page design and types of websites, visualize and recognize the basic concept of HTML and application in web designing, recognize and apply the elements of Creating Style Sheet (CSS), Understand the basic concept of Java Script and its application and introduce basics concept of Web Hosting and apply the concept of SEO.

**Course content:****Unit I- Introduction**

Basic principles involved in developing a web site, Planning process, Domains and Hosting, responsive Web Designing, Types of Websites (Static and Dynamic Websites), Web Standards and W3C recommendations.

**Unit II- Elements of HTML**

What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags., Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls

**Unit III- Concept of CSS:**

Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute selector), CSS Color, Creating page Layout and Site Designs.

**Unit IV- Elements of JavaScript**

Introduction to Client-Side Scripting, Introduction to Java Script, JavaScript Types, Variables in JS, Operators in JS, Conditions Statements, Java Script Loops, JS Popup Boxes, JS Events, JS Arrays, Working with Arrays, JS Objects, JS Functions, Using Java Script in Real time, Validation of Forms, Related Examples

**Unit V- Web Hosting**

Web Hosting Basics, Types of Hosting Packages, Registering domains, Defining Name Servers, Using Control Panel, Creating Emails in Cpanel, Using FTP Client, Maintaining a Website

**Concepts of SEO :** Basics of SEO, Importance of SEO, Onpage Optimization Basics

**Text Books:**

1. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
2. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

**Reference Books:**

1. Tomas A. Powell, "The Complete Reference: Web Designing", Second Edition, Tata McGraw Hill Publications.

**USC004 : Object Oriented Programming using C++**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objective:** To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

**Course content:****Unit-I Introduction to Object Oriented Programming:**

Basic concepts of OOP, Benefits of OOP, Introduction to object-oriented design and development, Design steps, Design example, Object oriented languages, Comparison of structured and object-oriented programming languages. Arrays, Pointers and Functions: Arrays, Storage of arrays in memory, Initializing Arrays, Multi-Dimensional Arrays, Pointers, accessing array elements through pointers, passing pointers as function arguments, Arrays of pointers, Pointers to pointers, Functions, Arguments, Inline functions, Function Overloading Polymorphism.

**Unit-II Classes and Objects:**

Data types, operators, expressions, control structures, arrays, strings, Classes and objects, access specifiers, constructors, destructors, operator overloading, type conversion. Storage classes: Fixed vs Automatic declaration, Scope, Global variables, register specifier, Dynamic memory allocation.

**Unit – III Inheritance:**

Inheritance, single Inheritance, Multiple Inheritance, Multi-level inheritance, hierarchical inheritance, hybrid inheritance, Virtual functions and Polymorphism. Exception Handling: List of exceptions, catching exception, handling exception.

**Unit-IV Streams and Files:**

Opening and closing a file, File pointers and their manipulations, Sequential Input and output operations, multi-file programs, Random Access, command line argument, string class, Date class, Array class, List class, Queue class, User defined class, Generic Class.

**Unit-V Standard Template Library:**

Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, Container Classes, General Theory of Operation, Vectors.

**Text Books:**

1. Dietel, Paul J. and Dietel, Harvey M., "C++ for Programmers", Prentice Hall, 10<sup>th</sup> Edition, 2016.
2. Bjarne, Stroustrup, "The C++ programming Language", Addison Wesley 2013.

**Reference Books:**

1. Lafore, Robert, "Object Oriented Programming in Turbo C++", Galgotia Publications 2001.
2. Booch, "Object Oriented Analysis and Design with Applications", Addison Wesley, 2007.
3. Balagurusamy, "Object Oriented programming with C++", Tata McGraw Hill, 2017.

**ECL207: Digital Electronics Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Lab Objectives:** The main objectives of this lab are to describe various logic gates, to design Code convertors using logic gates, to analyze the various Combinational logic circuits and Sequential logic circuits.

**List of Experiments**

1. Introduction of Digital Logic Gates: Investigate logic behavior of NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.
2. Gate-level minimization: Two level and multi-level implementation of Boolean functions.
3. To study Half adder and subtractor.
4. To study Full adder and subtractor.
5. To design BCD to Excess-3 code converter, gray code to binary converter, binary to gray code converter.
6. To design 4x1 Multiplexer and 1x4 Demultiplexer.
7. To design an 4x2 Encoder and 2x4 Decoder.
8. To design 4-bit binary adder and subtractor.
9. To construct S-R, D, J-K and T flip flops.
10. To design a MOD-5 asynchronous UP and DOWN counters.

**Text Books:**

1. Floyd T. L., "Digital Fundamentals" 11th Edition Pearson International Education, 2017.
2. Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition, PHI, 2016.
3. Morris. M. Mano, "Digital Design", Pearson International Education.

**Reference Books:**

1. R P Jain, "Modern Digital Electronics", McGraw-Hill Education (India) Pvt Limited, 2003



**CSC052 : Data Structure Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** To become familiar with different types of data structures and their applications and learn different types of algorithmic techniques and strategies.

**List of Experiments**

1. Implementation of array
2. Sorting techniques of array
3. Maximum and minimum problem using divide and conquer strategy.
4. Binary search.
5. Heap Sort algorithm.
6. Kruskal's algorithm.
7. Prim's algorithm.
8. Matrix chain multiplication
9. Dijkstra's algorithm.
10. Bellman-Ford algorithm.
11. Depth-first search (DFS) on a graph.
12. Breadth-first search (BFS) on a graph.
13. Advanced data structures.
14. Illustrating the different paradigms of algorithm design.
15. Problems in string manipulation, graph theory, and optimization.

**Text Books:**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

**Reference Books:**

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, McGraw Hill/ MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, 1st edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

**HUL209: Communication Skills Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** To impart to the students, communication skills that they need in their academic, and later in the professional pursuit and enhance their skills in Listening, Speaking, Reading, and Writing (LSRW). Train the students to adopt an innovative approach to English and learning.

**List of Experiments:**

1. Analyzing 3 Audio-visual advertisements for importance of Visual communication.
2. Presenting a book chapter using Power Point slides.
3. Data Analysis: Maintaining multiple results obtained over time and reporting them using charts and graphs.
4. Technical Documentation - Requirement/specification documentation, Design documentation, Test-cases documentation, Use-cases documentation.
5. Writing an installation/instruction manual.
6. Writing an abstract of a technical article - summarizing an article in 300 words.
7. Summarizing 3 papers into a report and its presentation.
8. Reading texts for Skimming (general purpose) and Scanning (specific purpose).
9. Writing an essay one each in Narrative, Descriptive, and cause and effect style.
10. Presenting Received Pronunciation, Indian Pronunciation and American Pronunciation of 10 words.

**Text Books:**

1. Orient Longman, A Textbook of English for Engineers and Technologists.
2. A Course in Phonetics and Spoken English by J Sethi & PV Dhamija PHI

**Reference Books:**

1. Quirk R. and Greenbaum S., A University Grammar of English.
2. Krishna swamv N., English Grammar (Longman publication) (Macmillan India Ltd)

**UCS053: Web Designing Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** The objective of course is to develop static web pages using HTML, develop Java programs for window/web-based applications, designing dynamic web pages using Javascript and XML, designing dynamic web page using server site programming Ex. ASP/JSP/PHP and designing server site applications using JDDC, ODBC and session tracking API.

**List of Experiments**

1. Write HTML/Java scripts to display your CV in navigator, your Institute website, Department Website and Tutorial website for specific subject
2. Write an HTML program to design an entry form of student details and send it to store at database server like SQL, Oracle or MS Access.
3. Write programs using Java script for Web Page to display browsers information.
4. Write a Java applet to display the Application Program screen i.e. calculator and other.
5. Writing program in XML for creation of DTD, which specifies set of rules. Create a style sheet in CSS/ XSL & display the document in internet explorer.
6. Program to illustrate JDBC connectivity. Program for maintaining database by sending queries. Design and implement a simple servlet book query with the help of JDBC & SQL. Create MS Access Database, Create on ODBC link, Compile & execute JAVA JDVC Socket.
7. Install TOMCAT web server and APACHE. Access the above developed static web pages for books web site, using these servers by putting the web pages developed.
8. Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following. Create a Cookie and add these four user id's and passwords to this Cookie. 2. Read the user id and passwords entered in the Login form and authenticate with the values available in the cookies.
9. Install a database (Mysql or Oracle). Create a table which should contain at least the following fields: name, password, email-id, phone number Write a java program/servlet/JSP to connect to that database and extract data from the tables and display them. Insert the details of the users who register with the web site, whenever a new user clicks the submit button in the registration page.
10. Design and implement a simple shopping cart example with session tracking API.

**Text Books:**

1. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
2. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

**Reference Books:**

1. Tomas A. Powell, "The Complete Reference: Web Designing", Second Edition, Tata McGraw Hill Publications.

**USC054 : Object Oriented Programming using C++ Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

**List of Experiments**

1. Implementation of array and pointers.
2. Implementation of functions.
3. Implementation of function overloading.
4. Implementation of classes and objects.
5. Implementation of functions in classes.
6. Implementation of operator overloading.
7. Implementation of different types of inheritance.
8. Implementation of Streams.
9. Implementation of various operations on files.
10. Implementation of exception handling.
11. Implementation of STL.

**Text Books:**

1. Dietel, Paul J. and Dietel, Harvey M., "C++ for Programmers", Prentice Hall, 10<sup>th</sup> Edition, 2016.
2. Bjarne, Stroustrup, "The C++ programming Language", Addison Wesley 2013.

**Reference Books:**

1. Lafore, Robert, "Object Oriented Programming in Turbo C++", Galgotia Publications 2001.
2. Booch, "Object Oriented Analysis and Design with Applications", Addison Wesley, 2007.
3. Balagurusamy, "Object Oriented programming with C++", Tata McGraw Hill, 2017.

**UCS005: Discrete Mathematics****Credit Assigned:**

L	T	P	C
3	1	0	4

**Course objective:** Detailed study of various discrete and algebraic structures, basic logic, basics of counting and proof techniques

**Course content:****Unit I Sets:**

Finite and Infinite sets, cardinality, Principle of Inclusion and Exclusion, Principle of Mathematical Induction (Weak & Strong versions), Relations and functions: properties of binary relations, reflexive, symmetric, transitive, Partial, Equivalence and Total ordered relations, partitions, Transitive closure and Warshall's algorithm.

**Unit II Algebraic Structure and Propositions:**

Definition and elementary properties of algebraic structures, semi groups, monoids and sub-monoids, groups and subgroups, homomorphism and isomorphism of monoids and groups, Quantified propositions, fundamentals of logic, first order logic, Permutations, Combinations, Numeric Functions, Generating Functions.

**Unit III Recurrence Relations and Recursive Algorithms:**

Recurrence relations, linear recurrence relations with constant coefficients, homogeneous solutions, particular solutions, general solutions, solution by substitution, solution by characteristic equations, solution by generating functions.

**Unit IV Graphs:**

Digraphs, Un-digraphs, Konigsberg seven bridges problem, Simple Graphs, Completed graphs, Regular Graphs, Bi-connected Graphs, Eulerian Graph, Hamiltonian Graph. Planar Graphs, Euler Formula. Five color theorem, four color conjecture,

**Unit V Trees:**

Spanning Trees, BFS, DFS, Weighted Graphs, Minimum spanning trees, Krushkal's, Prim's algorithms

**Text Books:**

1. Mott, Kandel, & Baker: *Discrete Mathematics for Computer Scientists and Mathematicians*, Prentice Hall, 2001.
2. Tremblay and Manohar: *Discrete Mathematical Structures*, McGraw Hill, 1987

**Reference Books:**

1. Kenneth H. Rosen : McGraw-Hill Higher Education; 8 edition (July 9, 2018)

**UCS006 : Design and Analysis of Algorithms****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** The objective of the course is to teach techniques for effective problem solving in computing. It covers good principles of algorithm design, elementary analysis of algorithms, and advanced data structures.

**Course content:****Unit I-Introduction**

Algorithm, performance evaluation of algorithms, space & time complexity, notion of optimality, Master's Theorem. Divide and Conquer: General Concept, Finding the maximum and minimum, Quick Sort, Merge Sort, Binary Search, Strassen's matrix multiplication.

**Unit 2: Greedy Algorithm:**

General Concept, Knapsack Problem (Fractional Knapsack), Job Sequencing with Deadline, Huffman's Codes, Minimum Cost Spanning Tree- Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path-Dijkstra's Algorithm.

**Unit III: Dynamic Programming**

General Concept, Matrix-Chain Multiplication, Knapsack Problem DP solution, Activity selection problem DP solution, Single Source Shortest Path- Bellman Ford Algorithm, All pairs shortest paths, Traveling salesman problem.

**Unit IV: Backtracking and Graph Algorithm**

Basic idea, 8-Queens problem, Graph Coloring, Hamiltonian Cycles. Branch-And-Bound: Basic idea, LC search, the 15-puzzle problem, LC Branch-and-Bound, 0/1 Knapsack Problem.

Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components, Bi-Connected Components and DFS, Euler Tour, Minimum Spanning Tree- Kruskal's Algorithm, Prim's Algorithm.

**Unit V: Introduction to NP-Completeness**

Basic concepts on NP- hard and NP-Complete Problems, Discussion on one NP- hard graph problem- CDP.

**Text Books:**

1. Data Structures & Program Design in C: Robert Kruse, G. L. Tondo and B. Leung PHI-IEEE.
2. Fundamentals of Data Structures in C : E. Horowitz, S. Sahni, and S. Anderson - Freed, University Press.

**Reference Books:**

1. Aho, Hopcroft and Ullmann, -Data Structures and Algorithms, II Addison Wesley. 983.

**UCS007 : Computer Organization****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to explore computing and to show students the art of design and analysis of the operation of digital gates. Students will learn design and implementation of combinational and sequential logic circuits.

**Course content:****Unit-I General System Architecture:**

Stored Program control concept (Von-Neumann architecture principle), Flynn's Classification of computers (SIMD, MISD, MIMD), Structure organization (CPU, Caches, Main memory, Secondary memory unit & I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic & logical, Data transfer, Control flow), Instruction set format, Instruction Set Architecture (Instruction set based classification of processor i.e. RISC, CISC, RISC vs CISC Comparison).

**Unit-II Processor Design:**

Arithmetic & logic unit, Stack organization, CPU Architecture types, Accumulator Based- Register, Stack Memory, Register, Detailed data path of a typical register-based CPU, Fetch, Decode, and Execute Cycle.

**Unit-III Computer Arithmetic and Control Design:**

Addition & Subtraction, Multiplication Algorithms (Booth's Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations. Control Design: Microprogrammed & Hard-wired control options, Hard-wired design methods, State table method, Multiplier control, CPU control unit. Microprogrammed, Basic concepts, control Memory, Address Sequencing.

**Unit-IV Memory Hierarchy & I/O Organization:**

Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues (performance, address mapping and replacement) Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation. Input / Output: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.

**Unit-V Introduction to Parallelism:**

Goals of parallelism, Instruction level parallelism, pipelining, superscaling, Processor level parallelism, Multiprocessor system overview.

**Text Books:**

1. M Moris Mano, "Computer System Architecture", Pearson Education, 3rd Ed. 1993.
2. David A. Patterson and John L. Hennessy, "Computer Organization & Design - The Hardware/Software Interface", Morgan Kaufmann, 2nd Ed. 1997.
3. William Stallings, "Computer Organisation and Architecture, Designing for Performance", Pearson Education Asia, 6th Ed. 2003.
4. Harry F. Jordan and Gita Alaghband, "Fundamentals of Parallel Processing", Pearson Education, 1st Ed. 2003. 5. Barry Wilkinson Michael Allen, "Parallel Programming", Prentice Hall, 1999

**Reference Books:**

1. William Stallings, "Computer Organisation and Architecture, Designing for Performance", Pearson Education Asia, 6th Ed. 2003.
2. Patterson, David A and Hennessy, John. L., "Computer Organization and Design", Morgan Kaufmann, 3rd Edition.



**USC008: Object Oriented Programming using JAVA**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objective:** To gain understanding of object-oriented programming (OOP) principles, explore their practical uses, and acquire knowledge of diverse algorithmic methods and approaches.

**Course content:****Unit 1- Classes and Objects**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods. Files and I/O Streams.

**Unit 2- Inheritance**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements. **Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. Concept of Interfaces.

**Unit 3- Exception Handling**

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions, try-with-resources, Catching Subclass Exception, Custom Exceptions, Nested try and catch Blocks, Rethrowing Exception, Throws Clause.

**Unit 4: Multithreaded Programming**

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread- Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication – Suspending, Resuming, and Stopping of Threads.

**Unit-5: AWT and Swing**

Frame class and its functions, Collection Framework, AWT, Swing, Applets, Applet Life cycle, Working with Applets, Database connectivity (JDBC, ODBC).

**Text Books:**

1. E. Balagurusamy, “Programming with Java”, TataMc-Graw Hill, 5th Edition.
2. Sagayaraj, Denis, Karthick and Gajalakshmi, “Java Programming for Core and advanced learners”, Universities Press (INDIA) Private Limited 2018.

**Reference Books:**

1. Herbert Schildt, “The complete reference Java”, TataMc-Graw Hill, 7 th Edition.

**UCS009: Automata and Formal Languages****Credit Assigned:**

L	T	P	C
3	1	0	4

**Course Objectives:** This course introduces basic theory of computer science and formal methods of computation. The course exposes students to the computability theory, as well as to the complexity theory

**Course content:****Unit I: Alphabets, Strings and Languages:**

Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem.

**Unit II Regular expression (RE),**

Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

**Unit III Context free grammar (CFG) and Context Free Languages (CFL):**

Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

**Unit IV Push Down Automata (PDA):**

Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA.

**Unit V- Pointers**

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

**Text Books:**

1. Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
3. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.
4. Y. N. Singh "Mathematical Foundation of Computer Science", New Age International.
5. Papadimitrou, C. and Lewis, C.L., "Elements of the Theory of Computation", PHI Learning Private Limited, Delhi India.

**UCS010: Database Management Systems****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** Emphasis is on the need of database systems. Main focus is on E-R diagrams, relational database, concepts of normalization and de-normalization and SQL commands.

**Course content:****Unit I- Introduction**

Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

**Unit II- Relational data Model and Language**

Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

**Unit III- Data Base Design & Normalization**

Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design

**Unit IV- Transaction Processing Concept**

Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.

**Unit V- Concurrency Control Techniques**

Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

**Text Books:**

1. Korth, Silbertz, Sudarshan, "Database Concepts", McGraw Hill
2. Date C J, "An Introduction to Database Systems", Addison Wesley
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addison Wesley

**Reference Books:**

1. RAMAKRISHNAN "Database Management Systems", McGraw Hill
2. Leon & Leon, "Database Management Systems", Vikas Publishing House
3. Bipin C. Desai, "An Introduction to Database Systems", Gargotia Publications
8. Majumdar & Bhattacharya, "Database Management System", TMH

**UCS056: Design and Analysis of Algorithms Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** The objective of the course is to teach techniques for effective problem solving in computing. It covers good principles of algorithm design, elementary analysis of algorithms, and advanced data structures.

**List of Experiments:**

1. Data structures
2. Sorting
3. Maximum and minimum problem using divide and conquer strategy.
4. Binary search.
5. Heap Sort algorithm.
6. Kruskal's algorithm.
7. Prim's algorithm.
8. Matrix chain multiplication
9. Dijkstra's algorithm.
10. Bellman-Ford algorithm.
11. Depth-first search (DFS) on a graph.
12. Breadth-first search (BFS) on a graph.
13. Advanced data structures.
14. Illustrating the different paradigms of algorithm design.
15. Problems in string manipulation, graph theory, and optimization.

**Text Books:**

1. Data Structures & Program Design in C: Robert Kruse, G. L. Tondo and B. Leung PHI-IEEE.
2. Fundamentals of Data Structures in C : E. Horowitz, S. Sahni, and S. Anderson - Freed, University Press.

**Reference Books:**

1. Aho, Hopcroft and Ullmann, -Data Structures and Algorithms, II Addison Wesley. 983.

**UCS057 : Computer Organization Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** This course is designed to explore computing and to show students the art of design and analysis of the operation of digital gates. Students will learn design and implementation of combinational and sequential logic circuits ALUs.

**List of Experiments**

1. Introduction to gates
2. Ripple Carry Adder
3. Carry-look-ahead adder
4. Registers and Counters
5. Wallace Tree Adder
6. Combinational Multipliers
7. Booth's Multiplier
8. Arithmetic Logic Unit
9. Memory Design
10. Associative cache Design
11. Direct Mapped Cache Design
12. CPU Design
13. Mathematical expressions
14. File operations-1
15. File operations-2

**Text Books:**

1. M Moris Mano, "Computer System Architecture", Pearson Education, 3rd Ed. 1993.
2. David A. Patterson and John L. Hennessy, "Computer Organization & Design -The Hardware/Software Interface", Morgan Kaufmann, 2nd Ed. 1997.
3. William Stallings, "Computer Organisation and Architecture, Designing for Performance", Pearson Education Asia, 6th Ed. 2003.
4. Harry F. Jordan and Gita Alaghband, "Fundamentals of Parallel Processing", Pearson Education, 1st Ed. 2003. 5. Barry Wilkinson Michael Allen, "Parallel Programming", Prentice Hall, 1999

**Reference Books:**

1. William Stallings, "Computer Organisation and Architecture, Designing for Performance", Pearson Education Asia, 6th Ed. 2003.
2. Patterson, David A and Hennessy, John. L, "Computer Organization and Design", Morgan Kaufmann, 3rd Edition.

**CSC410: Object Oriented Programming using JAVA Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** To gain understanding of object-oriented programming (OOP) principles, explore their practical uses, and acquire knowledge of diverse algorithmic methods and approaches.

**List of Experiments**

1. Command Line Arguments
2. Scope of Variable Identifier
3. if Expression,
4. Nested if Expressions, if-else Expressions
5. Ternary Operator, Switch Statement
6. Iteration Statements, while Expression, do-while Loop, for Loop
7. Classes and Objects Modifiers
8. Class Members
9. Overloaded Methods
10. Overloaded Constructor
11. Inheritance
12. Exception Handling
13. Multithreaded Programming

**Text Books:**

1. E. Balagurusamy, "Programming with Java", TataMc-Graw Hill, 5th Edition.
2. Sagayaraj, Denis, Karthick and Gajalakshmi, "Java Programming for Core and advanced learners", Universities Press (INDIA) Private Limited 2018.

**Reference Books:**

1. Herbert Schildt, "The complete reference Java", TataMc-Graw Hill, 7 th Edition.

**UCS060: Database Management Systems Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** Emphasis is on the need of database systems. Main focus is on E-R diagrams, relational database, concepts of normalization and de-normalization and SQL commands.

**List of Experiments**

1. Installing oracle/ MYSQL
2. Creating Entity-Relationship Diagram using case tools.
3. Writing SQL statements Using ORACLE /MYSQL:
4.
  - (a) Writing basic SQL SELECT statements.
  - (b) Restricting and sorting data.
  - (c) Displaying data from multiple tables.
  - (d) Aggregating data using group function.
  - (e) Manipulating data.
  - (f) Creating and managing tables.
5. Normalization
6. Creating cursor
7. Creating procedure and functions
8. Creating packages and triggers
9. Design and implementation of payroll processing system
10. Design and implementation of Library Information System
11. Design and implementation of Student Information System
12. Automatic Backup of Files and Recovery of Files
13. Mini project (Design & Development of Data and Application ) for following :
  - (a) Inventory Control System.
  - (b) Material Requirement Processing.
  - (c) Hospital Management System.
  - (d) Railway Reservation System.
  - (e) Personal Information System.

**Text Books:**

1. Korth, Silbertz, Sudarshan, " Database Concepts", McGraw Hill
2. Date C J, "An Introduction to Database Systems", Addison Wesley
3. Elmasri, Navathe, " Fundamentals of Database Systems", Addison Wesley
4. RAMAKRISHNAN "Database Management Systems", McGraw Hill
5. Leon & Leon, "Database Management Systems", Vikas Publishing House
6. Bipin C. Desai, " An Introduction to Database Systems", Gargotia Publications
8. Majumdar & Bhattacharya, "Database Management System", TMH



**UCS011 : Software Engineering****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:**

The course objectives are designed to provide students with a comprehensive understanding of Software Engineering Practices, Process Models, and the Git Process flow. Through a structured curriculum, students will gain knowledge and proficiency in various aspects of software engineering, enabling them to comprehend and apply industry-standard practices.

**Course content:****Unit-I Introduction to Software Engineering:**

Software crisis and factors, Exploratory vs software engineering of product development, chunking, abstraction vs decomposition, importance of software engineering. Types of projects- -Product vs. Service. SE history, Evolution of design techniques- high level language, control flow design, structure programming, object-oriented design. Introduction to life cycle models.

**Unit-II Life Cycle Models:**

Role of Software Engineering, Software Evolution, Software Development Life Cycle. Software Process Models: Software process models, Software Specification, Software design and implementation, Software validation, Automated process support, The Waterfall Model- pros. Cons, The V Model, Sashmi models, Incremental Process Models and their types, Unified process models. Spiral Model. Specialized process models and the measurements on predictive and adaptive scales

**Unit-III Agile Framework:**

Agile Mind Set, principles of Agile methodology and various values. Types of agile frameworks. Agile Methodology- Scrum and Kanban frameworks introduction

**Unit-IV Unified Modelling language:**

Introduction to UML, concept of user stories in UML, Use Case Diagrams- association. Aggregations, composition, Activity diagrams, sequential diagrams, merge activity. Instability index and importance  
Data Flow Diagrams, Design modularity- Coupling and Cohesion concepts and their types.

**Unit-V Distributed version control system:**

Git- introduction, installation, need of Git for project management, Architecture of Git, how to start project using Git, cloning remote Git repository from GitHub, Git ignore files, file status lifecycle, commit and staging, unstaging, renaming and moving files in git, working on remote repository, branching concept in Git, push and pull of data through git.

**Text Books:**

1. Sommerville Ian, "Software Engineering", Addison-Wesley, Ninth Edition, 2011.
2. Pressman R. S., "Software Engineering: A Practitioners Approach", McGraw Hill, Seventh Edition, 2010.
3. Nartin Robert C. and Martin Micah, "Agile Principles, Patterns, and Practices in C#", Prentice Hall, 2007

**Reference Books:**

1. Sommerville, Ian, "Software Engineering", Addison-Wesley 9 th Edition, 2011.
2. Jalote Pankaj, "Software Project Management in practice", Pearson Education, New Delhi, 2002

**UCS012: Probability and Statistical & Numerical Methods**

Credit Assigned:			
L	T	P	C
3	1	0	4

**Course objective:** This course shall make the students familiar with the concepts of Probability, Statistics and Numerical Methods useful in implementing various computer science models. One will also be able to associate distributions with real-life variables and make decisions based on statistical methods.

**Course content:****Unit I Curve fitting and Numerical Solution of linear and non-linear algebraic equations:**

Fitting of (i) Straight line (ii) Second degree parabola (iii) Exponential curves. Gauss-Seidal iteration and LU decomposition method to solve a system of equations— Power method for finding largest Eigen value. Numerical solution of algebraic and transcendental equations by Bisection, Regula-Falsi method Newton-Raphson's method.

**Unit II Interpolation:** Lagrange interpolation, Forward, backward and central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Numerical differentiation,

**Unit III Numerical Integration and Solution:**

Trapezoidal rule. Simpson's 1/3 rule, Simpson's 3/8 rule. Solution of Initial value problems: Taylor series method, Euler's method, Runge-Kutta method of 2<sup>nd</sup> and 4<sup>th</sup> order.

**Probability and Statistical Methods:****Unit IV Random variables and their distributions:**

Random variables (discrete and continuous), probability functions, density and distribution functions, special distributions (Binomial, Hypergeometric, Poisson, Uniform, exponential and normal). Mean and variance. Chebyshev's inequality, joint probability mass function, marginal distribution function, joint density function.

**Unit V Hypothesis Testing:-**

Testing of Hypothesis: Testing of Hypothesis, Null and alternative hypothesis, level of significance, one-tailed and two-tailed tests, tests for large samples (tests for single mean, difference of means, single proportion, difference of proportions), tests for small samples (T, F and Chi-square tests), goodness of fit, contingency tables, analysis of variance (one way and two way classification), Non-parametric tests, regression, correlation.

**Text Books:**

1. Jain, Iyengar and Jain, *Numerical Methods for Scientific and Engineering Computation*, New Age International Publications, 2008.
2. Miller and Freund, *Probability and Statistics for Engineers*, Pearson, 2005.

**Reference Books:**

1. S.S. Sastry Introductory methods of Numerical Analysis PHI learning pvt ltd. 2018

**UCS013: Operating System****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to expose the principles and practice of operating system design and to illustrate the current design practices using DOS and UNIX operating systems. Students will understand the principle of operating system design and their memory allocation strategies.

**Course content:****Unit-I: Introduction and System Structures:**

Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure.

**Unit-II: Process Management:**

Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication, Multi-threaded programming: Multi-core Programming, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Algorithm Evaluation.

**Unit-III Deadlock:**

System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

**Unit IV- Memory Management:**

Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Allocating Kernel Memory.

**Unit V- File & Disk Management Systems:**

File abstraction. File naming. File system organization. File system optimization. Reliability. Security and protection. I/O management and disk scheduling. Recent trends and developments. Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure.

**Text Books:**

1. Galvin, Silberschatz and Gagne, "Operating System Concepts 10<sup>th</sup> edition", John Wiley and Sons, 2018.
2. Stallings, William, "Operating Systems –Internals and Design Principles 8<sup>th</sup> Edition", Pearson Publications, 2014.

**Reference Books:**

1. J. I. Peterson & A.S. Chatz: Operating System Concepts, Addison Wesley, 1985.

**UCS014: Computer Networks****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To build the fundamental concepts of computer network, networking devices and various networking protocols.

**Course content:****Unit I- Layered Network Architecture**

ISO-OSI Model, TCP/IP, Data Communication Techniques: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes.

**Unit II- Data Link Protocols**

Stop and Wait protocols, Noise free and Noisy Channels, Performance and Efficiency, Sliding Window protocols, MAC Sublayer: The Channel Allocation Problem, Carrier Sense multiple Access Protocols, Collision Free Protocols, FDDI protocol, Distributed Queue Dual Bus (DQDB) protocol, Virtual LAN.

**Unit III- Network Layer Protocols**

Design Issues: Virtual Circuits and Datagrams, Routing Algorithms, Optimality principle, Shortest path routing Algorithms, Flooding and Broadcasting, Distance Vector Routing, Link State Routing, Flow Based Routing, Multicast Routing; Flow and Congestion Control: General Principles, Congestion control in datagram subnets, Choke Packets, Load Shedding, Jitter Control, RSVP. Interworking: Bridges, Routers and Gateways, IP packet, IP routing

**Unit IV- Transport Layer Protocols**

Design Issues, Quality of Services, Introduction to sockets, Connection Management: Addressing, Connection Establishment and Releases, Use of Timers, Flow Control and Buffering, Multiplexing, The internet Transport Protocols: User Datagram protocol UDP/TCP Layering, Segment Format, Checks Sum, Timeout Connection Management.

**Unit V- Session Layer Protocol**

Dialog Management, Synchronization, OSI Session primitives, Connection Establishment. Introduction to network management: Remote Monitoring Techniques: polling, traps performance management, class of service, quality of service, security management, firewalls.

**Text Books:**

1. Forouzan, A., “Data Communication and Networking, Fourth Edition”, McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., “Computer Networks, Fifth Edition”, Prentice Hall, India, 2013

**Reference Books:**

1. Olifer, Natalia and Olifer Victor, “Computer Network: Principles, Technologies and Protocols for network design”, Wiley India Publication, 2006.
2. Kurose, James F. and Ross, Keith W., “Computer Networking: A Top-Down Approach”, Pearson Education; Sixth edition (30 June 2017).

**UCS015: Microprocessor and Interfacing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** The objectives of this course are to learn the basic concepts of architectures and instruction sets of 8085 and 8086 microprocessors, to discuss the interfacing of various peripheral devices with 8085 microprocessors.

**Course Content****Unit-I Introduction to Microprocessor:**

Terms used in microprocessor literature, History and Evolution of microprocessors, 8085 Architecture and its operations, Block diagram and Pins Diagram of 8085, Concept of Multiplexing and Demultiplexing in a microprocessor, Review: logic devices for Interfacing.

**Unit-II Assembly Language Programming and Timing Diagram:**

8085 programming model, Instruction format of 8085, Addressing modes, Instruction set, Instruction cycles, Machine cycles, T-states, Timing diagram of 8085 instructions, Programming techniques: Looping, Counting and Indexing, Counters and Time delays, Stack and Subroutines, Assembly language programming and its development tools.

**Unit-III Serial I/O and Interrupt Structure:**

Classification and sources of Interrupts in 8085, Issues in implementing interrupts: Priorities, Enabling, disabling and masking of interrupts, INTR and its expansion, Serial I/O using SID and SOD, Programmable interrupt controller- INTEL 8259: Interfacing with 8085 microprocessor, Functional block diagram, Processing and programming 8259, Initialization and Operation Command Words.

**Unit-IV Peripheral Devices and Interfacing:**

Programmable peripheral devices, Parallel data transfer schemes, Programmable peripheral interface- INTEL 8255, Concept of Handshaking, Direct memory access: DMA concept, DMA data transfer schemes, DMA controller – INTEL 8237, Interfacing keyboard and Seven Segment Display controller- INTEL 8279, Programmable Interval Timer- INTEL 8254, Interfacing A/D and D/A converters.

**Unit-V Memory Interfacing and 8086 Microprocessor:**

Addressing memory, interfacing static RAMs, Interfacing and refreshing dynamic RAMs. 8086 Microprocessor: Architecture, Pins and signals diagram of 8086, Comparison of 8085 and 8086 microprocessors, minimum and maximum mode in 8086, 8086 Flag register, Introduction to Pentium and further series of microprocessors.

**Text Books:**

1. Gaonkar, Ramesh S, "Microprocessor architecture, Programming and applications with 8085", 6th Edition, Prentice Hall, 2013.
2. A Nagoor Kani, "8085 microprocessor and Applications", 4th Edition, CBS publishers and Distributors Pvt Ltd, 2022.

**Reference Books:**

1. Ufferbeck John, "The 8080/85 Family: Design, Programming & Interfacing", PHI India.

**UCS016 : Compiler Design****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objectives:** To Gain the working knowledge of the major phases of compilation and develop the ability to use formal attributed grammars for specifying the syntax and semantics of programming languages. Learn about function and complexities of modern compilers and design a significant portion of a compiler.

**Course content:****Unit I- Introduction to Compiler**

Phases of Compilation – Lexical Analysis, Regular Grammar and regular expression for common programming language features, pass and Phases of translation, interpretation, bootstrapping, data structures in compilation – LEX lexical analyzer generator.

**Unit II- Parsing Technique**

Context free grammars, Top-down parsing – Backtracking, LL (1), recursive descent parsing, Predictive parsing, Preprocessing steps required for predictive parsing. Bottom-up parsing: Shift Reduce parsing, LR and LALR parsing, Error recovery in parsing, handling ambiguous grammar.

**Unit III- Syntax-Directed Translation**

**Semantic analysis:** Intermediate forms of source Programs – abstract syntax tree, polish notation and three address codes, Syntax directed translation, Conversion of popular Programming languages language Constructs into Intermediate code forms, Type checker. **Symbol Tables:** Symbol table format, organization for block structures languages, hashing, tree structures representation of scope information. Block structures and non-block structure storage allocation: static, Runtime stack and heap storage allocation, storage allocation for arrays.

**Unit IV- Code optimization & Data flow analysis**

**Code optimization:** Consideration for Optimization, Scope of Optimization, local optimization, loop optimization, frequency reduction, folding, DAG representation.

**Data flow analysis:** Flow graph, data flow equation, global optimization, redundant sub expression elimination, Induction variable elements, Live variable analysis, Copy propagation.

**Unit V- Code Generation**

Object code generation: Object code forms, machine dependent code optimization, register allocation and assignment generic code generation algorithms, DAG for register allocation.

**Text Books:**

1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. "Compilers Principles, Techniques and Tools". Pearson Education Limited Boston, 2014.
2. Hollub, Allen I. "Compiler Design in C". Prentice-Hall Inc. New Jersey, 1990.
3. AW Appel, M Ginsburg, "Modern Compiler Implementation in C". Cambridge University Press, 2004.

**Reference Books:**

1. Loudon, Kenneth C. "Compiler Construction: Principles and Practice". Course Technology, 1997.
2. Bennet, J.P. "Introduction to Compiler Techniques". Tata McGraw-Hill, 1990.
3. K Cooper, L Torczon, "Engineering a Compiler", 2nd Ed., Morgan Kaufmann, 2011.



**UCS061 : Software Engineering Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** The Software Engineering Lab is designed to provide students with practical expertise in software engineering methodologies throughout the project development life cycle. The objectives include understanding the application of software engineering concepts, practicing design using Unified Modelling Language (UML), and mastering code management through Git. By the end of the lab, students should be adept at real-time code management, ensuring they can effectively apply these skills in the development and collaborative management of software projects.

**List of Experiments**

1. Create user stories for the various real time scenarios
2. Identify Functional and Non-Functional requirements in a chosen Project(s)
3. Create user stories out of functional requirements for a chosen Project(s).
4. Create use case diagrams from the epics
5. Create Class diagrams for the use cases
6. Create Sequential diagrams for the class diagrams
7. Identify object states for classes(s) create State chart diagram for each identified object.
8. Identify various activities in a project and draw activity diagrams for corresponding Actions.
9. cloning remote Git repository from GitHub
10. commit and staging, unstaging using Git
11. Manage a Project using Git

**Text Books:**

1. Sommerville Ian, "Software Engineering", Addison-Wesley, Ninth Edition, 2011.
2. Pressman R. S., "Software Engineering: A Practitioners Approach", McGraw Hill, Seventh Edition, 2010.
3. Nartin Robert C. and Martin Micah, "Agile Principles, Patterns, and Practices in C#", Prentice Hall, 2007

**Reference Books:**

1. Jalote Pankaj, "Software Project Management in practice", Pearson Education, New Delhi, 2002.
2. Mall Rajib, "Fundamentals of Software Engineering", PHI Publication, Third Edition, 2009.



**UCS063: Operating System Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** This course is designed to expose the principles and practice of operating system design and to illustrate the current design practices using DOS and UNIX operating systems. Students will understand the principle of operating system design and their memory allocation strategies.

**List of Experiments:**

1. Implementation Of FCFS scheduling Algorithm
2. Implementation of Round Robin Algorithm
3. Implementation of SJF or SRT Algorithm
4. Implementation of Priority Scheduling Algorithm
5. Implementation of Semaphore and Monitor
6. Implementation Of Dead Lock Detection Algorithm(Banker's Algorithm)
7. Implementation of Process Synchronization(Sleeping Barber Problem)
8. Implementation of Process Synchronization(Dining Philosopher Problem)
9. Implementation of Process Synchronization( Readers Writers Problem)
10. Implementation of Page Replacement Algorithm FIFO
11. Implementation of Page Replacement Algorithm LRU
12. Implementation of Page Replacement Algorithm Optimal Page Replacement

**Text Books:**

1. Galvin, Silberschatz and Gagne, "*Operating System Concepts 10<sup>th</sup> edition*", John Wiley and Sons, 2018.
2. Stallings, William, "*Operating Systems –Internals and Design Principles 8<sup>th</sup> Edition*", Pearson Publications, 2014.

**Reference Books:**

1. Peterson & A.S. Chatz: Operating System Concepts, Addison Wesley, 1985.

**UCS064: Computer Networks Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** To build the fundamental concepts of computer network, networking devices and various networking protocols.

**List of Experiments**

1. Study of different types of Networks Cable and Practically Implement the cross-wired cable and straight-through cable using a clamping tool.
2. Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.
3. Install and configure Network Devices: HUB, Switch and Routers.
4. Connect the Computers in the Local Area Network.
5. Configure Host IP, Subnet Mask and Default Gateway in a System in LAN (TCP/IP Configuration)
6. Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.
7. Configure Internet connection and use IPCONFIG, PING / Tracer and Net stat utilities to debug the network issues.
8. Transfer files between systems in LAN using FTP Configuration, install a Print server in a LAN and share the printer in a network.
9. Router Configuration Using Packet Tracer.
10. Connection-oriented Client-server applications with TCP Assignment.
11. Connectionless Client-server applications with UDP Assignment.
12. Programs using RPC remote procedure call
13. Configure a Network Topology using packet tracer software.
14. Configure a Network using various Routing Protocol.
15. To get the MAC or Physical address of the system using Address Resolution Protocol.

**Text Books:**

1. Forouzan, A., "Data Communication and Networking, Fourth Edition", McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., "Computer Networks, Fifth Edition", Prentice Hall, India, 2013

**Reference Books:**

1. Olifer, Natalia and Olifer Victor, "Computer Network: Principles, Technologies and Protocols for network design", Wiley India Publication, 2006.
2. Kurose, James F. and Ross, Keith W., "Computer Networking: A Top-Down Approach", Pearson Education; Sixth edition (30 June 2017).

**UCS065: Microprocessor and Interfacing Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** The objectives of this lab are to learn the concepts of assembly language programming and then apply them to perform various operations using 8085 instructions sets.

**List of Experiments**

1. Write an assembly language program to perform the addition and subtraction of two 8-bit numbers.
2. Write an assembly language program to perform the addition and subtraction of two 8-bit numbers with carry/borrow.
3. Write an assembly language program to perform the addition of two 4-digit BCD numbers.
4. Write an assembly language program to perform the multiplication of two 8-bit and two 16-bit numbers by using repeated addition method.
5. Write an assembly language program to perform the division of two 8-bit and two 16-bit numbers by using repeated subtraction method.
6. Write an assembly language program to find the sum of all elements in an array stored in memory. The first element gives the number of elements in an array. Assume that the sum does not exceed 16-bit.
7. Write an assembly language program to find the square of given numbers in array stored in memory. The first element gives the number of elements in an array.
8. Write an assembly language program to find the smallest and largest number in an array stored in memory. The first element gives the number of elements in an array.
9. Write an assembly language program to sort an array in ascending /descending order stored in memory.
10. Write an assembly language program to convert a two-digit BCD (8-bit) data to binary data and vice-versa.
11. Write an assembly language program to find the square-root of 8-bit binary number.

**Text Books:**

1. Gaonkar, Ramesh S, "Microprocessor architecture, Programming and applications with 8085", 6th Edition, Prentice Hall, 2013.
2. A Nagoor Kani, "8085 microprocessor and Applications", 4th Edition, CBS publishers and Distributors Pvt Ltd, 2022.

**Reference Books:**

1. Ufferbeck John, "The 8080/85 Family: Design, Programming & Interfacing", PHI India.

**UCS066 : Compiler Design Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objectives:** To Gain the working knowledge of the major phases of compilation and develop the ability to use formal attributed grammars for specifying the syntax and semantics of programming languages. Learn about function and complexities of modern compilers and design a significant portion of a compiler.

**List of Experiments**

1. Conversion of infix notation to postfix notation.
2. To Recognize declarative statements
3. Program to recognize arithmetic expression
4. Program to Check valid If statements in C program and report errors to users
5. Program to Check for un terminated, multi line comment statements in C program
6. To Create an assembler that will display warning/errors when symbols are used but not defined and vice versa
7. Write a program that will create and display content of Symbol table
8. Implementation for lexical analyzer
9. Write a C program to implement type checking
10. Implement Predictive parser using C.

**Text Books:**

1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. *"Compilers Principles, Techniques and Tools"*. Pearson Education Limited Boston, 2014.
2. Hollub, Allen I. *"Compiler Design in C"*. Prentice-Hall Inc. New Jersey, 1990.
3. AW Appel, M Ginsburg, *"Modern Compiler Implementation in C"*. Cambridge University Press, 2004.

**Reference Books:**

1. Louden, Kenneth C. *"Compiler Construction: Principles and Practice"*. Course Technology, 1997.
2. Bennet, J.P. *"Introduction to Compiler Techniques"*. Tata McGraw-Hill, 1990.
3. K Cooper, L Torczon, *"Engineering a Compiler"*, 2nd Ed., Morgan Kaufmann, 2011.

**UCS017: ENTERPRISE JAVA****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objectives:** To gain understanding and designing of Applet, Servlet, JAVA Beans and APIs,

**Course content:**

**Unit 1- Understanding Java EE:**

Java EE Technologies, Server and Containers: Types of System Architecture, Java EE Server, Java EE Containers. Introduction to Java Servlets, servlet API and Lifecycle, Getting Started, Using Annotations Instead of Deployment Descriptor. Working with Databases: JDBC Architecture, Accessing Database, The Servlet GUI and Database.

**Unit 2- Request Dispatcher:**

Interface, Methods and Application. COOKIES: Creating Cookies Using Servlet, Dynamically Changing the Colors of a Page, SESSION: Lifecycle of Http Session, Session Tracking, Working with Files: Uploading Files, Creating an Upload File Application, Downloading Files, Creating a Download File Application. Working with Non-Blocking I/O: Creating a Non-Blocking Read Application, Creating The Web Application, Creating Java Class, Creating Servlets, Retrieving The File, Creating index.jsp

**Unit 3- Introduction To Java Server Pages:**

Java Server Pages, JSP v/s Servlets, Life Cycle of a JSP Page, Java Server Pages: Comments, JSP Document, JSP Elements, JSP GUI. Action Elements: Including other Files, Forwarding JSP Page to Another Page, Passing Parameters for other Actions, Loading a Javabeen. Implicit Objects, Scope and El Expressions: Implicit Objects, Character Quoting Conventions, Unified Expression Language [Unified El], Expression Language

**Unit 4- Introduction To Enterprise Javabeans:**

Enterprise Bean Architecture, Application, Session Beans: Remote and Local Interfaces, Accessing Interfaces, Message Driven Beans: Lifecycle of a Message Driven Bean, Uses of Message Driven Beans, Interceptors: Request and Interceptor, Defining An Interceptor, AroundInvoke Method, Applying Interceptor, Adding An Interceptor To An Enterprise Bean, Build and Run the Web Application. Java Naming and Directory Interface.

**Unit 5- Persistence, Object/Relational Mapping And JPA:**

Persistence in Java, Current Persistence Standards in Java, Object/Relational Mapping, Introduction to Java Persistence API: The Java Persistence API, JPA, ORM, Database and the Application, Architecture of JPA, JPA Specifications. Writing JPA Application: Application Requirement Specifications, The Application Development Approach, Creating Database and Tables in Mysql, creating a Web Application, Adding the Required Library Files, creating a Javabeen Class, Creating Persistence Unit [Persistence.Xml], Creating JSPS, Running the JPA Application. Introduction to Hibernate: Database and The Application, Creating Database and Tables in Mysql, creating a Web Application.

**Text Books:**

1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. "Compilers Principles, Techniques and Tools". Pearson Education Limited Boston, 2014.
2. Herbert Schildt, "The complete reference Java", TataMc-Graw Hill, 7 th Edition.
3. Hollub, Allen I. "Compiler Design in C". Prentice-Hall Inc. New Jersey, 1990.
4. AW Appel, M Ginsburg, "Modern Compiler Implementation in C". Cambridge University Press, 2004.

**Reference Books:**

1. Loudon, Kenneth C. "Compiler Construction: Principles and Practice". Course Technology, 1997.
2. Bennet, J.P. "Introduction to Compiler Techniques". Tata McGraw-Hill, 1990.

**UCS018: Information Security**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objectives:** Learn the principles of information security to protect the confidentiality, integrity, and availability of information. Discuss the modes of threats and attacks on information systems, threat mitigation, cryptography, user identification and authentication, access control, privacy laws, and more.

**Course content:****UNIT-I: Information and Security**

Computer Security Concepts, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy.

**UNIT- II : Information and Security:**

Information Systems: Recent History, Trends, Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles, Privacy of Data.

**UNIT-III : Network and system security**

Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Non malicious Program errors- Buffer overflow, Incomplete mediation, Time-of-check to Time-of use Errors, Viruses, Trapdoors, Salami attack, Man-in-middle attacks, Covert channels

**Unit -IV : Database Security**

The need for Database Security, RDBMS and SQL Injection attacks, Database Access Control, Inference, Database Encryption.

**Unit -V : Firewalls and Intrusion Detection and Prevention Systems**

Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Biasing, Firewall Location and Configuration, Intrusion. Detection Systems, Intrusion Prevention Systems, Unified Threat Management Products.

**Text Books:**

1. Godbole, "Information Systems Security", Wiley
2. Merkov, Breithaupt, "Information Security", Pearson Education

**References:**

1. Yadav, "Foundations of Information Technology", New Age, Delhi

**UCS019 : Mathematics for Data Science****Credit Assigned:**

L	T	P	C
3	1	0	4

**Course Objectives:** Probability and Statistics plays a vital role in computing and computational intelligence. Knowledge of these topics is critical to decision making and to the analysis of data. Using concepts of probability and statistics, individuals are able to predict the likelihood of an event occurring, organize and evaluate data.

**Course content:****Unit-I: Algebra of Sets:**

sets and classes, limit of a sequence of sets, rings, sigma-rings, fields, sigma fields, monotone classes. Vector spaces, subspace, linear dependence and independence of vectors, Matrices projection matrices.

**Unit-II Probability:**

Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, problems, Random variable, some common discrete and continuous distributions (Binomial, Poisson, Negative binomial, Geometric, Rectangular, Exponential, Normal, Gamma).

**Unit-III: Bi-variate Probability Distribution:**

Probability distribution of functions of a random variable, joint and marginal distributions, conditional distributions.

**Correlation and Regression:** Covariance, Karl-Pearson and rank Correlation coefficients; linear regression between two variables.

**Unit-IV: Estimation:**

Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions.

**Unit-V: Hypothesis tests:**

Introduction to Sampling Distribution (standard normal, chi-square, t & F distributions), Theory of Estimation, Properties of an estimator, Tests for Goodness of fit: Method of maximum likelihood, Neyman-Pearson lemma (without proofs); Critical regions.

**Parametric & Non-parametric tests:** Based on Chi-square Test, one sample and paired sample tests; Sign Test, Signed-rank Test, Kolmogorov Smirnov Test

**Text Books:**

1. Meyer P. L., Introduction to Probability and Statistical Applications, Oxford & IBH, 2007.
2. Hogg, R. V. and Craig, A.T., Introduction to Mathematical Statistics, Prentice Hall of India, 2004.
3. S.M. Ross, A First Course in Probability, 9th edition, Pearson, 2012.
4. Walpole, R. E., Myers, R. H., Myers, S. L. and Ye, K., 1993. Probability and statistics for engineers and scientists, Pearson, 2010.



**UCS020 : Professional Communication and Soft Skills**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course Objective :** To enhance the holistic development of students and improve their understanding in various concepts of Professional communication and soft skills like team building, negotiation skills and stress & time management.

**Course content:****Unit-I Introduction to Soft Skills & Professional ethics:**

Definition and meaning of Soft Skills & Professional ethics, Aspects of Soft Skills, Effective Communication Skills, Importance of Professional Ethics.

**Unit-II Team Building:**

Definition of team, types of teams, personal and professional goals of the members of the group, interpersonal communication in Teams, Negotiation: Definition and types of negotiating, language and non-verbal communication in teams.

**Unit-III Organizing Meetings:**

How to call the meeting, organize a meeting, designing the agenda and prepare minutes of the meeting.

**Unit-IV Presentation Skills:**

Reading, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation.

**Unit-V Stress Management & Time Management:**

Kinds of stress, reasons of stress, Goal setting, Understand the importance of time management. Group Discussion: Nature of discussion, interview skills.

**Text Books:**

1. Rizvi, Ashraf., “*Effective Technical Communication*”, Tata McGraw Hill ,2008.
2. Mohan, Krishan., “*Developing Communication Skills*”, Mac Millan India Limited, 2009.

**Reference Books**

1. Dale, Carnegie., “*How to win Friends and Influence People*”, New York: Simon &Schuster, 1998.
2. Coleman, Daniel. “*Emotional Intelligence*”. Bantam Book, 2006.

**UCS021 : Machine Learning****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course objective is to provide an overview of Machine Learning and its application in real life. The primary objective is to introduce student to the fundamental principles and methodologies of Machine Learning.

**Course content:****Unit I- Introduction to Machine Learning Pipeline**

Introduction to Machine learning Pipeline, Problem definition, Data ingestion, Data preparation, Data segregation, Candidate model selection Model deployment, Performance monitoring.

**Unit II- Basics of Feature Engineering**

Feature Selection and Feature Engineering- Univariate selection, Correlation heatmaps, Wrapper-based methods, Filter-based methods, Embedded methods, Feature engineering-Imputation, Outlier management, One-hot encoding, Log transform, Scaling, Data manipulation.

**Unit III- Supervised Learning**

Supervised versus unsupervised learning, classification, Preprocessing data, Binarization, Mean removal, Scaling, Normalization, Label encoding, Logistic regression classifiers, k - Nearest Neighbour (KNN), The Naïve Bayes classifier, Confusion matrixes, Support Vector Machines. Decision tree, Building a decision tree classifier, Building a decision tree classifier, random forests, Regression- Simple, Multiple linear regressions, Problems in Regression Analysis.

**Unit IV- Unsupervised Learning**

Introduction, Applications, Clustering as a machine Learning task, clustering types, partitioning methods, k-medoids, hierarchical clustering, and density based methods, Association rules, a priori algorithm for association rule learning.

**Unit V- ML Evaluation Technique**

Classification metrics- Accuracy, confusion matrix, Per-class accuracy, log-loss, AUC, Ranking Metrics-Precision-Recall, Precision-Recall Curve and the F1 Score, NDCG Regression Metrics RMSE, Quantiles of Error, difference between Training metrics and Evaluation Metrics. Offline Evaluation Mechanisms: Hold-Out Validation, Cross Validation, and Bootstrapping  
Function and parameter passing, recursive functions, macros.

**Text Books:**

1. Saikat Dut, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning, 2020 Edition", Pearson, 2020.
2. Tom, Mitchell, "Machine Learning", McGraw-Hill, 2017.

**Reference Books:**

1. Ethem, Alpaydin, "Introduction to Machine Learning", PHI, 2005.
2. H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, 2000

**UCS067: ENTERPRISE JAVA Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objectives:** To gain understanding and designing of Applet, Servlet, JAVA Beans and APIs,

**List of Experiments:**

1. Java Database Connectivity (JDBC): JDBC Product, Types of Drivers, Two-Tier Client/Server Model, Three-Tier Client/Server Model, Basic Steps of JDBC, Creating and Executing SQL Statement, The Result Set Object, Working with Database MetaData Interface
2. Java Servlets: Servlet Interaction & Advanced Servlets, Life cycle of Servlet, Java Servlet Development Kit, javax.servlet package, Reading Servlet Parameters, Reading Initialization Parameters, The javax.servlet.http Package, Handling HTTP.
3. Java Server Pages (JSP): JSP Technologies, Understanding the Client-Server Model, Understanding Web server software, Configuring the JSP Server, Handling JSP Errors, JSP Translation Time Errors, JSP Request Time Errors, Creating a JSP Error Page
4. Remote Method Invocation (RMI): RMI Architecture, Designing RMI application, Executing RMI application
5. Enterprise Java Beans (EJB): Types of EnterpriseJava beans, Session Bean & Entity Bean, Features of Session Bean, Life-cycle of Stateful Session Bean, Features of Entity Bean, Life-cycle of Entity Bean, Container-managed Transactions & Bean-managed Transactions, Implementing a container-managed Entity Bean
6. Struts: Introduction to the Apache Struts, MVC Architecture, Struts Architecture, How Struts Works? Introduction to the Struts Controller, Introduction to the Struts Action Class, Using Struts ActionFrom Class, Using Struts HTML Tags, Introduction to Struts ValidatorFramework, ClientSide Address Validation in Struts, Custom Validators Example, Developing Application with Struts Tiles
7. Hibernate: Introduction to Hibernate 3.0, Hibernate Architecture, First Hibernate Application.

**Text Books:**

1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. "Compilers Principles, Techniques and Tools". Pearson Education Limited Boston, 2014.
2. Herbert Schildt, "The complete reference Java", TataMc-Graw Hill, 7 th Edition.
3. Hollub, Allen I. "Compiler Design in C". Prentice-Hall Inc. New Jersey, 1990.
4. AW Appel, M Ginsburg, "Modern Compiler Implementation in C". Cambridge University Press, 2004.

**Reference Books:**

1. Loudon, Kenneth C. "Compiler Construction: Principles and Practice". Course Technology, 1997.
2. Bennet, J.P. "Introduction to Compiler Techniques". Tata McGraw-Hill, 1990.

**UCS068 : Information Security Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objectives:** Learn the principles of information security to protect the confidentiality, integrity, and availability of information. Discuss the modes of threats and attacks on information systems, threat mitigation, cryptography, user identification and authentication, access control, privacy laws, and more.

**List of Experiments**

1. Make an experiment to implement WEP/WPA2 PSK, 802.1x EAP security protocol.
2. Implement firewall through App to login into bank-site,; to implement E-commerce, debit card transaction through payment gateway
3. Implement bio-metric system to have physical security through different access control permissions.
4. Implement RSA algorithm.
5. Implement DES algorithm
6. Implement Diffie-Hellman algorithm
7. Make a study of anyone simulation tool based on parameters of information security
8. Implement VPN through Packet-Tracer or any other network simulator tool

**Text Books:**

1. Godbole," Information Systems Security", Wiley
2. Merkov, Breithaupt," Information Security", Pearson Education

**UCS071: Machine Learning Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** To Implement various Machine Learning Models using Python/R

**List of Experiments**

1. Implement Feature Selection methods such as- feature importance, correlation, heat maps.
2. Implement feature engineering methods such as - Imputation, One-hot encoding.
3. Implement Scaling methods such as Normalization, Standardization.
4. Implement pre-processing techniques such as – Binarization, mean removal, scaling.
5. Implement label Encoding for any dummy dataset.
6. Implement logistic regression classifier.
7. Implement naïve Bayes classifier.
8. Implement Support Vector machine.
9. Implement decision Trees classifier.
10. Implement Random Forest.
11. Implement k mean algorithm for unsupervised learning.

**Text Books:**

1. Saikat Dut, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning, 2020 Edition”, Pearson, 2020.
2. Tom, Mitchell, “Machine Learning”, McGraw-Hill, 2017.

**Reference Books:**

1. Ethem, Alpaydin, “Introduction to Machine Learning”, PHI, 2005.
2. H. Witten and E. Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann, 2000

**UCS022: Artificial Intelligence****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To enable the students to understand Artificial Intelligence principles in Depth. By the end of this course, student will be able to implement various AI based concepts and algorithms.

**Course content:****Unit I-Introduction to Artificial Intelligence**

Basic concept of artificial intelligence (AI), history of AI, AI and consciousness, weak and strong AI, physical symbol, comparison of computer and human skills, practical systems based on AI, development of logic, components of AI.

**Unit II-Problem Solving Agents**

Introduction to Agents, AI agents and Environment, Intelligent agents, Structure of Intelligent Agent, PEAS representation, Types of AI agents- Simple Reflex agent, Model based reflex agent and Goal based agent.

Problem Solving Agents – state space problem, Problem and its components, Example of problem solving Agents.

**Unit III-Search Strategies**

Acting Under Uncertainty, Bayes Theorem, Uninformed Search Strategies - Breadth First Search, Uniform Cost Search, and Depth First Search.

Informed Search Strategies- Introduction, A\* Search Algorithm and example, Heuristic Function -

Admissibility and Consistency, Memory Bound Search Strategies.

Hill Climbing Algorithm- Features, state-space diagram, regions in state space landscape, types of hill climbing algorithm.

**Unit IV- Intelligent Agents**

Introduction, Alpha Beta Pruning: condition, working, and Move Ordering. Min Max Algorithm: working, properties and limitations. Knowledge based agent: introduction, architecture, inference system, levels of knowledge-based agent.

**Unit V- Reasoning in Artificial Intelligence**

Reasoning, types of reasoning: deductive, inductive, abductive, common sense, monotonic, and non-monotonic reasoning. Uncertainty in Artificial Intelligence, causes of uncertainty.

**Text Books:**

1. Russel and Norvig, Artificial intelligence A Modern Approach, 2nd Edition, Pearson Printice Hall.

**Reference Books:**

1. Kevin Knight, Elaine Ric, Artificial Intelligence, Tata mcgraw Hill publishing house, 2017
2. Winston, Artificial Intelligence, PHI publication, 2006.

**UCS023 : Distributed Database and Cloud Computing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course objective is to provide an overview of Distributed database and cloud computing and its application in real life. The primary objective is to introduce student to the fundamental principles and methodologies of Distributed database and cloud computing.

**Course content:****Unit 1- Cloud Computing Basics**

Cloud Computing overview, Applications, Service Delivery Models- SaaS and its examples, Platform as a Service (PaaS), Infrastructure as a Service (IaaS). Deployment Models- Public, Private and Hybrid, Community, Models, Benefits, Limitations and Security Concerns in the Cloud.

**Unit II- Cloud Storage and Policies**

Cloud Storage and its types, Provisioning Storage, Protection Capabilities, Storage Features, Access Protocols, Storage Security, Disaster Recovery Capabilities, Disaster Recovery Considerations, Business Continuity Plan. Compute Introduction, CPU Capabilities, Memory Requirements, Performance Considerations, Cost Considerations.

**Unit III- Cloud Security**

Cloud Security introduction, Challenges, Risks, Cloud Security Alliance Guidance, Security Policies, Standards and Compliance, Identity, Authentication, and Authorization, Multi-Factor Authentication.

**Unit IV- Maintaining Cloud Solutions**

Migration Types, Workload Management, Virtualizing Physical Systems, Migrating Security, Protocols and Services, Environmental Constraints, Technical policies in cloud, cloud governance model, different cloud threats, cloud compliance and considerations. Cloud control challenges.

**Unit V- Applications of Distributed Databases and Cloud Computing**

Distributed databases in e-commerce, Distributed databases in healthcare, Distributed databases in manufacturing, Cloud computing in e-commerce, Cloud computing in healthcare, Cloud computing in manufacturing.

**Text Books:**

1. **Distributed Databases:** Principles and Systems, 2nd Edition, by Özsu and Valduriez.
2. **Cloud Computing:** Principles and Paradigms, 2nd Edition, by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.

**Reference Books:**

1. **Distributed Databases:** 2nd Edition, by Ceri and Pelagatti.
2. **Cloud Computing:** Principles and Paradigms, by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.



**UCS072 : Artificial Intelligence Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** To get familiarize with advanced topics of the Artificial Intelligence.

**List of Experiments**

1. Write a program to traverse a Tree or Graph using Breadth First Search Algorithm.
2. Write a Program to traverse a Tree or Graph using Depth First Search Algorithm.
3. Write a Program to traverse a Tree or Graph using Uniform Cost Search Algorithm.
4. Write a program to traverse a Tree or Graph using Greedy Best First Search Algorithm.
5. Write a Program to traverse a Tree or Graph using A\* Search Algorithm.

**Implement following problems using Prolog-**

6. Check if a given element is present in the List or not .
7. Find total number of elements in a list.
8. Check if a list is sorted or not.

**Text Books:**

1. Russel and Norvig, Artificial intelligence A Modern Approach, 2nd Edition, Pearson Printice Hall.

**Reference Books:**

1. Kevin Knight, Elaine Ric, Artificial Intelligence, Tata mcgraw Hill publishing house, 2017
2. Winston, Artificial Intelligence, PHI publication, 2006.

**UCS024: Data Analytics & Visualization****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** Ability to manage, manipulate, clean, and analyze different types of data. And Ability to visualize data using different visualization techniques. Ability to develop dashboards for real-time data sets. Ability to understand data correlation, reduction, prediction, and summarization.

**Course content:****Unit-I: Introduction to Data Analytics:**

Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics.

**Data Analytics Lifecycle:** Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.

**Unit-II: Data Preprocessing:**

Data Cleaning and Data Integration: Missing Values, Noisy Data, Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution

**Unit-III: Data Reduction and Data Transformation:**

Overview of Data Reduction Strategies, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation, Data Transformation by Normalization, Discretization by Binning, Discretization by Histogram Analysis, Discretization by Cluster, Decision Tree, and Correlation Analyses, Concept Hierarchy Generation for Nominal Data.

**Unit-IV: Data Visualization:**

Visualizing Data Distribution- Distribution Function, Histograms, Percentiles, Box Plots, Stratification, Heat Map, Correlation Statistics, ANOVA, Data Visualization Practices- Scatter plots, Faceting, Data Transformation, Visualizing Multimodal Distributions, Data Visualization Principles.

**Unit-V: Analysis Techniques:**

Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R/Python.

**Analysis of time series:** linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalization, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.

**Text Books:**

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining Concepts and Techniques, (3rd Ed.), Morgan Kaufmann.
2. Rafael A. Irizarry, "Introduction to Data Science", CRC Press, 2019.
3. Roger D. Peng R Programming for Data Science Reference Books: Trevor Hastie Robert, Tibshirani Jerome Friedman, The Elements of Statistical Learning, Springer

**UCS074 : Data Analytics & Visualization Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** To get familiarize with advanced topics of the Data Analytics & Visualization approaches. .

**List of Experiments**

1. Find the statistical measures of central tendency and dispersion such as min(), max(), mean(), median(), quantile(), sd(), var() and summary() for real world datasets.
2. Demonstrate the different data visualization techniques. (Scatter Plot, Horizontal Bar Chart, Histogram, Visualization of Time Series data (Line Graphs) for applications such as weather analysis.
3. Perform the chi-square test and ANOVA F-test on datasets.
4. Acquiring and plotting data.
5. Multivariate Analysis, Correlation, regression and analysis of variance.
6. Financial analysis Clustering, Histogram and Heat Map.
7. Time-series analysis Stock Market.
8. Visualization of various massive dataset Healthcare, Census, Geospatial.
9. Visualization on Streaming dataset Stock market, weather forecasting.
10. Market-Basket Data analysis-visualization
11. Text visualization using web analytics.

**Text Books:**

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining Concepts and Techniques, (3rd Ed.), Morgan Kaufmann.
2. Rafael A. Irizarry, "Introduction to Data Science", CRC Press, 2019.
3. Roger D. Peng R Programming for Data Science Reference Books: Trevor Hastie Robert, Tibshirani Jerome Friedman, The Elements of Statistical Learning, Springer.

**UCS101: Data Warehousing and Data Mining**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objective:** This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs

**Course content:****Unit I- Introduction:**

Data Mining Concepts, Input, Instances, Attributes and Output, Knowledge Representation & Review of Graph Theory, Lattices, Probability & Statistics.

**Unit II- Data Warehousing Basics**

An overview of data warehousing and OLAP technology and decision support, Data Warehouse Constructs and Components, Data cube: a relational aggregation operator generalizing group-by, cross-tabs and subtotals, Dimensional Modeling, Data Cleaning, Data Integration, Record Linkage, The Merge/Purge Problem for Large Databases.

**Unit III- Query Processing SQL Server Query Processor**

Overview, Star Queries, Merge Join and Hash Join, Bitmap Indexes and Compression, Improved Query Performance, Bitmap indexes, projection indexes, and bit-sliced indexes, Performance Measurements of Compressed Bitmap Indices

**Unit IV- Quality Factors**

Quality factors of data warehouse and its evaluation, supporting data mining tasks, partitioning the data, Data warehouse CRM applications, Data warehouses in practice

**Unit V- Mining Complex Types of Data**

Multidimensional analysis & Descriptive mining of Complex data objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-series & Sequence data, Mining Text databases, Mining World -Wide Web. Data Mining Applications and Trends in Data Mining Massive Datasets/Text mining, Agent-Based Mining, Variance Analysis and MLE, F-test, Techniques of Analysis of Variance, Analysis of Variance in two-way Classification Model.

**Text Books:**

1. Inmon W. H.: Building the Data Warehouse, Wiley & Sons, 2002.
2. Zaki, Mohammed J., and Wagner Meira Jr. Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press, 2014.

**Reference Books:**

1. Jiawei Han, Micheline Kamber, Jian Pei : Data Mining: Concepts and Techniques, 2011

**UCS102 : Big Data****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to understand the Big Data Platform and its Use cases and apply analytics on Structured and Unstructured Data. It also helps to Acquire the knowledge and working on Big Data platforms

**Course content:****Unit I- Fundamentals of Business Analytics-Business Intelligence (BI),**

Business Intelligence vs. Business Analytics, BI Framework, BI Roles & Responsibilities, BI DW Best Practices, Popular BI Tools, BI Applications, Enterprise Reporting

**Unit II- Characteristics in OLAP World,**

Balanced Scorecard, Dashboards, Multidimensional Data Modelling (MDDM), SMART test, Measures, Metrics, KPIs, and Performance Management, Supply chain, Fact-based decision making and KPIs, Mapping metrics to business phases, Malcolm Baldrige Criteria for Performance Excellence Framework, Typical enterprise application architecture

**Unit III- Visualizing Relationship in Data,**

Probability, Estimation, Outliers and Normal Distribution, Inference, Regression, Exploratory Data Analysis (EDA), Big Data, Scaling Problems, HDFS, Design Patterns

**Unit IV- Cluster Data Statistics-**

Visualizing relationship in Data, Estimation, Outliers and Normal Distribution, Inference, Regression Big Data Analytics-In Memory Analytics, In-Database Processing

**Unit V- Symmetric Multiprocessor System (SMP),**

Massively Parallel Processing, Shared Nothing Architecture, Parallel and Distributed Systems, CAP Theorem, NoSQL Big Data Analytics Tool- Hadoop, MongoDB, Cassandra, MapReduce, Hive, Pig, JasperReport

**Text Books:**

1. Fundamentals of Business Analytics by R.N. Prasad, Seema Acharya, Wiley.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses by Michael Minelli, Michele Chambers, Ambiga Dhiraj

**Reference Books:**

1. An Introduction to Data Science by Jeffery Stanton.
2. Big Data and Analytics by Seema Acharya, Subhashini Chellapan

**UCS151: Data Warehousing and Data Mining Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs

**List of Experiments:**

1. Building a Database Design using ER Modeling and Normalization Techniques
2. Implementation of functions ,Procedures, Triggers and Cursors
3. Load Data from heterogeneous sources including text files into a predefined warehouse schema.
4. Design a data mart for a bank to store the credit history of customers in a bank .Use this credit profiling to process future loan applications.
5. Feature Selection and Variable Filtering (for very large data sets)
6. Association Mining in large data sets
7. Interactive Drill-Down, Roll up, Slice and Dice operations
8. Generalized EM &k-Means Cluster Analysis
9. Generalized Additive Models (GAM)
- 10.General Classification and Regression Trees (GTrees)
- 11.General CHAID (Chi-square Automatic Interaction Detection) Models
- 12.Interactive Classification and Regression Trees
- 13.Goodness of Fit Computations

**Text Books:**

1. Inmon W. H.: Building the Data Warehouse, Wiley & Sons, 2002.
2. Zaki, Mohammed J., and Wagner Meira Jr. Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press, 2014.

**Reference Books:**

1. Jiawei Han, Micheline Kamber, Jian Pei :Data Mining: Concepts and Techniques,· 2011

**UCS152 : Big Data Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** This course is designed to understand the Big Data Platform and its Use cases and apply analytics on Structured and Unstructured Data. It also helps to Acquire the knowledge and working on Big Data platforms

**List of Experiments:**

1. Install, configure and run python, numPy and Pandas.
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
5. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
6. Implement word count / frequency programs using MapReduce.
7. Implement a MapReduce program that processes a dataset.
8. Implement clustering techniques using SPARK.
9. Implement an application that stores big data in MongoDB / Pig using Hadoop

**Text Books:**

1. Fundamentals of Business Analytics by R.N. Prasad, Seema Acharya, Wiley.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses by Michael Minelli, Michele Chamber, Ambiga Dhiraj

**Reference Books:**

1. An Introduction to Data Science by Jeffery Stanton.
2. Big Data and Analytics by Seema Acharya, Subhashini Chellapan



**USC103 : Organizational Behavior****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To develop an insight into the nature and meaning of Organizational Behavior and provide the learner with theoretical foundations of Organizational Behavior. Enhance learner efficacy by raising their understanding of basic concepts in Organizational Behavior -stress, conflict, group dynamics etc.

**Course content:****Unit – I: Introduction to Organizational Behavior:**

Management and Organizational Behavior, Theories of Management, Major Behavioral Science that contribute to Organizational Behavior-Psychology, Sociology, Socio-Psychology, Political Science, Anthropology, Organizational structure, Dynamics of People and Organization, Models of Organizational Behavior, Hawthorne studies, Challenges and opportunities in Organizational Behavior.

**Unit-II Motivation, Personality & Perception:**

Motivation-Motivation and Behavior, theories of Motivation, Reinforcement theory, Organizational Learning Process, Motivation and performance, Financial and Non-financial incentives, Personality Determinants of personality, Type A and Type B personality, Values, Attitudes & Beliefs, Argyris's Maturity-Immaturity Continuum, Perception-Motivation and Perception, Meaning, Need of Perceptual process, Factors influencing Perceptual process, self-concept and self-esteem.

**UNIT-III: Group Dynamics and Stress Management:**

Group Dynamics-Team & Group difference, Group Effectiveness, Formal & Informal Group, Stages of Group Development, Group Decision Making, Inter group relation and Conflict, Stress Management-Stress and Behavior, Sources of Stress, Consequences of Stress and Performance.

**Unit – IV : Leadership, Conflict Management and Power & Politics:**

Leadership-Introduction and characteristics of Leadership, Formal and Informal leadership, Theories of Leadership, Conflict Management-Nature of Conflict, Sources of Organizational Conflict, Modes of Conflict Resolution, Conflict Management, Power & Politics-Difference between Influence, Power & Authority, Sources of power, Organizational Politics, Machiavellianism, Ethics of Power and Politics in Organizations.

**Unit – V : Organization Development and Culture:**

Organizational Change, Resistance to change, Steps for planned change, Quality Work Life, Organization Development Objective and Interventions, Organization Climate and Organizational Effectiveness, Managing Organizational Culture.

**Text Books:**

1. Uma Sekaran, Organizational Behavior, Tata McGraw Hill
2. John W Newstrom, Organizational Behavior, Tata McGraw Hill
3. Stephen P. Robbins, Timothy A. Judge, Niharika Vohra (18th ed.), Pearson Education, New Delhi
4. L. M. Prasad, Organizational Behavior, Sultan Chand & Sons

**Reference Books:**

1. Banerjee, Mrityunjay (1995). Organization Behavior. Allied Publication: New Delhi.
2. Newstrom, John W and Keith, Davis (1999). Organization Behaviour. Tata McGraw Hill: New Delhi.
3. Pareek, Udai and Khanna, Sushama (2016). Understanding Organizational Behaviour. 4th ed., Oxford University Press: New Delhi.

**UCS104 : Professional Ethics****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To enable the students to create an awareness on Engineering Ethics and Human Values and instill Moral and Social Values and loyalty and to appreciate the rights of others.

**Course content:****Unit-I Human Values**

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

**Unit-II Engineering Ethics**

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.

**Unit-III Engineering as Social Experimentation**

Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

**Unit-IV Safety, Responsibilities and Rights**

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Plagiarism, Discrimination.

**Unit-V Global Issues**

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

**Text Books:**

1. Martin Mike W., Schinzinger Roland, "Ethics in engineering", Tata Mc Graw Hill, 4<sup>th</sup> Editin, 2005.
2. Govindarajan M., Natarajan S., Senthilkumar V.S., "Engineering Ethics", Prentice Hall of India, 2013

**UCS102 : Forecasting Methods and Applications****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to Understand the fundamental concepts and techniques of various forecasting models, to evaluate the strengths, limitations, and ethical considerations associated with different forecasting approaches.

**Course Content:****Unit-I Introduction to Forecasting**

Definition and importance of forecasting, Types of forecasting: qualitative and quantitative, Role of forecasting in decision making, Overview of forecasting process and its applications, Ethical considerations in forecasting

**Unit-II Time Series Analysis:**

Concepts of time series data, Components of time series: trend, seasonality, cyclical variations, and irregular variations, Time series decomposition methods, Moving averages and exponential smoothing techniques, Autoregressive Integrated Moving Average (ARIMA) models.

**Unit-III Regression Analysis in Forecasting:**

Introduction to regression analysis, Simple linear regression model, Multiple regression model, Assumptions of regression analysis, Application of regression analysis in forecasting.

**Unit-IV Qualitative Forecasting Methods:**

Delphi method, Market research and consumer surveys, Expert judgment and opinion polling, Scenario building and scenario planning, Strengths and limitations of qualitative forecasting methods

**Unit-V Advanced Forecasting Techniques:** Neural networks and machine learning algorithms for forecasting. Time series forecasting with neural networks, Forecast combination methods, Bayesian forecasting, Evaluating and selecting forecasting models

**Text Books:**

1. "Forecasting: Principles and Practice" Authors: Rob J. Hyndman and George Athanasopoulos Publisher: OTexts Year: 2018 ISBN-13: 978-0-9876081-3-0

**Reference Books:**

1. "Business Forecasting" Authors: John E. Hanke and Dean W. Wichern Publisher: Pearson Year: 2020 ISBN-13: 978-0133066789

**UCS106 : Full Stack Development****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objectives:** The course covers Full Stack development, Client-server Architecture, Front end programming tools, frameworks, and libraries.

**Course content:****Unit I- Introduction**

Why Full Stack Development? Web development vs Full Stack Development, Client-Server architecture, Rules of three-tier architecture, MEAN, MERN, Rails, Django Stack and LAMP, MEAN vs MERN stack, Front End Frameworks and Libraries.

**Unit II- Web Development & HTML**

Web, Web Browser, Web Server, Anatomy of a Website, Developer tools, inspector, Wireframing, Web hosting steps, HTML, HTML Document Object Model, W3C standards for HTML, HTML Validation, Structural markup, Semantic markup, HTML Lists, Links, Absolute versus relative path names, URL: Anatomy, Types, HTML Formatting, HTML Tables, Meta tags, Structural tags, Character entities, escape codes, Image maps, Font awesome Icons, Forms Input Types.

**Unit III- CSS**

Why CSS? W3C CSS Validator, Syntax, Types, CSS Selectors, Cascading, Inheritance, Specificity, Units of Measure, Width and Height of element, Box Model Layout, Border Box Versus Content Box, Responsive website Design Bootstrap Grid System, CSS pre-processor: Less, Sass and features.

**Unit IV- Frontend Development & REACT JS**

Javascript basics OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format. Introduction to React, React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication.

**Unit V- Databases & Deployment**

Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles.

**Text Books:**

1. Flanagan, D., JavaScript: The Definitive Guide (7 ed.), Shroff and O'Reilly Media, 2020. ISBN 978-935213996.
2. Robbins, J., Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5 ed.), O'Reilly Media, 2020. ISBN 978-1491960158.
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BYAZAT MARDAN

**Reference Books:**

1. Meloni, J.C. and Kyrnin J, HTML, CSS, and JavaScript All in One, Sams Teach Yourself (5 ed.), Pearson, 2018. ISBN 978-9389552416.
2. Full-Stack JavaScript Development by Eric Bush.
3. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przorski , Maciej Czarnecki

**UCS107 : Object Oriented Analysis and Design**

Credit Assigned:			
L	T	P	C
3	0	0	3

**Course objective:** This course is designed to describe the concepts of object-oriented and basic class modelling. Draw class diagrams, sequence diagrams and interaction diagrams to solve problems. Choose and apply a befitting design pattern for the given problems.

**Course Content****Unit-I Advanced object and class concepts:**

Advanced object and class concepts; Association ends; N-array associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived Data; Packages. State Modeling: Events, States, Transitions and Conditions, State Diagrams, State Diagram Behavior.

**Unit-II UseCase Modelling and Detailed Requirements:**

Overview; Detailed object-oriented Requirements definitions; System Processes use case/Scenario view; Identifying Input and The system sequence diagram; Identifying Object Behaviour- The state chart Diagram; Integrated Object-oriented Models.

**Unit-III Process Overview:**

Process Overview, System Conception and Domain Analysis: Process Overview: Development stages; Development life Cycle; System Conception: Devising a system concept; elaborating a concept; preparing a problem statement. Domain Analysis: Overview of analysis; Domain Class model: Domain state model; Domain interaction model; Iterating the analysis.

**Unit-IV Use case Realization:**

The Design Discipline within up iterations: Object Oriented Design The Bridge between Requirements and Implementation; Design Classes and Design within Class Diagrams; Interaction Diagrams-Realizing Use Case and defining methods; Designing with Communication Diagrams; Updating the Design Class Diagram; Package Diagrams Structuring the Major Components; Implementation Issues for Three-Layer Design.

**Unit-V Design Patterns:**

Introduction; what is a design pattern?, Describing design patterns, the catalogue of design patterns, Organizing the catalogue, How design patterns solve design problems, how to select a design patterns, how to use a design pattern; Creational patterns: prototype and singleton (only); structural patterns adaptor and proxy (only).

**Text Books**

1. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.
2. Satzinger, Jackson and Burd: Object-Oriented Analysis & Design with the Unified Process, Cengage Learning, 2005.
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides: Design Patterns –Elements of Reusable Object-Oriented Software, Pearson Education, 2007.

**Reference Books:**

1. Grady Booch et. al.: Object-Oriented Analysis and Design with Applications, 3rd Edition, Pearson Education, 2007.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michel Stal: Pattern – Oriented Software Architecture. A system of patterns, Volume 1, John Wiley and Sons, 2007.
3. Booch, Jacobson, Rumbaugh: Object-Oriented Analysis and Design with Applications, 3rd edition, Pearson, Reprint 2013

**UCS108 : Internet of Things****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It is becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. It introduces some of the application areas where Internet of Things can be applied. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things.

**Course content:****Unit I- IOT**

Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

**Unit II- Hardware for IoT**

Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

**Unit III- Network & Communication aspects in IoT**

Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

**Unit IV- Programming the Arduino**

Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in arduino, programming the arduino for IoT.

**Unit V- Challenges in IoT Design**

Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

**Text Books:**

1. Olivier Hersent, David Boswarthick, Omar Elloumi “The Internet of Things key applications and protocols”, Wiley.
2. Jeeva Jose, Internet of Things, Khanna Publishing House
3. Michael Miller “The Internet of Things” by Pearson.

**Reference Books:**

1. Raj Kamal “INTERNET OF THINGS”, McGraw-Hill, 1ST Edition, 2016.
2. Arshdeep Bahga, Vijay Madisetti “Internet of Things (A hands on approach)” 1ST edition, VPI publications, 2014.



**UCS109 : Advance Software Engineering****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:**

To enable the students to understand Advance Software Engineering principles specially the principles of software testing and Project deployment in detail. By the end of this course student will be able to design both manual as well as automated software testing strategies and have command on Project testing and Containerizing software Applications.

**Course content:****Unit-1 Introduction**

Introduction to software design Principles, testing misconceptions, Objectives, Debugging, Quality Assurance, management and Control and testing, Error defects and failures, Defect root causes and effects analysis, testing principles, Test Planning, monitoring, control, activities and Test Analysis, Traceability Matrix.

**Unit-II Test Techniques**

Black-box vs. White-box Test Techniques Introduction and need, examples, - boundary value Analysis, Decision, cause Effect Graphing techniques, Decision and Branch coverages table, Test Organization. Test Estimation Techniques. Cost Estimation Techniques Functional Point Analysis.

**Unit-III Software Reviews**

Review of SDLC Models, Reviews Techniques - Key terms, Static Testing Basics, Work Products Static Testing, Benefits of Static Testing, Static vs. Dynamic Testing, Review Process, Work Product Review Process, Roles and responsibilities in a formal review, Review Types, Applying Review Techniques, Success Factors for Reviews.

**Unit-IV Introduction to Automation Tool**

Basic introduction to Selenium, Understanding the core concept of Browser driver classes and Webdriver Interface, running test cases in browser, basic Selenium WebDriver methods, locators in Selenium WebDriver- id, Xpath, CSS Selectors, Name, ClassName, TagName, Link Text, Identifying the Web elements using locators. Techniques to automate Web elements such as checkbox, dropdown, Synchronization in Selenium etc.

**Unit-V Introduction Docker & Containerizing Applications**

Introduction to Docker- Traditional Workflow vs, Industry Need, Docker Architecture and Docker Hub OS level Virtualization, Advantages, Disadvantages, DockerFiles and Container creation, Volumes and their Sharing. Docker port expose and publish. Importing images from docker hub, Containerizing- creation, removing, operations on containers, images.

**Text Books:**

1. Pressman, R. S., "Software Engineering: A Practitioners Approach, 7 th edition", McGraw Hill, 2010.
2. Docker Demystified: Learn How to Develop and Deploy Applications Using Docker by Saibal Ghosh Publisher BPB Publications
3. Selenium with Java – A Beginner's Guide: Web Browser Automation for Testing using Selenium with Java by Pallavi Sharma, Publisher : BPB Publications

**Reference Books:**

1. Sommerville, Ian, "Software Engineering", Addison-Wesley 9 th Edition, 2011.
2. Jalote Pankaj, "Software Project Management in practice", Pearson Education, New Delhi, 2002



**UCS155 : Forecasting Methods and Applications Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** This course is designed to Understand the fundamental concepts and techniques of various forecasting models, to evaluate the strengths, limitations, and ethical considerations associated with different forecasting approaches.

**List of Experiments:**

1. Overview of forecasting methods, Introduction to time series data  
Lab exercise: Loading and exploring time series data
2. Trend, seasonality, and residuals  
Lab exercise: Decomposing time series data
3. Moving averages, Exponential smoothing  
Lab exercise: Implementing simple forecasting methods
4. ARIMA models (Auto Regressive Integrated Moving Average), Seasonal ARIMA models  
Lab exercise: Fitting ARIMA models to time series data
5. Cross-validation and out-of-sample testing, Performance metrics: MAE, RMSE, MAPE  
Lab exercise: Evaluating forecasting models
6. Introduction to machine learning techniques for forecasting, Regression models, decision trees, and neural networks  
Lab exercise: Implementing machine learning forecasting models
7. Forecasting sales, demand, and financial metrics  
Lab exercise: Applying forecasting models to business scenarios
8. Forecasting climate patterns, population growth  
Lab exercise: Applying forecasting models to environmental and social data
9. Handling missing data, outliers, and structural breaks  
Lab exercise: Dealing with real-world time series challenges

**Text Books:**

1. "Forecasting: Principles and Practice" Authors: Rob J. Hyndman and George Athanasopoulos Publisher: OTexts  
Year: 2018 ISBN-13: 978-0-9876081-3-0

**Reference Books:**

1. "Business Forecasting" Authors: John E. Hanke and Dean W. Wichern Publisher: Pearson Year: 2020  
ISBN-13: 978-0133066789

**UCS156 : Full Stack Development Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objectives:** The course covers Full Stack development, Client-server Architecture, Front end programming tools, frameworks, and libraries.

**List of Experiments**

1. Write a program to create a website using HTML CSS and JavaScript.
2. Write a program to build a Chat module using HTML CSS and JavaScript.
3. Write a program to create a voting application using React JS.
4. Write a program to create and build a star rating system using JQuery.
5. Create a Simple Login form using React JS.
6. Develop a portfolio website for yourself which gives details about yourself for a potential recruiter.
7. Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items.
8. Create a simple micro blogging application (like twitter) that allows people to post their content which can be viewed by people who follow them.
9. Create a food delivery website where users can order food from a particular restaurant listed in the website.
10. Develop a leave management system for an organization where users can apply different types of leaves such as casual leave and medical leave. They also can view the available number of days.
11. Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions.
12. Create a blog using React JS Using the CMS users must be able to design a web page using the drag and drop method. Users should be able to add textual or media content into placeholders that are attached to locations on the web page using drag and drop method.

**Text Books:**

4. Flanagan, D., JavaScript: The Definitive Guide (7 ed.), Shroff and O'Reilly Media, 2020. ISBN 978-935213996.
5. Robbins, J., Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5 ed.), O'Reilly Media, 2020. ISBN 978-1491960158.
6. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BYAZAT MARDAN

**Reference Books:**

4. Meloni, J.C. and Kyrnin J, HTML, CSS, and JavaScript All in One, Sams Teach Yourself (5 ed.), Pearson, 2018. ISBN 978-9389552416.
5. Full-Stack JavaScript Development by Eric Bush.
6. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski , Maciej Czarnecki

**Reference Books:**

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach Connecting Everything", 1st Edition, Apress Publications, 2013
2. CunoPfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1

**UCS157 : Object Oriented Analysis and Design Lab**

Credit Assigned:			
L	T	P	C
0	0	2	1

**Course objective:** This course is designed to describe the concepts of object-oriented and basic class modelling. Draw class diagrams, sequence diagrams and interaction diagrams to solve problems. Choose and apply a befitting design pattern for the given problems.

**List of Experiments:**

1. Overview of OOAD concepts: classes, objects, inheritance, polymorphism, Introduction to UML (Unified Modeling Language)  
Lab exercise: Create basic class diagrams
2. Techniques for gathering and analyzing requirements, Identifying use cases and actors  
Lab exercise: Develop use case diagrams and use case descriptions
3. Creating class diagrams, Identifying classes, attributes, methods, and relationships  
Lab exercise: Design class diagrams for a given problem statement
4. Sequence diagrams and collaboration diagrams, State diagrams and activity diagrams  
Lab exercise: Model the behavior of a system using sequence and state diagrams
5. Introduction to common design patterns (e.g., Singleton, Factory, Observer), SOLID principles for object-oriented design  
Lab exercise: Apply design patterns to a practical problem
6. Component diagrams and deployment diagrams, Interaction diagrams  
Lab exercise: Create advanced UML diagrams for a complex system
7. Translating design models into code, Refactoring and improving code quality  
Lab exercise: Implement the object-oriented design into a working application
8. Techniques for testing object-oriented systems, Unit testing and integration testing  
Lab exercise: Develop and execute tests for the implemented system
9. Students will work on a project involving object-oriented analysis and design.  
Lab exercise: Project work and progress reviews
10. Presentation of the final project, including design models, implementation, and testing  
Lab exercise: Final project presentation and peer review

**Text Books**

1. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.
2. Satzinger, Jackson and Burd: Object-Oriented Analysis & Design with the Unified Process, Cengage Learning, 2005.
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides: Design Patterns –Elements of Reusable Object-Oriented Software, Pearson Education, 2007.

**UCS158 : Internet of Things Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:** The lab course provides the complete description about inner working of a IOT. Market forecast for IoT devices with a focus on sensors.

**List of Experiments**

13. Study and Install Python in Eclipse and WAP in Data Types in Python.
14. A program for arithmetic operation in Python.
15. A program Looping Statement in Python.
16. Study and Install IDE of Arduino and Different Types of Arduino.
17. Define and Explain Eclipse IoT Project.
18. List and summarize few Eclipse IoT Projects.
19. Sketch the architecture of IoT Toolkit and explain each entity in brief.
20. Describe gateway-as-a-service deployment in IoT toolkit.
21. Explain application framework and embedded software agents for IoT toolkit.
22. Study and Configure Rasberry Pi.

**Text Books:**

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

**Reference Books:**

3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach Connecting Everything", 1st Edition, Apress Publications, 2013
4. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1

**UCS159 : Advance Software Engineering Lab****Credit Assigned:**

L	T	P	C
0	0	2	1

**Course objective:**

The Advanced Software Engineering Lab aims to familiarize students with advanced topics in software engineering, with a primary focus on two key areas: Software Testing using Selenium as an open-source tool and Containerizing software applications. Students will gain hands-on experience in automated software testing using Selenium, mastering the techniques and tools essential for efficient and effective testing processes. Additionally, the lab will delve into the modern practice of containerization, providing students with practical skills to encapsulate and deploy software applications seamlessly. By the end of the lab, participants should be well-versed in advanced software engineering practices, contributing to their proficiency in testing and deploying contemporary software solutions.

**List of Experiments**

1. Understanding manual testing through excel
2. Understanding the core concept of Browser driver classes and Webdriver Interface
3. Run tests in Browser like - Google Chrome, Microsoft Edge
4. Getting Started with basic Selenium WebDriver methods
5. Identifying the Web elements using following Locators (with Live examples)
  - Id, Xpath, Css Selectors, Name, ClassName, TagName, Link Text
6. Techniques to identify objects using Regular Expressions.
7. Explore functional testing using selenium.
8. Docker Installation- windows/ubuntu/EC2
9. Operations on images –
  - Pull a centos/ubuntu image from dock hub
  - Create a container for the pulled images.
10. Finding number of images, containers running on Host Machine and various relevant operations such as
  - Finding number of Processes running on host machine vs process running inside container.
  - Existing containers, renaming containers, collecting container statistics, removing container history, inspect
11. Pulling, Removing, zipping, tagging various docker images.
12. Creating a Docker image without Dockerfile
13. Practice Basic Dockerfile Directives
14. Practice Containerizing using DockerFiles

**Text Books:**

1. Pressman, R. S., "Software Engineering: A Practitioners Approach, 7 th edition", McGraw Hill, 2010.
2. Docker Demystified: Learn How to Develop and Deploy Applications Using Docker by Saibal Ghosh Publisher BPB Publications
3. Selenium with Java – A Beginner's Guide: Web Browser Automation for Testing using Selenium with Java by Pallavi Sharma, Publisher : BPB Publications

**Reference Books:**

1. Sommerville, Ian, "Software Engineering", Addison-Wesley 9 th Edition, 2011.
2. Jalote Pankaj, "Software Project Management in practice", Pearson Education, New Delhi, 2002

**UCS110 : Soft Computing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:**

This course builds on the foundational principles of Soft Computing, with a particular focus on fuzzy logic, aiming to delve deeper into advanced techniques and applications. Students will gain expertise in developing adaptive and intelligent systems capable of handling complex, uncertain, and imprecise information. By the end of the course, participants will be proficient in employing various soft computing methods, with a special emphasis on mastering fuzzy logic for problem-solving.

**Course content:****Unit-I Introduction:**

The Case for Imprecision, An Historical Perspective, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, Statistics and Random Processes, Uncertainty and Information, Fuzzy Sets and Membership, Chance versus Fuzziness, Sets as Points in Hypercubes, Soft Computing, Fuzzy System, Genetic Algorithm, Particle Swarm optimization introduction.

**Unit-II Fuzzy Sets:**

Basic concepts of Crisp Set, Operations on Sets, Properties of sets, Fuzziness, vagueness and Inexactness, Set Membership, Features of Fuzzy sets- Normality, height, Support, Core, cardinality, Fuzzy Membership Functions like Triangular function, Trapezoidal function, Gaussian function and S- function, transformations to membership functions. Linguistic variables. Operations on Fuzzy Sets, Fuzzy relations and Operations on fuzzy Relations.

**Unit-III Fuzzy Logic:**

Fuzzy logic Basics, Fuzzy Rules- Fuzzy if-then, Fuzzy if-then else, Fuzzy Reasoning- Quantifiers, Fuzzification of Input Variables, Evaluation of Fuzzy Rules, Aggregation, Defuzzification methods- Centroid Method, Centre-of-Sum (CoS) method, Mean- of- Maxima (MoM) method, Practical implications of Fuzzy logic, Alpha Cuts for Fuzzy relations,

**Unit-IV- Fuzzy System Simulations:**

Membership Value Assignments- Intuition based, Inference, rank ordering, Fuzzy Associative Memory (FAMS), Fuzzy ordering- random variables, ambiguity. Non transitivity ranking, fuzzy decision support system Mult objective decision making using Fuzzy.

**Unit-V- Fuzzy Logic Application:**

Introduction to Fuzzy Logic application, Fuzzy Controllers--- Antecedent/Consequent variables, If then Else Rules and inference, Fuzzy Decision-making, Fuzzy logic application such as – Selection of Bridegroom for a bride, Selection of cricket Players from group of players, Aircraft landing Control Problem etc.

**Text Books**

- 1 Sivanandam, S. N., and S. N. Deepa., , 2007. *PRINCIPLES OF SOFT COMPUTING*. John Wiley & Sons
2. Mohan, C., 2015. *An introduction to fuzzy set theory and fuzzy logic*. MV Learning.

**Reference Books:**

1. Engelbrecht, A.P., 2007. *Computational Intelligence: An Introduction*.

**UCS111 : Signal and Image Processing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to learn the fundamentals of two-dimensional image signals, acquisition process, image enhancement in spatial and transform domains, image restoration and various color models.

**Course Contents:****Unit-I: Introduction to Signal and Image Processing**

Basics of signals: period, frequency, phase, a mathematical representation of signals, discrete-time signals, Overview of image processing, Digital image representation, Types of images, Digital image processing operations, Fundamental steps in image processing, Image processing applications, Digital imaging system: Physical aspects of imaging acquisition, Review of digital cameras, Sampling and Quantization, Image quality, Image storage and File formats.

**Unit II: Image Enhancement in Spatial and frequency Domains**

Some basic gray level transformations, Histogram processing, Smoothing and sharpening spatial filters, Smoothing and Sharpening frequency domain filters, Homomorphic filtering,

**Unit-III: Image Restoration and Reconstruction**

Noise models, Restoration in the presence of noise only-spatial filtering and transform-based filtering, Estimating the degradation functions, Inverse filtering, Minimum Mean Square Error (Wiener) filtering.

**Unit-IV: Image Compression**

Image compression models, Loss-less and Lossy compression, Morphological image processing: Dilation and erosion, Opening and closing, some basic morphological algorithms, Image segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

**Unit-V: Color Image Processing Fundamentals**

Devices for color Imaging, Color Image Storage and Processing, Color Models, Pseudocolor Image Processing, Noise in color images, Color image compression, Image segmentation based on color.

**Text Books:**

1. R. C. Gonzalez and R. E. Woods,, Digital Image Processing, Pearson Education , 2006.
2. S. Sridhar, Digital Image Processing, Oxford University Press , 2012.

**Reference Books:**

1. A.K. Jain, Fundamentals of Digital Image Processing, Pearson Education , 2007
2. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Pearson Education , 2004



**UCS112 : Sensor Technology****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to understand the Big Data Platform and its Use cases and apply analytics on Structured and Unstructured Data. It also helps to Acquire the knowledge and working on Big Data platforms

**Course Contents:****Unit-I Sensors Fundamentals and Characteristics**

Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics

**Unit-II: Physical Principles of Sensing**

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements

**Unit-III: Interface Electronic Circuits**

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

**Unit-IV: Sensors in Different Application Area**

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors

**Unit-V: Sensor Materials and Technologies**

Materials, Surface Processing, Nano-Technology

**Text Books**

1. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
3. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).

**UCS113 : GPU Computing****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course Objectives:** Distinguish between traditional computing and GPU computing the data-parallel execution models. Describe a typical GPU architecture and programming model.

**Course content:****Unit 1: Review of Traditional Computing**

Review of traditional computing model; Flynn's taxonomy; multithreading and concurrency; a brief history of GPU computing.

**Unit 2: Fundamentals of GPU Computing**

GPU architecture; stream processors, cache hierarchy, graphic pipeline; data parallel execution model; GPU programming model; problem decomposition and mapping; synchronization.

**Unit 3: Programming GPUs with CUDA**

CUDA device architecture; threads, blocks, grids, warps; scheduling; CUDA memory hierarchy, local memory, global memory, constant memory and texture memory; CUDA examples; CUDA profiling and optimization.

**Unit 4: Programming GPUs with OpenCL**

OpenCL syntax; OpenCL device architecture; OpenCL execution model; OpenCL examples; OpenCL profiling and optimization.

**Unit 5: GPU Algorithms and Applications**

Parallel prefix sum; parallel convolution; parallel histogram; video processing; options pricing on the GPU.

**Text Books:**

1. Kirk, David B., and W. Hwu Wen-Mei. Programming massively parallel processors: a hands-on approach. Morgan kaufmann, 2016.
2. Gaster, Benedict, Lee Howes, David R. Kaeli, Perhaad Mistry, and Dana Schaa. Heterogeneous computing with openCL, Newnes, 2012.

**Reference Books:**

1. CUDA C++ Programming Guide. Available here <https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html>
2. AMD APP SDK, OpenCL User Guide. Available here [http://developer.amd.com/wordpress/media/2013/12/AMD\\_OpenCL\\_Programming\\_User\\_Guide2.pdf](http://developer.amd.com/wordpress/media/2013/12/AMD_OpenCL_Programming_User_Guide2.pdf)

**UCS114 : Deep Learning****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course is designed to explore to build the foundation of deep learning. Student can understand how to build the neural network and to enable the students develop successful machine learning projects.

**Course content:****Unit I- Introduction to Machine Learning:**

Problems, data, and tools, Visualization tools, Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, Deep Learning, Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit saturation, the vanishing gradient problem, and ways to mitigate it. ReLU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout.

**Unit II- Convolutional Neural Networks:**

Architectures, convolution / pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.

**Unit III- Deep Unsupervised Learning:**

Autoencoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models. Dynamic memory networks, Applications of Deep Learning to Computer Vision: Imagesegmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention models for computer vision tasks.

**Unit IV- Applications of Deep Learning to NLP:**

Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity.

**Unit V- Analogy reasoning:**

Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs, Applications of Dynamic Memory Networks in NLP

**Text Books:**

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models by D. Koller, and N. Friedman, MIT Press

**Reference Books:**

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press

**UCS115 : Blockchain Technologies****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course aims to equip students with a comprehensive understanding of blockchain technology. Covering ledger structures, peer-to-peer networks, and blockchain features, students will delve into cryptography, consensus algorithms, and the intricacies of public blockchains such as Bitcoin and Ethereum.

**Course content:****Unit-1 Introduction to Blockchain**

Understanding Ledger, Types of Ledgers, Peer to Peer Network, Blockchain Introduction - Block Structure, Blockchain Features, Types of Blockchain- Public and Private, permissioned Blockchains.

**Unit-II Cryptography in Blockchain Technology**

Cryptography Introduction, Introduction to Public and Private Keys, Categories of Cryptography- Symmetric and Asymmetric cryptography, Hash Function, Merkle Tree.

Consensus Algorithms - Introduction to Consensus, The Two General Problem, Byzantine General's Problem, Byzantine Fault Tolerance, Proof of Work Consensus, Drawback of Proof of Work Consensus, Proof of Stake Consensus, Transaction Flow in Blockchain.

**Unit-III Public Blockchains-**

**Bitcoin:** Introduction, Life Cycle of Transaction, Bitcoin Mining, Bitcoin Wallets, Bitcoin Wallets Installation, Bitcoin Networks, Bitcoin Explorer

Ethereum vs. Bitcoin, Smart Contract Introduction, Ethereum Virtual Machine Introduction, Ethereum Gas Introduction, Ethereum Development Life Cycle,

**Unit- IV Permissioned Blockchain**

Enterprise Blockchain, Enterprise Blockchain Components, Hyperledger Fabric Introduction, Hyperledger Fabric Transaction Cycle, Hyperledger Fabric Setup Prerequisites, Hyperledger Fabric Setup, Hyperledger Fabric Networks, Hyperledger Fabric Dev Network, Hyperledger Fabric Test Network, Chain code Introduction, Chaincode Life Cycle, Chaincode Development Ways, Chaincode Development Use Cases.

**Unit V - Private Blockchain: Multichain**

Multichain Blockchain Introduction, Multichain Features, Multichain Architecture, Multichain Setup, Create Multichain Blockchain, Multichain Assets, Multichain Streams, Multichain Streams Handson, Multichain Mining Introduction, Perform Mining in Multichain.

**Text Books**

1. Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing
2. Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press

**Reference Books:**

1. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing.
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform,

**UCS116 : Security and Privacy****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course aims to equip students with a comprehensive understanding of Security issues. And also covers privacy, privacy regulations and various privacy models.

**Course content:****Unit- Introduction:**

Basic concepts of security and issues: number theory, Formal analysis and design of algorithms and protocols.

**Unit-II Provable Security**

Provable Security, Cryptosystems; Privacy: Foundations of Privacy, Differential Privacy: Definitions and Early Uses

**Unit-III Privacy Regulations**

Privacy Regulations, Noiseless Differential Privacy, Privacy preserving Data Mining techniques.

**Unit-IV Privacy preserving data publishing:**

Fundamental Concepts: anonymization methods, privacy models, anonymization method for transaction data, trajectory data, social networks data and textual data. One-Time Data Publishing,

**Unit-V Multiple-Time Data Publishing :**

Graph Data, Other Data Types, Access control of outsourced data, Future Research Directions

**Text Books**

1. T. Shaw, Information Security and Privacy, American Bar Association, 2012.
2. M. Bailey, Complete Guide to Internet Privacy, Anonymity and Security, Nerel Online, 2011.
3. Raymond Chi-Wing Wong, Ada Wai-Chee Fu, Privacy-Preserving Data Publishing: An Overview, Morgan and claypool publishers, 2010.

**UCS117 : Software Project Management****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** The course aims to provide students with a comprehensive understanding of software project management, focusing on fundamental principles and cultivating a strong knowledge base regarding the responsibilities of a project manager. Through exploration of various methods and techniques employed in project management, students will develop the skills necessary to create effective project plans tailored to address real-world management challenges.

**Course content:****Unit-1 Introduction and Software Project Planning:**

Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

**Unit-II Project Organization and Scheduling Project Elements:**

Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

**Unit-III Project Monitoring and Control:**

Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

**Unit-IV Software Quality Assurance:**

Program Correctness, Program Verification & validation, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model (CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.

**Unit-V Project Management and Project Management Tools:**

Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

**Text Books**

1. M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
2. Royce, Software Project Management, Pearson Education
3. Kieron Conway, Software Project Management, Dreamtech Press

**Reference Books:**

1. S. A. Kelkar, Software Project Management, PHI Publication.
2. Harold R. Kerzner, Project Management "A Systems Approach to Planning, Scheduling, and Controlling" Wiley. Mohapatra, Software Project Management, Cengage Learning.
3. P.K. Agarwal, SAM R., Software Project Management, Khanna Publishing House

**UCS118 : Operational Research****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** To demonstrate the powerful capabilities of optimization theory to enable reducing costs, improving efficiency, optimal usage of resources and providing benefits in many other key dimensions in engineering / industry / managerial / decision making problems.

**Course content:****Unit I-Introduction:**

Hyperplane and hyperspheres, Convex sets and their properties, Convex functions, Linear Programming Problems; Formulation through examples, Basic feasible and optimal solutions, Extreme points, Graphical Method, Simplex Method, Big-M Method, Degeneracy, Duality and Dual LPP and its properties, Dual simplex Algorithm and sensitivity analysis.

**Unit II-Transportation Problem:**

Mathematical formulation, basic feasible solution, North-West Corner Method, Least Cost Method, Vogel's approximation Method, Optimal solution by U-V Method, Stepping Stone Method, Degeneracy in Transportation problem.

**Unit III Assignment Problem:**

mathematical formulation, solution by Hungarian Method, unbalanced problem, Traveling Salesman problem and its solution.

**Unit IV- Game Theory:**

Two-Person Zero sum games, The Maximin-minimax principle, pure and mixed strategies, graphical solution, Dominance property, General solution of  $m \times n$  rectangular games, Linear programming of GP.

**Unit V-Network Analysis:**

PERT: Background, development, networking, estimating activity time, Determination of earliest expected and allowable times, determination of critical path, PERT cost, scheduling of a project, CPM method, Applications of these methods

Books:

**Text Books:**

1. Operations Research by V.K. Kapoor, Sultan Chand & Sons
2. Operations Research by K.Swarup, P.K.Gupta and Man Mohan, Sultan Chand and Sons.

**Reference Books:**

1. Introduction to Operations Research by F.S. Hillier and G.J. Libermann, McGraw Hill.
2. Linear Programming by V. Chvatal, W.H. Freeman publishers.
3. Mathematical Programming: Theory and Methods by S.M. Sinha, Elsevier Publications.
4. Linear programming by G. Hadley, Narosa Publishing House.
5. Operation Research: An Introduction by H. A. Taha, Prentice Hall of India.



**UCS119 : Research Methodology****Credit Assigned:**

L	T	P	C
3	0	0	3

**Course objective:** This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

**Course contents:****Unit-1 Introduction-**

Nature and Purpose of Research: Meaning of research, aim, Nature and scope of research, Prerequisites of research, Types of research: Exploratory, Descriptive and Experimental. Research Problem: Types of research problems, Characteristics of a good research problem, Hypothesis: Meaning and types of hypotheses, Research proposal or synopsis. Research Methods: Qualitative and Quantitative

**Unit-2 Data Collection and Analysis**

Types of data, Methods of data collection, Sample and Population, Sampling Techniques, Characteristics of a good sample, Tools of Data Collection: Observation method, Interview, Questionnaire, various rating scales, Characteristics of good research tools

**Unit-3- Descriptive Statistics**

Tabulation, Organization, and Tabulation and Graphical Representation of Quantitative data, Measures of Central Tendencies: Mean, Median, Mode Measures of Variability: Range, Quartile Deviation, Standard Deviation, and Coefficient of variation, Correlation analysis, regression analysis. Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z and Chi-square.

**Unit-4 -Algorithm research & Report**

Algorithmic research problems, types of algorithmic research, types of solution procedure, steps of development of algorithm, steps of algorithmic research, design of experiments.

**Unit-5 -Research Report:**

Structure and Components of Research Report, Types of Report, Characteristics of Good Research Report, Bibliographical Entries, Research Ethics.

**Text Books:**

1. Research Methodologies, R. Panneerselvam, Prentice Hall, 2007.
2. Research in Education, Best John V. and James V Kahn, Wiley eastern, 2005.
3. Elements of Educational Research, Sukhia, S.P., P.V. Mehrotra, and R.N. Mehrotra, PHI publication, 2003.
4. Methodology of Research Education, K. Setia, IEEE publication, 2004.
5. Research methodology, Methods and Techniques, Kothari, C.R., 2000.



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SONEPAT**

**भारतीय सूचना प्रौद्योगिकी संस्थान सोनीपत**

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