Courses of Study

(Detailed Course Contents)

Under-graduate Programme

(w.e.f 2024 Batch)

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

VISION

Establishment of a Scientific & Technical University of Excellence to nurture young and talented human resources for the service of Indian Society & world at large and preserving the integrity and sanctity of human values.

MISSION

The mission of the University is the pursuit of Education, Scholarship and Research at the highest International level of excellence.

OBJECTIVES

- Provide education and training of excellent quality, both at undergraduate and postgraduate level.
- Ensure that the University achieves and maintains an international standing in both teaching and research
- Promote study and research in new and emerging areas and encourage academic interaction of the faculty and the students at national and international levels.
- Encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

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Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Computer Science& Engineering

(Approved Under Section 2(f) and 12(B) of UGC act of 1956)

Shri Mata Vaishno Devi University

School of Computer Science and Engineering

Faculty of Engineering, SMVDU

Kakryal, Katra 182320

Dated: 20.2.25

Annexure "E"

Course Structure of
B. Tech (Computer Science & Engineering) programme
[w.e.f Entry Batch 2024]

Semester I

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 1	MTL BS101	Engineering Mathematics-I	3	1	0	4
BSC 2	PHL BS101	Engineering Physics	3	0	0	3
BSC 2	PHP BS101	Engineering Physics Lab	0	0	2	1
ESC 1	CSL ES101	Introduction to C Programming	3	0	0	3
ESC 1	CSP ES101	C Programming Lab	0	0	2	1
ESC 2	ECL ES103	Digital Electronics	3	0	0	3
ESC 2	ECP ES103	Digital Electronics Lab	0	0	2	1
SEC 1	MEM SE103	Engineering Graphics with CAD	1	0	2	2
AEC 1 / VAC 1		Ability Enhancement /Value Added Course				2
		Total Credits				**20**

Semester II

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 3	MTL BS102	Engineering Mathematics-II	3	1	0	4
BSC 4	MTL BS106	Discrete Structures	3	1	0	4
DCC 1	CSL DC102	Programming using Python	3	0	0	3
DCC 1	CSP DC102	Python Programming Lab	0	0	2	1
DCC 2	CSL DC104	Data structure	3	0	0	3
DCC 2	CSP DC104	Data Structure Lab	0	0	2	1
SEC 2	MEM SE102	Engineering Workshop	1	0	2	2
AEC 2		Ability Enhancement Course				2
VAC 2		Value Added Course				2
MAC 1	PCN MA102	Universal Human Values - II	2	0	0	0
		Total Credits				**22**

Exit option: Students who opt to exit after completion of the year and have secured 42 credits (As per the program structure) shall be awarded the UG Certificate if, in addition, they earn additional 6 credits through 2 months of summer internship/ ITI level course/skill-based course during the summer vacation of the first year.

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Semester III

Course Type	Course Code	Course Title	L	T	P/S	Credits
BSC 5	BTL BS201	Introduction to Biology for Engineers	3	0	0	3
ESC 3	ECL ES205	Microprocessors & Interfacing	3	0	0	3
ESC 3	ECP ES205	Microprocessors & Interfacing Lab	0	0	2	1
DCC 3	CSL DC201	Theory of Computation	3	1	0	4
DCC 4	CSL DC203	Operating Systems	3	0	0	3
DCC 4	CSP DC203	Operating Systems Lab	0	0	2	1
DCC 5	CSL DC205	Data Science & Analytics	3	0	0	3
DCC 5	CSP DC205	Data Science & Analytics Lab	0	0	2	1
SEC 3		Skill Enhancement Course - 3				2
PR	CSI PR201	Summer Internship-I				1
VAC 3		Value Added Course				2
		Total Credits				**24**

Semester IV

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 6	CSL DC202	Soft Computing	3	0	0	3
DCC 6	CSP DC202	Soft Computing Lab	0	0	2	1
DCC 7	CSL DC204	Design & Algorithm Analysis	3	0	0	3
DCC 7	CSP DC204	Design & Algorithm Analysis Lab	0	0	2	1
DCC 8	CSL DC206	Database Management Systems	3	0	0	3
DCC 8	CSP DC206	Database Management Systems Lab	0	0	2	1
DCC 9	CSL DC208	Computer Organization & Architecture	3	1	0	4
DCC 10	CSL DC210	Compiler Design	3	1	0	4
VAC 4	BTL VA202	Environmental Science & Education	2	0	0	2
		Total Credits				**22**

Exit option: Students who opt to exit after completion of the secondcomputer year and have secured 88 credits (As per the program structure) shall be awarded the UG Diploma if, in addition, they earn an additional 6 credits through 2 months of summer internship/ Diploma level courses/skill vacation of the second year.

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Semester V

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 11	CSL DC301	Computer Networks & Communication	3	0	0	3
DCC 11	CSP DC301	Computer Networks & Communication Lab	0	0	2	1
DCC 12	CSL DC303	Object Oriented Programming using JAVA	3	0	0	3
DCC 12	CSP DC303	Object Oriented Programming Lab using JAVA	0	0	2	1
DCC 13	CSL DC305	Machine Learning	3	0	0	3
DCC 13	CSP DC305	Machine Learning Lab	0	0	2	1
DEC 01		School Elective – I	3	1/0	0/2	4
DEC 2 /GEC 1		School Elective – II/Generic Elective - I	3	1/0	0/2	4
PR	CSI PR301	Summer Internship-II				1
DCC	CSD PR301	Project Work - I				2
		Total Credits				**23**

Semester VI

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 14	CSL DC302	Deep Learning	3	0	0	3
DCC 14	CSP DC302	Deep Learning Lab	0	0	2	1
DCC 15	CSL DC304	Software Engineering	3	0	0	3
DCC 15	CSP DC304	Software Engineering Lab	0	0	2	1
DEC 3	CSX DEXXX	School Elective - III	3	1/0	0/2	4
DEC 4 /GEC 2	CSX DEXXX / CSX GEXXX	School Elective – IV/Generic Elective -II	3	1/0	0/2	4
AEC		Management / Entrepreneurship/Economy	3	0	0	3
DCC	CSD PR302	Project Work - II				2
MAC 2	PCN MA302	Indian Knowledge System	2	0	0	NC
		Total Credits				**21**

Exit option: Students who opt to exit after completion of the third year and have secured 132 credits (As per the program structure) shall be awarded B.VOC Degree in the Major discipline if, in addition, they have completed the summer internship of additional 4 credits during summer vacation of the third year.

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Semester VII

Course Type	Course Code	Course Title	L	T	P/S	Credits
DCC 16	CSL DC401	Digital Image Processing	3	0	0	3
DCC 16	CSP DC401	Digital Image Processing Lab	0	0	2	1
DEC 5	CSX DEXXX	School Elective – V	3	1/0	0/2	4
DEC 6 / GEC 3	CSX DEXXX / CSX GEXXX	School Elective – VI/ Generic Elective – III	3	1/0	0/2	4
PR	CSI PR401	Summer Internship - III				2
DCC/PR	CSD PR401	Project Work– III				4
		Total Credits				**18**

Internship to be completed in summer vacation after sixth semester.

Semester VIII

DCC/PR	CSD PR402/ CSI PR402	Major Project /Internship (Industrial or In-house Project)				10
		Total Credits	**160**			**10**

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LIST OF SCHOOL ELECTIVE COURSES

List of School Electives For B.Tech. CSE						
S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
		DEC – I				
1	CSL DE301	Software Defined Networks	3	0	2	4
2	CSL DE303	Storage Networks	3	1	0	4
3	CSL DE305	Computer Vision	3	1	0	4
4	CSE DE307	Web Programming	3	0	2	4
5	CSL DE309	Block Chain Technology	3	1	0	4
6	CSL DE311	Data Visualization **(Hon. DS & AI)**	3	0	2	4
		DEC – II				
1	CSL DE313	Probability & Stochastic Processes **(Hon. DS & AI)**	3	1	0	4
2	CSL DE315	Cloud Computing	3	1	0	4
3	CSL DE317	Parallel & Distributed Computing	3	1	0	4
4	CSL DE319	Advanced Mobile Communication using 5G	3	1	0	4
5	CSL DE325	Advanced Computer Architecture	3	1	0	4
6	CSL DE323	Computer Network Security	3	0	2	4
		DEC – III				
1	CSL DE302	Data mining & warehousing **(Hon. DS & AI)**	3	0	2	4
2	CSL DE304	Human Computer Interaction	3	1	0	4
3	CSL DE306	Quantum Computing	3	0	2	4
4	CSL DE308	Mobile & App Development	3	1	0	4
		DEC – IV				
1	CSL DE322	Digital twin **(Hon. DS & AI)**	3	0	2	4
2	CSL DE310	Internet of Things **(Hon. DS & AI)**	3	1	0	4
3	CSL DE312	Wireless Networks	3	0	2	4
4	CSL DE314	Information Coding Practices	3	1	0	4
5	CSL DE316	Computer Embedded Systems	3	1	0	4
6	CSL DE318	Multimedia and Virtual Reality	3	1	0	4
7	CSL DE320	High Performance Computing	3	1	0	4
		DEC – V				
1	CSL DE401	Nature Inspired Algorithms **(Hon. DS & AI)**	3	0	2	4
2	CSL DE411	Robotics & Vision Control **(Hon. DS & AI)**	3	1	0	4
3	CSL DE403	Metaheuristic Design Framework	3	1	0	4
4	CSL DE405	Cyber Security	3	1	0	4
5	CSL DE407	E-Commerce & Cyber Laws	3	1	0	4
6	CSL DE409	Digital Forensic	3	1	0	4
		DEC – VI				
1	CSL DE413	Natural Language Processing **(Hon. DS & AI)**	3	1	0	4
2	CSL DE415	Foundation Models **(Hon. DS & AI)**	3	1	0	4

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B.Tech. CSE Honors. in Data Science & Artificial Intelligence

Course Type	Course Code	Course Title	L	T	P/S	Credits
DEC	CSL DE311	Data Visualization	3	0	2	4
DEC	CSL DE313	Probability & Stochastic Processes	3	1	0	4
DEC	CSL DE302	Data mining & warehousing	3	0	2	4
DEC	CSL DE322	Digital twin	3	0	2	4
DEC	CSL DE310	Internet of Things	3	0	2	4
DEC	CSL DE401	Nature Inspired Algorithms	3	0	2	4
DEC	CSL DE411	Robotics & Vision Control	3	1	0	4
DEC	CSL DE413	Natural Language Processing	3	1	0	4
DEC	CSL DE415	Foundation Models	3	1	0	4
DEC	CSL DE315	Cloud Computing	3	0	2	4
DEC	CSL DE320	High Performance Computing	3	1	0	4
DEC	CSL DE321	Business Analytics with R	3	0	2	4

a) **Minor Specialization in Artificial Intelligence**
b) **Minor Specialization in Information Security**

	Minor Specialization in Artificial Intelligence				
Course Code	**Course Title**	**L**	**T**	**P/S**	**Credits**
CSL GE301	Introduction to Artificial Intelligence	3	1	0	4
CSL GE305	Probability & Statistics	3	1	0	4
CSL GE302	Introduction to Machine Learning	3	0	2	4
CSL GE306	Data Analytics	3	0	2	4
CSL GE401	Soft Computing	3	0	2	4
CSL GE405	Natural Language Processing	3	1	0	4
CSL GE402	Artificial Intelligence for Engineering Applications	3	1	0	4
CSL GE406	Prompt Engineering	3	1	0	4
CSL GE410	Vision Transformers	3	1	0	4

	Minor Specialization in Information Security				
Course Code	**Course Title**	**L**	**T**	**P/S**	**Credits**
CSL GE303	Computer Network & Communication	3	0	2	4
CSL GE307	Information & Coding Practices	3	1	0	4
CSL GE304	Wireless Networks	3	0	2	4
CSL GE308	Internet of Things	3	0	2	4
CSL GE403	Introduction to Cyber Security	3	1	0	4
CSL GE407	Block Chain Coding	3	1	0	4
CSL GE404	Privacy & Security in Online Social Media	3	1	0	4
CSL GE408	Information Response & Management	3	1	0	4

B. Tech. (Honor's) Program: The four-year B. Tech. (Honor's) degree in the Major discipline will be awarded to those who have completed the credit requirement of a four-year B.Tech. degree program and earned 12 Additional Credits through DEC's provided a minimum of seven DEC's earned are from the basket of a particular specialization/domain.
These elective courses can be registered during V to VIII semester subject to a maximum limit of course

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registration up to 32 credits, including core and other courses.

Department Elective Course – 7	4	DEC
Department Elective Course – 8	4	DEC
Department Elective Course – 9	4	DEC

These elective courses can be registered during V to VIII semester subject to a maximum limit of course registration up to 32 credits, including core and other courses. On exit, student shall be awarded B.Tech.(Honor's) in Major discipline with specialization in the specific domain.

2. **B. Tech. Program with Minor/Interdisciplinary Area Specialization:**

The four-year B. Tech. degree in the Major discipline with Minor in a specific domain will be awarded to those who have completed the credit requirement of four-year B. Tech degree program and earned 12 Additional Credits through GECs provided all credits earned through GECs are from the basket of a particular Minor.

Generic Elective Course – 5	4	GEC
Generic Elective Course – 6	4	GEC
Generic Elective Course – 7	4	GEC

The set of courses required to be taken, by students of other School, to obtain Minor/Interdisciplinary Area Specialization will be clearly defined by each School for the benefit of the students. The four-year B. Tech. degree with Minor in a specific domain will be awarded to those who complete a four-year degree program with 172 credits and have satisfied the credit requirement. A student, who wishes to pursue B. Tech. with Minor, shall earn 12 additional credits from General Elective course provided all 7 GECs (GEC1 to GEC7) are earned from the basket of courses prescribed for that particular Minor.

Course Code : **MTL BS101**
Course Title : **Engineering Mathematics-I**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT-I
Differential Calculus: Partial Differentiation, asymptotes, concavity, convexity, point of inflexion, curvature, radius of curvature, curve tracing, envelopes and evolutes, change of variables, Jacobian, expansion of functions of several variables, chain rule, mean value theorem, Taylor series with remainder term, maxima & minima, saddle point.

UNIT-II
Integral Calculus: Fundamental theorem of Integral calculus, reduction formulae, properties of definite integral, applications to length, area, volume, surface of revolution. Moments, centre of gravity, improper integrals, β-γ functions

UNIT-III
Matrices: Elementary row and column transformation, linear dependence, rank of a matrix, consistency of system of linear equations, solution of linear system of equations, characteristic equations, Cayley Hamilton theorem, eigen values and eigen vectors, diagonalization, complex matrices.

Suggested Books:

Sr.	**Name of Book, Author, Publisher**	**Year of Publication/Reprint**
Text Books		
1	E. Kreysig , Advanced Engineering Mathematics , Wiley 10th Edition	2011
2	A . K. Gupta , Engineering Mathematics, Macmillan 7th Edition	2013
3	McQuarri Macmillan, Mathematical Methods by Scientists & Engineers, 1st Edition	2013
Reference Books		
1	Shanti Narayan, Differential Calculus, S. Chand; 30th Revised edition	2005
2		

Course Outcome

Sr	**Course Outcome**	**CO**
1	Introduce the basic concept of differential calculus to understand the different subjects of engineering as well as basic sciences.	CO1
2	Enable the students to develop the concept of partial differentiation to understand their applications in engineering	CO2
3	Understand the fundamentals of Integral calculus to understand their applications to length, area, volume, surface of revolution, moments and centre of gravity	CO3
4	Understand the improper integrals and Beta and Gamma functions and their applications	CO4
5	Understand the idea of Linear Algebra which are useful to all branches of engineering	CO5

Course Code : **PHL BS101**
Course Title : **Engineering Physics**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Basic Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT I: Force and electric field due to continuous charge distribution, Field lines-Electric Flux, Gauss's Law (differential and integral forms), Applications of Gauss's law Electric potential, work done in assembling a charge distribution
UNIT II: Force Law - line current, surface current and volume current densities (Equation of continuity), Biot-savart law, Properties of B, Magnetic flux-Divergence B, Curl B, magnetic vector potential A Ampere's law (differential and integral forms), displacement current, modified Ampere's law Faraday's laws of electromagnetic induction, Four Maxwell's equations in differential and integral forms
UNIT III: Electromagnetic Spectrum, brief introduction to black body radiation, photo-electric Effect, Compton Effect, wave particle duality (de-Broglie waves), Davisson-Germer Experiment, concept of wave function and its physical significance, Phase and group velocities, Uncertainty principle.

UNIT IV : Bohr theory of atom (with finite and infinite nuclear mass) Derivarion of time dependent and time independent Schrödinger wave equations, Expectation values and operators (momentum, energy and angular momentum operators), Commutators, Particle in a box of infinite height (One dimensional)
UNIT V: Free electron theory-Free electron gas, Energy levels and density of states in one dimension
Band theory of solids, Classification of metals, semiconductors and insulators on the basis of band theory

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Introduction to Electrodynamics, D. J. Griffiths, Pearson.	2001
2	Electromagnetics, B. B. Laud, New Age International Publisher	2005
3	Electromagnetics, B. B. Laud, New Age International Publisher	2006
Reference Books		
1	Introduction to Solid State Physics, Charles Kittel, Wiley	2015
2	Solid State Physics, S.O. Pillai, Wiley	2008

Course Outcome

Sr	Course Outcome	CO
1	Know the vocabulary and concepts of Physics as it applies to: Electricity and Magnetism and Modern Physics	CO1
2	Develop the mathematical description of these concepts and principles to build up problem solving skills that will benefit their future career.	CO2
3	Apply an understanding of these concepts to develop various modern systems, structures, technology and devices.	CO3
4	Gain confidence to apply mathematical methods to understand Physics problems in real-life situations.	CO4

Course Code : PHP BS101
Course Title : Engineering Physics Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Basic Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	To study the Measuring Instruments (Vernier Calipers, Screw Gauge &Spherometer)
2	To find the angle of prism by rotating the telescope method.
3	To find the refractive index of the material of the given prism using a spectrometer
4	To determine the refractive index of the given liquid (water) using a hallow prism and spectrometer.
5	To study the Newton's Interference Rings and to determine the wavelength of Sodium light.
6	To determine the Wave Length of Sodium Light using a plane diffraction grating.
7	To determine the frequency of A.C. mains with a Sonometer using non magnetic wire.
8	To study the V-I characteristics of a Zener Diode.
9	To study the performance of a Half-wave, Full-wave & Bridge wave rectifier without filters
10	To verify Stefan's law by estimating the temperature of a torch bulb filament from resistance measurement.
11	To study the Hall Effect and to calculate the Hall Coefficient and Charge Carrier Concentration of a given sample
12	To study the dependence of Refractive Index(μ) of the material of the prism on the Wavelength(λ) of light; and hence(1) to determine the Dispersive Power of the material of prism;(2)to verify the

	Cauchy Relationship $\mu=a+b/\lambda^2$,and to estimate the values of a & b(3)to plot a graph of $d\mu/d\lambda$ versus λ.
13	To determine the band gap by measuring the resistance of a Thermistor at different temperatures
14	To determine the energy band gap of a semiconductor diode (Ge) using Four Probe Method.
15	To study the wavelength of He-Ne Laser

Course Code : CSL ES101
Course Title : Introduction to 'C' Programming
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :No
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

History of Programming Languages and their constructs , approach , Basics of computer systems , programs, flowchart , algorithms.

Different Number systems , Algorithms and flow charts , types of algorithm , properties of good algorithm , examples , use of flow chart. C- fundamentals , constants, variables ,data types and ranges , Different , expressions operators Methods of writing C program

C- fundamentals , constants, variables ,data types and ranges , Different , expressions operators. Methods of writing C program. Input output statements , format conversions.

Character operation, control statements simple , if- , if else , ternary , compound , nested .

Switch case statements, different programs on the topic Looping statements FOR , WHILE, Do- WHILE, Nested FOR, Parallel FOR, Goto , continue , break statement, programs on the topic.

Looping statements FOR , WHILE, Do- WHILE, Nested FOR, Parallel FOR.. Programs on the covered topics

Introduction to functions , different types of functions in C, Recursion , function as argument, Nesting of functions. Call by reference and call by value=s, Various programs with usage of different function in C

Arrays in C , Numeric array, single dimensional, multi dimensional arrays printing of arrayssupply of values to array , character array , matrix , input output formats for String

String operation , Types of operations , string functions , length of string , comparing of string

Auxiliary statements and operations , types of variables automatic static , global , register variables

User defined data types, Enumerated , Typedef Unions

Pointers in C ,Decalration of pointer , concept of pointer , types of pointers pointer as argument of function program.

Use of pointer in an array, character operation using pointer , function pointer Use of pointer in multi dimensional array,

Pointers as a main variable of structure , Structure of pointers . Structure of normal variables and pointers Nested structure programs on structure and pointers.

File operations , Creation of files , file organization Sequential, direct, indexed , Random access file organization, file pointers, file input output functions
Error in opening file end of file Fgets ,Exit, Fread , Fputs , Eof, Fprintf, StdinStdout, Stdeer file pointer

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Gottfried, Byron S., —Programming with C, Tata McGraw Hill	2016

2	Balagurusamy, E., —ANSI C, Tata McGraw-Hill	2011
3	YashwantKanetker, —Let us C, BPB	2022
Reference Books		
1	C, The Complete Reference, Scholdt, TMH	2001
2	Programming with C, S. Kaicher, Macmillan	2003

Course Outcome

Sr	Course Outcome	CO
1	Have knowledge and understanding of programming.	CO1
2	Attain the logical ability to write programs in C language by using basic control structures (conditional statements, loops, switches, branching, etc.).	CO2
3	Understand the usage of advanced programming concepts using functions, arrays, strings, pointers and structures, and implement the various data structures	CO3
4	Attain the ability to create a programmable model for a problem given	CO4

Course Code : CSP ES101
Course Title : 'C' Programming Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

S.No.	List of Programs
1.	Write a program to print "Hello World" on the screen
2.	Write a program to find sum of the two numbers
3.	Write a program to find average of two numbers
4.	Write a program to know the number of bytes of data type contains
5.	Write a program to display the ASCII code of a variable on the screen
6.	Writ a program to determine the area of a circle
7.	Write a program to find the area of a square
8.	Write a program to find the sum of digits of a 4 digit number
9.	Write a program to reverse a 4 digit number
10.	Write a program to swap the values of two variables with/without using third variable
11.	Write a program to display if a number is even or odd
12.	Write a program to display if a number is positive or negative
13.	Write a program to display that a person is eligible for voting
14.	Write a program to display greatest among two numbers
15.	Write a program to display subject of 5 marks & compute percentage and display pass or fail
16.	Write a program to read number between 1-7 & display corresponding day of week
17.	Write a program to read marks of five subjects and compute percentage and display grade of students based on percentage
18.	Write a program to check whether the year entered is leap year or not
19.	Write a program to print the relation between 2 numbers as equal to, less than or greater than
20.	Write a program to read lower case character and display it in upper case
21.	Write a program to convert dollar into rupees
22.	Write a program to convert Celsius into Fahrenheit
23.	Write a program to swap the values to two variables with the help of temporary variable
24.	Write a program to make a calculator
25.	Write a program to print "Hello world" 10 times using while loop
26.	Write a program to print "Hello world" n times using while loop
27.	Write a program to print 1 to 10 on screen
28.	Write a program to print 10 to 1 on screen
29.	Write a program to print sum of all even numbers between 1 to 100
30.	Write a program to print sum of all odd numbers between 1 to n
31.	Write a program to print multiplication table of n
32.	Write a program to find factorial of a number
33.	Write a program to find sum of all numbers between m to n
34.	Write a program to read a number and print each digit on separate line

35.	Write a program to find the sum of digits of a number
36.	Write a program to reverse a number
37.	Write a program to find if the number is Palindrome or not
38.	Write a program to read +ve numbers from user till user enters 0 & display for each number whether it is even or odd
39.	Write a program to find the reverse of a number
40.	Write a program to read +ve number from user till user enters 0 and display count of even numbers and odd numbers.
41.	Write a program to read character from user till user enters special character and display count of vowels and digits
42.	Write a program to read a number from user and display whether it is prime or not
43.	Write a program to print all leap years between year m to n
44.	Write a program to read a number and find if it is an Armstrong number or not
45.	Write a program to print all prime number between n to m
46.	Write a program to print 1st n prime numbers.
47.	Write a program using switch case to read one number and perform 1. Sum of digit 2. Reverse of number 3. Number is palindrome or not
48.	Write a program using switch case to read operator and perform (+, -, /, *) operators of operands
49.	Write a program using switch case to read a number and perform 1. Factorial of a number 2. Number is prime 3. Number is Armstrong 4. Even or odd
50.	Write a program to sort an array of type integer
51.	Write a program to reverse an array element in the array
52.	Write a program to check if the array is palindrome or not
53.	Write a program to reverse an array element in the array
54.	Write a program to check of the array is palindrome or not
55.	Write a program to insert an element in sorted array at its right place
56.	Write a program to delete all the duplicate numbers from the array
57.	Write a program to read temperature recorded for the month of September. Display the highest and lowest temperature recorded
58.	Write a program to read total marks of 90 students. Find the average marks scored by the class. Display the number of students having marks below average and total number of students marks equal to or above average.
59.	Write a program to read n numbers in an array. Display the count of total –ve numbers, +ve numbers and total zero. Your program must derive m which should be added to all –ve numbers so as they are converted to either zero or +ve number.
60.	Write a program to sum the two arrays into another array.
61.	Write a program to add two matrix using multi-dimensional arrays
62.	Write a program to multiply to matrix using multi-dimensional arrays
63.	Write a program to find transpose of a matrix
64.	Write a program to print the characters of a string in vertical order
65.	Write a program to find the length of a string
66.	Write a program to find the frequency of characters in string
67.	Write a program to find the total number of vowels in the string
68.	Write a program to find the number of vowels, consonants, digits and white space in string using Switch - case
69.	Write a program to concatenate two strings
70.	Write a program to find the total number of words in a sentence
71.	Write a program to reverse a sentence
72.	Write a program to remove all characters in a string except alphabet
73.	Write a program to sort elements in different orders in string
74.	Write a program to insert a character in a string
75.	Write a program to search a character in a string
76.	Write a program to delete a character in a string
77.	Write a program to insert a word in a string
78.	Write a program to search a word in a sentence
79.	Write a program to delete a word in a sentence
80.	Write a program to find the length of each string in a 2-dimensional array
81.	Write a program to find sort each string in a 2-dimensional array
82.	Write a program to change the case of each string in a 2-dimensional array
83.	Write a program to change the reverse each string in a 2-dimensional array
84.	Write a program to display prime numbers between m and n using function
85.	Write a program to check Armstrong number using user-defined function
86.	Write a program to check whether a number can be expressed as sum of two prime numbers using function
87.	Write a program to find the sum of n natural numbers using function
88.	Write a program to calculate factorial of a number using function
89.	Write a program to reverse a sentence using function

90.	Write a program to calculate power of a number using function
91.	Write a program to convert binary number to decimal and vice-versa using function
92.	Write a program to store information (name, roll and marks) of student using structure
93.	Write a program to add two distances (in inch-feet) system using structure
94.	Write a program to add two complex numbers by passing structure to a function
95.	Write a program to calculate between two time period
96.	Write a program to store information of 10 students using structure and display the roll no, name and total marks of each student
97.	Write a program to access elements of an array using pointer
98.	Write a program to swap numbers of an array using call by reference
99.	Write a program to find largest number in an array using function
100.	Write a program to multiply two matrices by passing matrix to function

Course Code : ECL ES103
Course Title : Digital Electronics
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Basic concepts of Boolean Algebra
Review of number systems - Binary, Hexadecimal, conversion from one to another, complement arithmatic, Signed and unsigned numbers and their arithmetic operations. BCD, Excess-3, Gray and Alphanumeric codes. Review of Boolean algebra, De-Morgan's Theorems, Standard Forms of Boolean Expressions, MinimizationTechniques: K-MAPS, VEM Technique, Q-M (Tabulation) method.

Logic Gates & families
Logic Families: TTL, MOS, CMOS, Bi-CMOS; Performance parameters of IC families: input and output loading, fan-in, fan-out, tri-state, current drive, voltage levels, noise margins, power-speed tradeoff; Unused inputs; Interfacing between logic families.

Combinational Logic Circuits
Problem formulation and design of Basic Combinational Logic Circuits, Combinational Logic Using Universal Gates. Basic Adders, ALU, Parity-Checkers and Generators, Comparators, Decoders, Encoders, Code Converters, Multiplexer (Data Selector), De-multiplexers

Sequential Circuits
Latches, Flip-flops (SR, JK, T, D, Master/Slave FF,) Edge-Triggered Flip-Flops, Flip-Flop Operating Characteristics, Basic Flip-Flop Applications, Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters.

Shift registers & Memories
Shift Register Functions, Serial In - Serial Out Shift Registers, Serial In - Parallel Out Shift Registers, Parallel In - Serial Out Shift Registers, Parallel In - Parallel Out Shift Registers, Bidirectional Shift Registers,Basics of Semiconductor Memories, Random-Access Memories (ROM), Read Only Memories (ROMs), Programmable ROM's (PROMs and EPROM's), PAL, PLA.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Digital Fundamentals" by Thomas L. Floyd, Prentice Hall, Inc	2015
2	SWITCHING THEORY AND LOGIC DESIGN By A. ANAND KUMAR, PHI	2014
3	Digital Logic Design By Brian Holdsworth, Clive Woods - Elsevier	2002
4	Digital Logic Circuit Analysis & Design, by Victor P. Nelson, H. Troy Nagle, Bill D. Carroll and J. David Irwin, Prentice Hall	1995
Reference Books		
1	Digital logic and computer design: M Morris Mano –PHI	2017
2	Modern digital electronics: R.P. Jain. TMH	2010

Course Outcome

Sr	Course Outcome	CO
1	To provide the skills to efficiently acquire knowledge on digital electronic circuit analysis and design	CO1
2	To acquire Knowledge of various number systems and codes from historic point of view.	CO2
3	To understand the logic families in digital circuits.	CO3
4	To obtain the ability to analyze various aspects of sequential circuit design.	CO4

Course Code : ECP ES103
Course Title : Digital Electronics Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Introduction to Digital Electronics Lab- Nomenclature of Digital ICs, Specifications, Study of the Data Sheet, Concept of V_{CC} and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.
2	To Study and Verify NAND and NOR as a Universal Gate.
3	To Design &Verify Operation of Half Adder &Full Adder.
4	To Study &Verify Half Subtractor and Full Subtractor.
5	Implementation of 4x1 Multiplexer using IC 74153.
6	Implementation of 4-Bit Parallel Adder Using 7483 IC.
7	Implementation and Verification of Decoder/De-Multiplexer using IC 74139.
8	Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates
9	To Design & Verify the Operation of Magnitude Comparator
10	Design, and Verify the 4-Bit Asynchronous Counter.
11	To design and implement a binary to gray and gray to binary converter.

Course Code : MEM SE103
Course Title : Engineering Graphics with CAD
L-T-P/S=Credits : 1-0-2 =2
Course Category : Skill Enhancement Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction of Engineering Graphics: Drawing instruments and their uses, Orthographic Projections: Planes of projection – Projection of points in different quadrants. Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane – Straight Line inclined to both the planes – True Length and inclination of lines with reference planes – Traces of line – Projection of Planes, Projection of Solids.
Section of Solids: Classification of Solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.
Development of Surfaces: Principle, Engineering applications and Methods of development
Introduction to AutoCAD: Starting AutoCAD, AutoCAD screen components, creating a drawing on AutoCAD, invoking different commands, Dialog boxes, Coordinate Systems, Exercises on Drawing of Line, Circle, Arc, Ellipse, Polygon, etc.
Drawing Aids and Editing Commands: Layers, Drafting Settings, Object Snaps, Function and Control keys, various Editing Commands, Editing the Objects with Grips, Grip Types.

Creating Text, Dimensions and Tolerances in AutoCAD: Creating Text, Editing Text, Styles of Dimensioning, Dimensioning System Variables, Editing/Updating Dimensions, Adding Tolerances.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Bhat, N.D. and Panchal, V. M. - Engineering Drawing, Charotar Publishers, Anand	
2	Narayana, K.L. and Kannaiah, P.- Engineering Graphics, Tata Mc Graw Hill, New Delhi.	
3	Gill, P.S- Engineering Drawing, S.K Kataria& Sons, New Delhi	
Reference Books		
1	Ellen Filkensten - AutoCAD & AutoCAD LT Bible,Wiley, New York	
2	Sham Tickoo - AutoCAD ,Tata McGraw Hill, New Delhi.	

Course Outcome

Sr	Course Outcome	CO
1	To learn basics of drawing including dimensioning	CO1
2	To draw orthographic projections of points and lines and traces of line	CO2
3	To draw orthographic projections of planes.	CO3
4	To draw orthographic projections and section of solids.	CO4

Course Code : MTL BS102
Course Title : Engineering Mathematics-II
L-T-P/S=Credits : 3-1-0 =4
Course Category : Basic Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Vector Calculus:
Beta & Gamma functions. Differentiation of vector functions of scalar variables. Gradient of a scalar field, Divergence & Curl of a vector field and their properties.Line& surface integrals, Greens theorem, Stokes Theorem and Gauss Theorem both in vector & Cartesian forms (statement only) with simple applications
Ordinary Differential Equation(ODE): Formation of ODE, definition of order and degree of ODE and solution, ODE's of first order, method of separation of variables, homogeneous and non-homogenous differential equations and their solution, exactness and integrating factor, Bernoulli equation, linear ODE's of order, operator method, method of undetermined coefficients, method variation of parameters, solution of simple simultaneous ODE's.
Partial Differential Equation(PDE): Formation of (PDE), Solution of PDE by direct integration, Lagrange's linear equation, Non-linear PDE of first order, Method of separation of variables, Wave & Laplace equations (Two dimensional Polar & Cartesian Co-ordinates).

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	E. Kreysig, Advanced Engineering Mathematics, Wiley 10thedition	2011
2	Frank Ayres , Vector Analysis, Mc Graw Hills, 6thedition	2011
3	T. Marsden and W.H. Freeman,VectorCalclus, Freeman, 6 edition	2011
Reference Books		
1	G.Simons,DifferentialEquationswithApplications,TMH**,**McGraw-HillHigher Education; 2 edition	1991
2	S.L. Ross, Differential Equations, Wiley 3rd edition	1984
3	R. Zalman, A Course in Ordinary and PDEs, Academic Press, 1st edition	2014

Course Outcome

Sr	Course Outcome	CO
1	Understand the concepts of vector calculus like directional derivative, gradient, divergence and curl, and their applications.	CO1
2	Learn and apply the concepts of vector integral calculus for the computation of work done, circulation, and flux.	CO2
3	Formulate the differential equations concerning physical phenomena like electric circuits, wave motion, heat equation etc.	CO3
4	Learn various methods of solution of ordinary and partial differential equations	CO4
5	Solve various partial differential equations arising in heat conduction problems and wave propagation problems	CO5

Course Code : MTL BS106
Course Title : Discrete Structures
L-T-P/S=Credits : 3-1-0 =4
Course Category : Basic Sciences Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Section A

Basic counting Techniques: Unary & Binary relation, equivalence relation. Functions, Injective, Surjective & Bijective mappings.Partial orders, Lattice & Boolean Algebra, Pigeon-hole principle, Binomial and multinomial coefficients, Mathematical Induction, Inclusion-exclusion principle.

Section B

Recurrence relations, Generating functions, Discrete numeric functions, Asymptotics (Big-O, Little-O, asymptotic dominance, growth of functions)
Mathematical Logic: Truth tables, Logical equivalence, rules of inferences, argument and its validity, Methods of proof, Predicate Calculus- Symbolizing everyday language.

Section C

Introduction to Graph, Euler graph, Hamiltonian paths and circuits; Trees, Fundamental Circuits, Distance and Centre, Spanning Tree, Cut-sets and Cut-vertices, Connectivity and Separability, Planar graph, Geometric dual, Combinatorial dual, Matrix representation of graph, Colouring, Chromatic number, Chromatic Polynomial; Covering and Partitioning, Chromatic partitioning, Matching, Covering, Network flows

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	K. H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph	
2	Theory (English) Macgraw Hill Education, 7th Edition	
3	R.R Stoll., Set Theory and Logic, Dover Publications, New ed., 2012	
Reference Books		
1	Graph Theory – with application to Engineering and Computer Science, NarshingDeo, PHI	
2	Algorithm Graph Theory, Gibbons, Cambridge University Press	

Course Outcome

Sr	Course Outcome	CO
1	Know the counting principles concerning set relations and functions	CO1
2	Understand Mathematical logic and solve problems on recurrence relations, generating functions	CO2
3	Understand the concepts of graph theory.	CO3
4	Apply combinatorial and graph theoretic techniques to solve relevant problems of engineering	CO4

Course Code : **CSL DC102**
Course Title : **Programming using Python**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :**No**
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction to importance of IDEs like Spyder(Anaconda)/PyCharm for professional programming, explorePython shell as a calculator and for inputting Python
expressions directly, Data Types in. Operators in Python:comparison, arithmetic, logical, Boolean, bitwise,assignment. Python: numbers, list, tuple, strings, set,
dictionary, conversion between various data types
HelloWorld program in Python script, Python keyword andIdentifiers, Indentation, Comments,
Data Types. Operators in Python: comparison, arithmetic,logical, Boolean, bitwise, assignment.
Python: numbers, list, tuple, strings, set, dictionary,conversion between various data types

Input and Output in Python, if-else , for loop, while loop,break, pass, continue, global and local variables, Importingother modules/packages and using their functions, creatingrandom numbers/random-choice to create programs forcreating Functions, functions with arguments, returningvalues form functions, lambda expressions, recursion,simple guessing games like Rock –Paper-Scissors. Problemson 1D/2D/3D arrays using list. Problem solving usingdictionary as look-up table.
Global and local variables, Importing othermodules/packages and using their functions, creating randomnumbers/random-choice to

Create programs for simple guessing games like Rock –Paper-Scissors. Problems on 1D/2D/3D arrays using list. Problemsolving using dictionary as look-up table.

Object oriented programming: Class and Object. Definingvariables and functions inside class. Creating objects, Inheritance, Multiple and Multi Level Inheritance, Functionover-riding.
Concept of composing objects of a different class in anobject, problems on object composition
Python's de-facto GUI package like tkinter or alternativepackages like: wxPython, PyQt (PySide), Pygame, Pyglet,and PyGTK.

Creating labels, buttons, entry (textbox), combobox,checkbutton, radiobutton, scrolledText (textarea), spinbox,progressbar, menubar, filedialog, tabs etc.

Creating GUI simple games like Tic-Tac-Toe
Dicussion about implementation of python in Machine learning Algorithms,Python with Data Sets,

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Think Python 2nd Edition - How to Think Like a Computer Scientist, Allen B Downey, O'Reillypublication	2015
2	Learn Python 3 the Hard Way, Zed A. Shaw, Pearson publication	2022
3	Head First Programming: A Learner's Guide to Programming using the Python Language, Paul BarryDavid Griffiths Barry Griffiths, O'Reilly publication	2018
Reference Books		
1	Dive into Python 3, Mark Pilgrim, Apress publication	2017

Course Outcome

Sr	Course Outcome	CO
1	Know the basic syntax and Data Structures in Python.	CO1
2	Think and Design solution in Object Oriented way as well as Procedural way.	CO2
3	Enjoy coding and compete at online programming sites like CodeChef, HackerEarth etc.	CO3

Course Code : **CSP DC102**
Course Title : **Python Programming Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Write a program to add two numbers.
2	Write a program to calculate grade of a student.
3	Write a program to print following pattern. * ** ***
4	Write a program to print table of a number.
5	Write a program to print following pattern: 0 01 012
6	Write a program to add and multiply numbers using user define functions.
7	Write a program to concatenate strings in Python.
8	Give at least five examples of inbuilt functions of Python.
9	Give at least five examples of inbuilt Math functions of Python.
10	Write a program to calculate factorial of a number using recursion.
11	Write a program to make a List in Python and perform following operations on List: a) Length using len() function b) Print element at index 0 c) Adding an element to the list using + operator d) Appending an element to the list e) Negative indexing in list f) Remove the first occurrence of element a from list g) Reverse the list h) Sort list
12	Write a program to demonstrate use of Dictionary in Python with their inbuilt functions.
13	Write a program to demonstrate use of Set in Python with their inbuilt functions.
14	Write a program to demonstrate use of Tuple in Python with their inbuilt functions.
15	Write a program to calculate Median using List.
16	Write a program to calculate Mode using List.
17	Write a program to calculate Mean using List.
18	Write a program to inherit properties of a person to a student using inheritance in Python.
19	Write a program to calculate Coefficients of given numbers.
20	Write a program to calculate Covariance of given numbers.
21	Write a program to plot a graph using python library.
22	Write a program to make a class Vehicle and their properties.
23	Write a program to make a game Rock-Paper-Scissor.
24	Write a program to make classes for bird and animal with their properties and simulate a zoo like environment.
25	Write a program to make a GUI to take input from user and display.

Course Code : **CSL DC 104**
Course Title : **Data structures**
L-T-P/S=Credits : **3-0-0**

SYLLABUS

Unit-1: INTRODUCTION
Introduction to data structures: Concept and Need of Data Structure, Definition, Abstract Data Type, Types of Data Structures: Linear Data Structures, Non-Linear Data Structures, Operations on Data Structures: Traversing, Insertion, Deletion, updating, searching, sorting, Study and implementation of basic data structure:

Arrays, multidimensional arrays and their organization, storage structure for arrays, introduction to sparse arrays

Unit-2: LINKED LIST

Linked list (singly, doubly and circular): Dynamic storage, Concept of linked list, Difference of link list & array, Single linked list, Representation, Operations, Traversing, Insertion(first node, last node, at a position, after a node value), Deletion(first node, last node, at a position, after a node value), Double linked list, Representation , Operations, traversing, Insertion (first node, last node, at a position, after a node value), Deletion (first node, last node, at a position, after a node value), Introduction to Circular link list & header link list: examples and applications

Unit-3: STACKS & QUEUES

Stacks & Queues: Operations on Stack, Array & Linked Representation, Programs on stack: Push, Pop operations and traversing, Applications of stack. Operations on Queue, Array & Linked Representation, Programs on Queue: Insert, Deletion and traversing, Circular queue: Programs on Circular Queue: Insert, Deletion and traversing, Introduction to other types of queues: Deque, Priority Queue, Application of queue.

Unit-4: SORTING AND SEARCHING

Searching algorithm: Linear search and Binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort

Unit-5: TREES AND GRAPHS

Introduction to trees and graphs: Tree terminology, Introduction to Types of Trees: Binary tree, Complete Binary Tree, Binary search tree, AVL Tree, Tree Traversal algorithms, Memory representation of trees, Applications of Trees, Graph: Graph terminology, Memory representation of graphs, Graph Traversal algorithms: BFS (breadth first search), DFS (depth first search), Applications of Graph

Course outcomes

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 - Perform basic operations on Arrays.
CO2 - Apply and compare different Searching and Sorting methods on the basis of time efficiency.
CO3 - Implement basic operations on Linked List.
CO4 - Perform operations on Stack using Array and Linked List Implementations.
CO5 - Perform operations on Queue using Array and Linked List Implementations.
CO6 - Understand and Traverse Tree and Graphs to solve real life problems

Course Code : CSP DC104
Course Title : Data Structure Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Design, Develop and Implement a menu driven Program in C for the following Array operations a. Creating an Array of N Integer Elements b. Display of Array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position(POS) e. Exit. Support the program with functions for each of the above operations.
2	Design, Develop and Implement a Program in C for the following operations on Strings a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR. Support the program with functions for each of the above operations. Don't use Built-in functions.
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations

4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^ (Power) and alphanumeric operands.
5	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks.
6	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations.
7	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion and Deletion at End of SLL d. Perform Insertion and Deletion at Front of SLL e. Demonstrate how this SLL can be used as STACK and QUEUE f. Exit
8	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit
9	Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10	Binary Search Tree (BST) of Integers a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in In order, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Delete an element(ELEM) from BST Exit
11	Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using BFS method c. Check whether a given graph is connected or not using DFS method.
12	Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K ®L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Course Code : MEM SE102
Course Title : Engineering Workshop
L-T-P/S=Credits : 1-0-2 =2
Course Category : Skill Enhancement Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Carpentry shop:Tools and Equipment, Making of Various Joints, Pattern Making.

Foundry Shop: Tools and Equipments, Preparation of Moulds of Simple Objects Using Single Piece, Two Piece and Match Plate Patterns.
Fitting Shop:Tools And Equipments, Practice in Chipping, Filing and Drilling, Making of V, Dovetail and Square Joints of M.S Flat.
Welding Shop:Tools and Equipments, Making of Various Joints Using Gas Welding and Arc Welding (MIG Welding) ,Bead Formation in Horizontal, Vertical and Overhead Positions, Brazing and Soldering Operations.
Sheet Metal Shop:Tools and Equipments, Making Tray, Cone, etc. with GI Sheet Metal
Machine Shop:Introduction to Various Lathe Operations and Practice on Milling, Drilling Machines, etc.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Raghuvanshi, B. S. - Workshop Technology–Vol 1, Dhanpat Rai & Sons, New Delhi.	2010
2	Gupta, R. B. - Production Technology, Satyaprakashan, New Delhi	2006
3	Swarn Singh - Workshop Practice, Kataria& Sons, New Delhi	2005
Reference Books		
1	Upadhyay, R. – Manufacturing Practice, Kataria& Sons, New Delhi	2004
2	Narayana, K L Kannaiah P. - Manual on Workshop Practice, Scitech Publishers, Chennai	2006

Course Outcome

Sr	Course Outcome	CO
1	Study and practice on machine tools and their applications so that students should know and operate the machine tools and perform various processes in welding, sheet metal, smithy and machines shop.	CO1
2	Students should understand the functioning and applications ofcutting tools, machines, processes ; like fabrication of joints using arc welding, seam joints, forging and taper turning	CO2
3	Students should document the job performed, safety precautions observed while performing experiment on different machine tools	CO3
4	Students should perform the jobs, safety precautions taken while performing the experiments using various tools/ machine tools.	CO4

Course Code : PCL MA102
Course Title : Universal Human Values-II
L-T-P/S=Credits : 2-0-0 =NC
Course Category : Mandatory Course
Pre-requisite Courses (if any) : No
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit I
1. What is Value Education?
2. Knowledge and Skill
3. Value and Virtue
4. Moral Agency and the Notion of Dharma
5. Freedom of Will and Determinism

Unit II
6. Understanding Human Existence: Human Being and Human Person
7. The Basic Human Aspirations: Continuous Happiness and Prosperity
8. Understanding harmony at the level of Individual, Family and Society

Unit III
9. Understanding harmony at the level of Nature
10. Cardinal Human Virtues such as Compassion, Wisdom, Justice, Tolerance, Non-violence, Service to Humanity with the help of suitable illustrations

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint

Text Books		
1	Das, Gurucharan (1990), The Difficulty of Being Good (Chapter 3), New Delhi: Penguin Books.	1990
2	Frankfurt, Herry G. (1971). Freedom of the Will and the Concept of a Person. The Journal of Philosophy, 68 (1): 5 – 20.	1971
3	Gaur, R.R. et. al. (2006), A Foundation Course in Human Values and Professional Ethics. New Delhi: Excel Books.	2006

Course Outcome

Sr	Course Outcome	CO
1	Understand the relevance of human values and peaceful co-existence	CO1
2	Widen their perspectives in moral decision making	CO2
3	Develop right understanding with respect to the basic aspirations of human life	CO3
4	Gain holistic understanding of the interrelatedness of individual, family, society and nature	CO4
5	Enhance clarity, assurance & purposefulness of life	CO5

Course Code : BTL BS201
Course Title : Introduction to Biology for Engineers
L-T-P/S=Credits : 3-0-0 =3
Course Category : Basic Science Course
Pre-requisite Courses (if any) : Nil
Equal Course Code (if any) : Nil
Equivalent Course Code (if any) : Nil

Detailed Syllabus

Introduction to Basic Biology
Cell, Cell theory, Cell shapes, structure of a Cell, prokaryotic and eukaryotic Cell, Plant Cell and animal Cell, protoplasm, Plant Tissue and Animal Tissue. Cell cycle

Introduction to Bio-molecules
Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types.Enzymes and their application in Industry. Large scale production of enzymes by Fermentation

Gene structure and recombinant DNA technology
Prokaryotic gene and Eukaryotic gene structure, gene replication, Transcription and Translation in Prokaryotes and Eukaryotes. Recombinant DNA technology and introduction to cloning.

Applications of Biology
Brief introduction to Production of vaccines, Enzymes, antibodies, Cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels. Tissue engineering and its application, transgenic plants and animals, Stem cell and applications.Bio engineering (production of artificial limbs, joints and other parts of body).

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Essential Cell Biology Fifth edition by Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, WW Norton & Co	2019
2	Karp's Cell Biology Eighth edition by Gerald Karp, Janet Iwasa, Wallace Marshall; Wiley	2018
3	Biology for Engineers by T Johnson press	2011
Reference Books		
1	The Cell: A Molecular Approach Fifth edition by Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, M.A.	2009
2	Lehninger: Principles of Biochemistry, 8th edition by David L. Nelson and Michael. M. Cox; W. H. Freeman and Company.	2021

Course Outcome

Sr	Course Outcome	CO
	After successful completion of this course, students will be able to:	
1	Understand the detailed structure of the cell and cell cycle.	CO1

2	Understand the structure and function of biomolecules and their importance.	CO2
3	Illustrate about genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms	CO3
4	Demonstrate the concept of biology and its uses in combination with different technologies for the production of medicines and production of transgenic plants and animals.	CO4

Course Code : ECL ES205
Course Title : Microprocessors & Interfacing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit-I
8085 Architecture: Introduction to microprocessors and microcontrollers, 8085 Processor Architecture, Internal operations, Instructions and timings, Programming the 8085 – Introduction to 8085 instructions, addressing modes and Programming techniques with Additional instruction.

Unit-II
Stacks and subroutines, interfacing peripherals - Basic interfacing concepts, interfacing output displays, interfacing input keyboards. Interrupts - 8085 Interrupts, Programmable Interrupt Controller (8259A). Direct Memory Access (DMA) – DMA Controller (Intel 8257), Interfacing 8085 with Digital to Analog and Analog to Digital converters.

Unit-III
Programmable peripheral interface (Intel 8255A), Programmable communication interface (Intel 8251), Programmable. Interval timer (Intel 8253 and 8254), Programmable Keyboard / Display controller (Intel 8279).Serial and parallel bus standards RS 232 C, IEEE 488.

Unit-IV
Introduction to Microcontrollers, 8051 – Architecture – Instruction set, Addressing modes and Programming Techniques. Comparison of various families of 8-bit micro controllers. System Design Techniques Interfacing of LCD, ADC, Sensors, Stepper motor, keyboard and DAC using microcontrollers Communication standards – serial RS232 and USB

Unit-V
Microprocessor Applications and trends in microprocessor Technology – 8-bit, 16-bit and 32-bit microprocessors. Advanced Processor Architecture – Register structure, Instruction set, Addressing modes of 8086.Features of advanced microprocessors.80386, 80486, Pentium and Multi-Core Processors.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Microprocessor Architecture, Programming, and Applications with the 8085" by R Gaonkar	
2	"The 8051 Microcontroller and Embedded Systems : Using Assembly and C" by Muhammad Ali Mazidi	
3	"Introduction to Microprocessors and Microcontrollers" by Crisp John Crisp	
Reference Books		
1	"Microprocessors And Microcontrollers" by A NagoorKani	
2	Barry B. Brey, The Intel Microprocessor, 8086/8088,8018/80188, 80286, 80386, 80486, Pentium and Pentium pro-processors – architecture, Programming and interfacing, 4 Edition, Prentice Hall 1993.	1993

Course Outcome

Sr	Course Outcome	CO
1	List and specify the various features of microprocessor, memory and I/O devices including concepts of system bus.	CO1
2	Identify the various elements of 8085 microprocessor architecture, its bus organization including control signals.	CO2
3	List the pin functions of the 8085 microprocessor.	CO3
4	Describe the 8085 processor addressing modes, instruction classification and function of each instruction and write the assembly language programs using 8085 instructions	CO4

Course Code : **ECP ES205**
Course Title : **Microprocessors & Interfacing Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Write a program to add two 8-bit numbers stored in the memory location 2300H & 2301H and store the result in memory location 2302H and the carry in location 2303H.
2	Write a program to transfer 16 bytes of data stored at memory location 2300H to 2400H.
3	Write a program to add two twodigit BCD numbers stored in memory location 2100H & 2101H, the 3 digit BCD result should be stored from memory location 2102H onwards
4	Write a program to add two 16 bit numbers stored in memory location 2100H & 2102H and store the sum at memory location 2104H onwards
5	Write a program to subtract two 8-bit numbers
6	Write a program to subtract two 16-bit numbers
7	Write a program to subtract two digit BCD numbers stored at memory location 2100H & 2101H and store the result in memory location 2102H
8	Write a program to unpack two digit BCD number stored at memory location 2100H and store the unpacked BCD numbers at memory locations 2101H & 2102H
9	Write a program to read a two digit BCD number stored at memory location 2100H and switch the digits of the BCD number and store the result at memory location 2101H
10	Write a program to sort 16 numbers stored at memory location 2100H to 210FH in ascending order
11	Write a program to convert an 8-bit binary number to ASCII Hex Code
12	Write a program to convert a two digit BCD number, stored at location 2100H, into its binary equivalent number and store the result in memory location 2200H
13	Write a program to convert a Binary number to its equivalent BCD number
14	Write a Program to generate a ramp waveform
15	Write a Program to generate staircase waveform
16	Write a Program to display the character "V" in 8x8 LED Matrix
17	Write a Program to rotate a Stepper Motor in Anticlockwise Direction
18	Write a Program to Control Traffic
19	Write a program to interface ADC 0808 with the 8085 microprocessor and store the A/D result in memory location 3200H
20	Write a program to convert an 8-bit binary number to ASCII
21	Write a program to blink Port C bit 0 of the 8255. Assume address of control word register of 8255 as 0BH. Use Bit Set/Reset mode
22	Calculate the sum of series of even numbers from the list of numbers. The length of the list is in memory location 2200H and the series itself begins from memory location 2201H. Assume the sum to be 8 bit number so you can ignore carries and store the sum at memory location 2210H
23	Design a system (both Software and Hardware) that will cause 4 LEDs to flash 10 times when a push button switch is pressed. Use 8255

Course Code : **CSL DC201**
Course Title : **Theory of Computation**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit - I : Introduction

Basic Concepts: Symbols, Strings, Language, Formal Language, Natural Language. Basic Machine and Finite State Machine. Finite Automata: Definition and Construction – Deterministic Finite Automata, Non Deterministic Finite Automat, NFA with Epsilon-Moves, Equivalence of NFA and DFA, Minimization of Finite Automata, Concept of Generalized non-deterministic finite automata.

Unit - II : Regular Expressions, Regular Grammar And Languages

Definition and Identities of Regular Expressions, Regular Grammar and Finite Automata: FA to RG and RG to FA, Left Linear and Right Linear Grammar and Inter-conversion between them. Closure Properties of Regular Languages, Non-regular languages and Pumping Lemma.

Unit - III : Context Free Grammar And Languages

Definition and Construction of CFG, Definition, Parse tree, derivation, ambiguity, Ambiguous Grammar and Removal of Ambiguity. Simplification of Grammar. Normal Forms of Grammar: Chomsky normal form and GNF. Non-Context Free Languages, pumping lemma.

Unit - IV : Pushdown Automata

Definition and Construction of Deterministic pushdown automata (DPDA) and Non-Deterministic pushdown automata (NPDA). Pushdown Automata - Examples and Relation with CFGs, Equivalence of PDAs and CFGs, Closure Properties of CFLs.

Unit - V : Turing Machines & Decidability

Definition and Construction of Turing Machines.Languages of TM.Types of TM. Time Complexity of TM, Halting Problem, Decidability/ undecidability

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Hopcroft Ulman, "Introduction To Automata Theory, Languages And Computations", Pearson Education Asia, 2nd Edition	
2	K.L.P Mishra, N. Chandrasekaran, " Theory Of Computer Science(Automata, Languages and Computation)", Prentice Hall India, 2nd Edition	
3	John C. martin, "Introduction to Language and Theory of Computation", TMH, Third Edition. 978-0-07-066048-9	
Reference Books		
1	Michel Sipser "Introduction to Theory of Computation" Thomson Course Technology, Second Edition 0-534-95097-3.	
2	Peter Linz, "An introduction to formal languages and Automata", Narosa Publication.	

Course Outcome

Sr	Course Outcome	CO
1	Design the FSM and its variants for the given problem	CO1
2	Able to convert RE to FA, differentiate between Regular and Non-regular languages, argue about diff. properties of Regular Languages	CO2
3	Define and construct CFG along with corresponding machines, classify the languages into different Normal Forms	CO3
4	Define and construct various type of TM, argue about decidability/undecidability of the problems	CO4

Course Code : CSL DC203
Course Title : Operating Systems
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction to OS: Processor management, memory management, file system management, system calls.

Process management: Scheduling levels, quantities to be optimized , preemptive/non preemptive, interrupting clock, FIFO , shortest job first, shortest remaining job first, round robin, priority, multilevel queues, multilevel feedback queues.

Concurrent processes: Mutual exclusion and Bernstein's conditions, Fork/Join construct, PARBEGIN/PAREND construct; semaphores: use of semaphores to complement PARBEGIN/PAREND; critical section problem ; 2 process critical section problem and solution, both H/W and S/W; monitors; message passing ; case studies: dining philosophers problem, reader writer problem and disk head scheduler problem.

Memory management: Single user contiguous: protection; fixed partition multiprogramming; protection, fragmentation, relocation; variable partition multiprogramming: compaction, storage placement strategies;

multiprogramming with storage swapping; paging: segmentation; paging and segmentation together; virtual memory: page replacement and strategies, locality, working sets, page fault frequency, demand paging, optimization technique.

Dead locks: Resource concepts, necessary conditions, resource allocation graph, deadlock prevention: three strategies of Havender, deadlock avoidance: Bankers algorithm, deadlock detection: reduction of resource allocation graph, deadlock recovery.

File systems: directory organization, functions, data hierarchy, blocking and buffering, file organization, free space management, allocation techniques: contiguous, non contiguous; sector oriented linked; block: block chaining , index block chaining, block oriented file mapping;

Device management: types: block, character; PIO, DMA, I/O channels, virtual devices.

Disk scheduling: operations of disks, quantities to be optimized, seek optimization : FCFS, SSTF, SCAN, C-SCAN, M-STEP SCAN, Eschenbach; rotation optimization, system consideration, disk caching and other optimizations.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Operating system concepts : Silberschatz, Addison Wesley Longman	
2	Modern Operating Systems : Tanenbaum, PH(I)	
3	Operating systems : H.M.Deitel, Addison Wesley Longman	
Reference Books		
1	Operating systems :Madnick and Donovan, McGraw-Hill I.E.	

Course Outcome

Sr	Course Outcome	CO
1	To learn different types of operating systems along with of history of operating systems and basic functions of operating systems	CO1
2	Students will have knowledge of Process management, process synchronization and deadlock handling algorithms, inter-process communication and CPU scheduling algorithms used in operating system. Memory management and virtual memory concepts, I/o Devices management, file management	CO2
3	Students will be able to analyze and implement various algorithms used for management, process scheduling, memory allocation and process communication in operating system.	CO3
4	Analyse the structure of OS and basic architectural components involved in OS design.	CO4

Course Code : CSP DC203
Course Title : Operating Systems Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1.	Write a shell script to ask your name, program name and enrolment number and print it on the screen.
2.	Write a shell script to find the sum, the average and the product of the four integers entered
3.	Write a shell program to exchange the values of two variables
4.	Find the lines containing a number in a file
5.	Write a shell script to display the digits which are in odd position in a given 5-digit number
6.	Write a shell program to reverse the digits of five-digit integer
7.	Write a shell script to find the largest among the 3 given numbers
8.	Write a shell program to search for a given number from the list of numbers provided using binary search method
9.	Write a shell program to concatenate two strings and find the length of the resultant string
10.	Write a shell program to find the position of substring in a given string
11.	Write a shell program to display the alternate digits in a given 7-digit number starting from the first digit

12.	Write a shell program to find the gcd for the 2 given numbers
13.	Write a shell program to check whether a given string is palindrome or not.
14.	Write a shell program to find the sum of the series sum=1+1/2+…+1/n
15.	Write a shell script to find the smallest of four numbers
16.	Write a shell program to add, subtract and multiply the 2 given numbers passed as command line arguments
17.	Write a shell program to convert all the contents into the uppercase in a particular file
18.	Write a shell program to count the characters, count the lines and the words in a particular file
19.	Write a shell program to concatenate the contents of 2 files
20.	Write a shell program to find factorial of given number
21.	WAP that accepts user name and reports if user logged in.
22.	WAP that takes a filename as input and checks if it is executable, if not make it executable.
23.	WAP which displays the following menu and executes the option selected by user: 1. ls 2. pwd 3. ls –l 4. ps -fe
24.	Write a shell script to find the average of the numbers entered in command line
25.	Write a shell script to sort the given numbers in descending order using Bubble sort
26.	Write a shell program to find the sum of all the digits in a given 5-digit number
27.	Shell script to find occurrence of particular digit in inputted number
28.	Write a shell script to print following pattern. * * * * * * * * * *
29.	Write a shell script to print following pattern. 1 2 3 4 5 6
30.	Create a data file called employee in the format given below: a. EmpCode Character b. EmpName Character c. Grade Character d. Years of experience Numeric e. Basic Pay Numeric Sort the file on EmpCode. Sort the file on EmpName. Sort the file on (i) Decreasing order of basic pay (ii) Increasing order of years of experience. (iii) Display all records with ‘smith’ as a part of employee name.

Course Code : CSL DC205
Course Title : Data Analytics
L-T-P/S=Credits : 3-0-0

Syllabus

Ordered Statistics, probability distributions of Sample Range, Minimum and Maximum order Statistics. Random Sampling, Sampling distributions: Chi-square, T, F distributions.
Point Estimation: Sufficiency, Factorization theorem, Consistency, Moment method of estimation, Unbiased Estimation, Minimum Variance Unbiased Estimator and their properties, Rao-Cramer lower bound, Rao-Blackwellization, Fisher Information, Maximum Likelihood Estimator and properties, Criteria for evaluating estimators: Mean squared error.
Interval Estimation: Coverage Probabilities, Confidence level, Sample size determination, Shortest Length interval, Pivotal quantities, interval estimators for various distributions.

Testing of Hypotheses: Null and Alternative Hypotheses, Simple hypothesis, Composite hypothesis, Test Statistic, Critical region, Error Probabilities, Power Function, Level of Significance, Neyman-Pearson Lemma, One and Two Sided Tests for Mean, Variance and Proportions, One and Two Sample T-Test, Pooled T-Test, Paired T-Test, Chi-Square Test, Contingency Table Test, Maximum Likelihood Test, Duality between Confidence Intervals.
Bayesian Estimation: Prior and Posterior Distributions, Quadratic Loss Function, Posterior Mean, Bayes Estimates for well Known Distributions (Normal, Gamma, Exponential, Binomial, Poisson, Beta etc.)
Regression & ANOVA Regression ANOVA(Analysis of Variance)

Course Outcomes:

CO1: Apply statistical estimation and hypothesis testing methods to real-world datasets.
CO2: Use appropriate statistical software tools to perform estimations and hypothesis testing.
CO3: Understand a wide range of data analytic techniques around different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics.

Suggested Books:

1. Kandethody M. Ramachandran, Chris P. Tsokos, Mathematical Statistics with applications, Academic Press, 2009.
2. William W. Hines, Douglas C. Montgomery, David M. Goldsman, Connie M. Borror, Probability and Statistics in Engineering, 4th Edition, John Wiley & Sons, 2003.
3. Robert V. Hogg, Joseph W. McKean, Allen T. Craig, Introduction to Mathematical Statistics, 7th Edition, Pearson, 2012.

Course Code : CSP DC205
Course Title : Data Science & Analytics Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Write a Program to Explore various Data Manipulation Functions provided by Pandas and Visualize the Data Using Seaborn
2	To predict if a person will purchase a product on a specific combination of Day, Discount and Free delivery using Naïve Bayesian Classifier.
3	Predict Employee Salary based on Year of Experience using Linear Regression
4	Predict if a person will buy an SUV based on their Age and Estimated Salary using Logistic Regression.
5	Does Kyphosis exist after surgery using Decision Tree?
6	Write a Program to Demonstrate Random Forest Algorithm
7	Predict if a person will buy a SUV based on Age and Estimated Salary using KNN?
8	Features Extraction from Text using Word Vectorization for Text Semantics?
9	Sentiment Analysis from online news website using simple natural language processing.
10	Use of KmeansClustering algorithm for classifying persons into 5 categories according to their salary.
11	Write a program for demonstrating (Support Vector Machine Classifier) SVM algorithm.

Course Code : CSL DC202
Course Title : Soft Computing
L-T-P/S=Credits : 3-0-0

Prerequisite: Neural Networks or Equivalent

Syllabus
Introduction to Soft Computing

Concept of computing systems, Soft computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

Fuzzy logic

Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

Genetic Algorithms

Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using GAs.

Multi-objective Optimization Problem Solving

Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Course Outcomes

CO1: Understand soft computing techniques and their role in problem solving.
CO2: Conceptualize and parameterize various problems to be solved through basic soft computing techniques.
CO3: Analyze and integrate various soft computing techniques in order to solve problems effectively and efficiently.

Books Recommended:

1. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
3. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
4. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
5. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
6. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
7. Soft Computing, D. K. Pratihar, Narosa, 2008.
8. Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.

Course Code : CSP DC202
Course Title : Soft Computing Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Design and simulate the behaviour of AND Gate using Perceptron Network in C for bipolar inputs and targets
2	Design and simulate the behaviour of OR Gate using Adaline Network in C for bipolar inputs and targets
3	Design and simulate the behaviour XOR Gate using Madaline network in C language for bipolar inputs and targets
4	Design and simulate the behaviour of XOR gate using Back Propagation Network in c for Bipolar inputs and Binary targets
5	Write a program in C to Implement the various primitive operations of classical sets
6	Write a program in C to implement and verify various Laws associated with Classical sets
7	Write a program in C to perform various primitive operations on Fuzzy Sets with Dynamic Components
8	Write a program in C to verify various Laws associated with Fuzzy Sets
9	Write a program in C to perform Cartesian product over two given Fuzzy Sets
10	Write a program in C to perform Max-Min Composition of Two Matrices obtained from Cartesian Product
11	Write a program in C to perform Max-Product Composition of Two Matrices obtained from Cartesian Product
12	Write a program in C to maximize $F(X) = X^2$ using Genetic Algorithm where $0<X<31$

Course Code : **CSL DC204**
Course Title : **Design & Algorithm Analysis**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction: Definition of algorithm, algorithm specification, performance analysis: Time and space analysis, Asymptotic, recurrence relations.
Design of Efficient algorithms: Graphs, trees, recursion, divide and conquer, balancing, dynamic programming.
Sorting: Merge sort, Heaps and maintaining the heap properties, building a heap, Heap sort, Quicksort: algorithm, performance and anlaysis, Sorting without comparison: Radix sort, counting sort, bucket sort.
Some data structures: Hash tables, hash functions, Open addressing, Binary search trees-insertion and deletion, Balanced trees: AVL trees, m-way trees, B Trees, 2-3 Trees, Binomial heaps: Binomial trees and operations on binomial heaps.
Advanced design and analysis Techniques: Dynamic programming: Definition, Matrix-chain multiplication, Optimal binary search trees, Longest common subsequence, 0-1 knapsack problem.
Greedy algorithms: Definition, Fractional knapsack problem, Huffman coding, Task-scheduling problem.
Divide and conquer algorithm: Definition, Strassen's matrix multiplication, finding minimum and maximum from an array.
Backtracking: Definition, n-queens problem, sum of subset problem.
Graph algorithm: Elementary graph algorithms, Breadth-first and Depth-first search, Minimum spanning trees: Prim's and Krushkal's algorithm, Single source shortest path problem, Bellman-Ford algorithm, Floyd-Warshall algorithm, Johnson's algorithm.Integer and Polynomial arithmetic:Polynomial addition and multiplication.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Introduction to Algorithm, TH Corman, Charles E, PHI	
2	The design and anal. Of Comp. Algorithms Aho, Hopcroft, Ullman Addition Wesley	
3	Computer Algorithms, Galgotia., Horowitz, Sahni and Rajsekaran	

Course Outcome

Sr	Course Outcome	CO
1	Analyze the run time complexity of algorithms when developed using different approaches like Greedy, Dynamic Programming, Divide and Conquer etc.	CO1
2	Identify an appropriate data structure and approach while designing an algorithm for a specific problem	CO2
3	Analytically examine the correctness of algorithms on the basis of recurrence relations, inductive proofs etc	CO3
4	Analyze the Best, Worst and Average Case running time of algorithms and how it is affected by the nature of input variables	CO4
5	Analyze various graph algorithms and deploy these algorithms to model engineering problems	CO5

Course Code : **CSP DC204**
Course Title : **Design & Algorithm Analysis Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Write a program for Binary Search using divide and conquer strategy.
2	Write a program for Max-Min using divide and conquer strategy.
3	Write a program for Merge Sort using divide and conquer strategy.

4	Write a program for Quick Sort using divide and conquer strategy.
5	Write a program to select the kth element using divide and conquer strategy.
6	Write a program to implement Knapsack problem using greedy approach.
7	Write a program to implement Dijkstras Algorithm using greedy approval.
8	Write a program to generate Optimal Matrix Chain multiplication series using dynamic programming approach.
9	Write a program to generate Longest Common Subsequence using dynamic programming approach.
10	Write a program to generate single source shortest path using Bellman Ford algorithm.
11	Write a program to find and generate all pairs shortest path using Floyd Warshall algorithm.
12	Write a program to implement Jonson's Algorithm.
13	Write a program to Sort the elements using Counting sort.
14	Write a program to Sort the elements using Bucket Sort .
15	Write a program to sort the element using Radix sort .
16	Write a program to implement Kruskal's Algorithm for finding Minimum Spanning Tree.
17	Write a program to implement Prim's Algorithm for finding Minimum Spanning Tree.
18	Write a program to implement Breadth First search Algorithm.
19	Write a program to implement Depth First search Algorithm.

Course Code : CSL DC206
Course Title : Database Management Systems
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introductory Database Concepts: Introduction to data processing, overview of files and file systems, drawbacks of files systems, concept of a database, data abstraction and data independence, data models, database language, database users and administrators, transaction management, database system structure.
Entity Relationship Model: Basic concepts, constraints, design issues, entity relationship diagram, week entity sets, extended ER features, design of ER database schema, reduction of ER schema to tables.
Relational Model: Concept of a relation, primary and secondary keys, foreign keys, structure of relational databases, the relational algebra and extended relational algebra operations, formulation of queries, modification of the database, views.
SQL: Background, basic structure, set operations, aggregate functions, null values, nested queries, views, complex queries, database modification, DDL, embedded SQL, stored procedures and functions, dynamic SQL, other SQL features.
Integrity & Security: Domain constraints, referential integrity, assertions, triggers, triggers and assertions in SQL, security in authorization in SQL.
Relational Database Design: First normal form, pitfalls in relational database design, functional dependencies, decomposition, desirable properties of decomposition, boycecodd normal form, third and fourth normal forms, other normal forms.
Transactions: Transaction concept, transaction state, implementation of atomicity and durability, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL.
Concurrency Control: Lock based protocols, timestamp based protocols, validation based protocols, multiple granularity, multiversion schemes, deadlock handling, inset and delete operations.
Recovery Systems: Failure classification, storage structure, recovery and atomicity, log based recovery, shadow paging, recovery with concurrent transitions, buffer management.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Principles of Database System, Ullman ,Galgotia	
2	Database System Concepts,Silberschatz, Korth&Sudarshan, McGraw Hill.	
3	Database Management Systems , Raghu Ramakrishnan, McGraw Hill	
Reference Books		

1	Fundamentals of Database Systems , Elmasri&Navathe	Addison Wesley	

Course Outcome

Sr	Course Outcome	CO
1	Define the terminology, features, classifications, and characteristics embodied in database systems.	CO1
2	Convert any information model into a relational database schema and implement the same using SQL	CO2
3	Formulate the data requirement in terms of Relational algebra operation and query languages operations	CO3
4	Apply the normalization theory to normalize the given Database schema	CO4
5	Understand the requirement of ACID properties & their implementation	CO5

Course Code : CSP DC206
Course Title : Database Management Systems Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Creation of a database and writing SQL queries to retrieve information from the database.
2	Data Definition Language (DDL). a. CREATE b. ALTER c. DROP d. TRUNCATE e. RENAME f. COMMENT
3	Data Manipulation Language (DML) a. INSERT b. UPDATE c. DELETE d. SELECT
4	Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
5	Creation of Views, Synonyms, Sequence, Indexes, Save Implementation of Views. Implementation of Synonyms Implementation of Sequence Implementation of Indexes Implementation of Save point.
6	Creating an Employee database to set various constraints. (a). Primary key, (e).Null, (i). Disable Constraints (b).Foreign Key,` (f). Not null, (j). Drop Constraints (c). Check, (g) . Default, (d). Unique, (h). Enable Constraints,
7	Creating relationship between the databases. Implementation of set operations Implementation of Nested Queries / Sub queries Implementation the Join Operations
8	Creation and use of Triggers
9	Creation of functions using PL/SQL.

Course Code : **CSL DC208**
Course Title : **Computer Organization & Architecture**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Course Contents:

Unit-I: Introduction
Overview of Digital Fundamentals

Unit-II:
Register Transfer and Micro operation
Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations and Shift, Micro operations.

Unit-III:
Basic Computer Organization and Design
Instruction Codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupts, Design of Basic Computer, Design of Accumulator Logic.

Unit-IV
Micro-programmed Control Unit
Control Memory, Address Sequencing.
Central Processing Unit:Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes.

Unit-V
Computer Arithmetic
Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating Point Arithmetic Operation, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

Unit-VI
Input–Output Organization
Peripheral devices, Input – Output interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access, Input – Output Processor.

Unit-VII
Memory Organization
Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Unit-VIII
Multiple ProcessOrganization
Flynn's classification of parallel processing systems, pipelining concepts

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Computer System and Architecture, Mano, M , PHI	
2	Computer Organization & Design, Pal Chaudhuri, P., PHI	
3	Digital Computer Electronics: An Introduction to Microcomputers, Malvino	
Reference Books		
1	Digital Principles and Applications, 4/e ,Malvino , M G Hill	
2	Computer Architecture and Organization, Hayes. J.P , M G Hill	
3	Computer Organization & Architecture, Stallings, W , PHI	

Course Outcome

Sr	Course Outcome	CO
1	To Learn basic micro operations and organization of a basic digital computer	CO1
2	To Learn Overall organization of CPU, pipelining and vector processing	CO2
3	To understand various various arithmetic algorithms and communication techniques with Input/output devices.	CO3
4	To understand the organization and operation of various memory	CO4

Course Code : **CSL DC210**
Course Title : **Compiler Design**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit I: Introduction
Issues related to programming Language Design, Issues related to Finite-State Machines, Phases of Compiler Design, Lexical Analysis, Error Detection and Recovery.
Unit II: Basic Parsing Techniques
Parsers, Shift-Reduced Parsers, Operator-Precedence Parsing, Predictive Parsers.
Unit III: Top-Down Parsing, Bottom-up Parsing
LL(1) Grammars, Recursive Descent Parsers, LR Grammars – Concepts and Terminology, LR(O) Parsers, SLR(1) Parsers, Canonical LR(1) Parsers, LALR(1) Parsers, using ambiguous grammar. Attributed Translation Grammar, L-Attributed Translation Grammar.
Unit IV: Syntax-Directed Translation (SDT)
SDT Schemes, Implementation of SDTs, Intermediate Code, Parse Trees and Syntax Trees.Three Address Code, Quadruples and Triples. Translation schemes for Declarations, Assignment statements, Boolean Expressions, Flow of control statements, Array references in Arithmetic Expressions, Procedure Calls, Case Statements, and |Structures.
Unit V: Semantic Analysis & Type Checking
Introduction, Implicit-Stacking in Recursive Descent Compilation, Semantic Stacks in Bottom-up Compilation, Action-Symbols in Top-Down Compilation, Type Expressions, Overloaded Functions, Polymorphic Functions.
Unit VI: Symbol Table Handling Techniques
When to construct and Interact with the symbol Table, Symbol-Table Contents, Operations on symbol Table. Symbol Table organizations for Block – Structured Languages.
Unit VII: Run-Time Storage Organization and Management
Static Storage Allocation, Dynamic Storage Allocation, Heap Storage Allocation, Garbage Collection and Compaction.
Unit VIII: Code Optimization
Principal sources of Optimization, Loop Optimization, Loop-Invariant Computation, Induction variable elimination, Other Loop Optimizations, The DAG representation of Basic Blocks. Global Data – Flow Analysis.
Unit IX: Code Generation
Object programs, Problems Code Generation, A simple Code Generator. Register Allocation and Optimization, Code Generation from DAG, PEECPhole optimization.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Principles of Compiler Design; A. V. Aho& J. D. Ullman Narosa	
2	The Theory and Practice of Compiler Writing, J Tremblay and Paul G. S.	

Course Outcome

Sr	Course Outcome	CO
1	Understand the different phases of compiler in detail.	CO1
2	Analyze the requirement of NFA and DFA in compiler design.	CO2
3	Case studies of tools available for lexical analysis, parsing like LEX, YACC.	CO3
4	Understanding and develop code optimization techniques.	CO4
5	Analyzing and Designing time and space efficient compiler	CO5

Course Code : **BTL VA202**
Course Title : **Environmental Science & Education**
L-T-P/S=Credits : **2-0-0 =2**
Course Category : **Value Added Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT I:
Environment: concept, importance and components Ecosystem: Concept, structure and function (food chain, food web, ecological pyramids and energy flow), Ecosystem services: (Provisioning, regulating and cultural), Biodiversity: levels, values, threats, and conservation, Concept and objectives of environmental education, environmental ethics

UNIT II:
Natural resources and Environmental pollution Natural resources: Renewable and non-renewable (Global status, distribution and production), Management of natural resources: Individual, community and government managed, Air, water and soil pollution: Causes, consequences and control, Solid waste management: Collection, segregation, transportation and disposal; 3R's,Climate change: Causes and consequences

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Asthana, D. K. Textbook of Environmental Studies. S. Chand Publishing	2010
2	Basu, M., Xavier, S. Fundamentals of Environmental Studies, Cambridge University Press, India	2017
3	Bharucha, E. Textbook of Environmental Studies for Undergraduate Courses. Universities Press.	2021

Course Outcome

Sr	Course Outcome	CO
1	Understand the basics of environmental science with emphasis on ecosystems and Biodiversity.	CO1
2	Understand the concerns related to utilization of natural resources for sustainable Development.	CO2

Course Code : CSL DC301
Course Title : Computer Networks & Communication
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :CSL GE303

Detailed Syllabus

Introduction: Uses of Computer Networks, Network Architecture, Reference Model (ISO-OSI, TCP/IP-Overview, IP Address Classes, Subneting), Domain Name Registration & Registrars
The Physical Layer: Theoretical basis for data communication, transmission media-Magnetic
Media, Twisted Pair, Baseband Coaxial Cable, Broadband Coaxial Cable, Fibre Cable, Structured Cabling, Cable Mounting, Cable Testing, Wireless transmission, the telephone system, narrowband ISDN, broadband ISDN and ATM.
The Data Link Layer: Data link layer design issues, error detection and correction, data
link protocols, sliding window protocols, Examples of Data Link Protocols.
The Medium Access Sublayer: The channel allocation problem, multiple access protocols, IEEE standard 802 for LANS and MANS, high-speed LANs, satellite networks, Network devices-repeaters, hubs, switches and bridges.
The Network Layer: Network layer design issues, routing algorithms, congestion control algorithm, internetworking, the network layer in the internet, the network layer in ATM networks.
The Transport Layer: A simple transport protocol, internet transport protocols, UDP, introduction to TCP, service model, TCP connection establishment, transmission policy, congestion control, timer management, wireless TCP and UDP, transactional TCP.
The Application Layer: HTTP, electronic mail, SNMP, SMTP, DNS.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		

1	Computer Networks, 3rd Ed, Tananbaum A.S, PHI	
2	Computer Networks-Protocols, Standards and Interfaces, Black U. PHI	
3	Computer Communication Networks, Stallings W. , PHI	
Reference Books		
1	Data communication and networking, B. F. Ferouzan, TMH	

Course Outcome

Sr	Course Outcome	CO
1	Understand computer networking and data communications	CO1
2	Understand the standard networking models along with their layers and associated applications	CO2
3	Be familiar with the different concepts of network protocols	CO3
4	Analyse the features and operations of various protocols	CO4

Course Code : CSP DC301
Course Title : Computer Networks & Communication Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Introduction to NetSim, development of a layout and analyse performance factors generated based on the constructed network layout.
2	Understand IP forwarding within a LAN and across a router using NetSim. Disable static ARP Enable static ARP
3	Understand the working of "Connection Establishment" in TCP using NetSim. Disable static ARP Enable static ARP
4	Study the working of spanning tree algorithm by varying the priority among the switches
5	Study the throughput of the communication link while using different congestion control algorithms i.e. Congestion avoidance (Old Tahoe) and Fast Retransmit (Tahoe), Reno
6	Study how the Data Rate of a Wireless LAN (IEEE 802.11b) network varies as the distance between the Access Point and the wireless nodes is
7	Plot the characteristic curve throughput versus offered traffic for a Slotted ALOHA system
8	Plot the characteristic curve throughput versus offered traffic for a Pure ALOHA system
9	To determine the optimum persistence of a p-persistent CSMA / CD network for a heavily loaded bus capacity
10	Study the working and routing table formation of Interior routing protocols, i.e. Routing Information Protocol (RIP) and Open Shortest Path First (OSPF)
11	Understand the impact of bit error rate on packet error and investigate the impact of error of a simple hub based CSMA / CD network
12	Analyze the performance of a MANET, (running CSMA/CA (802.11b) in MAC) with increasing node density
13	Analyze the performance of a MANET, (running CSMA/CA (802.11b) in MAC) with increasing node mobility
14	Study the working of BGP and formation of BGP Routing table

Course Code : CSL DC303
Course Title : Object Oriented Programming using JAVA
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit I: Object-Oriented Programming Concepts

OOP concepts, abstraction and encapsulation, inheritance and polymorphism, Java Byte code, JDK, JRE,JVM, garbage collection, java buzzwords, Data types, type casting, arithmetic operators, bitwise operators, relational operators, Boolean and logical operators, assignment operator, ternary (?) Operator, operator precedence, Control statements, and loops: if statement, if-else, while, do-while, for loop, enhanced for loop, nested loops, and statements, break, continue, using command line arguments, Comments

Unit II: Input, Classes & Objects, Strings, Constructors & Inheritance

Input using Scanner, Output, String class, String immutability, String operations, Big Numbers, Arrays, 2D, 3D arrays, Classes and Objects, Methods, Encapsulation, Getters and Setters, access modifiers (public, default, private) declaring objects, assigning an object to reference variables, constructors (default and parameterized), this keyword, finalize keyword, method introduction and returning a value from a method, overloading method, overloading constructor, object as a parameter to the method, returning objects, recursion, understanding static keyword, final keyword, introduction to inner and nested classes, exploring Inheritance basics, use of super, method overriding, abstract class, Object class,defining a package, access protection, importing a package

Unit III: Interface, Exception Handling, Multi-Threading & Collections

Introduction to the interface, defining an interface, variables in the interface, extension of the interface, fundamentals of Exception handling, types of exception, use of try and catch, nested try block, throw, throws, finally keywords, java's built-in exception, creating your exception. The java thread model, thread priorities, synchronization, creating a thread, creating multiple threads, using is Alive() and join(), Synchronization in multiple threads, Collection interface, Set interface, List interface, Queue interface, SortedSet interface, HashSet class, LinkedHashSet class, TreeSet class, ArrayList class, Vector class,LinkedList class, PriorityQueue class, Arrays class, Collections class, map interface, HashTable class,
LinkedHashMap class, HashMap class, Sortedmap interface, TreeMap class, Iterator, ListIterator, Stack

UNIT IV: Swing, Event Handling & JDBC

Exploring Swing and various events, Event Listener interface, Adapter class, Anonymous inner class, creating Frames and Windows, working with graphics, working with color, fonts, layout managers, using buttons, checkboxes, choice lists, lists, scroll bar, text fields, text area, menu bars, and menus, and handling the corresponding events generated by above components, JDBC basics, accessing MySQL database with JDBC

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Core Java-Volume I & II by Cay S.Horstmann, Gary Cornell, Pearson Education	
2	Java-How to Program, Deitel and Deitel: PHI Publication	
3	Thinking in JAVA, Bruce Eckel, Pearson	
Reference Books		
1	Head First Java, Bert Bates & Kathy Sierra, O'Reilly publications	
2	The Complete Reference Java , Herbert Schildt: TMH	

Course Outcome

Sr	Course Outcome	CO
1	Understand the Syntax, Data structures & Concepts of java programming language and use Industry standard IDEs (Integrated Development Environments) like NetBeans/Eclipse for coding, debugging&best practices like documentation etc.	CO1
2	Apply the concepts of Java to code the algorithms and provide solution to computational problems	CO2
3	Build Desktop applications with GUI (Graphical User Interface) and Database connectivity to create real-life/business solutions	CO3

Course Code : CSP DC303
Course Title : Object Oriented Programming Lab using JAVA
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Program to display Hello world
2	Program to understand command line arguments

3	Program to Input values using Scanner/BufferedReader class, do simple calculations and print values
4	Program to learn about data types & various arithmetic/bitwise/logical/unary operators
5	Program to understand loops and conditions
6	Program to generate patterns and series like Fibonacci/Prime/Even/Odd etc.
7	Program to understand Classes & Objects
8	Program to understand Inheritance and its concepts
9	Program to understand Constructor overloading & calling super class constructor
10	Program to understand method overloading and overriding
11	Program to understand the importance of Getters and Setters
12	Program to understand various access modifiers
13	Program to understand various types of comments in Java
14	Program to understand Interfaces, Abstract class, Inner Class
15	Program to understand Final Classes and Methods
16	Program to learn String, StringBuffer, StringBuilder classes
17	Program to BigInteger and BigDecimal classes
18	Program to understand Arrays & do matrix problems
19	Program to understand raw and generic ArrayList, Auto boxing and Unboxing
20	Program to understand concepts like Array of Objects &ArrayList of Objects
21	Program to sort/sorting algorithms
22	Program to understand methods available in Math class
23	Program to understand the Cosmic superclass "Object"
24	Program to understand the concept of Object Cloning
25	Program to compare objects using Comparable
26	Program to understand Collections(HashMap, HashTable, Set, TreeSet etc.) & Iterators
27	Program to understand try-catch-finally block in Exception Handling
28	Program to understand throw and throws keywords, checked and unchecked Exceptions
29	Program to create user defined exceptions
30	Program to understand Multithreading using Thread class and Runnable Interface
31	Program to understand Thread Synchronization
32	Program the classical Problems of Thread Synchronization like Dining Philosophers, Producer-Consumer
33	Program to learn about various (byte/character etc.) streams in Java
34	Program to learn about File I/O
35	Program to Create GUI frames using Swing/AWT and Event Handling
36	Program to understand various layout managers,
37	Program to understand the Adapter classes,
38	Program to connect to database and perform operations like Create Table, Update Table, Select query, Insert query
39	Program to learn about basic Applet concepts
40	Program to strengthen logic building in students using simple/medium level problems from CodeChef etc.

Course Code : CSL DC305
Course Title : Machine Learning
L-T-P/S=Credits : 3-0-0

Syllabus
Unit 1: Introduction to Machine learning: Motivation and role of machine learning in computer science and problem solving. Representation (features), linear transformations, Appreciate linear transformations and matrix vector operations in the context of data and representation. Problem formulations (classification and regression). Appreciate the probability distributions in the context of data, Prior probabilities and Bayes Rule. Introduce paradigms of Learning (primarily supervised and unsupervised. Also a brief overview of others).
Unit 2: Fundamentals of Machine Learning: Statistical Decision Theory, Bias-variance Trade-off. Notion of Training, Validation and Testing; Connect to generalisation and overfitting. Subset Selection, Shrinkage Methods, PCA, Linear Discriminant Analysis and Dimensionality Reduction.
Unit 3: Selected Algorithms: Nearest Neighbours and KNN. Linear Regression, Multivariate Regression. Decision Tree Classifiers. Notion of Generalization and concern of Overfitting. Linear SVM, K Means, Logistic Regression, Naive Bayes and Ensembling and RF
Unit 4: Role of Loss Functions and Optimization, (ii) Gradient Descent and Perceptron/Delta Learning, (iii) MLP, (iv) Backpropagation (v) MLP for Classification and Regression, (vi) Regularisation, Early Stopping (vii) Parameter Estimation- Maximum Likelihood estimation and Bayesian Estimation.
Unit 5: Clustering Methods: Kernels (with SVM), Bayesian Methods, Generative Methods, HMM, GMM, EM, PAC learning.
Course Outcomes:
CO1 Know the basics and mathematics behind various Machine Learning algorithms.

CO2 Capability to implement basic algorithms using basic machine learning libraries mostly in python.
CO3 Enable formulating real world problems as machine learning tasks .
Co4 Think analytically and suggest possible solutions to problems using Machine Learning.
CO5 Ensure awareness about importance of core CS principles such as algorithmic thinking and systems design in ML

Suggested Books:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020) .
2. Tom M. Mitchell- Machine Learning- McGraw Hill Education, International Edition.
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition
4. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition.
5. Christopher M. Bishop Pattern Recognition and Machine Learning- Springer, 2nd edition.

Course Code : **CSP DC305**
Course Title : **Machine Learning Lab**
L-T-P/S=Credits : **0-0-2 =1**
Course Category : **Departmental Core course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

NOTE: Use any of these programming language: Python/Octave/Matlab/R)

Sr	Contents
1	Explore the Weka tool and practice various pre-coded ML algorithms for regression, classification, clustering algorithms on the sample WEKA-datasets/UCI datasets.
2	Compute cost function for linear regression
3	Implement gradient descent for univariate linear regression
4	Compute cost function for multivariate linear regression
5	Implement gradient descent for multivariate linear regression
6	Given a UCI-Iris dataset (or any other dataset)code the classifier/clustering algorithm to: predict the type (Iris-Setosa /Iris-Versicolor / Iris-Verginica) when given an input combination of: (sepal length, sepal width, petal length, petal width)
7	Cluster and visualize the data given in the Iris.xls based on Sepal Length.
8	Cluster and visualize the data given in the Iris.xls based on Sepal Width.
9	Cluster and visualize the data given in the Iris.xls based on Petal Length.
10	Cluster and visualize the data given in the Iris.xls based on petal Width.
11	Cluster and visualize the data based on Iris (types: Iris-Setosa /Iris-Versicolor / Iris- Verginica)

Course Code : **CSL DC302**
Course Title : **Deep Learning**
L-T-P/S=Credits : **3-0-0**

Syllabus

Unit 1:
History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons
Unit 2: Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, FeedForward Neural Networks, Backpropagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalue Decomposition
Unit 3: Autoencoders, Regularization in autoencoders, Variational autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods.
Unit 4: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks.
Unit 5: Recurrent neural networks (RNNs): Sequence modeling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture.
Unit 6: Generative models: Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets

Course Outcomes

CO1: Explain different network architectures and how these are used in current applications
CO2: Implement, train, and evaluate neural networks using existing software libraries

CO3: Present and critically assess current research on neural networks and their applications
CO4: Relate the concepts and techniques introduced in the course to your own research
CO5: Plan and carry out a research project on neural networks within given time limits

Recommended Books:

1. Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville.
2. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013
3. B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999 4. C.M.
4. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Course Code : CSP DC302
Course Title : Deep Learning Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Design and simulate the McCulloch Pitts Neuron Network model in Python language.
2	Design and simulate the behaviour of AND Gate using Perceptron Network in Python language for bipolar inputs
3	Design and simulate the behaviour of OR Gate using Adaline Network in Python language for bipolar inputs and
4	Design and simulate the behaviour of XOR Gate using Madaline Network in Python language for bipolar inputs a
5	Design and simulate the behaviour of XOR gate using Back Propagation Network in Python language for bipolar
6	Multi LayerPerceptrons implementation for solving Linearly Separable Problems.
7	Multi LayerPerceptrons implementation for solving Non-Linearly Separable Problems.
8	Multi LayerPerceptrons implementation for solving Non-Linearly Separable Problems like XOR problems.
9	Feed Forward Neural Networks model implementation in Python language.
10	Auto-encoders implementation in Python language.
11	Back Propagation Network models like Gradient Descent in Python language.
12	Simple Image Classification using Convolutional Neural Network - Deep Learning in python.
13	Recurrent Neural Networks model in Python language.
14	Some Applications of Deep Belief Network
15	BPTT - Deep Learning in python.
16	LSTM - Deep Learning in python.

Course Code : CSL DC304
Course Title : Software Engineering
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit I: Introduction
The role of Software, Software Characteristics, Industrial strength software, Classification of software products, Legacy Software, Software Engineering Challenges, Software Development Life Cycle.
Unit II: Software Process
Software Development Process Models: Waterfall, Prototyping, Iterative, Spiral. Comparison of Models, Project Management Process, Inspection Process, Software Configuration management Process, Requirements Change management Process, Agile Process.
Unit III: Feasibility Study, Requirements Engineering & Analysis Modeling

Feasibility study: Technical, Economic & Behavioral; Data Gathering: Sources of Data, Observation, Interviewing, Questioners, On-site Observation, Software Process & Characteristics, Software Requirements, Problem Analysis: Data Flow Modeling, Object Oriented Modeling, Prototyping, Cost Benefit Analysis, SRS, Developing Use Cases. Validation & Metrics

Unit IV: Planning Software Projects

Effort Estimation: Constructive Cost Model (COCOMO), Project Scheduling, SCM planning, Quality Planning, Risk Management, Project Monitoring Planning

Unit V: Design Engineering

Design Concepts & Principles, Cohesion, Coupling, Design Methodology, Introduction to Unified Modeling Language (UML), Verification, Metrics

Unit VI: Coding & Testing

Programming principles, Coding Conventions, Coding process, Refactoring, Verification, Coding Metrics, Test Cases, Test Plan, White box & Black box testing, Unit Testing, Integration Testing, Validation Testing: Alpha & Beta Testing, System Testing, Debugging, Testing Metrics

Unit VII: Reliability, Quality & Maintenance

Software Reliability & Metrics, ISO 9000 Standard, Capability Maturity Model, CASE Tools, User Training, Software Maintenance

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Software Engineering: A practitioner's Approach, Pressman,6th Ed., McGraw Hill	
2	System Analysis & Design, Elias M Awad	
3	Fundamentals of Software Engineering, Ghezzi, C ,PHI	
Reference Books		
1	Managing the Software Process,W S Humphrey Addison–Wesley	
2	Ed. Encyclopedia of Software Engineering, Vols 1&2 , J JMarciniak, John WileY	
3	Software Engineering, 5th Edition, Sommerville Ian Addison Wesley	
4	Software Engineering , Manmdrioli, Dino	
5	Software Engineering: A programming Approach,3rd Edition, Bell, Douglas	
6	An integrated Approach to Software Engineering. ,Jalote, P ,Narosa Pub House	

Course Outcome

Sr	Course Outcome	CO
1	Understanding the basics of Software Development Life Cycle and appreciating the complex process of Engineering an Industry Standard Software	CO1
2	Appreciating the importance of a software process by understanding the already existing software process models.	CO2
3	Understanding the Software metrics, Project Planning, ISO & CMM standards.	CO3
4	Inculcating the ability to write a good quality SRS document, Design document. Ability to model the problem, designing solution through Data Flow Diagrams, Object Oriented Modeling, Use-cases etc.	CO4
5	Ability to Code & Test following industry standards for documentation and other best practices.	CO5
6	Usage of Industry standard tools like IBM Rational Software Architect during the entire life cycle of software building.	CO6

Course Code : CSP DC304
Course Title : Software Engineering Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Railway Commodity Reservation System
2	Multimedia Content Protection System
3	Delivery Agent System
4	Social Networking
5	Online Campus Security System
6	Airline Management System
7	Bus Service System

8	Hall Management System
9	Wallet Management System
10	Tournament Management System
11	Hospital Management System
12	Payroll Management System
13	Examination Management System
14	Smart Home Management System
15	Cyber Cafe
16	Graphics Editor System
17	Online Examination System
18	Toll Plaza System
19	Health Monitoring System
20	Security monitoring system

Complete following Phases of the SDLC :

a) To assign the requirement engineering tasks
b) To perform the system analysis : Requirement analysis, SRS
c) To perform the function oriented diagram : DFD and Structured chart
d) To perform the user's view analysis : Use case diagram
e) To draw the structural view diagram : Class diagram, object diagram
f) To draw the behavioral view diagram : Sequence diagram, Collaboration diagram
g) To draw the behavioral view diagram : State-chart diagram, Activity diagram
h) To draw the implementation view diagram: Component diagram
i) To draw the environmental view diagram : Deployment diagram

To perform various testing using the testing tool unit testing, integration testing

Course Code : CSL DC401
Course Title : Digital Image Processing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit-1 Introduction and Digital Image Fundamentals
Application of Image Processing, Image Processing definition, steps in image Processing, Image Sensing and Acquisition, Image Sampling and Quantization, Spatial and Intensity resolution-Effect of reducing spatial resolution, DPI, Effect of reducing image gray levels. Basic relationships between pixels and adjacency

Unit-2 Intensity Transformation and Spatial Filtering
Basics of intensity transformation and spatial filtering, intensity transformation functions- image negative, log transformation, power law; Piecewise-linear transformation functions- contrast stretching, intensity level slicing, bit plane slicing; Histogram Processing-histogram stretching, histogram equalization, Spatial Filtering, Spatial Correlation and Convolution, Smoothing Spatial Filters, order statistic filters, Sharpening Spatial Filters- The Laplacian, The Gradient-Robert cross gradient operator, Sobel operators

Unit-3 Image Restoration
Model of the image degradation/restoration process, Noise Models, Periodic Noise, Estimation of noise parameters, Restoration in the presence of noise-spatial filtering- Mean filters, Order-statistics filters, Median filter, Max and Min filters, Mid-point filter, Alpha-trimmed mean filter, adaptive filters.

Unit-4 Color Image Processing
Introduction to the color image processing, color models: RGB, HSI, CMY/ CMYK; Conversion of color models: converting colors from RGB to HSI, HSI to RGB, RGB to CMY and CMY to RGB etc. Pseudo coloring of images.

Unit-5 Image Compression
Introduction to image compression, need of compression, methods of image compression: coding redundancy, spatial and temporal redundancy, irrelevant information, models of image compression, Huffman coding, Arithmetic coding, LZW coding, run-length coding, block transform coding, JPEG compression, predictive coding

Unit-6 Image Segmentation
Fundamental, Point, Line and Edge detection, edge linking and boundary detection, Hough transform, thresholding, region-based segmentation, region splitting and merging

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 3rd edition, Pearson Education	
2	David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Prentice Hall	
3	A.K. Jain, "Fundamental of Digital Image Processing", PHI	
Reference Books		
1	W.K. Pratt, "Digital Image Processing	

Course Outcome

Sr	Course Outcome	CO
1	Understand image formation for the acquisition of images.	CO1
2	Get broad exposure of the various applications of image processing in industry, medicine, agriculture	CO2
3	Get knowledge of existing algorithms for the processing of digital images.	CO3
4	Apply knowledge/skills to solve industrial problems based on image processing.	CO4
5	Think independently to evolve new methods and procedures with the analysis of image processing problems and techniques.	CO5

Course Code : CSP DC401
Course Title : Digital Image Processing Lab
L-T-P/S=Credits : 0-0-2 =1
Course Category : Departmental Core course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

List of Experiments

Sr	Contents
1	Input a colored image and convert it into Black & White Image using Matlab Function.
2	Input an image and compare the effects of reduced Quantization levels to produce False Contouring.
3	Input an image and compare the effects of increased Quantization levels to produce Saturation affect.
4	Input an image and down-sample the image to a desired size.
5	Input an image an up-sample it to study the effect on image clarity.
6	Input an image and resize it to a desired size.
7	Write a code in Matlab to display the negative of an image.
8	Write a code in Matlab to improve the contrast of an image and compare the original and enhanced image.
9	Write a code in Matlab to observe thresholding (or extreme mage contrast).
10	Perform Gray level slicing on an image using both with and without background slicing techniques and compare the outputs.
11	Write a code in Matlab to hide a text in an input image and retrieve the same.
12	Write a Matlab code to improve the dynamic range of an input image using Log transformation or power law transformation.
13	Add Gaussian noise to an image and perform low –pass Average filtering on the image to study the effect.
14	Add salt & pepper noise to an image and perform Low-pass median filtering on it to analyse the effect.
15	Write a Matlab code to zoom an image using both replication as well as interpolation and compare the results.
16	Input an image and perform histogram stretching on it to see the resulting image.
17	Input an image to perform histogram equalisation on it and plot the resulting image to analyse the effect.
18	Perform masking on an input image using Sobel , Roberts and Prewitts operators

Course Code : CSL DE301
Course Title : Software Defined Networks
L-T-P/S=Credits : 3-0-2

UNIT I
Introduction to Traditional networks: Traditional networks, Control Plane, Data Plane and Management Plane , Flow table, Limitations of traditional networks- Need for simplification, Lowering operating costs ,Single flow table, Flexibility issues, Proprietary protocols and Destination based forwarding. ,ForCES .
UNIT II
Introduction to SDN: Software defined networks, SDN Planes-Dataplane, Control Plane, Application Plane, OpenFlow, Open Network Foundation, Protocol-Encryption, Northbound & SouthboundAPI, Multi-level flow table and pipeline processing, Group table, Meter table-Meter bands, OpenFlow version- 1.0,1.1,1.2,1.3
UNIT III
SDN Messages and Table matching: Messages-Controller-Switch, Symmetric & Asynchronous messages Counters, OpenFlow Ports, Table matching in SDN, Network Automation and Virtualization.
UNIT IV
Mininet Emulator: Introduction to Mininet, Custom topologies of OpenFlow and Legacy Networks, Flow table manipulation-Adding & Deleting Flow entries, Packet Dissection via Wireshark
UNIT V
SDN Applications and Use Cases: SDN Controllers-Ryu, POX, Floodlight, SDN Applications, SDNUseCases, SDN in the DataCenter and WAN, SDN-OpenSource and its Features

List of Experiments:

Lab 1: Introduction to Mininet and Cloudlab
Lab 2: Legacy Metqorks: BGP Example as a Distributed System and Autonomous
Lab 3: Early efforts of SDN: MPLS Example of a Control Plane that Establishes Semi-static Forwarding Paths
Lab 4: Introduction to SDN, SDN Network Configurationbr
Lab 5: Configuring VXLAN to provide Network Traffic Isolation, Configuring VXLAN
Lab 6: Introduction to Openflow, OpenFlow Protocol Management
Lab 7: Routing within a SDN network
Lab 8: Interconnection between Legacy Networks and SDN Networks, Incremental Deployment of SDN Networks within legacy Networks
Lab 9: Configuring Virtual Private LAN Service(VPLS)
Lab 10: Applying Equal-cost Multi-path Protocol (ECMP) within SDN networks

Course Outcomes:
1. Understand the difference between traditional Networks and SDN
2. Understand the design principles and performance enhancement strategies that adopted in performance evolution of different network components
3. Able to solve the performance related problems of SDN, including those in routing, optimizing traffic engineering.
4. Able to analyze the performance of routing, optimizing traffic engineering using SDN

Suggested Books:
- Nadeau, Thomas D., and Ken Gray. SDN: Software Defined Networks: an authoritative review of network programmability technologies. " O'Reilly Media, Inc.", 2013.
- Chuck Black and Paul Goransson, " Software Defined Networks: A Comprehensive Approach", Morgan Kaufman.
- Coker, Oswald, and Siamak Azodolmolky. Software-defined Networking with OpenFlow: Deliver Innovative Business Solutions. Packt Publishing Ltd, 2017

Course Code : CSL DE303
Course Title : Storage Networks
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1: Introduction to Storage Technology
Data proliferation and the varying value of data with time & usage, Sources of data and states of data creation, Data center requirements and evolution to accommodate storage needs, Overview of basic storage

management skills and activities, The five pillars of technology, Overview of storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Data categorization within an enterprise, Storage and Regulations

UNIT-II: Storage Systems Architecture

Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure- components, properties, performance, and specifications, Logical partitioning of disks, RAID & parity algorithms, hot sparing, Physical vs. logical disk organization, protection, and back end management, Array caching properties and algorithms, Front end connectivity and queuing properties, Front end to host storage provisioning, mapping, and operation, Interaction of file systems with storage, Storage system connectivity protocols

UNIT-III:Introduction to Networked Storage

JBOD, DAS, SAN, NAS, & CAS evolution, Direct Attached Storage (DAS) environments: elements, connectivity, & management, Storage Area Networks (SAN): elements & connectivity, Fibre Channel principales, standards, & network management principles, SAN management principles, Network Attached Storage (NAS): elements, connectivity options, connectivity protocols (NFS, CIFS, ftp), & management principles, IP SAN elements, standards (iSCSI, FCIP, iFCP), connectivity principles, security, and management principles, Content Addressable Storage (CAS): elements, connectivity options, standards, and management principles, Hybrid Storage solutions overview including technologies like virtualization & appliances.

UNIT-IV:Introduction to Information Availability

Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques

UNIT-V:Managing & Monitoring

Management philosophies (holistic vs. system & component), Industry management standards (SNMP, SMI-S, CIM), Standard framework applications, Key management metrics (thresholds, availability, capacity, security, performance), Metric analysis methodologies & trend analysis, Reactive and pro-active management best practices, Provisioning & configuration change planning, Problem reporting, prioritization, and handling techniques, Management tools overview

UNIT-VI:Security & Virtualization

Storage Security (Importance of Information security, elements and attributes of security), Developing a storage security model (Restricting Access Path, Vulnerability Management, Understanding Vulnerabilities), Securing Data Storage (Storage Security domains, Risk assessment Methodology, Security elements, threats against applications, Controlling user access to data, threats again backup , recovery and archive) Virtualization (Define virtualization, types of virtualization), Storage Virtualization (Storage functionality, Virtual storage, Comparison of virtualization architectures, challenges of storage virtualization), Block level virtualization, File level virtualization.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Robert Spalding: "Storage Networks the Complete Reference", Tata McGraw-Hill, 2011.	
2	Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.	
3	Richard Barker and Paul Massiglia: "Storage Area Network Essentials "A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.	
4	Information Storage and Management by EMC Corporation.	

Course Outcome

Sr	Course Outcome	CO
1	To Learn about the data generation sources and identification of Storage devices	CO1
2	To learn about different storage devices like NAS, DAS, SAN and CAS	CO2
3	To help business organizations to identify their storage requirements, I/O's and security of data	CO3
4	To understand the need of Virtualization and ILM	CO4

Course Code : CSE DE307
Course Title : Web Programming using JavaScript
L-T-P/S=Credits : 3-0-2 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1: Introduction to HTML5

Base HTML tags, Paragraph tags, Break tags, Header tags, Bold, Italic tags, Ordered Lists, Unordered List, hyperlinks, table, iFrame, Form, Text fields, Text areas, Radio Buttons, Comments in code, Data Input, Meta tags, Images, Anchor elements, Introduction to hosting Websites

UNIT 2: CSS3 & Front-end development Frameworks :

CSS selectors, properties, attributes, ID, Class, Element, Internal Style sheet, External Style Sheet, Inline Styles, Box model, CSS colors, fonts, background images, Styling Links and ID, Introduction to Front-end frameworks and Libraries: React, Angular, Vue.js, Bootstrap

UNIT 3: JavaScript

Introduction to Javascript: data types, variables, alerts, naming conventions, Strings, Arithmetic, modulo operator, comparison operators, increment and decrement, functions, control statements, switch statements, Arrays, Introduction to Document Object Model, Adding Javascript to websites, Selecting HTML elements with Javascript, Manipulating and changing styles of HTML elements with Javascript, Javascript objects, event handling and responding to events

UNIT 4: Back-end development, APIs, DBMS, Deployment, Security

Introduction to server-side programming languages: Node.js, Express.js, Django. Handling Requests, and Responses: the GET Request, Responding to requests, POST requests, JSON parsing, AJAX basics, Rendering Website, Version control using Git/Github, CRUD operations on the database MySQL/Mongo, Deploying web app, API paths, parameters, Introduction to creating RESTful APIs and Web Services, Security considerations in web development: Authentication, Authorization, Introduction to Continuous Integration and Continuous Deployment tools.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	A Smarter Way to Learn JavaScript by Mark Myers	
2	You Don't Know JS by Kyle Simpson	
3	JavaScript – The Definitive Guide, 7e: The Definitive Guide: Master the World's Most-used Programming Language	

Course Outcome

Sr	Course Outcome	CO
1	Ability to apply HTML5 to create well-structured web pages	CO1
2	Ability to use CSS3 to style web pages	CO2
3	Ability to implement JavaScript Functionality	CO3
4	Ability to develop backend solutions	CO4
5	Abiltiy to deploy web applications	CO5

Course Code : CSL DE309
Course Title : Block Chain Technology
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit 1

Introduction to Bit coin, Basic concepts about: Transactions, Transaction Blocks, Blockchain, Mining, Bitcoin Addresses, Wallet technology, Transaction inputs and outputs, Transaction Script, Digital Signature, Advanced Concepts in Transactions and scripting.

Unit 2

The Bit coin Network: Peer to Peer Network Architecture, Full Nodes and SPV Nodes, Encryption and authentication in connections, Transactions Pool, Structure of Block, Block Header, Block Header Hash and Height, Genesis Block, Markle Trees, Linking Blocks in chains.

Unit 3

Mining and Decentralized consensus, Aggregating Transactions in Blocks, Mining the Block, Validating Block, Mining and the Hashing Race, Consensus Attacks, Bit coin Security principles and best practices, Block Chain Applications.

Unit 4

Introduction to Hyper ledger-Fabric/Ethereum for building distributed ledgers (blockchain), Smart contracts, decentralized blockchain applications.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Mastering Bitcoin – Programming the Open Blockchain, 2nd Edition by Andreas M Antonopoulos, O'Reilly Publications	
2	Building Blockchain Projects: Building decentralized Blockchain applications with Ethereum and Solidity, by Narayan Prusty, Packt publications	
3	Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric and Composer, by Nitin Gaur, Packt publications	
Reference Books		
1	Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, by Imran Bashir, Packt Publications	
2	Blockchain: Blueprint for a New Economy, 1st Edition, by Melanie Swan, O'Reilly publications	
3	Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits	

Course Outcome

Sr	Course Outcome	CO
1	Know the Basic concepts, Design, Architecture, Mining, Network and Security aspects of a Block chain & Crypto currency.	CO1
2	Know the basics of the languages used in building Block chain & Smart Contracts.	CO2
3	Understand the application of Block chain in various other domains like Smart Contracts, IoT, Business Process Management etc.	CO3

Course Code : CSL DE311
Course Title : Data Visualization
L-T-P/S=Credits : 3-0-2

UNIT I

Introduction: Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools. Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs

UNIT II

Visualization Techniques For Time-Series, Trees & Graphs: Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods, Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

UNIT III

Text And Document Visualization: Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder ,Asynchronous Image Downloads, Web Techniques, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV

Interactive Data Visualization: Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – D3.js, Tableau Dashboards.

UNIT V

Security In Data Visualization: Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system.

List of Experiments:

1. Introduction to various Data Visualization tools
2. Basic Visualization in Python
3. Basic Visualization in R
4. Introduction to Tableau and Installation
5. Connecting to Data and preparing data for visualization in Tableau
6. Data Aggregation and Statistical functions in Tableau
7. Data Visualizations in Tableau
8. Basic Dashboards in Tableau

Course Outcomes:

1. Apply mathematics and basic science knowledge for designing information visualizing System.
2. Collect data ethically and solve engineering problem in visualizing the information.
3. Implement algorithms and techniques for interactive information visualization.
4. Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.

Suggested Books:

1. Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.
2. Colin Ware, "Information Visualization Perception for Design", Third edition, Margon Kaufmann Publishers, 2012.
3. Matthew O. Ward, George Grinstein, Daniel Keim, "Interactive Data Visualization: Foundation, Techniques and Applications", Second Edition, A. K. Peters/CRC Press, 2015.
4. Joerg Osarek, "Virtual Reality Analytics", Gordon's Arcade, 2016.

Course Code : CSL DE302
Course Title : Cloud Computing
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit I: Cloud Computing Fundamental: Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

Unit II: Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Unit III: Cloud Services Management: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

Unit IV: Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]	
2	Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]	
3	Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]	

Course Outcome

Sr	Course Outcome	CO
1	Understand the architecture and different types of clouds	CO1
2	Case studies of different cloud servers	CO2
3	Understanding popular cloud platforms and creating virtual machines	CO3

Course Code : CSL DE325
Course Title : Advanced Computer Architecture
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit-I: Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors. Conventional and EPIC architecture. Evolution of parallel processors, future trends and there architecture. Overview of Parallel Processing and Pipelining Processing Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, future trends, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture, Case study of Intel Itanium Processor. Principles of scalable performance: Performance Metrics and Measures, Speedup Performance Laws. Programming aspects for Intel Itanium Processor

Unit-II: Principles and implementation of Pipelining, Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining. General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining, VLIW (Very Long Instruction Word) processor, Case study: Super scalar Architecture- Pentium, Ultra SPARC. Super scalar architecture of Pentium, Ultra SPARC, Advances in pipeline architectures. Implementation issues of a program on any pipelined processor their analysis.

Unit-III: Study and comparison of Vector and array processors, Vector and Array Processor, Basic vector architecture, Issues in Vector Processing, Vector performance modeling, vectorizers and optimizers, Case study: Cray Arch. SIMD Computer Organization Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network. Parallel Algorithms For Array Processors: Matrix Multiplication. Sorting, SIMD computer organization. Implementation issues of Matrix multiplication and sorting on array processor and their analysis.

Unit-IV: Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors.Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP), Cow's and NOW's Cluster and Network of Work Stations), Chip Multiprocessing (CMP), Case Study of IBM Power4 Processor Inter Processor Communication and Synchronization, Implementation issues of a program on multiprocessor system.

Unit-V: Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions. Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.

Unit-VI: Parallel software issues, study of parallel programming concepts. a)Parallel algorithms for multiprocessors, classification of parallel algorithms, performance of parallel algorithms b) Operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI), Threads (in shared memory system) c) Parallel Programming Languages : Fortran 90, Occam, C-Linda, CCC etc. d) Issues towards cluster computing. Introduction to Neuro Computing and Grid Computing:

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition	

2	Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill	
3	V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.	
Reference Books		
1	William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.	
2	Kai Hwang, Scalable Parallel Computing.	
3	Harrold Stone, High performance computer Architecture.	
4	Richard Y. Kain, Advanced Computer Architecture	
5	http://www.intel.com/products/processor (for Intel Itanium Processor)	

Course Outcome

Sr	Course Outcome	CO
1	Understand the Concept of Parallel Processing and its applications	CO1
2	Implement the Hardware for Arithmetic Operations	CO2
3	Analyze the performance of different scalar Computers	CO3
4	Develop the Pipelining Concept for a given set of Instructions	CO4
5	Distinguish the performance of pipelining and non pipelining environment in a processor	CO5

Course Code : CSL DE323
Course Title : Computer Network Security
L-T-P/S=Credits : 3-0-2

Syllabus
UNIT 1
Introduction to cryptography and network security, Networks OSI Model of networking layers, Importance of Security in networks, types on internetwork, attacks, security services pervasive security mechanism.
UNIT 2
Foundation of Modern Cryptography, private key cryptography, DES, TDEA, Block Ciphers, linear cryptanalysis, differential cryptanalysis, AES public key Cryptography, DH algorithm, Algorithms for discrete algorithms birth day paradox, pollard's p algorithm for discrete algorithm, EI Gomel public key, RSA, Elliptic curve cryptography, stream chippers
UNIT 3
Hashing Authentication & Signature Schemes Hashing schemes SHA- Family, MAC, Digital Signature RSA EI Gamel, DSS DSA Authentication Protocols, applications Kereberos X.509 Directory Services, E-mail security, Email architecture SSL PGP, MIME, S/MIME Internet Protocol Security (IPSec) IPSec architecture, IPSec verses other layers security, Mobile IPsec VPN Web Security, SSl, TLS, SETetc
UNIT 4
System Security Intruders, Types of Attacks, Protecting against Intruders, Honeypots, Scanning and analysis tools, Viruses and Worms, Types of Viruses, Protection, Firewall architecture implementing firewalls, XML firewalls, Trusted systems, Trusted system security implementation, wireless security.
Suggested Books:

Sr.	Name of Book, Author, Publisher
1	Cryptography and Network Security: Behrouz A. Forauzan 2/e
2	Cryptography and Network Security: William Stallings 4/e
3	Cryptography and Network Security: AtulKahate 2/e

Course Outcome

Sr	Course Outcome	CO
1	Identify factors driving the need for network security	CO1
2	Identify and classify particular examples of attacks	CO2
3	Define the terms vulnerability, threat and attack	CO3
4	Identify physical points of vulnerability in simple networks	CO4
5	Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and the characteristics of hybrid systems	CO5

List of Experiments

NOTE: Experiments will be implemented in C/C++/Python.

Sr	Contents
1	Installation of Virtual Machine and Linux OS.
2	Practicing various network troubleshooting commands.
3	Write programs to implement traditional Ciphers.
4	Write a program to implement DES algorithm.

5	Write a program to implement 3DES algorithm.
6	Write a program to implement RSA algorithm.
7	Write a program to implement AES algorithm.
8	Write a program to implement message digest.
9	Installation and Configuration of Wireshark tool.
10	Analyzing network traffic using Wireshark.
11	Analyze and investigate network information of packets.
12	Understanding preliminary digital forensic using Wireshark.

Course Code : CSL DE302
Course Title : Data mining & Warehousing
L-T-P/S=Credits : 3-0-2

UNIT I
Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II
Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.
Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT III
Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT IV
Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V
Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

List of Experiments:
1. Experiments related to file format for data mining
2. Experiments related to conversion of various data files
3. Experiments related to Training the given dataset for an application
4. Testing the given dataset for an application
5. Generating accurate models
6. Data pre-processing – data filters
7. Experiments related to Feature selection
8. Experiments related to Web mining
9. Experiments related to Text mining
10. Design of fact & dimension tables
11. Generating graphs for star schema.

Course Outcomes:
5. To be familiar with the Data warehouse architecture and its Implementation.
6. To know the Architecture of a Data Mining system.
7. To understand the various Data preprocessing Methods.
8. To perform classification and prediction of data.

Suggested Books:

5. Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.
6. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
7. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
8. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
9. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

Course Code : CSL DE304
Course Title : Human Computer Interaction
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction: Course objective and overview, Historical evolution of the field ofHuman Computer Interaction (HCI)
Interactive system design : Concept of usability - definition and elaboration, HCI and software engineering, GUI design and aesthetics, Prototyping techniques.
Model-based Design and evaluation: Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN-GOMS), Fitts' law and HickHyman's law, Model-based design case studies.
Guidelines in HCI: Shneiderman's eight golden rules, Norman's seven principles, Norman's model of interaction, Nielsen's ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Cognitive walkthrough.
Empirical research methods in HCI: Introduction (motivation, issues, research question formulation techniques), Experiment design and data analysis (with explanation of one-way ANOVA)
Task modeling and analysis: Hierarchical task analysis (HTA), Engineering task models and Concur Task Tree (CTT).
Dialog Design: Introduction to formalism in dialog design, design using FSM (finite state machines), State charts and (classical) Petri Nets in dialog design.
Cognitive architecture: Introduction to CA, CA types,relevance of CA in IS design, Model Human Processor (MHP)
Object Oriented Programming: OOP- Introduction, OOM- Object Oriented Modeling of User Interface Design
Design -Case Studies: Case Study 1- MultiKey press Hindi Text Input Method on a Mobile Phone, Case Study 2 - GUI design for a mobile phone based Matrimonial application, Case Study 3 - Employment Information System for unorganised construction workers on a Mobile Phone

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Dix A., Finlay J.,Abowd G. D. and Beale R. Human Computer Interaction, 3 rd edition, Pearson Education, 2005.	
2	Preece J., Rogers Y.,Sharp H.,Baniyon D., Holland S. and Carey T. Human Computer Interaction,Addison-Wesley, 1994.	
3	B.Shneiderman; Designing the User Interface,Addison Wesley 2000 (Indian Reprint).	

Course Code : CSL DE306
Course Title : Quantum Computing
L-T-P/S=Credits : 3-0-2 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

1. Introduction to Quantum Computing (6 Hours)
   1.1 Motivation for studying Quantum Computing
   1.2 Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)
   1.3 Origin of Quantum Computing
   1.4 Overview of major concepts in Quantum Computing
   - Qubits and multi-qubits states, Bra-ket notation.
   - Bloch Sphere representation
   - Quantum Superposition
   - Quantum Entanglement

2. Math Foundation for Quantum Computing (9 Hours)
   2.1 Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

3. Building Blocks for Quantum Program (8 Hours)
   3.1 Architecture of a Quantum Computing platform
   3.2 Details of q-bit system of information representation:
   - Block Sphere
   - Multi-qubits States
   - Quantum superposition of qubits (valid and invalid superposition)
   - Quantum Entanglement
   - Useful states from quantum algorithmic perceptive e.g. Bell State
   - Operation on qubits: Measuring and transforming using gates.
   - Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.

   3.3 Programming model for a Quantum Computing Program
   - Steps performed on classical computer
   - Steps performed on Quantum Computer
   - Moving data between bits and qubits.

4. Quantum Algorithms (22 Hours)
   4.1 Basic techniques exploited by quantum algorithms.
   - Amplitude amplification
   - Quantum Fourier Transform
   - Phase Kick-back
   - Quantum Phase estimation
   - Quantum Walks

   4.2 Major Algorithms
   - Shor's Algorithm
   - Grover's Algorithm
   - Deutsch's Algorithm
   - Deutsch -Jozsa Algorithm 4.3 OSS Toolkits for implementing Quantum program
   - IBM quantum experience
   - Microsoft Q
   - RigettiPyQuil (QPU/QVM)

LIST OF PRACTICALS

1. Building Quantum dice
2. Building Quantum Random No. Generation
3. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4. Implementation of Shor's Algorithms
5. Implementation of Grover's Algorithm
6. Implementation of Deutsch's Algorithm
7. Implementation of Deutsch-Jozsa's Algorithm
8. Mini Project such as implementing an API for efficient search using Grover's Algorithms or Integer factorization using Shor's Algorithm

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.	
2	David McMahon, "Quantum Computing Explained", Wiley	
3	IBM Experience: https://quantumexperience,ng,bluemix.net	

Reference Books		
1	Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit	
2	Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/	

Course Outcome

Sr	Course Outcome	CO
1	Explain the working of a Quantum Computing program, its architecture and program model	CO1
2	Develop quantum logic gate circuits	CO2
3	Develop quantum algorithm	CO3
4	Program quantum algorithm on major toolkits	CO4

Course Code : CSL DE308
Course Title : Mobile & App Development
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) : Yes (Basic understanding of programming preferably in languages like: Java, Python, or JavaScript)

Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit-1 Overview & Design

Overview of mobile platforms (iOS, Android), Introduction to mobile development frameworks, the mobile development lifecycle, UI/UX design & Tools (Sketch, Adobe XD, Figma)

Unit-II Mobile Development Fundamentals

Introduction to programming languages for mobile development, Overview of development environments (Android Studio, Xcode), Building basic UI components and layouts

Unit-III Mobile App Development Frameworks

Introduction to cross-platform development frameworks (React Native, Flutter), Building cross-platform applications, Pros and cons of cross-platform development

Unit-IV Advanced Mobile Development Concepts

Incorporating device features (camera, GPS, sensors) into mobile apps, Data storage and management on mobile devices, Implementing authentication and authorization in mobile apps

Unit-V Test, Deployment & Optimization

Testing methodologies for mobile Applications, Deployment process for iOS and Android platforms, Performance optimization techniques for mobile applications

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Android Programming: The Big Nerd Ranch Guide (Big Nerd Ranch Guides) 5th Edition, by by Bryan Sills (Author), Brian Gardner (Author), Kristin Marsicano (Author), Chris Stewart (Author)	
2	iOS Programming: The Big Nerd Ranch Guide" , 7th Edition by Christian Keur and Aaron Hillegass	

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamental concepts of mobile application development.	CO1
2	Design and implement user interfaces for mobile applications.	CO2
3	Utilize development frameworks and tools for mobile app development.	CO3
4	Apply best practices for optimizing performance and user experience in mobile	CO4

	applications. Test and debug mobile applications effectively.	
5	Demonstrate proficiency in integrating various features such as sensors, location services, and multimedia in mobile applications.	CO5

Course Code : CSL DE310
Course Title : Internet of Things
L-T-P/S=Credits : 3-0-2
Syllabus

Introduction: Definition of Internet of Things: Life in IoT ecosystem Characteristics of IoTIoT components Pillars of IoTIoT Design goals Applications of IoT Why IoT Examples of IoT ecosystem Definition of THINGS, examples of things

IoT Protocol Stack : IoT protocol stack layers physical or sensor layer processing and control action layer hardware interface layer RF layer session / message layer user experience layer application layer Sensor Networks Design principles of connected devices IoT Architecture Reference Models Physical design of IoT Logical design of IoT

IoT enabling technologies : Wireless sensor networks Sensing & Actuation cloud computing IaaS PaaS SaaS Fog layer Role of fog layer in IoT eco system big data analysis embedded systems security protocols and architecture Communication protocols web services microcontrollers and their interface to sensors ARM microcontroller

Protocols for IoT :Addressing and identification IP address IPV4 IPV6 address formats embedding IPV4 into IPV6 neighbour discovery in IPV6 IPV6 packet IPV6 frame format IPV6 extension header. Low power wide area networking Domain specific IoT, Routing protocol RPL low power and lossy networks, IoT and M2M (Machine-to-Machine) communication, Interoperability in IoT

Messaging in IoT : Message queuing telemetry transport (MQTT) architecture of MQTT MQTT message format publish- subscribe architecture in MQTT client and broker architecture MQTT broker constrained application protocol (CoAP) CoAP architecture CoAP messages CoAP request / response model HTTP vs MQTT /CoAP

IoT communication modules : Bluetooth Bluetooth low energy (BLE) BLE over Bluetooth BLE features BLE components BLE protocol stack IEEE 802.15.X architecture of LR-WPAN 6LoWPAN Zigbee Wireless HART RFD FFD IEEE 802.15.4 network topologies Link quality indication clear channel assessment

IoT security security threats in governing IoT routing attacks, privacy and security issues, governing IoT, issues approaches and new paradigms, steps towards a secure platform, data aggregation and security for IoT applications in smart cities

List of Experiments

1. Study of aurdino board
2. Interfacing Aurdino board with light sensor
3. LED Blinking code
4. LDR sensor detecting light sensitivity
5. Temperature recording of particular location Traffic Light system
6. Implement humidity recording Smart irrigation system
7. Smart doorbell system
8. Home automation System
9. Smart street light System
10. Smart locking System
11. IoT weather reporting system
12. Surveillance alarm
13. Water overflow alarm
14. Motion detection alarm

15. Study of raspberry pi

Course Outcomes

CO1: The students will be thorough about the technology behind the IoT and associated technologies
CO2: The students will be able to use the IoT technologies in real life like design of smart city, smart agriculture etc.
CO3: The students will be able to gain knowledge about the state of the art methodologies in IoT application domains.
CO4 : The students will be able to use the sensors for data collection, use the communication technologies for data transmission, and analyze the data for various applications.
CO5 : The students will learn to do the performance analysis of the protocols like efficiency, throughput, delay, packet delivery ratio etc during data transmission.

Text Books:

1. Rajkumar Buyaa and Amir V Dastjerdi, *Internet of things: Principles and Paradigms*, Morgan Kaufmann
2. A Bahga & V Madisetti, *Internet of Things: A Hands On Approach*, Universities Press
3. Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley
4. Olivier Hersent, David Boswarthick and Omar Elloumi, *The Internet of Things: Key applications and Protocols*, Wiley

Course Code : CSL DE312
Course Title : Wireless Networks
L-T-P/S=Credits : 3-0-2

Syllabus

UNIT I : WIRELESS LAN
Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART

UNIT II MOBILE NETWORK LAYER
Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III 3G OVERVIEW
Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS
Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT V 4G & BEYOND
Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

LIST OF EXPERIMENTS SIMULATION USING MATLAB
1. 5G-Compliant waveform generation and testing
2. Modelling of 5G Synchronization signal blocks and bursts
3. Channel Modelling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation
6. Development of 5g New Radio Polar Coding

Course Outcomes:
CO1: To study the evolving wireless technologies and standards

CO2: To understand the architectures of various access technologies such as 3G, 4G, WiFi etc.
CO3: To understand various protocols and services provided by next generation networks

TEXT BOOKS:
1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.(Unit IV,V)

REFERENCES:
1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

Course Code : CSL DE314
Course Title : Information Coding Practices
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1 Mathematical Background and Introduction
Introduction to algebraic structures, Field extensions, Quadratic Residues, Krawtchouk Polynomials, Combinatorial Theory, Probability Theory, Shannon's Theorem, Coding Gain, Problems.
UNIT 2 Linear and Good Codes
Block Codes, Linear codes, Hamming codes, Majority Logic decoding, Weight enumerators, The Lee Metric, Hadamard codes and generalizations, Binary Golay code, The Ternary Golay code, Constructing codes from other codes, Reed-Muller codes, Kerdock codes
UNIT 3 Bounds on Codes and Cyclic Codes
Gilbert bound, Asymptotic Plotkin bound, Griesmer bound, The Linear Programming bound, Cyclic codes, Zeros of a Cyclic codes, The Idmpotent of a cyclic codes, Other representations of a Cyclic codes.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Introduction to Coding Theory, J. H. Van Lint	

Course Outcome

Sr	Course Outcome	CO
1	Understands the fundamentals of coding theory	CO1
2	Understands concept of source coding.	CO2
3	Understands channel coding theorem.	CO3

Course Code : CSL DE316
Course Title : Computer Embedded Systems
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1 Product Specification (7 Contact Periods)

Hardware / Software partitioning – Detailed hardware and software design –Integration –Product testing Selection Processes, Microprocessor Vs Micro Controller, Performance tools Bench marking RTOS Micro Controller, Performance tools, Bench marking, RTOS availability,Tool chain availability, Other issues in selection processes.

UNIT 2 Partitioning Decision (8 Contact Periods)

Hardware / Software duality – coding Hardware – ASIC revolution Managing the Risk –Co-verification – execution environment – memory organization – System startup –Hardware manipulation – memory mapped access – speed and code density.

Unit 3 Interrupt Service Routines (7 Contact Periods)

Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyser – Caches – Computer optimisation –Statistical profiling

Unit 4 In Circuit Emulators (6 Contact Periods)

Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

Unit 5 Testing (6 Contact Periods)

Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.	
2	SriramIyer, "Embedded Real time System Programming"	
3	ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.	

Course Outcome

Sr	Course Outcome	CO
1	Foster ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.	CO1
2	Foster ability to write the programs for microcontroller.	CO2
3	Foster ability to understand the role of embedded systems in industry	CO3
4	Foster ability to understand the design concept of embedded systems.	CO4

Course Code : CSL DE318
Course Title : Multimedia and Virtual Reality
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1 Multimedia preliminaries and applications (9 Contact Periods)

Multimedia preliminaries and applications: Development and use of multimedia packages; introduction to virtual reality and modeling languages. CD-ROM and the Multimedia Highway, Introduction to making multimedia - The Stages of project, the requirements to make good multimedia, Multimedia skills and training, Training opportunities in Multimedia. Motivation for multimedia usage, Frequency domain analysis, Application Domain & ODA etc. Multimedia-Hardware and Software: Multimedia Hardware – Macintosh and Window production Platforms, Hardware peripherals – Connections, Memory and storage devices, Media software – Basic tools, making instant multimedia, Multimedia software and Authoring tools, Production Standards.

UNIT 2 Multimedia building blocks (7 Contact Periods)

Multimedia – making it work – multimedia building blocks – Text, Sound, Images, Animation and Video, Digitization of Audio and Video objects, Data Compression: Different algorithms concern to text, audio, video and images etc., Working Exposure on Tools like Dream Weaver, 3D Effects, Flash Etc.

UNIT 3 Multimedia and the Internet (7 Contact Periods)

Multimedia and the Internet: History, Internet working, Connections, Internet Services, The World Wide Web, Tools for the WWW – Web Servers, Web Browsers, Web page makers and editors, Plug-Ins and Delivery Vehicles, HTML, Designing for the WWW – Working on the web, Multimedia Applications – Media Communication, Media Consumption, Media Entertainment, Media games.

UNIT 4 Multimedia-looking towards Future (6 Contact Periods)

Multimedia-looking towards Future: Digital Communication and New Media, Interactive Television, Digital Broadcasting, Digital Radio, Multimedia Conferencing, Assembling and delivering a project-planning and costing, Designing and Producing, content and talent, Delivering, CD-ROM technology.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Steve Heath, 'Multimedia and Communication Systems' Focal Press, UK.	
2	Tay Vaughan, 'Multimedia: Making it Work', TMH	
3	Keyes, 'Multimedia Handbook', TMH	

Course Outcome

Sr	Course Outcome	CO
1	Graduate will demonstrate an ability to do research by designing and conducting experiments, analyze and interpret multimedia data individually as well as part of multidisciplinary teams.	CO1
2	Graduates will demonstrate an ability to design a system, component or process as per needs and specifications of the customers and society needs.	CO2
3	Graduates will demonstrate an ability to prepare short films and documentaries to showcase their knowledge of multimedia tools.	CO3

Course Code : CSL DE320
Course Title : High Performance Computing
L-T-P/S=Credits : 3-1-0

Prerequisites: Computer Organization and Architecture or equivalent
Syllabus: Parallel Processing Concepts; Levels and model of parallelism: instruction, transaction, task, thread, memory, function, data flow models, demand-driven computation; Parallel architectures: superscalar architectures, multi-core, multi-threaded, server and cloud;
Fundamental design issues in HPC: Load balancing, scheduling, synchronization and resource management; Operating systems for scalable HPC; Parallel languages and programming environments; OpenMP, Pthread, MPI, java, Cilk; Performance analysis of parallel algorithms;
Fundamental limitations in HPC: bandwidth, latency and latency hiding techniques; Benchmarking HPC: scientific, engineering, commercial applications and workloads; Scalable storage systems: RAID, SSD cache, SAS, SAN; HPC based on cluster, cloud, and grid computing: economic model, infrastructure, platform, computation as service; Accelerated HPC: architecture, programming and typical accelerated system with GPU, FPGA, Xeon Phi, Cell BE; Power-aware
HPC Design: computing and communication, processing, memory design, interconnect design, power management; Advanced topics: peta scale computing; big data processing, optics in HPC, quantum computers.

HPC programming assignments: Hands on experiment and programming on parallel machine and HPC cluster using Pthread, OpenMP, MPI, Nvidia Cuda and Cilk. Also there will be some hands on experiments on standard multiprocessor simulator or cloud simulator.
Course Outcomes
CO1: Demonstrate understanding of the HPC laws, models and architectures.
CO2: Explain how algorithms can be parallelized.
CO3: Apply concepts and techniques of programming shared-memory multi-core and cluster computers.
CO4: Build and evaluate framework-based systems that utilize hybrid shared/distributed memory computer clusters.

Texts:
1.Georg Hager and Gerhard Wellein. Introduction to High Performance Computing for Scientists and Engineers (1st ed.). CRC Press, Chapman & Hall/CRC Computational Science, India, 2010.
2. Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India . 2003.
3. John L. Hennessy and David A. Patterson. Computer Architecture: A Quantitative Approach (5th ed.). Elsevier India Pvt. Ltd. 2011.
4. David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-On Approach (1st ed.). Elsevier India Pvt. Ltd. 2010.
5. Michael T. Heath. Scientific Computing: An Introductory Survey (2nd ed.). McGraw Hill Education (India) Private Limited, 2011

Course Code : **CSL DE401**
Course Title : **Nature Inspired Algorithms**
L-T-P/S=Credits : **3-0-2**

Syllabus

Unit I: Introduction to Algorithms

Topic I: What is an algorithm, Newton's method, Gradient Descent Method, Formulation for optimization problems, Optimization algorithms, search for optimality, No-free lunch theorem, Heuristic and Meta-heuristic algorithms, NP Hard and NP Complete Problems

Topic II: Mathematical foundations: Norms, Eigen values, Eigen vectors, Sequences & Series, Convex Optimization – Hessian Matrix, Subgradient Descent, Computational Complexity, Convex Hull- Graham Scan Algorithm, Random Variables & Probability distributions

Unit II: Simulated Annealing

SA: Annealing & Boltzman distributions, SA Parameters, SA Algorithms, Convergence properties, Stochastic tunnelling
Diiferential Evolution: Introduction, Diiferential Evolution, Variants, Choice of parameters, Convergence Analysis, Genetic Algorithm

Unit III: Particle Swarm Optimization

PSO Algorithm, Accelerated PSO, Implementation, Convergence Analysis, Binary PSO Ant Colony Optimization: Algorithm, Implementation and convergence analysis Genetic Algorithm: Algorithm, Implementation and convergence analysis

Unit IV: Nature Algorithms – I

Firefly Algorithm: Analysis, Implementation, Variants of Firefly algorithm, Applications, Why the Firefly is efficient Cuckoo Search: Cuckoo Breeding behavior, levy flights, cuckoo search, implementation, variants of cuckoo search Bat Algorithm: Analysis, Implementation, Binary BAT algorithm, Applications, Why the Bat is efficient

Unit V: Nature Algorithms – II

Grey-Wolf Algorithm: Analysis, Implementation, Variants of Grey-Wolf algorithm, Applications, Why the Grey-Wolf is efficient Whale algorithm: Analysis, Implementation, Variants of Whale algorithm, Applications, Why the Whale is efficient

List of Programs:

1. Implement a basic Genetic Algorithm for solving the Knapsack problem.
2. Apply Genetic Algorithm to optimize traveling salesman problem (TSP).
3. Optimize a function (e.g., sphere function or Rastrigin function) using Particle Swarm Optimization.
4. Apply Particle Swarm Optimization to train a neural network for classification tasks.
5. Solve the Traveling Salesman Problem (TSP) using Ant Colony Optimization.
6. Apply Ant Colony Optimization to network routing problems.
7. Implement Simulated Annealing for solving the Travelling Salesman Problem.
8. Apply Simulated Annealing for function optimization and parameter tuning in machine learning models.
9. Optimize a function (e.g., sphere function or Rastrigin function) using Simulated Annealing.
10. Implement Differential Evolution for multi-modal optimization problems.
11. Use Differential Evolution to optimize engineering design problems.
12. Implement the Cuckoo Search Algorithm to solve multi-objective optimization problems.
13. Apply the Cuckoo Search Algorithm to the feature selection problem in machine learning.
14. Solve multi-dimensional optimization problems using Firefly Algorithm.
15. Implement Bat Algorithm to solve non-convex optimization problems.

Course Outcomes

CO1: Define the basic concepts of Nature Inspired algorithms and analyse the performance of algorithms.

CO2: Explain the characteristics of combinatorial problems and relevant bio-inspired algorithms to be applied on it.

CO3: Analyse the working methodology of bio-inspired algorithms.

CO4: Ability to apply nature inspired algorithms to solve engineering optimization problems.

Textbooks:

1. Nature-Inspired Optimization Algorithms, Author: Xin-She Yang, Elsevier

2. Nature Inspired Algorithms and Their Applications, Wiley

Course Code : CSL DE403
Course Title : Metaheuristic Design Framework
L-T-P/S=Credits : 3-1-0 =4
Course Category : Departmental Elective course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit 1: Introduction. Classes of difficult problems (planning, assignment,selection, adaptation, prediction) and corresponding search spaces. Classes ofmetaheuristics. The overall structure of a metaheuristic algorithm.Trajectory-based Metaheuristics. Deterministic local search (PatternSearch, Nelder Mead). Random local search (Matyas and Solis-Wetsalgorithms). Global search (restarted local search, iterated local search,simulated annealing, tabu search, variable neighbourhood search).

Unit 2: Population-based Metaheuristics. Overall structure. Main components(exploration and exploitation operators). Operators for Discourse, evolutionaryalgorithms (EA): mutation, crossover, selection. Encoding types. Geneticalgorithms, evolution strategies, evolutionary programming.... MemeticAlgorithms, hybridizing EA with local search operators. Swarm Intelligence.Ant colony optimization. Particle swarm optimization. Artificial bee colony.

Unit 3: Swarm Intelligence. Ant colony optimization. Particle swarm optimization. Artificial bee colony. Difference-based and Probabilistic Algorithms. Differential Evolution, Population Based Incremental Learning, Estimation of Distribution Algorithms, Bayesian Optimization Algorithms Scalability of Metaheuristic Algorithms. Cooperative coevolution. Parallel models for population-based metaheuristics (master-slave, island, cellular Multi-objective/ multi-modal/ dynamic optimization. Particularities of multi-objective optimization (non-domination, Pareto front etc). Apriori and aposteriori techniques. Quality metrics. Multi-modal optimization and specific approaches (niching, sharing etc). Techniques for dynamic optimization (hyper-mutation, random immigrants, ageing mechanisms).

Unit 4: Deep Hybrid Learning Models: Applications of Metaheuristicalgorithms for: neural networks design, data mining, scheduling. Hyperparameter tuning using Grid search. Hybridizing CNN with Particle swarm optimization, K-Nearest Neighbour and L-STM networks.

Reference Books:

1. Essentials of Metaheuristics, Sean Luke Department of Computer Science George Mason University Second Edition Version 2.3 February, 2016.
2. Sean Luke: Essentials of Metaheuristics, Lulu, second edition, 2013, available for free at http://cs.gmu.edu/~sean/book/metaheuristics/
3. Jason Brownlee: Clever Algorithms. Nature-inspired Programming Recipes, 2011, available at http://www.CleverAlgorithms.com
4. A. Engelbrecht: Computational Intelligence. An Introduction, Wiley, 2007
5. Z. Michalewicz, D. Fogel: How to Solve It. Modern Heuristics. Springer, 1999

Course Outcome

Sr	Course Outcome	CO
1	Interpret and explain the concepts of Metaheuristics based optimization and it's application in a diverse range of applications.	CO1
2	Model single solution and population based Metaheuristic algorithms to solve a given optimization problem..	CO2
3	Model Metaheuristic algorithms to solve Multi-objective optimization problems.	CO3
	Model hybrid Metaheuristic algorithms to solve a given optimization problem.	CO4
	To be able to build computational implementations of a meta-heuristic approach and apply it to a case study.	CO5

Course Code : **CSL DE405**
Course Title : **Cyber Security**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Elective course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Introduction
Terminologies : cyberspace, cybercrime, cyber security, Cyber squatting, cyberpunk, cyber warfare, cyber terorrism, Cyber security needs, Cyber criminals : Introduction, Cybercriminals Groups, Classification of cyber crimes, Cybercrime categories, Cybercrime : The legal perspective

Cyber offenses
Hackers, crackers, phreakers : Introduction, Planning cybercrime, Social engineering Cyberstalking, Cybercafe and cybercrime, Attack vector, Botnets

Cybercrime techniques
Proxy servers and Anonymizers, phishing, Password cracking, Keyloggers and spywares, Virus and worms, Trojan horse and backdoors, Steganography, Dos and DDosattacks,SQL injection, Buffer overflow

Phishing and Identity theft
Phishing : Introduction, Phishing methods : Dragnet, Rod-and-reel , Lobsterpot, Gillnet, Techniques of phishing, Phishing Toolkits and Spy Phishing, Phishing countermeasures, Personally Identifiable Information (PII),Types of Identity theft, Techniques of Identity theft, Identity Theft Countermeasures

Legal Perspective of Cyber security & Forensics fundamentals
Need for cyber laws: The Indian context, Indian IT Act 2000,Changes made in IT Act 2000, Digital signatures and the Indian IT Act, Cybercrime and punishment, Cyberforensics : introduction, types, Needs of cyber forensics, Cyberforensics and digital evidence

Cyber Security: Organization Implications
Search Breach: PI Collecting by Organization, Insiders threats in Organization,PrivacyDimension,Key-challenges in Organization,Cost of cyber crimes and IPR issues,Organizational guidelines for Internet usage, safe computing guidelines and computer usage policy,Forensics best practices for organization

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Marjie T. Britz Computer Forensics and Cyber Crime: An Introduction, Pearson	
2	AlfaredBasta and Wolf Holten, Computer Security Concepts, Issues and Implementation, CENGAGE learning	
3	Raghu Santanam, M. Sethumadhavan, MohitVirendraCyber Security, Cyber Crime and Cyber Forensics, IGI Global	
Reference Books		
1	George M. Mohay,AlisonAndersonComputer and intrusion forensics, Artech House	

Course Outcome

Sr	Course Outcome	CO
1	Student should understand cyber-attack, types of cybercrimes, cyber laws and also how to protect them self and ultimately society from such attacks	CO1
2	Hands-on experience with cyber-attacks using kali linux based operating system.	CO2
3	Understand the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.	CO3
4	Understand the Indian IT Act 2000 that govern electronic commerce activities, different types of cybercrime and apply critical thinking in analysing judicial decision related to e-commerce cybercrimes.	CO4

Course Code : **CSL DE407**
Course Title : **E-Commerce & Cyber Laws**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Elective course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Unit-1- Introduction to E-commerce
Define E-commerce, Brief history of E-commerce, Forces fueling E-commerce, Challenges to traditional methods, Types of E-commerce, E-Business, E business trident, E-com Vs E-Business.
Unit-2 E-Commerce Challenges and Issues
E-commerce Challenges, E-commerce Issues- Technical issues, Privacy vs Security, Data, Type of data, Protection of data, Security – challenges and requirements, E-commerce players and attacks, Defenses: Firewall, Network security, , Emerging firewall management issues, Types of online transactions, Requirement for online transactions, Securing the Network Transactions – Cryptography - Encryption, Public key encryption vs Private key encryption, Security Protocols for Web Commerce – SSL, SET, SHTTP.
Unit-3 Electronic Payment system.
Overview of E- payment system, Pre, Post and Instant payment methods in e-commerce, Digital cash, Properties, Electronic cheques and benefits, online credit card system, types of credit card payments, secure electronic transactions, Debit cards, E-benefit transfer.
Unit-4 E business Issues and Internet Marketing
E-Business, Organizational issues, Implementation issues, Marketing issues, Model for E business, Internet Marketing, Different stages of internet marketing, Critical success factor of internet marketing, E commerce strategies for development, E-commerce & sales.
Unit -5 Cyber laws
Definition, Need for cyber laws, Jurisprudence of Indian cyber law, Cyber crimes and criminal justice IT ACT2000 objectives, E-governance, digital signature, Sections related to ,Electronic records, Attribution, acknowledgement and dispatch of Electronic Records, security of E-records and digital signature, Controller functions, Certificates, subscriber duties, Penalties and Adjudications, Cyber regulation Appellate tribunal, Offences, Contracts in the InfoTech world, Power of arrest without warrant a critique, IT Act Modifications. Cyber consumer protection.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	E Commerce, Bharat Bhasker TMH	
2	E- Commerce, Ravi kalakote, Pearson ed.	
3	E commerce, Lauden , PHI	
Reference Books		
1	Cyber Law Simplified, VivekSood, TMH	

Course Outcome

Sr	Course Outcome	CO
1	Demonstrate an understanding of the foundations, importance, types and the technical infrastructure requirement of E-commerceand E-business.	CO1
2	Understand the components of Business model, importance of business models in E-commerce and analyse the impact of E-commerce on business models and strategy.	CO2
3	Recognize and discuss the E-commerce issues like data privacy and security and various solutions to achieve the privacy and security in e-commerce.	CO3
4	Understand and assess electronic prepaid and post-paid payment systems for e-commerce.	CO4
5	Understand the Indian IT Act 2000 that govern electronic commerce activities, different types of cybercrime and apply critical thinking in analysing judicial decision related to e-commerce cybercrimes.	CO5

Course Code : **CSL DE409**
Course Title : **Digital Forensic**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Elective course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

UNIT 1: Introduction to Cyber Crime and Ethical Hacking
Introduction of Cybercrime: Types of cybercrime ,categories of cybercrime , Computers' roles in crimes, Prevention from Cyber crime, Hackers, Crackers, Phreakers
Ethical Hacking: Difference between Hacking and Ethical hacking : Steps of Ethical Hacking, Exploring some tools for ethical hacking
UNIT 2: Introduction to Digital Forensics and Digital Evidences
Digital Forensic, Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Digital Evidences : Types and characteristics and challenges for Evidence Handling
UNIT 3: Incidence Response Process and Live Data Collection
Introduction, Goals of Incident response, Incident Response Methodology, Formulating Response Strategy IR Process – Initial Response, Activities in Initial Response, Phases after Detection of an Incident Live Data Collection : Live Data collection from UNIX System: Live Data
UNIT 4: Forensic Duplication and Disk Analysis, and Investigation
Forensic Duplication : Forensic Image Formats, Traditional Duplication, Live System Duplication
Disk and File System Analysis: Media Analysis Concepts, Partitioning and Disk Layouts, Special Containers, Hashing, Carving, Forensic Imaging
Data Analysis: Analysis Methodology Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis
UNIT 5: Report and Forensic Tools: Report
Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report.
Computer Forensic Tools: need and types of computer forensic tools, task performed by computer forensic tools . Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence

Suggested Books:

Sr.	**Name of Book, Author, Publisher**	**Year of Publication / Reprint**
Text Books		
1	Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.	
2	Nilakshi Jain, DhananjayKalbande, "Digital Forensic" Wiley India Pvt Ltd 2017 ISBN: 9788126578399, 320 pages.	
3	Cory Altheide, Harlan Carvey "Digital forensics with open source tools "Syngress Publishing, Inc. 2011.	
Reference Books		
1	Chris McNab, Network Security Assessment, By O'Reily.	

Course Code : **CSL DE4111**
Course Title : **Robotics & Vision Control**
L-T-P/S=Credits : **3-1-0 =4**
Course Category : **Departmental Elective course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Computer vision :Introduction. The human eye and the camera.Vision as an information processing task.Homogeneous transformations.A geometrical framework for vision.2D and 3D images interpretation.Industrial applications.

Digital Image. Basics of image processing. Image acquisition. Segmentation, Binary and grey morphology operations. Thresholding.Filtering.Edge and corner detection.Features detection.Contours.Tracking edges and corners. Object detection and tracking. Image data compression, Real time Image processing.
Lighting in Machine Vision: Introduction.Light used in machine vision. Basic rules and laws of light distribution.Filters. Light sources. Light techniques. Choice of illumination.
Camera and Optical System: Camera technology.Analog and digital camera.Camera model.CCD and CMOS Technology.Sensor size.Intrinsic and extrinsic camera parameters. Camera calibration.Systems of lenses The thin lens. Beam converging and beam diverging lenses. General imaging equation.Aberrations.Practical aspects.
Fundamental of Robot.Robotics: Introduction.Robot.Definition.Robot anatomy.Robot parts and their functions.Classification of robot and robotic systems.Laws of robotic.Co-ordinate systems. Drives and control systems, Power transmission systems. Planning for navigation.Different applications.
Robot actuator effectors: Types of end effectors.Types of grippers. Interface. Sensors.Touch and Tactile sensors.
Kinematics of Robot Introduction: Definition. Open and closed kinematic mechanisms. Matrix representation.Homogeneous transformation, forward and inverse kinematics. Direct vs inverse kinematic task. Programming.Basics of Trajectory planning.
Industrial applications: Quality control.Mapping and robot guidance.Motion estimation.Passive navigation and structure from motion .Autonomous systems.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Computer Vision: Algorithms and Applications, Richard Szeliski, Ed. Springer, ISBN-10: 1848829345,ISBN-13: 978- 1848829343, Publishing, 2010.	
2	Handbook of Robotics, Bruno Siciliano, Ed. Springer-Verlag Berlin and Heidelberg GmbH & Co. K, ISBN-10: 354023957X, ISBN-13: 978-3540239574,Publishing, 2008.	

Course Outcome

Sr	Course Outcome	CO
1	To learn about kinematics and dynamics	CO1
2	To design controllers for tracking control of a robot	CO2
3	To apply computer vision for motion control of robotic systems	CO3

Course Code **: CSL VA102**
Course Title : **Introduction to Artificial Intelligence**
L-T-P/S=Credits **: 2-0-0**

Syllabus
1. Introduction to Artificial Intelligence:

- Definition and history of AI
- Importance of AI in the modern world
- Different branches of AI: Machine Learning, Expert Systems, Robotics, Natural Language Processing, etc.
- Real-world applications of AI (healthcare, finance, entertainment, etc.)

2. Fundamentals of Problem Solving in AI:

- Problem-solving techniques and strategies
- Search algorithms:
  - Uninformed search: Breadth-first, Depth-first, Uniform Cost
  - Informed search: A* search, Greedy search
- State-space representations and search trees

3. Basic Concepts in Machine Learning:

- Introduction to Machine Learning
- Types of learning:
  - Supervised Learning (classification and regression)
  - Unsupervised Learning (clustering, dimensionality reduction)
  - Reinforcement Learning (basic concepts)

- Simple machine learning models: Linear regression, k-nearest neighbors (KNN)

4. Introduction to Natural Language Processing (NLP):
- Basic concepts of NLP
- Text processing techniques: Tokenization, Stemming, Lemmatization
- Basic applications of NLP: Sentiment analysis, Text classification, Chatbots

5. Introduction to Neural Networks:
- Overview of Neural Networks
- Perceptrons: Basic unit of neural networks
- Introduction to Multi-layer Perceptrons (MLP)
- Simple neural network applications

6. Basic Tools for AI:
- Introduction to Python programming for AI
- Libraries used in AI: NumPy, Pandas, scikit-learn
- Simple data analysis and visualization with Python

7. Ethical Considerations in AI:
- Ethical challenges in AI (e.g., bias in algorithms)
- Privacy and security concerns
- The role of human oversight in AI systems
- The future of AI in society

Course Outcomes:

By the end of this course, students will be able to:

1. Understand Key AI Concepts:
2. Apply Basic AI Problem-Solving Techniques:
3. Understand and Use Basic Machine Learning Techniques:
4. Understand and Apply Basic NLP Techniques:
5. Understand Neural Networks and Their Applications:
6. Work with Python for AI:
7. Recognize Ethical Issues in AI Development:
8. Communicate AI Concepts

Course Code : CSL SE102
Course Title : Introduction to Cloud Computing
L-T-P/S=Credits : 2-0-0

SYLLABUS

1. Fundamentals of Cloud Computing
- Definition and characteristics of cloud computing.
- Evolution and history of cloud computing.
- Key enabling technologies (virtualization, distributed computing).
- Benefits and challenges of cloud adoption.

2. Cloud Computing Models
- Service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS).
- Deployment models: Public, Private, Hybrid, and Community clouds.

3. Cloud Architecture and Concepts
- Cloud computing architecture.
- Multitenancy, elasticity, scalability, and on-demand provisioning.
- The role of APIs in cloud computing.
- Cloud storage and computing concepts.

4. Virtualization Technology

- Basics of virtualization.
- Hypervisors and virtual machines.
- Role of virtualization in cloud computing.
- Containers vs. traditional virtualization.

5. Cloud Security

- Shared responsibility model.
- Security challenges in cloud computing.
- Authentication and authorization.
- Data encryption and secure access.

6. Cloud Service Providers Overview

- Overview of leading cloud providers (AWS, Microsoft Azure, Google Cloud Platform).
- Comparison of services and pricing.
- Selecting the right cloud provider for specific use cases.

7. Cloud Economics and Pricing

- Cloud pricing models: Pay-as-you-go, subscription, reserved instances.
- Cost management strategies.
- Total cost of ownership (TCO) and return on investment (ROI).

8. Real-World Applications of Cloud Computing

- Use cases in healthcare, education, finance, and e-commerce.
- Examples of cloud-based services and applications.
- Emerging trends: IoT, AI, and edge computing in the cloud.

9. Hands-On Exercises

- Setting up and managing a free cloud account (AWS, Azure, or Google Cloud).
- Launching virtual machines and managing resources.
- Basic cloud storage operations (uploading, sharing, and managing files).

Recommended Books

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl.
2. "Mastering Cloud Computing" by Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi.
3. "Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti.
4. "Cloud Security and Privacy" by Tim Mather, Subra Kumaraswamy, and Shahed Latif.
5. ` "Architecting the Cloud" by Michael J. Kavis.

Course outcomes

1. Explain the fundamental concepts of cloud computing and its benefits.
2. Identify and compare cloud service models and deployment models.
3. Understand the role of virtualization in enabling cloud services.
4. Analyze the security challenges associated with cloud computing and best practices.
5. Compare leading cloud service providers and evaluate their offerings.
6. Apply basic cloud computing concepts to set up and manage cloud resources.
7. Describe the economic benefits and pricing models of cloud computing.

Course Code : **CSL GE305**
Course Title : **Probability and Statistics**
L-T-P/S=Credits : **3-1-0**

Syllabus
Probability and random variable : σ field; measurable space; construction of measure probability and properties; definitions, scope and examples of probability; sample spaces and events; axiomatic definition of probability; joint and conditional probabilities; independence, total probability; Bayes' rule and applications.

Definition of random variables, continuous and discrete random variables; cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf); probability density functions (pdf) and properties; expectation: mean, variance and moments of a random variables.

Distribution Functions : Some special distributions: uniform, exponential, Chi-square, Gaussian, binomial, and poisson distributions; Law of large numbers; Central limit theorem and its significance.

Statistics: Scatter diagram; graphical residual analysis, Q-Q plot to test for normality of residuals, autocorrelation and autocovariance functions; stationarity and non stationarity ; correlation and covariance

Sampling distributions; point and interval estimation, testing of hypothesis, Goodness of fit and contingency tables, linear regression, ANOVA.

Introduction to stochastic process; random walk and Brownian motion.

COURSE OUTCOMES:
CO1. Understand the basic probability concepts and random variables that have numerous applications in computer science.
CO2. To understand fundamentals and application of statistics to engineering problems.
CO4. To form hypothesis and able to test hypothesis with various statistical tests.
CO5. Identify the concept of statistical quality control in computer science engineering.

Text Books
1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press.
2. D. C. Montgomery and G.C. Runger, "Applied Statistics and Probability for Engineers", 5th edition, John Wiley & Sons.
2. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications with R Examples", Third edition, Springer Texts in Statistics.

Course Code : **CSE 4001/CSN 4001**
Course Title : **Fundamentals of Cloud Computing**
L-T-P/S=Credits : **3-0-0=3 / Non-Credit**

Syllabus

1. Introduction to Cloud Computing
- Overview of cloud computing concepts.
- Key features: On-demand provisioning, elasticity, scalability, and pay-as-you-go.
- Benefits and challenges of cloud adoption.
- Cloud service models: IaaS, PaaS, SaaS.
- Deployment models: Public, Private, Hybrid, and Community clouds.

2. AWS Overview
- Introduction to Amazon Web Services (AWS).
- Global AWS infrastructure: Regions, Availability Zones, and Edge Locations.
- Overview of key AWS services and their categories (Compute, Storage, Networking, and Databases).

3. AWS Core Services
- **Compute**:
  - Amazon EC2 basics: Launching, configuring, and managing virtual servers.
  - Introduction to AWS Lambda (serverless computing).

- **Storage**:
  - Amazon S3: Object storage and its use cases.
  - Amazon EBS: Block storage for virtual machines.
  - Amazon Glacier: Long-term archival storage.
- **Databases**:
  - Amazon RDS: Managed relational databases.
  - Amazon DynamoDB: NoSQL database for scalable applications.

4. Networking and Content Delivery

- Basics of networking in the cloud.
- Introduction to Amazon VPC (Virtual Private Cloud).
- Elastic Load Balancer (ELB) and Auto Scaling.
- Overview of Amazon CloudFront for content delivery.

5. Security and Identity

- Shared responsibility model in AWS.
- Basics of AWS Identity and Access Management (IAM).
- Role-based access control and policies.
- AWS Trusted Advisor for security best practices

Recommended Books

1. "AWS Certified Cloud Practitioner Study Guide" by Ben Piper.
2. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl.
3. "Getting Started with AWS: Hosting Applications and Services on the Cloud" by Jeffrey Barr.
4. "AWS in Action" by Andreas Wittig and Michael Wittig.
5. AWS Whitepapers:
   - "Overview of Amazon Web Services"
   - "Architecting for the Cloud: AWS Best Practices**"**

Course Outcomes

By the end of this course, students will be able to:

1. Understand the foundational concepts of cloud computing and AWS architecture.
2. Identify the core AWS services and their practical use cases.
3. Launch and manage virtual servers using Amazon EC2.
4. Utilize Amazon S3 for secure and scalable object storage.
5. Understand and implement basic cloud networking with Amazon VPC and related services.
6. Gain knowledge of AWS security practices, including IAM and data encryption.
7. Monitor cloud resources and manage costs effectively using AWS tools.
8. Develop and deploy basic applications using AWS services.
9. Analyze real-world use cases to understand cloud solutions in various industries.

Course Code : CSL SE104
Course Title : Introduction to Programming using Python
L-T-P/S=Credits : 2-0-0

Course Contents:

Unit-1 Introduction

Introduction to importance of IDEs like Spyder (Anaconda)/PyCharm for professional programming, explore Python shell as a calculator and for inputting Python expressions directly, HelloWorld program in Python script, Python keyword and Identifiers, Indentation, Comments, Data Types in. Operators in Python: comparison, arithmetic, logical, Boolean, bitwise, assignment. Python: numbers, list, tuple, strings, set, dictionary, conversion between various data types

Unit-2 Basic constructs

Input and Output in Python, if-else , for loop, while loop, break, pass, continue, creating Functions, functions with arguments, returning values form functions, lambda expressions, recursion, global and local variables,

Importing other modules/packages and using their functions, creating random numbers/random-choice to create programs for simple guessing games like Rock –Paper-Scissors. Problems on 1D/2D/3D arrays using list. Problem solving using dictionary as look-up table.

Course Outcomes

CO1 Know the basic syntax and Data Structures in Python.
CO2 Think and Design solution in Object Oriented way as well as Procedural way.
CO3 Enjoy coding and compete at online programming sites like CodeChef, HackerEarth etc.

Course Code : CSL SE105
Course Title : Artificial Intelligence in Applications
L-T-P/S=Credits : 2-0-0

Syllabus

1: Introduction to Artificial Intelligence

- Overview of AI and its importance in various industries.
- AI techniques and approaches: search algorithms, knowledge representation, reasoning.
- Intelligent agents and problem-solving strategies.
- AI in real-world applications: challenges and opportunities.

2: AI in Data Science and Machine Learning

- Role of AI in Data Science and Machine Learning (ML).
- Supervised and unsupervised learning algorithms.
- Regression, classification, clustering, and anomaly detection.
- Model evaluation techniques: accuracy, precision, recall, F1-score, and ROC curves.

3: AI in Natural Language Processing (NLP)

- Introduction to NLP and its challenges.
- Text preprocessing techniques: tokenization, stemming, lemmatization.
- Text classification, sentiment analysis, and named entity recognition.
- Applications of NLP in chatbots, information retrieval, and machine translation.

4: AI in Computer Vision

- Computer Vision: Basic concepts, image processing techniques.
- Object detection, image classification, and face recognition.
- Deep Learning for computer vision: Convolutional Neural Networks (CNNs).
- Applications of AI in autonomous vehicles, medical imaging, and surveillance.

5: AI in Robotics and Automation

- Robotics and AI integration: intelligent agents in physical environments.
- Path planning and motion control algorithms.
- Autonomous robots: SLAM (Simultaneous Localization and Mapping).
- Applications in manufacturing, drones, and autonomous vehicles.

6: AI in Healthcare

- AI techniques used in medical diagnostics, personalized medicine, and drug discovery.
- Machine learning models for predicting disease outcomes and patient care.
- Natural language processing for analyzing medical texts (e.g., EHR).
- Ethical considerations in AI-driven healthcare applications.

7: AI in Business and Finance

- AI in business analytics: demand forecasting, customer segmentation, and recommendation systems.
- Algorithmic trading, fraud detection, and risk management.
- Use of AI for optimizing business operations, marketing, and customer service.
- Impact of AI on financial decision-making and automated systems.

8: AI in Society: Ethics, Challenges, and Future Directions

- Ethical issues: fairness, bias, accountability, and transparency in AI applications.
- Regulatory and societal challenges: privacy concerns, job displacement, and automation.
- Future trends in AI applications: Artificial General Intelligence (AGI), AI in creativity and art.

Human-AI collaboration and the future of AI in society.

Course Outcomes

By the end of this course, students will be able to:

1. Understand Core AI Concepts
2. Identify AI Applications in Real Life
3. Apply Simple AI Algorithms
4. Develop Simple Machine Learning Models
5. Understand Natural Language Processing Basics
6. Learn Responsible AI Practices

Recommended Books

1. **Artificial Intelligence: A Modern Approach** by Stuart Russell and Peter Norvig
2. **Computer Vision: Algorithms and Applications** by Richard Szeliski
3. **Reinforcement Learning: An Introduction** by Richard S. Sutton and Andrew G. Bart.
4. **Artificial Intelligence in Practice** by Bernard Marr

Course Code : CSL AE102
Course Title : Introduction to Cyber Security
L-T-P/S=Credits : 2-0-0

Detailed Syllabus

Unit-1-Introduction to Cyber Security

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker.

Unit-2 Cyber crimes

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Debit/ credit card fraud, Online payment fraud.

Unit-3 Cyber Law

Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act,2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies-AI/ML, IoT, Blockchain, Darknet and Social media.

Unit-4 Data Privacy and Data Security

Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security,Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges.

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Marjie T. Britz Computer Forensics and Cyber Crime: An Introduction, Pearson	2012
2	AlfaredBasta and Wolf Holten, Computer Security Concepts, Issues and Implementation, CENGAGE learning	2015
3	Raghu Santanam, M. Sethumadhavan, MohitVirendraCyber Security, Cyber Crime and Cyber Forensics, IGIGlobal	2022
Reference Books		
1	George M. Mohay,AlisonAndersonComputer and intrusion forensics, Artech House	2006

Course Outcome

1 Understand the cyber security threat landscape. CO1

2	Develop a deeper understanding and familiarity with various types ofcyberattacks, cyber crimes, vulnerabilities.	CO2
3	Analyse and evaluate existing legal framework and laws on cyber security.	CO3
4	Analyse and evaluate the importance of personal data its privacy and security.	CO4
5	Analyse and evaluate the security aspects of social media platforms andethical aspects associated with use of social media.	CO5

Course Code : CSL GE403
Course Title : Introduction to Cyber Security
L-T-P/S=Credits : 3-1-0

Detailed Syllabus

Unit-1-Introduction to Cyber Security
Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies

Unit-2 Cyber crimes
Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Cryptojacking, Darknet-illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft,job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyberstalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Unit-3 Cyber Law
Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act,2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies-AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies

Unit-4 Data Privacy and Data Security
Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security,Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues andchallenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016
Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy andsecurity issues

Unit -5 Cyber security M a n a g e m e n t , Compliance and Governance
Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Riskassessment, Types of security controls and their goals, Cyber security audit and compliance, National cybersecurity policy and strategy

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication/Reprint
Text Books		
1	Marjie T. Britz Computer Forensics and Cyber Crime: An Introduction, Pearson	2012
2	AlfaredBasta and Wolf Holten, Computer Security Concepts, Issues and Implementation, CENGAGE learning	2015
3	Raghu Santanam, M. Sethumadhavan, MohitVirendraCyber Security, Cyber Crime and Cyber Forensics, IGIGlobal	2022
Reference Books		
1	George M. Mohay,AlisonAndersonComputer and intrusion forensics, Artech House	2006

Course Outcome

Sr	Course Outcome	CO
1	Understand the cyber security threat landscape.	CO1
2	Develop a deeper understanding and familiarity with various types ofcyberattacks, cyber crimes, vulnerabilities and remedies thereto.	CO2
3	Evaluate and communicate the human role in security systems with anemphasis o n ethics, social engineering vulnerabilities and training.	CO9
4	Increase awareness about cyber-attack vectors and safety against cyber-frauds.	CO10
5	Take measures for self-cyber-protection as well as societal cyber-protection	CO11

Course Code : **CSL DE321**
Course Title : **Business Analytics Using R**
L-T-P/S=Credits : **3-0-2**

Syllabus

Unit 1: Introduction to Data Analysis: 08 Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics.

Unit 2: Introduction to R Programming: Overview of R programming, Features of R, Applications of R, Introduction and Installation of R Studio, Creation and Execution of R File in R Studio, Clear the Console and the Environment in R Studio , Basic Syntax in R Programming , R Commands, Variables and scope of variables, Data Types, Operators, Keywords.

Unit 3: R Programming Basics: How to take Input from user in R, Output in R using different functions, Decision making statements, Looping statements, Break next, return statements, Switch case, Data Structure in R: Vectors , Lists , Data frames , Matrices, Arrays.

Unit 4: Data Visualization using R : Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Bar Charts, Line Graphs, Scatterplots, Pie Charts, Boxplots, Histograms

Unit 5: Statistics with R: Mean, Median and Mode, Variance and Standard Deviation, Descriptive Analysis, Normal Distribution, Binomial Distribution, Analysis of Variance (ANOVA) Test : One Way & Two Way ANOVA, Regression: Linear and Multiple Linear Regression, Logistic Regression. Time Series Analysis, Survival Analysis.

Course Outcomes

CO1: To learn about Data analytics and its application areas.
CO2. To understand the use of R-software and its fundamental concepts for data analytics.
CO3. To be able to understand R Programming Decision making, functions, control statements and data structures.
CO4. To be able to understand data visualization using R programming. 5. To learn statistical methods and models for data analytics.

Suggested Books:

1. "R for Everyone", Jared P Lander, Pearson Education 2017, Latest Edition.
2. "Beginning R: An Introduction to Statistical Programming"-Larry Pace, Latest Edition.
3. "Big Data Fundamentals" Thomas Erl, Wajid Khattak,and Paul Buhler:: Concepts, Dribers and techniques , Pearson, Latest Edition.