INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SONEPAT
भारतीय सूचना प्रौद्योगिकी संस्थान सोनीपत
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Scheme and Syllabus for B.Tech. in Computer Science & Engineering (Data Science & Analytics)
(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**	

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	UDS001	Data Mining and Visualization	3	0	0	3
2	UDS002	Introduction to Cryptography	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	UDS051	Data Mining and Visualization Lab	0	0	2	1
8	UDS052	Introduction to Cryptography 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-I 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	UDS004	Big Data Analytics	3	0	0	3
4	XXXXX	Elective VI-I	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	UDS054	Big Data Analytics Lab	0	0	2	1
8	XXXXX	Elective VI-I Lab	0	0	2	1
9	UCS202	Minor Project-I	0	0	4	2
Total credits					**20**	

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.	XXXXX	Elective I	3	0	0	3
3.	XXXXX	Elective II	3	0	0	3
4.	XXXXX	Elective III	3	0	0	3
6.	UDS004	Advanced Data Analytics	3	0	2	3
7.	UDS005	Advanced Deep Learning	3	0	0	3
8.	UDS054	Advanced Data Analytics 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.	XXXXX	Elective I	3	0	0	3
3.	XXXXX	Elective II	3	0	0	4
4.	XXXXX	Elective III	3	0	0	3
6.	UCS024	Data Analytics & Visualization	3	0	0	3
7.	UDS005	Advanced Deep Learning	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 Vth Semester		
Electives List	**Course Code**	**Name**
Elective -V-I	UDS101	Embedded System and IOT
	UDS151	Embedded System and IOT Lab
	UDS102	Signal and Image Processing
	UDS152	Signal and Image Processing Lab
List of Electives in VIth Semester		
Management Elective Elective-VI-I	UCS103	Organizational Behavior
	UCS104	Professional Ethics
Elective-VI-II	UDS105	Natural Language Processing
	UDS155	Natural Language Processing Lab
	UDS106	Soft Computing and Evolutionary AI
	UDS156	Soft Computing and Evolutionary AI Lab
List of Electives in VIIth & VIIIth Semester		
Elective VII-I	UDS107	Brain Computer Interaction
	UDS108	Computer Vision
Elective VII-II	UDS109	Robotic Intelligence
	UCS116	Security & Privacy
Elective VII- III	UCS117	Operational Research
	UCS118	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. Langrage'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 Langrage'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, 7th edition by Red cross society.
3. Certificate of Yoga Professionals: Official Guidebook, Excel books 1st 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, Supermesh, 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; Modem 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, 8th 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. ErachBarucha 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 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; Modem 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, 8th 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/Deques 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, Hop croft and Ullmann, -Data Structures and Algorithms, II Addison Weslev. 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 sector), 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, 10th Edition, 2016.
2. Bjarne, Strustrup,*"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 section 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, 10th Edition, 2016.
2. Bjarne, Strustrup,*"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 Warshal'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, Hop croft and Ullmann, -Data Structures and Algorithms, II Addison Weslev. 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), Structureorganization (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 9 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 Frame work, 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 tabl e, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transi ion, Language of NFA, Equi valence of NFA and DFA, Minimization of Finite Automata, Distinguis hing 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 Grammer, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Memership, 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", Addision Wesley
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addision 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", Gagotia Publications8. 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, Hop croft and Ullmann, -Data Structures and Algorithms, II Addison Weslev. 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", Addision Wesley
3. Elmasri, Navathe, " Fundamentals of Database Systems", Addision 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", Gagotia Publications8. 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:
Trapizoidal rule. Simpson's1/3 rule, Simpson's3/8 rule. Solution of Initial value problems: Taylor series method, Euler's method, Runge-Kutta method of 2^{nd} and 4^{th} 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 o 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 10th edition*", John Wileyand Sons, 2018.
2. Stallings, William, "*Operating Systems –Internals and Design Principles 8th Edition*",Pearson Publications, 2014.

Reference Books:
1. 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 Distributers 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. 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.

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 o 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 Philospher 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 10th edition*", John Wileyand Sons, 2018.
2. Stallings, William, "*Operating Systems –Internals and Design Principles 8th 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 LANand 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/IPConfiguration)
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 todebug the network issues.
8. Transfer files between systems in LAN using FTP Configuration, install a Print server in aLAN 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., "C*omputer 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 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 Distributers 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.

UDS001: Data Mining and 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

UDS002: Introduction to Cryptography

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objectives: This course is designed to understand basic mathematics behind cryptography and able to secure a message over insecure channel by various means. Students will learn Confidentiality, Integrity and Availability of a data.

Course content:

Unit-I- Introduction to Cryptography
Introduction to Cryptography, Security Threats, Vulnerability, Active and Passive attacks, Security services and mechanism, prevention, detection, deterrence, Malicious code Conventional Encryption Model, CIA model.

Unit-II- Confidentiality and Modular Arithmetic
Confidentiality using conventional encryption, Traffic confidentiality, Key distribution, Random number generation Introduction to grap, Ring and field, Modular Arithmetic, Euclidean and Extended Euclidean algorithm, Prime numbers, Fermat and Euler's Theorem

Unit-III- Block Ciphers
Classical encryption techniques: Substitution ciphers and transposition ciphers, Cryptanalysis, Steganography, Stream and Block-ciphers, Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, Data Encryption Standard(DES), Strength of DES, Triple DES – AES.

Unit-IV - Public Key Cryptography
Principles Of Public-Key Cryptography, RSA Algorithm, Security of RSA, Key Management, Diffie-Hellman Key Exchange, Elgamal Algorithm, Elliptic Curve Cryptography, Message Authentication and Hash Function, Authentication requirements, Authentication functions.

Unit-V - Integrity Check and Authentication Algorithms
Secure hash algorithm (SHA), MD5 message digest algorithm, Digital Signatures: Digital Signatures, Authentication protocols, Digital Signature standards (DSS), Proof of digital signature.

Text Books:

1. Kahate, Atul, "Cryptography and Network Security." Tata McGraw Hill, 2017.
2. Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.

Reference Books:

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.

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 dependance 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.

CS021 : 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. 2. H. Witten and E. Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann, 2000

UDS051: Data Mining and 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.

UDS052: Introduction to Cryptography Lab

Credit Assigned:			
L	**T**	**P**	**C**
0	0	2	1

Course objectives: This course is designed to understand basic maths behind cryptography and able to secure a message over insecure channel by various means. 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 a program to check whether a number is prime or not.
5. Write a program for encryption, decryption using substitution technique Ceaser cipher.
6. Write a program for encryption, decryption using substitution technique Playfair cipher.
7. Write a program for encryption, decryption using substitution technique Hill Cipher.
8. Write a program for encryption, decryption using substitution technique Vigenere cipher.
9. Write a program for encryption, decryption using transposition technique Rail fence.
10. Write a program for encryption, decryption using transposition technique row & Column Transformation.
11. Write a program to apply DES algorithm for practical applications.
12. Write a program to apply AES algorithm for practical applications.
13. Write a program to implement RSA Algorithm using HTML and JavaScript.
14. Write a program to implement the Diffie-Hellman Key Exchange algorithm for a given problem.
15. Write a program to calculate the message digest of a text using the SHA-1 algorithm.
16. Write a program to implement the SIGNATURE SCHEME – Digital Signature Standard.

Text Books:

1. Kahate, Atul, "Cryptography and Network Security." Tata McGraw Hill, 2017.
2. Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.

Reference Books:

1. W. Mao, "Modern Cryptography – Theory and Practice", 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. 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.

UDS004 : Big Data Analytics

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: This course objective is to demonstrate Big Data Analytics concepts and its applications in business, discuss NoSQL environment, explain process of developing Map Reduce based distributed processing applications.

Course content:

Unit I-Introduction to Big Data

Introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.

Unit II-Hadoop

Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System, Map Reduce: Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Red uce types, input formats, output formats, Map Reduce features, Real-world Map Reduce.

Unit III- HDFS (Hadoop Distributed File System)

HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud

Unit IV- Hadoop Eco System and YARN:

Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features - NameNode high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. NoSQL Databases, MongoDB: Introduction, capped collections Spark: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN, SCALA: Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.

Unit V-Hadoop Eco System Frameworks:

Applications on Big Data using Pig, Hive and HBase Pig - Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries. HBase, Hbase vs RDBMS, schema design, advance indexing, Zookeeper.

Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers and Techniques", Prentice Hall.

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:

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.

UDS054 : Big Data Alalytics Lab

Credit Assigned:			
L	**T**	**P**	**C**
0	0	2	1

Course objective: The primary objective of this course is to optimize business decisions and create a competitive advantage with Big Data analytics. This course will introduce the basics required to develop map reduce programs, derive business benefit from unstructured data. This course will also give an overview of the architectural concepts of Hadoop and introducing map reduce paradigm. Another objective of this course is to intro duce programming tools PIG & HIVE in Hadoop ecosystem.

List of Experiments

1. Lab on set up : Manipulating files in HDFS [4 lab]
2. Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner [4 lab]
3. Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators [2 lab]
4. Big data analytics in Spark using PySpark: Installing Apache Spark, Spark Ecosystem, Resilient Distributed Dataset (RDD) in Spark, building machine learning model using PySpark [2 lab]

Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers and Techniques”, Prentice Hall.

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

UDS005: Advanced Deep Learning

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: This course is designed to exposure of working on Deep learning and Data Analytics platforms. This course is helps students to design and implement solutions for real life problems.

Course content:

Unit I- Introduction to Machine Learning,
Problems, data, and tools, Visualization tools, Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, Deep Learning, Instance-Based Learning

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: Image segmentation, 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- Deep learning Techniques:
CNN, RNN, DNN, Resnet, Yolo and its different variants. Generative Adversarial Networks, Self-Organizing Maps, Boltzmann Machines

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. 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

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.

UDS101 : Embedded System and IOT

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: To learn the internal architecture and programming of an embedded processor and I/O devices and build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.

Course content:

Unit I- Introduction
8-Bit Microcontroller Architecture, Instruction Set and Programming, Programming Parallel Ports, Timers and Serial Port, Interrupt Handling.

Unit II- Embedded C Programming
Memory And I/O Devices Interfacing, Programming Embedded Systems in C, Need For RTOS, Multiple Tasks and Processes, Context Switching, Priority Based Scheduling Policies.

Unit III- IOT and Arduino Programming
Introduction to the Concept of IoT Devices, IoT Devices Versus Computers, IoT Configurations, Basic Components, Introduction to Arduino, Types of Arduino, Arduino Toolchain, Arduino Programming Structure, Sketches, Pins, Input/Output From. Pins Using Sketches, Introduction to Arduino Shields, Integration of Sensors and Actuators with Arduino.

Unit IV- IOT Communication and Open Platforms
IoT Communication Models and APIs, IoT Communication Protocols, Bluetooth, Wi-Fi, ZigBee, GPS, GSM modules, Open Platform (like Raspberry Pi), Architecture, Programming, Interfacing, Accessing GPIO Pins, Sending and Receiving Signals Using GPIO Pins, Connecting to the Cloud.

Unit V- Applications Development
Complete Design of Embedded Systems, Development of IoT Applications, Home Automation, Smart Agriculture, Smart Cities, Smart Healthcare.

Text Books:
1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

Reference Books:
1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

UCS151 : Embedded System and IOT 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

1. Study and Install Python in Eclipse and WAP in Data Types in Python.
2. A program for arithmetic operation in Python.
3. A program Looping Statement in Python.
4. Study and Install IDE of Arduino and Different Types of Arduino.
5. Define and Explain Eclipse IoT Project.
6. List and summarize few Eclipse IoT Projects.
7. Sketch the architecture of IoT Toolkit and explain each entity in brief.
8. Describe gateway-as-a-service deployment in IoT toolkit.
9. Explain application framework and embedded software agents for IoT toolkit.
10. 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 ofThings", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a
4. HighlyConnected World", Cambridge University Press, 2010.

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

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

UDS152 : Signal and Image processing Lab

Credit Assigned:			
L	**T**	**P**	**C**
0	0	2	1

Course objective: This course provides the basic understanding of the digital image formation and visualization, the visualization of relationships between spatial and frequency, the understanding of mapping the signal processing techniques to the digital image, an idea of multimedia data (image, video), and an exposure to various image and video compression standards.

List of Experiments:

1. Simulate the process of digital image formation using MATLAB/Python, including sampling and quantization. Visualize the effects of different sampling rates and quantization levels on image quality.
2. Implement color space transformations (RGB to HSV, RGB to CMYK) and visualize the color representation in different color spaces. Discuss the applications of each color space in image processing.
3. Implement point processing techniques such as contrast stretching and gamma transformation. Apply these techniques to enhance grayscale and color images, analyzing the impact on image quality.
4. Implement histogram equalization and histogram matching algorithms. Apply these techniques to enhance the contrast of images with varying histograms.
5. Implement linear smoothing filters (e.g., mean filter) and sharpening filters (e.g., Laplacian filter). Apply these filters to noisy images and discuss their effectiveness in noise reduction and edge enhancement.
6. Implement frequency domain filters such as low-pass and high-pass filters using Fourier transform. Compare the performance of different frequency domain filters in image smoothing and sharpening.
7. Implement noise reduction techniques like median filtering and adaptive filtering. Evaluate their performance in removing various types of noise from images.
8. Implement first-order and second-order edge detection operators (e.g., Sobel, Prewitt). Evaluate the performance of different edge detection algorithms on noisy images.
9. Implement the Hough transform for line detection. Detect lines in images with varying complexities and discuss the limitations of the Hough transform.
10. Implement morphological operations such as erosion, dilation, opening, and closing. Apply these operations for image segmentation and feature extraction tasks.
11. Implement basic lossless compression techniques like Run-Length Encoding (RLE) and Huffman coding. Compare their performance with lossy compression techniques like JPEG.
12. Implement the JPEG compression algorithm and analyze the trade-offs between compression ratio and image quality. Discuss the impact of compression artifacts on image visual quality.
13. Implement basic video processing tasks such as frame extraction, frame interpolation, and frame merging. Discuss the challenges and techniques in video processing.
14. Implement basic video compression techniques based on MPEG standards. Compare the compression efficiency and complexity of different MPEG variants.
15. Implement motion estimation algorithms such as block matching and optical flow. Evaluate their performance in predicting motion vectors for video compression.

Text Books:

1. Digital Image Processing by Willam K. Pratt, John Willey & Sons
2. Digital Image Processing by Gonzalez, Rafael C., and Richard E. Woods, Pearson Education
3. The Essential Guide to Video Processing by Alan C. Bovik, Academic Press

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, Machiavellian ism, 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, Mrityunjoy (1995). Organization Behavior . Allied Publication: New Delhi.
2. Newstorn, John W and keita, 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 on 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, 4th Editin,2005.
2. Govindarajan M., Natarajan S., Senthilkumar V.S., "Engineering Ethics", Prentice Hall of India, 2013

UDS105 : Natural Language Processing

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: To learn the fundamentals of natural language processing and use of CFG and PCFG in NLP, the role of semantics of sentences and pragmatics and apply the NLP techniques to IR applications

Course content:

Unit I-Introduction
Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

Unit II- Word Level Analysis
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff, Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and Maximum Entropy models.

Unit III-Syntactic Analysis
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures.

Unit IV- Semantics and Pragmatics.
Requirements for representation, First-Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selection restrictions, Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods, Word Similarity using Thesaurus and Distributional methods.

Unit V- Discourse Analysis and Lexical Resources
Discourse segmentation, Coherence, Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm, Coreference Resolution, Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)

Text Books:
1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.

Reference Books:
1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Java‖, O_Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

UDS106 : Soft Computing and Evolutionary AI

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objectives: 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:
Artificial Intelligence (AI) Role in engineering and daily life, Intelligence and AI, task domains, programming methods, limi tations, Intelligent Agent, Hard vs Soft Computing, ANN, Fuzzy Logic, GA. Applications of Soft Computing, Principles, Genetic Algor ithms (GA), Applications of Evolutionary AI.

Unit II- Knowledge Representation
Need to represent knowledge, Knowledge representation with mapping scheme, Properties of good knowledge -based system, Knowledge representation issues, AND-OR graph, Types of knowledge.

Unit III- Neural Network
Artificial Neural Network: Introduction, Fundamental Concept, Artificial Neural Network, Brain vs. Computer , Comparison Between Biological Neuron and Artificial Neuron, Basic Models of Artificial Neural Network.
Supervised Learning Network: Linear Separability, Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network. Unsupervised Learning Networks: MaxNet.

Unit IV- Fuzzy Inference System
Truth Values and Tables in Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules (Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Inference Systems (FIS)- Construction and Working Principle of FIS, Methods of FIS, Overview of Fuzzy Expert System.

Unit V- Prolog
Basic concept of programming languages related to artificial intelligence problems, concept of programming in Logic, basic pr olog constructs, Applications of Prolog, Relations in Prolog Family Relationship in Prolog, Data Objects- Introduction, Data Objects- Atoms and Numbers, Variables, Structures, Representation of Lists. List Operations Membership, Length Calculation, Concatenation, U nion of two Lists, operations on Lists such as Intersection of Two Lists. Types of Operators Comparison, Arithmetic Operators, Structures and Matching in Prolog, Built in Predicates- Identifying Terms, Decomposing Structures, Inbuilt Mathematical Predicates

Text Books:
1. Russel and Norvig, Artificial intelligence A Modern Approach, 2nd Edition, Pearson Printice Hall Publication, 2010.
2. Sivanandam, S. N., and S. N. Deepa, 2007. Principles of Soft Computing. John Wiley & Sons.
3. 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.
2. Kevin Knight, Elaine Ric, Artificial Intelligence, Tata mcgraw Hill publishing house, 2017.

UDS155 : Natural Language Processing Lab

Credit Assigned:			
L	**T**	**P**	**C**
0	0	2	1

Course objective: To learn the fundamentals of natural language processing and use of CFG and PCFG in NLP, the role of semantics of sentences and pragmatics and apply the NLP techniques to IR applications

List of Experiments:

1. Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.
2. Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers.
3. Check how many words are there in any corpus. Also check how many distinct words are there?
4. Write a program to implement both user-defined and pre-defined functions to generate
   (a) Uni-grams (b) Bi-grams (c) Tri-grams (d) N-grams
5. Write a program to calculate the highest probability of a word (w2) occurring after another word(w1).
6. (i) Write a program to identify the word collocations.
   (ii) Write a program to print all words beginning with a given sequence of letters.
   (iii) Write a program to print all words longer than four characters.
7. (i) Write a program to identify the mathematical expression in a given sentence.
   (ii) Write a program to identify different components of an email address.
8. (i) Write a program to identify all antonyms and synonyms of a word.
   (ii) Write a program to find hyponymy, homonymy, polysemy for a given word

Case Studies: (At Least any one Case Study has to be performed)

Case Study-1. Write a program to implement Named Entity Recognition (NER) for any corpus.

Case Study-2. Write a program to perform Auto-Correction of spellings for any text.

Case Study-3. Check for all positive words in a news article/ any text

Text Books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.

Reference Books:

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Java‖, O_Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

UDS156 : Soft Computing and Evolutionary AI Lab

Credit Assigned:			
L	**T**	**P**	**C**
0	0	2	1

Course objectives: 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.

List of Experiments:

1. Implementation of Fuzzy Operations.
2. Implementation of Fuzzy Relations (Max-min Composition)
3. Implementation of Fuzzy Controller (Washing Machine)
4. Implementation of Simple Neural Network (McCulloh-Pitts model)
5. Implementation of Perceptron Learning Algorithm
6. Implementation of Unsupervised Learning Algorithm
7. Implementation of Simple Genetic Application
8. Study of ANFIS Architecture
9. Study of Derivative-free Optimization
10. Study of research paper on Soft Computing.

Text Books:

1. Russel and Norvig, Artificial intelligence A Modern Approach, 2nd Edition, Pearson Printice Hall Publication, 2010.
2. Sivanandam, S. N., and S. N. Deepa, 2007. Principles of Soft Computing. John Wiley & Sons.
3. 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.
2. Kevin Knight, Elaine Ric, Artificial Intelligence, Tata mcgraw Hill publishing house, 2017.

UDS107 : Brain-Computer Interaction

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: To understand the fundamental principles of Brain-Computer Interaction (BCI), demonstrate proficiency in brain signal acquisition, preprocessing, feature extraction, classification, and real-time data processing

Course Content

Unit-I Introduction to Brain-Computer Interaction:
Historical Development and Milestones in BCI Research, Applications and Use Cases of BCI Systems (e.g., healthcare, assistive technology, gaming), Ethical and Privacy Considerations in BCI Research and Applications, Neurophysiology: Structure and Function of Neurons Brain Signals: Electroencephalography (EEG), Magnetoencephalography (MEG), Electrocorticography (ECoG) Neural Recording Techniques: Invasive and Non-invasive Methods Brain Imaging Methods: Functional Magnetic Resonance Imaging (fMRI), Functional Near-Infrared Spectroscopy (fNIRS).

Unit-II Signal Processing for BCI:
Signal Acquisition: EEG Electrode Placement and Setup, Preprocessing Techniques: Filtering, Artifact Removal, Feature Extraction: Time Domain, Frequency Domain, Spatial Features, Signal Classification: Machine Learning Algorithms for BCI (e.g., Support Vector Machines, Neural Networks), EEG Signal Acquisition: Electrode Types, Sampling Rate, Common Reference Systems, Artifact Removal Techniques: Eye Movement and Blink Artefacts, Muscle Artefacts, Signal Filtering: Bandpass, Notch, Common Spatial Patterns (CSP), Feature Extraction and Representation: Time-Frequency Analysis, Spatial Filters

Unit-III Human-Computer Interaction (HCI)
Principles, System Design, Implementation and Machine Learning: HCI Fundamentals: Design Principles and Models, User-Centered Design: User Requirements and Task Analysis, Interaction Techniques for BCI: Motor Imagery, Steady-State Visual Evoked Potentials (SSVEP), P300 Event-Related Potentials (ERPs), Usability Evaluation Methods for BCI Systems, System Architecture and Components: Signal Acquisition Hardware, Data Processing Software, User Interface, Software and Hardware Integration: OpenBCI, Emotiv, Neurosky, Real-time Data Processing: Buffering, Feature Extraction, Classification, User Feedback and Adaptation: Feedback Modalities (Visual, Auditory, Tactile), Adaptive Systems, Classification Algorithms for BCI: Linear Classifiers, Non-linear Classifiers, Feature Selection and Dimensionality Reduction Techniques, Evaluation Metrics for BCI Performance: Accuracy, Sensitivity, Specificity, Information Transfer Rate (ITR).

Unit-IV BCI Applications:
BCI Applications in Rehabilitation: Motor Recovery, Stroke Rehabilitation, BCI Applications in Neurofeedback: Attention Training, Meditation, BCI Applications in Cognitive Neuroscience: Brain-Computer Interfaces for Research, BCI Applications for Communication: Spelling, Typing, Voice Synthesis, BCI Applications for Mobility Assistance: Wheelchair Control, Prosthetic Limbs, BCI Applications for Environmental Control: Home Automation, Smart Devices, BCI Gaming: Mind-Controlled Games, Brainwave-Based Interfaces, BCI Applications in Virtual Reality (VR) and Augmented Reality (AR), Ethical Considerations in BCI Gaming: Privacy, Consent, Fairness

Unit-V BCI Project Design and Implementation:
BCI Project Proposal: Research Question, Objectives, Scope, Data Collection and Preprocessing for BCI Project, Feature Extraction and Classification for BCI Project, Evaluation and Validation of BCI Project, Brain-Computer Interface Paradigms: Motor Imagery, Visual P300, Auditory BCI, Hybrid BCI Systems: Combining EEG with Other Modalities (fNIRS, EMG), Brain-Computer Interface for Neuromarketing and Consumer Neuroscience, Brain-Computer Interface for Brain-Computer Music Interface (BCMI)

Text Books

1. "Brain-Computer Interfaces: Principles and Practice" by Jonathan R. Wolpaw and Elizabeth Winter Wolpaw..
2. "Fundamentals of Brain-Computer Interface Systems" by Chang S. Nam and Anton Nijholt.Skiena Steven S.
3. "Brain-Computer Interfacing: An Introduction" by Rajesh P. N. Rao.
4. "Neuroergonomics: The Brain at Work" by Raja Parasuraman and Matthew Rizzo.

UDS108 : Computer Vision

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: To develop an appreciation for various issues in the design of computer vision and object recognition systems; and to provide the student with programming experience from implementing computer vision and object recognition applications.

Unit 1: Essential mathematical tools:
Least squares, RANSAC, Eigen-analysis, PCA, SVD, clustering, gradient-based optimization methods. Geometry, Camera models, Epipolar geometry, Stratified reconstruction, Applications: large scale reconstruction, single-view metrology

Unit 2: Probabilistic graphical models:
MRF, CRF, Combinatorial optimization methods. Stereo disparity estimation, Optical flow (Lucas Kanade and Horn Schunk approaches, contemporary energy minimization methods)

Unit 3: Features detection and tracking:
Harris corner detector, KL tracking, SIFT, Overview of other contemporary descriptors. Segmentation: Low-level segmentation, energy minimization and clustering based methods, semantic segmentation

Unit 4: High level vision:
CNN overview, single image depth estimation, Flow-net, 3D scene understanding and segmentation.

Unit 5: Synthesis:
GAN overview, 3D shape synthesis, integrating viewpoint and texture, semantic image synthesis

Text Books:
1. D. A. Forsyth and J. Ponce, Computer Vision, A Modern Approach, Pearson Education, 2003.
2. R. Hartley and A. Zisserman, Multiple view geometry in computer vision, Second edition, Cambridge univ. press, 2003
3. S. Prince, Computer vision – Models, learning and inference, Cambridge univ. press, 2012.
4. C. Bishop, Pattern Recognition and Machine learning, Springer, 2006.

UDS109 : Robotics Intelligence

Credit Assigned:			
L	**T**	**P**	**C**
3	0	0	3

Course objective: To develop an appreciation for various issues in the design of computer vision and object recognition systems; and to provide the student with programming experience from implementing computer vision and object recognition applications.

Course content:

Unit-I: Introduction
Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.

Unit-II: End Effectors and Robot Controls
Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

Unit-III: Robot Transformations and Sensors
Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactilesensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Unit-IV: Robot Cell Design
Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devicesin Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection,Welding, Spray painting and undersea robot.

Unit-IV: Micro/Nano Robotics System
Micro/Nanorobotics system overview-Scaling effect-Top down and bottom up approach- Actuators of Micro/Nano robotics system-Nanorobot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot workingprinciples-Biomimetic robot-Swarm robot-Nanorobot in targeted drug delivery system.

Text Books:

1. Craig. J. J. “Introduction to Robotics mechanics and control”, Addison- Wesley,1999
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
3. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012
4. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering anIntegrated Approach, Phi Learning.,2009.
5. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishingcompany limited, 1994
6. Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications,McGraw Hill Co, 1995.
7. Klafter. R.D, Chmielewski.T.A. and Noggin‟s., “Robot Engineering : An IntegratedApproach”, Prentice Hall of India Pvt. Ltd.,1994.

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.

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 mxn 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. 5. Research methodology, Methods and Techniques, Kothari, C.R., 2000.