MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

III SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT31	Engineering Mathematic-III	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	IPCC	21AI32	Data Structures and Applications	AI&ML	AI&ML	3	0	2	03	50	50	100	4
3	IPCC	21AI33	Analog and Digital Electronics	AI&ML/ BM&RE	AI&ML/ BM&RE	3	0	2	03	50	50	100	4
4	PCC	21AI34	Computer Organization	AI&ML	AI&ML	2	2	0	03	50	50	100	3
5	PCC	21AI35	Software Engineering	AI&ML	AI&ML	2	2	0	03	50	50	100	3
6	PCC	21AI36	Discrete Mathematical Structures	AI&ML	AI&ML	2	2	0	03	50	50	100	3
7	CEE	21CIV37	Environmental Studies	CEE	CEE	1	0	0	NA	50	-	50	1
8	UHV	21UHV38	Universal Human Values and Professional Ethics	AI&ML	AI&ML	1	0	0	NA	50	-	50	1
Total						**16**	**08**	**04**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, BM&RE: Biomedical and Robotics Engineering, UHV: Universal Human Values, NCMC: Non-credit mandatory course, INT: Internship, IESC: Integrated Engineering Science Course.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	21MATDIP31	Additional Mathematics-1	Basic Science	Basic Science	2	2	0	03	50	50	100	0
11	NCMC	21KANDIP32	Technical Kannada	Basic Science	Basic Science	0	2	0	-	50	-	50	0

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student has to fulfil the requirements during subsequent semester/s to appear for SEE.
(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree

Credit Definition:
1-hour lecture **(L)** per week per semester = **1 Credit**
2-hour tutorial **(T)** per week per semester = **1 Credit**
2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

Four-credit courses are to be designed for **50** hours of Teaching-Learning process.
Three credit courses are to be designed for **40** hours of Teaching-Learning process.
Two credit courses are to be designed for **25** hours of Teaching-Learning process.
One credit course is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points to be earned by students admitted to BE/B.Tech., day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to UoM. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

IV SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT41	Engineering Mathematics-IV	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	IPCC	21AI42	Design and Analysis of Algorithms	AI&ML	AI&ML	3	0	2	03	50	50	100	4
3	IPCC	21AI43	Operating Systems	AI&ML	AI&ML	2	2	2	03	50	50	100	4
4	PCC	21AI44	Data Communication	AI&ML	AI&ML	3	0	0	03	50	50	100	3
5	PCC	21AI45	Programming in C++	AI&ML	AI&ML	2	0	2	03	50	50	100	3
6	PCC	21AI46	Graph Algorithms	AI&ML	AI&ML	2	0	2	03	50	50	100	3
7	CEE	21CPH47	Constitution of India, Professional Ethics and Cyber Law	Basic Science	Basic Science	1	0	0	NA	50	-	50	1
8	UHV	21AEC48	Ability Enhancement Course-II	AI&ML	AI&ML	1	0	0	NA	50	-	50	1
9	BSC	21INT49	Summer Internship-II	(To be carried out during the intervening vacations of IV and V semesters)					-	-	-	-	-
Total						**16**	**04**	**08**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, AEC: Ability Enhancement Course, INT: Internship, IESC: Integrated Engineering Science Course.

Summer Internship-I (21INT59): shall be carried out at industrial (State and Central Government /Non-government organizations (NGOs)/Micro, Small and Medium Enterprise (MSME)/Innovation centres / Incubation centres. The internship can also be Rural internship. All the students admitted shall have to undergo a mandatory internship of 04 weeks during the intervening vacation of IV and V semesters. A University Viva-Voce examination (Presentation followed by Question & Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)
Summer Internship-I: SEE shall be through seminar and viva-voce.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

11	NCMC	21MATDIP41	Additional Mathematics-II	Basic Science	Basic Science	02	02	-	03	50	50	100	0
12	NCMC	21ENGDIP42	Technical English	Basic Science	Basic Science	-	2	-	-	50	-	50	0

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student has to fulfil the requirements during subsequent semester/s to appear for SEE.
(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree

Credit Definition:
1-hour lecture**(L)** per week per semester = **1 Credit**
2-hour tutorial **(T)** per week per semester = **1 Credit**
2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

Four-credit courses are to be designed for **50** hours of Teaching-Learning process.
Three credit courses are to be designed for **40** hours of Teaching-Learning process.
Two credit courses are to be designed for **25** hours of Teaching-Learning process.
One credit course is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points: In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

Engineering Mathematics-III (21MAT31)

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Fourier Series:** Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Application of Practical harmonic analysis.	**08 Hours**
Module 2	**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.	**08 Hours**
Module 3	**Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.	**08 Hours**
Module 4	**Partial Differential Equations (PDE's):** Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation. Solution of one-dimensional heat equation and wave equation by the method of separation of variables.	**08 Hours**
Module 5	**Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares-fitting the curves of the form- $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of Fourier Series, Fourier Transforms, Z-Transforms, Partial Differential Equations, Some concepts of statistical analysis and curve fitting.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed. (Reprint), 2017.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. Srimanta Pal & Subobh C Bhunia: “Engineering Mathematics”, Oxford University Press, 3rd Reprint, 2016.
4. C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics", 6th Edition, 2. McGrawHill Book Co., New York, 1995.
5. S.S.Sastry: “Introductory Methods of Numerical Analysis”, 11th Edition, Tata McGraw-Hill, 2010.
6. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
7. N.P.Bali and Manish Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications. Latest edition, 2014.
8. Chandrika Prasad and Reena Garg “Advanced Engineering Mathematics”, Latest edition, Khanna Publishing, 2018.

Additional Mathematics-I (21MATDIP31)

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Complex Variables:** Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). **Vector Algebra:** Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.	**08 Hours**
Module 2	**Differential Calculus**: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	**08 Hours**
Module 3	**Vector Differentiation**: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.	**08 Hours**
Module 4	**Numerical Methods:** Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)-Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.	**08 Hours**
Module 5	**Ordinary differential equations (ODE's)**. Introduction-solutions of first order and first-degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of complex trigonometry, differential calculus and vector differentiation, Numerical methods, Ordinary Differential Equations of first order.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Reference Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering*, 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.
5. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
6. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
7. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Data Structures and Applications (21AI32)

Semester III			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays. **Array Operations:** Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices. **Strings:** Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.	**10 Hours**
Module 2	**Stacks:** Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. **Recursion:** Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function. **Queues:** Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples.	**10 Hours**
Module 3	**Linked Lists**: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples	**10 Hours**
Module 4	**Trees:** Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples	**10 Hours**
Module 5	**Graphs:** Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. **Sorting and Searching:** Insertion Sort, Radix sort, Address Calculation Sort. **Hashing:** Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. **Files and Their Organization:** Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing.	**10 Hours**

Sl. No.	List of experiments
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 / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. 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	Design, Develop and Implement a menu driven Program in C for the following operations on 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 Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. 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 DFS/BFS 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 outcomes:

At the end of the course the students will be able to:

- Use stack, Queue, Lists, Trees and Graphs in solving real world problems.
- Implement all data structures in a high-level language for problem solving.
- Analyse and compare various linear and non-linear data structures
- Code, debug and demonstrate the working nature of different types of data structures and their applications
- Implement, analyse and evaluate the searching and sorting algorithms.

Reference Books:

1. Ellis Horowitz and SartajSahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. 2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
3. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
4. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
5. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
6. A M Tenenbaum, Data Structures using C, PHI, 1989.
7. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

Analog and Digital Electronics (21AI33)

Semester III			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**BJT Biasing:** Introduction, operating point, Fixed-bias configuration, Emitter-bias configuration, Voltage-divider biasing, Collector feedback bias, Emitter follower configuration. Current mirror circuits, Bias stabilization, Application of BJT as Rely Driver, Switch and constant current source.	**10 Hours**
Module 2	**FET Biasing:** Introduction, Fixed-bias configuration, Self-bias configuration, Voltage-divider biasing. **FET Amplifiers:** Introduction, JFET Small signal model, JFET AC equivalent circuit, Fixed- bias configuration, Self-bias configuration with by passed source resistance, Voltage-divider configuration, Source follower configuration.	**10 Hours**
Module 3	**Principles & Design of Combinational Logic:** Theorems and Properties of Boolean algebra, Boolean Functions, Definition of combinational logic, Canonical forms, Generation of switching equations from Truth Tables, Relevant Problems.	**10 Hours**
Module 4	**Karnaugh maps:** Minimum forms of switching functions, two and three variable Karnaugh maps, four variable karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants. Related Problems. **Logic Circuit Design:** Arithmetic Operation Combinational Circuit, Binary Adder, Binary Subtractor, Binary Parallel Adder, The Look-Ahead-Carry Binary Adders, Binary Multipliers, Binary Dividers, Comparator.	**10 Hours**
Module 5	**Power Amplifiers:** Introduction, Series Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier operation. **Class B amplifier circuits:** Transformer-Coupled Push-Pull and Complementary–Symmetry circuits, Amplifier Distortion. **Latches and Flip-Flops:** Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3, SR Flip Flop, J K Flip Flop, T Flip Flop, Flip Flop with additional inputs, Relevant Problems.	**10 Hours**

Sl. No.	List of experiments
1	Study and plot the input and output characterises of CE transistor
2	Study and plot the drain and transfer characteristics of FET
3	Find the Efficiency and ripple factor of full-wave bridge rectifier
4	Study the frequency response of CE amplifier with and without bypass capacitor
5	Simplification, realization of Boolean expressions using logic gates and Universal gates.
6	Operational verification of Flip–Flops: (i) T type (ii) D type and iii) J–K Master slave.
7	Realization of half and full adders, half and full subtractor using logic gates.
8	(a) Realization of parallel adder and parallel subtractor using 7483 chip (b) Demonstration of BCD to Excess–3 code conversion and vice versa.
9	Realization of half and full adders, half and full subtractor using logic gates.

Course outcomes:
At the end of the course the students will be able to:

- Design and implement a biasing circuit for BJT and FET
- Model the FET amplifier for ac analysis.
- Ability to apply the knowledge of mathematics and science to understand the operation of logic circuits and performance parameters.
- Ability to apply the simplification techniques/methods to optimize and implement the digital functions/circuits.
- Acquire the knowledge of classifications of Power amplifier, operation, and design power amplifier.
- Ability to analyse the given logic circuit based on the knowledge of digital elements.

Reference books:

1. Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Pearson Prentice Hall, 2009
2. Charles H. Roth. Jr, Larry L. Kenny, "Fundamentals of Logic Design", 7th edition, Cengage Learning, ISBN: 978-1133628477.
3. Morris Mano, Digital Logic and Computer Design, Pearson, 2016, ISBN: 9789332542525.
4. Charles H Roth and Larry L Kinney and Raghunandan., G H Analog and Digital Electronics, Cengage Learning,2019.

Computer Organization (21AI34)

Semester III			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Basic Structure of Computers:** Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions	**08 Hours**
Module 2	**Input/Output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB.	**08 Hours**
Module 3	**Memory System:** Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations.	**08 Hours**
Module 4	**Arithmetic:** Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division.	**08 Hours**
Module 5	**Basic Processing Unit:** Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Pipelining: Basic concepts of pipelining.	**08 Hours**

Course Outcome:
At the end of the course the student will be able to:

- Explain the basic organization of a computer system.
- Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
- Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems.
- Design and analyse simple arithmetic and logical units.

Reference Books:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002.
2. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.R. S. Sedha, “A Text book of Applied Electronics,” 7th Edition, S. Chand and Company Ltd., 2011.

Software Engineering (21AI35)

Semester III			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies. Software Processes: Models: Waterfall Model, Incremental Model and Spiral Model. Process activities. **Requirements Engineering:** Requirements Engineering Processes, Requirements Elicitation and Analysis. Functional and non-functional requirements. The software Requirements Document. Requirements Specification. Requirements validation. Requirements Management.	**08 Hours**
Module 2	What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling; abstraction; The Three models. **Introduction, Modelling Concepts and Class Modelling:** What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling; abstraction; The Three models. Class Modelling: Object and Class Concept; Link and associations concepts; Generalization and Inheritance; A sample class model; Navigation of class models;	**08 Hours**
Module 3	**System Models:** Context models. Interaction models. Structural models. Behavioral models, Model-driven engineering. **Design and Implementation:** Introduction to RUP, Design Principles. Object-oriented design using the UML. Design patterns. Implementation issues. Open-source development.	**08 Hours**
Module 4	**Software Testing:** Development testing, Test-driven development, Release testing, User testing. Test Automation. **Software Evolution:** Evolution processes. Program evolution dynamics. Software maintenance. Legacy system management.	**08 Hours**
Module 5	**Project Planning:** Software pricing. Plan-driven development. Project scheduling: Estimation techniques. **Quality management:** Software quality. Reviews and inspections. Software measurement and metrics. Software standards	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Design a software system, component, or process to meet desired needs within realistic constraints.
- Assess professional and ethical responsibility
- Function on multi-disciplinary teams
- Use the techniques, skills, and modern engineering tools necessary for engineering practice
- Analyse, design, implement, verify, validate, implement, apply, and maintain software systems or parts of software systems.

Reference Books:

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.
2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005.
3. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
4. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

Discrete Mathematical Structures (21AI36)

Semester III			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Sets:** Set basics, Venn diagrams, Union, intersection, set difference, complement, Cartesian product, Power sets, Cardinality of finite sets. **Relation:** Reflexivity, symmetry, antisymmetry, transitivity, Equivalence relations, partial orders. **Function:** Domain, target, and range/image of a function, surjection, injections, bijections, inverses, composition.	**08 Hours**
Module 2	**Basic Logic:** Propositional logic, Logical connectives, Truth tables, Disjunctive normal form, Validity of a well-formed formula, Propositional inference rules, Universal and existential quantifiers and their negations. **Proof Techniques:** Proof by Induction.	**08 Hours**
Module 3	**Counting:** The basics of counting, the pigeonhole principle, permutations and combinations, recurrence relations, solving recurrence relations, generating functions, inclusion-exclusion principle and application of inclusion-exclusion, Basic modular arithmetic.	**08 Hours**
Module 4	**Discrete Probability:** Finite probability space, events, Properties of events, Conditional probability, Bayes' theorem, Independence. **Statistical Distribution:** Discrete Distribution, Binomial distribution, Gamma distribution, Beta distribution, Chi-square distribution, Univariate normal distribution.	**08 Hours**
Module 5	**Group theory**: Groups, subgroups, generators and evaluation of powers, cosets and Lagrange's theorem, permutation groups and Burnside's theorem, isomorphism, automorphisms, homomorphism, monoids, concepts of rings, fields. Introduction to vector space.	**08 Hours**

Course outcomes:
At the end of the course the students will be able to:

- Perform the operations associated with sets, functions, and relations.
- Convert logical statements from informal language to propositional (and quantified) logic expressions.
- Use the rules of inference to construct proofs in propositional logic.
- Identify the proof technique used in a given proof.
- Apply each of the proof techniques correctly in the construction of a sound argument.

- Make a probabilistic inference in a real-world problem using Bayes' theorem to determine the probability of a hypothesis given evidence.
- Model a variety of real-world problems in computer science using appropriate forms of graphs and trees, such as representing a network topology or the organization of a hierarchical file system.

Reference Books:

1. Edgar Goodaire and Michael Parmenter, Discrete Mathematics with Graph Theory, Third Edition, PHI, ISBN-13-9750131679955.
2. S. Lipschutz, Discreate Mathematics, TMH, ISBN 0-07-066932-0
3. Bernard Kolman C,Busby and Sharon Ross, Discrete Mathematical Structures, 2007, ISBN - 81-203-2082-4, Publication PHI.
4. Rosen, K.H., Discrete Mathematics and its Applications, 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.

Environmental Studies (21CIV37)

Semester III (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Environment - Components of Environment **Ecosystem:** Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. **Impacts:** Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development.	**03 Hours**
Module 2	**Natural Resources, Water resources** – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **Energy** – Different types of energy, Conventional sources & non-conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	**04 Hours**
Module 3	**Environmental Pollution** – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. **Global Environmental Issues:** Population Growth, Urbanization, Land Management, Water & Waste Water Management	**03 Hours**
Module 4	**Air Pollution & Automobile Pollution:** Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. **Solid Waste Management,** E –Source, Segregation, Transportation, and Waste Treatment and Management &Biomedical Waste Management - Sources, Characteristics & Disposal methods.	**03 Hours**
Module 5	Applications of GIS & Remote Sensing and Smart Technologies in Environmental Engineering Practices. **Environmental Legislations**: Acts, Rules& Regulations, Role of government, Legal aspects, Role of Nongovernmental Organizations (NGOs), Environmental Education & Women Education.	**03 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment,

- Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components
- Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
- Build inquisitiveness to protect environment through societal interventions.

Reference Books:

1. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi.
3. R Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005,
4. Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt. Ltd. 2012.
5. Raman Sivakumar, "Principals of Environmental Science and Engineering", Second Edition, Cengage learning Singapore, 2005
6. P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006
7. S.M. Prakash, "Environmental Studies", Elite Publishers Mangalore, 2007
8. Erach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2005
9. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Tenth Edition, Thomson Brooks /Cole, 2004
10. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006
11. Dr.Pratiba Sing, Dr.AnoopSingh and Dr.Piyush Malaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.

UNIVERSAL HUMAN VALUE & PROFESSIONAL ETHICS (21UHV38)

Semester III (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	**03 Hours**
Module 2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	**03 Hours**
Module 3	**Harmony in the Family and Society:** Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	**03 Hours**
Module 4	**Harmony in the Nature/Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	**03 Hours**
Module 5	**Implications of the Holistic Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	**04 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Holistic vision of life.
- Socially responsible behaviour and environmentally responsible work.
- Ethical human conduct.
- Having Competence and Capabilities for Maintaining Health and Hygiene.

- Appreciation and aspiration for excellence (merit) and gratitude for all.

Reference Books:

1. R R Gaur, R Asthana, G P Bagaria, The Textbook "A Foundation Course in Human Values and Professional Ethics", 2ndRevised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 447-1 b.
2. R R Gaur, R Asthana , The Teacher's Manual for "A Foundation Course in Human Values and Professional Ethics",.

Engineering Mathematics-IV (21MAT41)

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Calculus of complex functions:** Review of function of a complex variables, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. **Construction of analytic functions:** Milne-Thomson method-Problems.	**08 Hours**
Module 2	**Conformal transformations:** Introduction. Discussion of transformations: $w = z^2,\ w = e^z,\ w = z + \frac{1}{z}, (z \neq 0)$. Bilinear transformations- Problems. **Complex integration:** Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.	**08 Hours**
Module 3	**Numerical Solutions of Ordinary Differential Equations (ODE's):** Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae)-Problems. Numerical Solution of Second Order ODE's - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).	**08 Hours**
Module 4	**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.	**08 Hours**
Module 5	**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance. **Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the concepts of integral calculus, Higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Reference Books

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017
3. Srimanta Pal et al , Engineering Mathematics, Oxford University Press, 3rd Edition, 2016.
4. C.Ray Wylie, Louis C.Barrett , Advanced Engineering Mathematics, McGraw-Hill Book Co, 6th Edition, 1995
5. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition 2010
6. B.V.Ramana, Higher Engineering Mathematics, McGraw-Hill, 11th Edition,2010
7. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014.

Additional Mathematics-II (21MATDIP41)

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Integral Calculus**: Review of elementary integral calculus. Reduction formulae for $sin^n x, cos^n x$ (with proof) and $sin^m x cos^n x$ (without proof) and evaluation of these with standard limits-Examples. Double integrals-Simple examples. Beta and Gamma functions- Simple problems	**08 Hours**
Module 2	**Higher order ODE's:** Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. [Particular Integral restricted to$R(x) = e^{ax}, \sin ax / \cos axforf(D)y = R(x)$].	**08 Hours**
Module 3	**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only)-problems. Inverse Laplace Transform: Inverse Laplace transforms by method of partial fractions, Convolution theorem to find the inverse Laplace transforms. Solution of linear differential equations using Laplace transforms.	**08 Hours**
Module 4	**Introduction to Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability, Bayes's theorem, problems.	**08 Hours**
Module 5	**Linear Algebra:** Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the concepts of integral calculus, Higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Reference Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.
4. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
5. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
6. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Design and Analysis of Algorithms (21AI42)

Semester IV			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to** Algorithm, Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity. Asymptotic Notations: Mathematical analysis of non-recursive and recursive Algorithms with Examples. Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems. **Fundamental Data Structures:** Stacks, Queues, Graphs, Trees, Sets and Dictionaries.	**10 Hours**
Module 2	**Divide and Conquer:** General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum, Merge sort, Quick sort, Strassen's matrix multiplication, Advantages and Disadvantages of divide and conquer. Decrease and Conquer Approach: Topological Sort.	**10 Hours**
Module 3	**Greedy Method:** General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm. Single source shortest paths: Dijkstra's Algorithm. Optimal Tree problem: Huffman Trees and Codes. Transform and Conquer Approach: Heaps and Heap Sort.	**10 Hours**
Module 4	**Dynamic Programming:** General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem, Reliability design.	**10 Hours**
Module 5	**Backtracking:** General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem: LC Branch and Bound solution, FIFO Branch and Bound solution. NP-Complete and NP-Hard problems: Basic concepts, nondeterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.	**10 Hours**

Sl. No.	List of experiments
1	a. Create a Java class called ***Student*** with the following details as variables within it. (i) USN (ii) Name (iii) Branch (iv) Phone Write a Java program to create *n Student* objects and print the USN, Name, Branch, and Phone of these objects with suitable headings. b. Write a Java program to implement the Stack using arrays. Write Push(), Pop(), and Display() methods to demonstrate its working.
2	a.Design a superclass called ***Staff*** with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely ***Teaching*** (domain, publications), ***Technical*** (skills), and ***Contract*** (period). Write a Java program to read and display at least 3 *staff* objects of all three categories. b. Write a Java class called ***Customer*** to store their name and date_of_birth. The date_of_birth format should be dd/mm/yyyy. Write methods to read customer data as <name, dd/mm/yyyy> and display as <name, dd, mm, yyyy> using StringTokenizer class considering the delimiter character as "/".
3	a. Write a Java program to read two integers *a*and*b*. Compute *a*/*b* and print, when *b* is not zero. Raise an exception when *b* is equal to zero. b. Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square ofthe number and prints; third thread will print the value of cube of the number.
4	Sort a given set of ***n*** integer elements using **Quick Sort** method and compute its time complexity. Run the program for varied values of *n*> 5000 and record the time taken to sort. Plot a graph of the time taken versus ***n***on graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
5	Sort a given set of ***n*** integer elements using **Merge Sort** method and compute its time complexity. Run the program for varied values of *n*> 5000, and record the time taken to sort. Plot a graph of the time taken versus ***n***on graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case,average case and best case.
6	Implement in Java, the **0/1 Knapsack** problem using (a) Dynamic Programming method (b) Greedy method.
7	From a given vertex in a weighted connected graph, find shortest paths to other vertices using **Dijkstra's algorithm**. Write the program in Java.
8	Find Minimum Cost Spanning Tree of a given connected undirected graph using **Kruskal'salgorithm.** Use Union-Find algorithms in your program
9	Find Minimum Cost Spanning Tree of a given connected undirected graph using **Prim's algorithm**..
10	Write Java programs to (a) Implement All-Pairs Shortest Paths problem using **Floyd's algorithm**. (b) Implement **Travelling Sales Person problem** using Dynamic programming.

11	Design and implement in Java to find a **subset** of a given set **S** = {Sl, S2,.....,Sn} of ***n*** positive integers whose SUM is equal to a given positive integer ***d***. For example, if S ={1, 2,5, 6, 8} and ***d***= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.
12	Design and implement in Java to find all **Hamiltonian Cycles** in a connected undirected Graph G of *n* vertices using backtracking principle.

Course Outcome:

At the end of the course the student will be able to:

- Describe computational solution to well-known problems like searching, sorting etc.
- Estimate the computational complexity of different algorithms.
- Devise an algorithm using appropriate design techniques (brute-force, greedy, dynamic programming, backtracking) for problem solving.
- Implement a variety of algorithms such as sorting, graph related, combinatorial, etc., in a high-level language to solve real-world problems.
- Analyse and compare the performance of algorithms using language features.

Reference Books:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, 2rd Edition, 2009. Pearson.
2. Ellis Horowitz, Satraj Sahni and Rajasekaran, Computer Algorithms/C++, 2nd Edition, 2014, Universities Press.
3. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Edition, PHI.
4. S. Sridhar, Design and Analysis of Algorithms, Oxford (Higher Education).

Operating System (21AI43)

Semester IV			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to operating systems, System structures:** What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot. **Process Management**: Process concept, Process scheduling; Operations on processes; Inter process communication	**10 Hours**
Module 2	**Multi-threaded Programming:** Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling. Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	**10 Hours**
Module 3	**Deadlocks:** Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.	**10 Hours**
Module 4	**Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. File System, Implementation of File System: File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.	**10 Hours**
Module 5	**Secondary Storage Structures, Protection:** Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems. Case Study: The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.	**10 Hours**

Sl.	List of Experiments

No	
1	Simulate the following CPU scheduling algorithms: a) FCFS b) SJF c)Round Robin d)Priority
2	Simulate the following Memory management Techniques a) Multi Programming with Fixed Number of Tasks (MFT) b) Multi Programming with Variable Number of Tasks (MVT)
3	Write a C program to stimulate the following contiguous memory allocation techniques a) Worst-fit b) Best fit c) First fit
4	Simulate Paging Technique of memory management
5	Simulate following page replacement Algorithms a) FIFO b) LRU c) LFU
6	Simulate Producer-Consumer Problem Using Semaphores
7	Write a C program to simulate the concept of Dining-Philosophers problem.
8	Write a C program to stimulate the disk scheduling algorithms. a) FCFS b) SCAN c) C-SCAN
9	Simulate Bankers Algorithm for Deadlock Avoidance
10	Simulate the file allocation strategies: a) Sequential b) Indexed c) Linked
11	Simulate all File Organization techniques a) Single level directory b) Two level c) Hierarchical

Course Outcome:

At the end of the course the students will be able to:

- Demonstrate need for OS and different types of OS
- Apply suitable techniques for management of different resources
- Realize the different concepts of OS in platform of usage through case studies
- Design and solve synchronization problems.
- Simulate and implement operating system concepts such as scheduling, deadlock management, file management, and memory management.

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006.
2. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
3. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw-Hill, 2013.
4. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
5. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Data Communication (21AI44)

Semester IV			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance. SLE: Internet History, Standards and Administration	**08 Hours**
Module 2	**Digital Transmission:** Digital to digital conversion: Line coding- Polar, Bipolar, Manchester coding, AMI, Pseudo ternary, Physical Layer-2: Analog to digital conversion, Pulse Code Modulation, Delta Modulation, Transmission Modes, Analog Transmission: Digital to analog conversion. SLE: Bandwidth Utilization: Multiplexing	**08 Hours**
Module 3	**Transmission Media:** Introduction, Guided Media: Twisted Pair Cable, Coaxial Cable, Fiber Optics Cable, switching: Introduction, Circuit Switched Networks and Packet switching, Data Link Layer: Error Detection and Correction: Introduction, Block Coding, Cyclic Code. SLE: Checksum	**08 Hours**
Module 4	**Data link control:** DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control (HDLC), Media Access control: Random Access, Controlled Access. SLE: Channelization	**08 Hours**
Module 5	**Introduction to Network Layer:** Network Layer Services, Packet Switching, Network Layer Performance, IPv4 Addresses. SLE: IPv6	**08 Hours**

Course Outcome:

At the end of the course the students will be able to:

- Explain the fundamentals of data communication.
- Illustrate the techniques for digital transmission and bandwidth utilization using various transmission media.
- Analyse the principles of protocol layering in modern communication systems.
- Demonstrate the working of physical, data link and network layer services using simulation tools such as Cisco packet tracer, Wireshark and so on (Additional CO).

Reference Books:

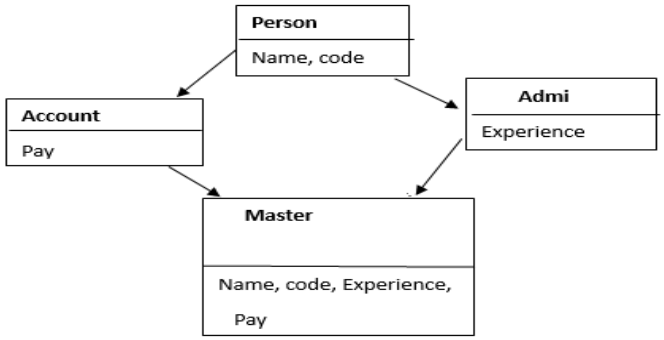
1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019
2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015
3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014

Programming in C++ (21AI45)

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:0:1	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to C++:** Introduction to Procedure-oriented programming vs. object-oriented programming, concepts of object-oriented programming. Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & user-defined types Function Components, argument passing, inline functions, function overloading, recursive functions.	**08 Hours**
Module 2	**Classes, Objects and Polymorphism:** Class Specification, Class Objects, Scope resolution operator, Access members, Defining member functions, Data hiding, Constructors, Destructors, Static data members and functions. Constant data members and functions, mutable data members. Friend functions, Passing objects as arguments, Returning objects, Arrays of objects, Dynamic objects, Pointers to objects, Generic functions and classes, Operator overloading and their applications such as +, - , pre-increment, post-increment, [ ] etc.	**08 Hours**
Module 3	**Inheritance:** Introduction to Inheritance, Different types of Inheritances, Inheritance and protected members, protected base class inheritance, Constructors and Destructors in Inheritance, Granting access, Virtual base classes.	**08 Hours**
Module 4	**Run-time polymorphism and Exception handling:** Virtual functions and Polymorphism: Introduction to Virtual functions, calling a Virtual function through a base class reference, Inheritance of virtual attributes, Hierarchy of virtual functions, Pure virtual functions and Abstract classes, Early and late binding. **Exception Handling:** Exception handling fundamentals, Catching Class Types, Using Multiple catch Statements, Handling Derived-Class Exceptions, Exception handling options: Catching All Exceptions, Restricting Exceptions & Re-throwing an Exception, user defined exceptions, Applying Exception Handling.	**08 Hours**
Module 5	**I/O System Basics and Standard template library:** I/O System Basics: The C++ I/O system basics: C++ stream classes, Formatted I/O, I/O manipulators; C++ file I/O: fstream and the File classes, File operations. STL: An overview, the container classes, general theory of operations, vectors, lists, maps.	**08 Hours**

Sl.	Experiments

No.	
1	Write a function using reference variables as arguments to swap the values of pair of integers.
2	Write a program to perform the addition of two complex numbers using friend function (use constructor function to initialize data members of complex class).
3	Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.
4	Write a C++ program to display names, roll no and grades of 3 students appeared in the examination. Declare the class containing the name, roll no and grade.
5	Define a class string and overload == to compare two strings and + operator for concatenation two strings.
6	Write a program to perform matrix addition using operator overloading concept.
7	Write a program to compute square root of a number. The input value must be tested for validity. If it is negative, the user defined function my_sqrt() should raise an exception.
8	Consider the class network diagram of Figure 1. Define all the four classes and write a program to create, update and display the information contained in Master objects.  Figure 1
9	Create a class called STACK which represents one dimensional numeric array. Implement operations on the stack using integer and double data types. Use exception handling mechanism to handle overflow and underflow exceptions.
10	Write a C++ program to perform the following operations a) Read from the File b) Write into a File c) Copy contents from one file to another

Course Outcomes:

At the end of the course the students will be able to:

- Understand the features of C++ supporting object-oriented programming.
- Understand the relative merits of C++ as an object-oriented programming language.
- Understand how to apply the major object-oriented concepts to implement object-oriented programs in C++, encapsulation, inheritance and polymorphism.
- Understand advanced features of C++ specifically stream I/O, templates and operator overloading.
- Develop applications for a range of problems using object-oriented programming techniques using C++.

Reference Books:

1. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2003.
2. Stanley B.Lippmann, JoseeLajore: C++ Primer, 4th Edition, Pearson Education, 2005.
3. E Balagurusamy: Object Oriented Programming with C++, 7th Edition, Tata Mcgraw Hill Education, 2017
4. Paul J Deitel, Harvey M Deitel: C++ for Programmers, Pearson Education, 2009.
5. K R Venugopal, RajkumarBuyya, T Ravi Shankar: Mastering C++, Tata McGraw Hill, 2017
6. Yashavant P. Kanetkar: Let Us C++, 2nd Edition, BPB Publications.

Graph Algorithms (21AI46)

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:0:1	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Graph Theory:** Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits.	**08 Hours**
Module 2	**Introduction to Graph Theory contd.:** Planar Graphs, Hamilton Paths and Cycles, Graph Colouring, and Chromatic Polynomials	**08 Hours**
Module 3	**Trees:** Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Weighted Trees and Prefix Codes	**08 Hours**
Module 4	**Optimization and Matching:** Dijkstra‟s Shortest Path Algorithm, Minimal Spanning Trees - The algorithms of Kruskal and Prim, Transport Networks - Max-flow, Min-cut Theorem, Matching Theory	**08 Hours**
Module 5	**The Principle of Inclusion and Exclusion:** The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements - Nothing is in its Right Place, Rook Polynomials.	**08 Hours**

Sl. No.	List of Experiments
1	Obtain the Topological ordering of vertices in a given digraph.
2	Compute the transitive closure of a given directed graph using Warshall's algorithm.
3	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm
4	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm
5	Print all the nodes reachable from a given starting node in a digraph using BFS method.
6	Check whether a given graph is connected or not using DFS method.
7	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm
8	Find a subset of a given set S = {sl, s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.
9	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm, implement it using OpenMP and determine the speed-up achieved.

Course Outcomes:

At the end of the course the students will be able to:

- Explain what a graph is and how it is used.
- Learn how to use algorithms to explore graphs, compute shortest distance, min spanning tree, and connected components.
- Implement a variety of algorithms such as topological sorting, prims, kruskals and Dijkstra's etc., in a high-level language to solve real-world problems.
- Implement the transitive closure of a directed graph using Warshall's algorithm.
- Analyse and differentiate DFS and BFS, prims and kruskals through high level programming languages.
- Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.

Reference Books:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education, 2004.
2. D.S. Chandrasekharaiah: Graph Theory and Combinatorics, Prism, 2020.
3. Chartrand Zhang: Introduction to Graph Theory, TMH, 2006.
4. Richard A. Brualdi: Introductory Combinatorics, 6th Edition, Pearson Education, 2018.
5. Geir Agnarsson & Raymond Geenlaw: Graph Theory, Pearson Education, 2018.

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & CYBER LAW (21CPH47)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Indian Constitution:** Definition of Constitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	**03 Hours**
Module 2	**Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's):** Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP's and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.	**03 Hours**
Module 3	**Union Executive:** Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	**03 Hours**
Module 4	**State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	**03 Hours**
Module 5	**Professional Ethics:** Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. **Cyber Laws:** Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. **Computer & Cyber Security:** (a) Types of Attacks, (b) Network Security (c) Overview of Security threats, (d) Hacking Techniques, (e) Password cracking (f) Insecure Network connections, (g) Malicious code (h) Concept of Fire wall Security	**04 Hours**

Course Outcomes:

At the end of the course the students will be able to:

- Have constitutional knowledge and legal literacy.
- Understand Engineering and Professional ethics and responsibilities of Engineers.

- Understand cyber threats & cyber laws, acts and their powers.

Reference Books:

1. Shubham Singla, 'Constitution of India, Professional Ethics & Human Rights', CENGAGE Publications 2018.
2. Cyber Law & Cyber Crimes by Advocate Prashant Mali; Snow White publications, Mumbai.
3. Cyber Law in India by Farooq Ahmad; Pioneer Books.

ABILITY ENHANCEMENT COURSE II (21AEC48)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.	**03 Hours**
Module 2	**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.	**03 Hours**
Module 3	**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (Samples of resumes)	**03 Hours**
Module 4	**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles. Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.	**04 Hours**
Module 5	**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.	**03 Hours**

Course Outcomes:
At the end of the course the students will be able to:

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Reference Books:

1. Sanjay Kumar and Pushpalata, ‘Communication Skills’, Oxford University Press. 2018.
2. M. Ashraf Rizvi, ‘Effective Technical Communication’, McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. ‘Technical Communication’, Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022(As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

V-SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	HSMC	21AI51	Management and Entrepreneurship	AI&ML	AI&ML	3	0	0	03	50	50	100	3
2	IPCC	21AI52	Programming in Java	AI&ML	AI&ML	2	0	2	03	50	50	100	3
3	IPCC	21AI53	Database Management System	AI&ML	AI&ML	3	0	2	03	50	50	100	4
4	PCC	21AI54	Automata Theory	AI&ML	AI&ML	3	0	0	03	50	50	100	3
5	PCC	21AI55	Principles of Artificial Intelligence	AI&ML	AI&ML	3	0	2	03	50	50	100	4
6	PEC	21AI56X	Professional Elective -1	AI&ML	AI&ML	3	0	0	03	50	50	100	3
7	OEC	21AI57X	Open Elective - 1	AI&ML	AI&ML	3	0	0	03	50	50	100	3
8	INT	21INT58	Summer Internship - 1	Completed during the vacation of IV and V semesters		0	0	2	NA	50	-	50	1
Total						**20**	**00**	**08**	**21**	**400**	**350**	**750**	**24**

Note: PCC: Professional Core Courses, IPCC: Integrated Professional Core Courses, AI&ML: Artificial Intelligence and Machine Learning, PEC: Professional Elective Course, OEC: Open Elective Course and INT: Internship.

Professional Elective-1		**Open Elective-1**	
Course Code	**Course Title**	**Course Code**	**Course Title**
21AI561	Web Technology	21AI571	Introduction to Data Structure and Algorithm
21AI562	Liner Algebra	21AI572	Introduction to Database Management System
21AI563	Data Mining	21AI573	Programming in Java
		21AI574	Introduction to Artificial Intelligence
		21AI575	Python Programming

Credit Definition:
1-hour lecture**(L)** per week per semester = **1 Credit**
2-hour tutorial **(T)** per week per semester = **1 Credit**
2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

Four-credit courses are to be designed for **50** hours of Teaching-Learning process.
Three credit courses are to be designed for **40** hours of Teaching-Learning process.
Two credit courses are to be designed for **25** hours of Teaching-Learning process.
One credit course is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points: In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022(As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

VI-SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	IPCC	21AI61	Application Development using Python	AI&ML	AI&ML	3	0	2	03	50	50	100	4
2	IPCC	21AI62	Statistical Analysis	AI&ML	AI&ML	3	0	2	03	50	50	100	4
3	IPCC	21AI63	Machine Learning	AI&ML	AI&ML	3	0	2	03	50	50	100	4
4	PCC	21AI64	Cloud Computing	AI&ML	AI&ML	3	0	0	03	50	50	100	3
5	PEC	21AI65X	Professional Elective -2	AI&ML	AI&ML	3	0	0	03	50	50	100	3
6	OEC	21AI66X	Open Elective – 2	AI&ML	AI&ML	3	0	0	03	50	50	100	3
7	MP	21AIP67	Mini Project	AI&ML	AI&ML	0	0	2	NA	50	-	50	1
Total						**18**	**0**	**08**	**18**	**350**	**300**	**650**	**22**

Note: PCC: Professional Core Courses, IPCC: Integrated Professional Core Courses, AI&ML: Artificial Intelligence and Machine Learning, MP: Mini Project, PEC: Professional Elective Course, OEC: Open Elective Course and INT: Internship.

Professional elective - 2		**Open Elective - 2**	
Course Code	**Course Title**	**Course Code**	**Course Title**
21AI641	Research Methodology and Intellectual Property Rights	21AI651	Introduction to Internet of Things
21AI642	Principles of Data Science	21AI652	Introduction to Machine Learning
21AI643	Social Network Analysis	21AI653	Introduction to Cyber Security
21AI644	Big Data Analytics	21AI654	Introduction to Web Technology
		21AI655	Animation and Visualization

Students can select any one of the open electives offered by any department.
Selection of an open elective is not allowed provided,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor.

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

AICTE Activity Points: In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

Management and Entrepreneurship (21AI51)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** meaning, nature and characteristics of management, scope and functional areas of management, goals of management, levels of management, brief overview of evolution of management theories, Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of organization, Staffing- meaning, process of recruitment and selection.	**08 Hours**
Module 2	**Directing and Controlling:** meaning and nature of directing, leadership styles, motivation theories, Communication- meaning and importance, Coordination- meaning and importance, Controlling- meaning, steps in controlling, methods of establishing control.	**08 Hours**
Module 3	**Project Management**: Project/Program/Portfolio Management, Phases in Project Life Cycle, Top Down and Bottoms up Estimation, WBS, Stake Holder Management. Identification of new ideas, Evaluation of Alternatives. **Human Resource Management:** Functions of HRM, Recruitment and Selection, Interviewing Candidates. Human Resource Development, Training and Development, Performance Appraisal and Employee Compensation	**08 Hours**
Module 4	**Marketing Management**: Introduction, 5 Ps of Marketing, product life cycle, market Strategy. **Financial Management**: Introduction, Types of Finance, Balance Sheet and Profit and Loss account statement, working capital, International Finance	**08 Hours**
Module 5	**Entrepreneurship:** Introduction, Management & Administration, Types of ownership and Organization structures. Concept of Entrepreneur, kind of Entrepreneurs, Entrepreneurship development and Govt. support in India. Role of Entrepreneurs in Economic Development. **Micro and Small Enterprises:** Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Introduction to IPR.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the development of management thought and Concept of Entrepreneurs.
- Evaluate the human behavior concepts and HRM.
- Make use of IPRs and institutional support in entrepreneurship
- Apply the project management tools to manage projects.
- Illustrate financial statements and concepts of Marketing.

Reference Books:

1. K R Phaneesh, *Management and Entrepreneurship* - (Sixth Edition) Sudha Publication, Year 2013.
2. P. C. Tripathi, P. N. Reddy, *Principles of Management* 4th / 6th Edition Tata McGraw Hill, 2010.
3. Vasant Desai, *Dynamics of Entrepreneurial Development & Management* Himalaya Publishing House.
4. Poornima M Charantimath, *Entrepreneurship Development -Small Business Enterprises* Pearson Education – 2006.
5. Kanishka Bedi, *Management and Entrepreneurship* Oxford University Press-2017

Programming in Java (21AI52)

Semester V			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	2:0:1	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Java:** Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java, Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Type Conversion and Casting, Automatic Type Promotion in Expressions, A Few Words About Strings	**8 Hours**
Module 2	**Objects and Classes:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character **Operators:** Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses. **Control Statements**: Java's Selection Statements, Iteration Statements, Jump Statements.	**8 Hours**
Module 3	**Event and GUI programming:** Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons,Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle.	**8 Hours**
Module 4	**Packages and Interfaces:** Packages, Access Protection, Importing Packages, Interfaces. **Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Chained Exceptions, Using Exceptions.	**8 Hours**
Module 5	**I/O Programming:** Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. **Multithreading in Java:** Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans.	**8 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard.
- Develop computer programs to solve real world problems in Java.
- Demonstrate an introductory understanding of graphical user interfaces, multi-threaded programming, and event-driven programming.

Reference Books:

1. Y. Daniel Liang, *Introduction to Java Programming (Comprehensive Version)*, Seventh Edition, Pearson.
2. Sachin Malhotra, Saurabh Chaudhary, *Programming in Java*, Oxford University Press.
3. Doug Lowe, Joel Murach, Andrea Steelman, *Murach's Beginning Java 2*, SPD.
4. Horstmann, Cornell, *Core Java Volume-I Fundamentals*, Eight Edition, Pearson Education.
5. Herbert Schild, *The Complete Reference, Java 2* (Fourth Edition), TMH.
6. D. S. Malik, *Java Programming*, Cengage Learning.

Database Management System (21AI53)

Semester V			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas and Instances. Three schema architecture, Data independence, Database languages and interfaces, The Database System Environment. **Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets, Attributes, Roles and Structural constraints, Weak entity types, ER diagrams, Examples.	**10 Hours**
Module 2	**Relational Model:** Relational Model Concepts, Relational Model Constraints and Relational database schemas, Update operations, Transactions, and dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.	**10 Hours**
Module 3	**SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. **Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL. **Database Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.	**10 Hours**
Module 4	**Normalization:** Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies, Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms. **Normalization Algorithms:** Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and Alternate relational designs.	**10Hours**

Module 5	**Transaction Processing:** Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.	**10 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
- Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.
- Design and build simple database systems and relate the concept of transaction, concurrency control and recovery in database.
- Demonstrate the Basics Concepts and SQL Queries of Database Management System
- Analyze the various constraints to populate the database through SQL Queries.
- Implement different working concepts of DBMS using SQL Queries.
- Present the result of database creation and querying process, document it.

Reference Books:

1. Ramez Elmasri, Shamkant B. *Navathe Fundamentals of Database Systems*, 7th Edition, Pearson, 2017.
2. Ramakrishnan, Gehrke, *Database Management Systems*, 3rd Edition, McGraw Hill, 2014.
3. Silberschatz Korth, Sudharshan, *Database System Concepts*, 6th Edition, McGraw Hill, 2013.
4. Coronel, Morris, Rob, *Database Principles Fundamentals of Design, Implementation and Management*, Cengage Learning, 2012.

Automata Theory (21AI54)

Semester V			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Why study the Theory of Computation, Languages and Strings:** Strings, Languages. A Language Hierarchy, Computation. **Finite State Machines (FSM):** Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, From FSMs to Operational Systems, Simulators for FSMs, Minimizing FSMs, Canonical form of Regular languages, Finite State Transducers, Bidirectional Transducers.	**08 Hours**
Module 2	**Regular Expressions (RE):** what is a RE, Kleene"s theorem, Applications of REs, Manipulating and Simplifying REs. Regular Grammars: Definition, Regular Grammars and Regular languages. Regular Languages (RL) and Non-regular Languages: How many RLs, To show that a language is regular, Closure properties of RLs, to show some languages are not RLs.	**08 Hours**
Module 3	**Context-Free Grammars (CFG):** Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, proving that a Grammar is correct, Derivation and Parse trees, Ambiguity, Normal Forms. Pushdown Automata (PDA): Definition of non-deterministic PDA, Deterministic and Non-deterministic PDAs, Non -determinism and Halting, alternative equivalent definitions of a PDA, alternatives that are not equivalent to PDA.	**08 Hours**
Module 4	**Algorithms and Decision Procedures for CFLs:** Decidable questions, Un-decidable questions. Turing Machine: Turing machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction. Variants of Turing Machines (TM), The model of Linear Bounded automata.	**08 Hours**
Module 5	**Decidability:** Definition of an algorithm, decidability, decidable languages, Undecidable languages, halting problem of TM, Post correspondence problem. Complexity: Growth rate. of functions, the classes of P and NP, Quantum Computation: quantum computers, Church-Turing thesis. **Applications:** G.1 Defining syntax of programming language, Appendix J: Security	**08 Hours**

Course Outcome:

At the end of the course the student will be able to:

- Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation
- Learn how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).
- Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.
- Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness.
- Classify a problem with respect to different models of Computation.

Reference Books:

1. John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd Edition, Pearson Education, 2013.
2. Michael Sipser, *Introduction to the Theory of Computation*, 3rd Edition, Cengage learning,2013.
3. John C Martin, *Introduction to Languages and The Theory of Computation*, 3rd Edition, Tata Mc Graw –Hill Publishing Company Limited, 2013.
4. Peter Linz, *An Introduction to Formal Languages and Automata*, 3rd Edition, Narosa Publishers, 1998.
5. Basavaraj S. Anami, Karibasappa K G, *Formal Languages and Automata theory*, Wiley India, 2012.
6. C K Nagpal, *Formal Languages and Automata Theory*, Oxford University press, 2012.
7. Elaine Rich, *Automata, Computability and Complexity*, 1st Edition, Pearson education,2012/2013
8. K L P Mishra, N Chandrasekaran, *Theory of Computer Science*, 3rd Edition, PHI, 2012.

Principles of Artificial Intelligence (21AI55)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L:T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	Introduction, goals of AI, Types of AI, Types of agents, Intelligent Agent, Agent environment, Turing Test and Chatterbots, AI and Society, Applications of AI, Advantages, Disadvantages.	**10 Hours**
Module 2	Propositional Logic – Syntax, Semantics, Proof Systems, Resolution, Horn Clauses, Computability and Complexity, Applications and Limitations. First Order Predicate logic – Syntax, Semantics, Quantifiers and Normal Forms, Proof Calculi, Resolution, Automated Theorem Provers, Mathematical Examples, Applications. Limitations of Logic – The Search Space Problem, Decidability and Incompleteness, Modelling Uncertainty.	**10 Hours**
Module 3	Knowledge representation: Knowledge based agent in AI, Architecture of knowledge based agent, Inference system, Operations performed by KBA, Generic KBA, Levels of KBA, approaches to design KBA, Types of Knowledge, Relationship between knowledge and Intelligence, AI knowledge cycle, Approaches to knowledge representation, Requirements for knowledge representation system, Techniques for knowledge representation.	**10 Hours**
Module 4	Search algorithms: Properties of search algorithms, Types of search algorithms - Uninformed search algorithm, Informed search algorithms, Hill climbing algorithm, Means-Ends analysis, Adversarial search, Min-Max algorithm, Alpha-Beta pruning.	**10 Hours**
Module 5	AI Applications, Expert Systems Learning, Language Models, Information Retrieval, Information Extraction, Natural Language Processing, Machine Translation, Speech Recognition, Robot – Hardware, Perception, Planning, Moving.	**10 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Ability to apply Artificial Intelligence techniques for problem solving.
- Explain the limitations of current Artificial Intelligence techniques.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar Nair, *Artificial Intelligence*, Tata McGraw Hill.
2. Patrick Henry Winston, *Artificial Intelligence*, AWL.
3. Dan W. Patterson, *Artificial Intelligence and Expert systems*, PHI.
4. Nils J Nilson, *Artificial Intelligence*, Elsevier, Morgan Kaufmann.

Professional Elective – 1

Web Technology (21AI561)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to HTML**: What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling	**08 Hours**
Module 2	**HTML Tables and Forms:** Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks	**08 Hours**
Module 3	**JavaScript:** Client-Side Scripting, what is JavaScript and What can it do? JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions.	**08 Hours**
Module 4	**PHP**: Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling	**08 Hours**
Module 5	**Managing State:** The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation, Backbone MVC Frameworks, XML Processing and Web Services, XML Processing, JSON, Overview of Web Services	**08 Hours**

Course outcomes:

At the end of the course the student will be able to:

- Adapt HTML and CSS syntax and semantics to build web pages.
- Construct and visually format tables and forms using HTML and CSS.
- Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to
- generate and display the contents dynamically.
- Appraise the principles of object-oriented development using PHP.
- Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Reference Books:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, 1st Edition, Pearson Education India.
2. Robin Nixon, *Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5*, 4thEdition, O'Reilly Publications, 2015.
3. Luke Welling, Laura Thomson, *PHP and MySQL Web Development*, 5th Edition, Pearson Education, 2016.
4. Nicholas C Zakas, *Professional JavaScript for Web Developer*, 3rd Edition, Wrox/Wiley India, 2012.
5. David Sawyer Mcfarland, *JavaScript & jQuery: The Missing Manual*, 1st Edition, O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 2014.
6. Zak Ruvalcaba Anne Boehm, *Murach's HTML5 and CSS3*, 3rd Edition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.

Professional Elective – 1

Linear Algebra (21AI562)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Vectors**: Vectors and Linear Combinations, Lengths and Dot Products Matrices. Solving Linear Equations, Vectors and Linear Equations, The Idea of Elimination: Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices. Elimination = Factorization: A = LU Transposes and Permutations.	**08 Hours**
Module 2	**Vector Spaces and Subspaces:** Spaces of Vectors The Nullspace of A: Solving Ax = 0 and Rx = 0 The Complete Solution to Ax = b Independence, Basis and Dimension Dimensions of the Four Subspaces **Orthogonality:** Orthogonality of the Four Subspaces Projections	**08 Hours**
Module 3	**Determinants:** The Properties of Determinants Permutations and Cofactors Cramer's Rule, Inverses, and Volumes Eigenvalues and Eigenvectors Introduction to Eigenvalues Diagonalizing a Matrix	**08 Hours**
Module 4	**The Singular Value Decomposition (SVD):** Image Processing by Linear Algebra Bases and Matrices in the SVD Principal Component Analysis (PCA by the SVD) The Geometry of the SVD	**08 Hours**
Module 5	**Linear Transformations:** The Idea of a Linear Transformation, The Matrix of a Linear Transformation, The Search for a Good Basis.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain linear equations, linear models, projections, linear transformations
- Illustrate orthogonal projections and apply Eigen vectors to solve differential equations.
- Apply singular value decomposition and analyze singular value decomposition to develop applications in image processing

Reference Books:

1. Gilbert Strang, *Introduction to linear algebra*, 5th edition, Wellesley - Cambridge press.
2. David C Lay, *Linear Algebra and its Application*, 4th Edition, Addison Wesley,

Professional Elective – 1

Data Mining (21AI563)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Data Mining:** Data, Types of Data, Data Mining Functionalities, Interestingness Patterns, Classification of Data Mining systems, Data mining Task primitives , Integration of Data mining system with a Data warehouse, Major issues in Data Mining, Data Pre-processing.	**08 Hours**
Module 2	**Association Rule Mining:** Mining Frequent Patterns, Associations and correlations, Mining Methods, Mining Various kinds of Association Rules, Correlation Analysis, Constraint based Association mining. Graph Pattern Mining, SPM.	**08 Hours**
Module 3	**Classification:** Classification and Prediction, Basic concepts, Decision tree induction, Bayesian classification, Rule, based classification, Lazy learner.	**08 Hours**
Module 4	**Clustering and Applications:** Cluster analysis, Types of Data in Cluster Analysis, Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density, Based Methods, Grid, Based Methods, Outlier Analysis	**08 Hours**
Module 5	**Advanced Concepts:** Basic concepts in Mining data streams, Mining Time, series data, Mining sequence patterns in Transactional databases, Mining Object, Spatial, Multimedia, Text and Web data , Spatial Data mining, Multimedia Data mining, Text Mining, Mining the World Wide Web.	08 Hours

Course outcomes:

At the end of the course the students will be able to:

- Apply pre-processing methods for any given raw data.
- Extract interesting patterns from large amounts of data.
- Discover the role played by data mining in various fields.
- Choose and employ suitable data mining algorithms to build analytical applications.
- Evaluate the accuracy of supervised and unsupervised models and algorithms.

Reference Books:

1. Jiawei Han & Micheline Kamber, *Data Mining – Concepts and Techniques* –, 3rd Edition Elsevier.
2. Margaret H Dunham, *Data Mining Introductory and Advanced topics* –PEA.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: *Introduction to Data Mining*, Pearson, First impression,2014.
4. Jiawei Han, Micheline Kamber, Jian Pei: *Data Mining -Concepts and Techniques*, 3rd Edition, Morgan Kaufmann Publisher, 2012.

Open Elective – 1

Introduction to Data Structures and Algorithms (21AI571)

Semester V			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to C:** Constants, variables, data types, input output operations, operators and expressions, control statements, arrays, strings, string handling functions, structures, unions and pointers, Dynamic Memory Allocation.	**08 Hours**
Module 2	**Algorithms:** Introduction to algorithms, Performance Analysis: Estimating Space complexity and Time complexity of algorithms, Asymptotic notations, Introduction to data structures, Types of data structures.	**08 Hours**
Module 3	**Stacks:** Definition, Stack Operations, Array Representation of Stacks, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. **Queues:** Definition, Array Representation, Queue Operations, Circular Queues, Deque, Priority Queues,	**08 Hours**
Module 4	**Linked Lists**: Definition, Representation of linked lists in Memory, Singly linked list, Doubly linked lists, Circular linked lists. **Trees:** Terminology, Binary Trees, Array and linked Representation of Binary Trees, Binary Tree Traversals, Threaded binary trees, Binary Search Trees, Expression Tree.	**08Hours**
Module 5	**Graphs:** Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Graph Traversal methods: Breadth First Search and Depth First Search **Hashing:** Hash Table organizations, Hashing Functions. **Files and Their Organization:** Data Hierarchy, File Attributes Text Files and Binary Files, Basic File Operations.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Use stack, Queue, Lists, Trees and Graphs in solving real world problems.
- Implement all data structures in a high-level language for problem solving.
- Analyse and compare various linear and non-linear data structures.
- Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze mathematically the complexity of the algorithm.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, *Fundamentals of Data Structures in C*, 2nd Edition, Universities Press, 2014.
2. Seymour Lipschutz, *Data Structures Schaum's Outlines*, Revised 1st Edition, McGraw Hill, 2014.
3. Gilberg, Forouzan, *Data Structures: A Pseudo-code approach with C*, 2nd Edition, Cengage Learning, 2014.
4. Reema Thareja, *Data Structures using C*, 3rd Edition, Oxford press, 2012.
5. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, 2nd Edition, Pearson, 2009.
6. Ellis Horowitz, Satraj Sahni, Rajasekaran, *Computer Algorithms/C++*, 2nd Edition, Universities Press, 2014.

Open Elective – 1

Introduction to Database Management System (21AI572)

Semester V			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.	**08 Hours**
Module 2	**Relational Model:** Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping	**08 Hours**
Module 3	**Relational Algebra**: Selection and projection set operations, renaming, joins, division, Examples of algebra over views. **Relational calculus:** Tuple relational calculus, Domain relational calculus. **Overview of the SQL Query Language:** Basic Structure of SQL Queries, Set Operations, Aggregate Functions – GROUPBY, HAVING, Nested Sub queries, Views, Triggers.	**08 Hours**
Module 4	**Normalization:** Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.	**08Hours**
Module 5	**Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques.	**08Hours**

Course outcomes:

At the end of the course the students will be able to:

- Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
- Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.
- Design and build simple database systems and relate the concept of transaction, concurrency control and recovery in database.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, *Fundamentals of Database Systems*, 7th Edition, Pearson, 2017.
2. Ramakrishnan, Gehrke, *Database Management Systems*, 3rd Edition, McGraw Hill, 2014.
3. Silberschatz Korth, Sudharshan, *Database System Concepts*, 6th Edition, McGraw Hill, 2013.
4. Coronel, Morris, Rob, *Database Principles Fundamentals of Design, Implementation and Management*, Cengage Learning, 2012.

Open Elective – 1

Programming in JAVA (21AI573)

Semester VI			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**An Overview of Java**: Features of Java, JVM, Object-Oriented Programming, A First Simple Program, ASecond Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries. **Data Types Variables, and Arrays:** Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings.	**08 Hours**
Module 2	**Operators:** Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The? Operator, Operator Precedence, Using Parentheses. **Control Statements**: Java's Selection Statements, Iteration Statements, Jump Statements. **Introducing Classes:** Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class.	**08 Hours**
Module 3	**A Closer Look at Methods and Classes:** Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Arrays Revisited. **Inheritance:** Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. **Multithreading:** Life cycle of a thread, Creating and Running a thread, Concurrency Problem.	**08 Hours**
Module 4	**Packages and Interfaces:** Packages, Access Protection, Importing Packages, Interfaces. **Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.	**08 Hours**
Module 5	**Enumerations:** Enumerations, Type Wrappers. **String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String. Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, String Buffer, StringBuilder.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.
- Develop simple GUI interfaces for a computer program to interact with users

Reference Books:

1. Herbert Schildt, *Java The Complete Reference*, 7th Edition, Tata McGraw Hill, 2007.
2. Mahesh Bhave and Sunil Patekar, *Programming with Java*, First Edition, Pearson Education,2008.
3. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, *Object oriented Programming with java,* Tata McGraw Hill education private limited.
4. E Balagurusamy, *Programming with Java A primer*, Tata McGraw Hill companies.
5. Anita Seth and B L Juneja, *JAVA One step Ahead*, Oxford University Press, 2017.

Open Elective – 1

Introduction to Artificial Intelligence (21AI574)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	Introduction, goals of AI, Types of AI, Types of agents, Intelligent Agent, Agent environment, Turing Test and Chatterbots, AI and Society, Applications of AI, Advantages, Disadvantages.	**08 Hours**
Module 2	Propositional Logic – Syntax, Semantics, Proof Systems, Resolution, Horn Clauses, Computability and Complexity, Applications and Limitations. First Order Predicate logic – Syntax, Semantics, Quantifiers and Normal Forms, Proof Calculi, Resolution, Automated Theorem Provers, Mathematical Examples, Applications. Limitations of Logic – The Search Space Problem, Decidability and Incompleteness, Modelling Uncertainty.	**08 Hours**
Module 3	Knowledge representation: Knowledge based agent in AI, Architecture of knowledge based agent, Inference system, Operations performed by KBA, Generic KBA, Levels of KBA, Approaches to design KBA, Types of Knowledge, Relationship between knowledge and Intelligence, AI knowledge cycle, Approaches to knowledge representation, Requirements for knowledge representation system, Techniques for knowledge representation.	**08 Hours**
Module 4	Search algorithms: Properties of search algorithms, Types of search algorithms - Uninformed search algorithm, Informed search algorithms, Hill climbing algorithm, Means-Ends analysis, Adversarial search, Min-Max algorithm, Alpha-Beta pruning.	**08 Hours**
Module 5	AI Applications, Expert Systems Learning, Language Models, Information Retrieval, Information Extraction, Natural Language Processing, Machine Translation, Speech Recognition, Robot – Hardware, Perception, Planning, Moving.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Ability to apply Artificial Intelligence techniques for problem solving.
- Explain the limitations of current Artificial Intelligence techniques.

Reference Books:

5. Elaine Rich, Kevin Knight, Shivashankar Nair, *Artificial Intelligence*, Tata McGraw Hill.
6. Patrick Henry Winston, *Artificial Intelligence*, AWL.
7. Dan W. Patterson, *Artificial Intelligence and Expert systems*, PHI.
8. Nils J Nilson, *Artificial Intelligence*, Elsevier, Morgan Kaufmann.

Open Elective – 1

Phyton Programming (21AI575)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction data, expressions, statements:** Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.	**08 Hours**
Module 2	**Control Flow, Loops:** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (ifelif-else); Iteration: while, for, break, continue, pass statement.	**08 Hours**
Module 3	**Functions and strings:** Functions: Function calls, adding new functions, definition and uses, local and global scope, return values. **Strings:** strings, length of string, string slices, immutability, multiline comments, string functions and methods;	**08 Hours**
Module 4	**Lists, Tuples, Dictionaries Lists:** List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, List Comprehension; **Tuples:** tuple assignment, tuple as return value, tuple comprehension; Dictionaries: operations and methods, comprehension;	**08 Hours**
Module 5	**Regular expressions, files and exception:** Regular expressions, Character matching in regular expressions, extracting data using regular expressions, Escape character **Files and exception:** Text files, reading and writing files, command line arguments, errors and exceptions, handling exceptions, modules	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Represent compound data using Python lists, tuples, Strings, dictionaries.
- Read and write data from/to files in Python Programs.

Reference Books:

9. Al Sweigart, *Automate the Boring Stuff with Python*,1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/).
10. Charles R. Severance, *Python for Everybody: Exploring Data Using Python 3*, 1st edition, Create Space Independent Publishing Platform, 2016. http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf.
11. R. Nageswara Rao, *Core Python Programming*, Dream Tech publication.
12. Vamsi Kurama, *Python Programming: A Modern Approach*, Pearson.
13. Reema theraja, *Python Programming*, OXFORD publication.

Application Development Using Python (21AI61)

Semester VI			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L:T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Python Basics:** Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number	**10 Hours**
Module 2	**Lists:** The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References, Dictionaries and Structuring Data, The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things, Manipulating Strings, Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup	**10 Hours**
Module 3	**Pattern Matching with Regular Expressions:** Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Non greedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re .IGNORECASE, re .DOTALL, and re .VERBOSE, Project: Phone Number and Email Address Extractor, Reading and Writing Files, Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint. pformat() Function, Project: Generating Random Quiz Files, Project: Multiclip board, Organizing Files, The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates,Project: Backing Up a Folder into a ZIP File, Debugging, Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE‟s Debugger	**10 Hours**

Module 4	**Classes and objects**: Programmer – defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions, Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods, Object-oriented features, Printing objects, Another example, A more complicated example, The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation, Inheritance, Card objects, Class attributes, Comparing cards, Decks, Printing the deck, Add, remove, shuffle and sort, Inheritance, Class diagrams, Data encapsulation	**10 Hours**
Module 5	**Web Scraping Project:** MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML, Parsing HTML with the Beautiful Soup Module, Project: "I'm Feeling Lucky" Google Search, Project: Downloading All XKCD Comics, Controlling the Browser with the selenium Module, Working with Excel Spreadsheets, Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns, Charts, Working with PDF and Word Documents, PDF Documents, Project: Combining Select Pages from Many PDFs, Word Documents, Working with CSV files and JSON data, The csv Module, Project: Removing the Header from CSV Files, JSON and APIs, The json Module, Project: Fetching Current Weather Data	**10 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Demonstrate proficiency in handling of loops and creation of functions.
- Identify the methods to create and manipulate lists, tuples and dictionaries.
- Discover the commonly used operations involving regular expressions and file system.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Determine the need for scraping websites and working with CSV, JSON and other file formats.

Reference Books:

1. Al Sweigart, *Automate the Boring Stuff with Python*,1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)
2. Allen B. Downey, *Think Python: How to Think Like a Computer Scientist*, 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf).
3. Gowrishankar S, Veena A, *Introduction to Python Programming*, 1st Edition, CRC Press/Taylor & Francis, 2018.
4. Jake VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*, 1st Edition, O'Reilly Media, 2016.

Statistical Analysis (21AI62)

Semester VI			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L:T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Data and Representation:** Introduction to Statistics, Collection of data, classification and tabulation of data, Types of data: Primary data, Secondary data, Presentation of data Diagrammatic and Graphical Representation: Histogram, frequency curve, frequency polygon, Ogive curves, stem and leaf chart.	**10 Hours**
Module 2	**Measures of Central Tendency**: Mean (A.M.) Definition, Mode, Median, Partition Values: Quartiles, Deciles and Percentiles, Box Plot, Percentile ranks. Means of transformed data, Geometric Mean (G.M.) Definition, Harmonic Mean (H.M.), Weighted Mean: Weighted A.M., G.M. and H.M.	**10 Hours**
Module 3	**Dispersion Arithmetic:** Range, Mean deviation Mean square deviation, Variance and Standard Deviation, Combined variance (derivation for 2 groups), Combined standard deviation.	**10 Hours**
Module 4	**Correlation and Regression:** Bivariate normal distribution, types, importance, methods of measuring correlation-scatter diagram, Karl Pearson's Coefficient of Correlation and Spearman's rank Correlation. Regression lines, Difference between regression and correlation, uses of Regression.	**10 Hours**
Module 5	**Sampling theory and tests of significance:** Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRWOR) stratified random sampling, systematic sampling. Tests of significance – z, t, chi-square and F.	**10 Hours**

Course outcomes:

- Adapt HTML and CSS syntax and semantics to build web pages.
- Construct and visually format tables and forms using HTML and CSS
- Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.
- Appraise the principles of object-oriented development using PHP
- Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Reference Books:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, 1stEdition, Pearson Education India.
2. Robin Nixon, *Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5*, 4thEdition, O'Reilly Publications, 2015.
3. Luke Welling, Laura Thomson, *PHP and MySQL Web Development*, 5th Edition, Pearson Education, 2016.
4. Nicholas C Zakas, *Professional JavaScript for Web Developers*, 3rd Edition, Wrox/Wiley India, 2012.
5. David Sawyer Mcfarland, *JavaScript & jQuery: The Missing Manual*, 1st Edition, O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 2014.
6. Zak Ruvalcaba Anne Boehm, *Murach's HTML5 and CSS3*, 3rdEdition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.

Machine Learning (21AI63)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	Introduction, Machine learning definition, importance of machine learning, machine learning framework, types of machine learning, relation to other fields, examples of machine learning applications, designing a learning system, issues in machine learning.	**10 Hours**
Module 2	Introduction to Supervised Learning, Decision tree based classifier, Bayesian theory based classifier, Neural network based classifier, Nearest neighbor classifier, Support vector classifier, Linear Regression, Logistic Regression, Random Forest, performance evaluation.	**10 Hours**
Module 3	Introduction to Unsupervised Learning, Clustering methods, Criteria functions for clustering, proximity measures, Component analysis, Dimensionality reduction techniques: Principal Component Analysis (PCA), Factor Analysis (FA), Linear Discriminant Analysis (LDA) and Truncated Singular Value Decomposition (SVD), Gaussian Mixture Models, Low dimensional analysis and multidimensional scaling.	**10 Hours**
Module 4	Additional topics, Reinforcement learning, Genetic algorithms, Analytical learning, Ensemble of classifiers, Natural Language Processing, Computer Vision, Design and analysis of machine learning experiments.	**10 Hours**
Module 5	Evaluation Measures: SSE, MME, R2, confusion matrix, precision, recall, F-Score, ROC-Curve, Imbalanced Training Tests, Context-Dependent Domains, Unknown Attribute Values, Attribute Selection, Miscellaneous, Introduction to Deep Learning, Popular Deep Learning Architectures.	**10 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Gain knowledge about basic concepts of Machine Learning.
- Identify machine learning techniques suitable for a given problem.
- Solve the problems using various machine learning techniques
- Design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Reference Books:

1. Kevin Patrick Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, March 2014.
2. Alex Smola and S.V.N. Vishwanathan, *Introduction to Machine Learning*, Cambridge University Press.
3. Shai Shalev-Shwartz and Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, Published 2014 by Cambridge University Press.

Cloud Computing (21AI64)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments. **Virtualization:** Introduction, Characteristics of Virtualized, Environments, Taxonomy of Virtualization Techniques, Execution Virtualization.	**08 Hours**
Module 2	**Virtualization and Cloud Computing:** Other Types of Virtualization, Pros and Cons of Virtualization, Technology Examples. Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies.	**08 Hours**
Module 3	**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Open Challenges. **Cloud Security**: Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security.	**08 Hours**
Module 4	**Concurrent Computing:** Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, what is a Thread? Thread APIs, Techniques for Parallel Computation with Threads, **Multithreading with Aneka:** Introducing the Thread Programming Model, Aneka Thread vs. Common Threads, Programming Applications with Aneka Threads, Aneka Threads Application Model.	**08 Hours**
Module 5	**Data Intensive Computing:** Map-Reduce Programming, Data-Intensive Computing, Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka MapReduce Programming. **Cloud Applications:** HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain cloud computing, virtualization and classify services of cloud computing
- Illustrate architecture and programming in cloud
- Describe the platforms for development of cloud applications and list the application of cloud.

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education.
2. Dan C. Marinescu Morgan Kaufmann, *Cloud Computing Theory and Practice*, , Elsevier, 2013.

Professional Elective - 2

Research Methodology and Intellectual Property Rights (21AI651)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Research methodology:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics	**08 Hours**
Module 2	**Results and analysis:** Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), hypothesis, concept, theory, model etc.	**08 Hours**
Module 3	**Technical writing**: Effective technical writing, how to write a manuscript/ response to reviewers' comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee.	**08 Hours**
Module 4	**Intellectual property rights:** Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT**.**	**08 Hours**
Module 5	**Patent rights and new developments in IPR:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR, Administration of Patent System.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Understand that today's world is controlled by Computer, Information Technology, buttomorrow world will be ruled by ideas, concept, and creativity.
- Understand research problem formulation & Analyze research related information andFollow research ethics.
- Correlate the results of any research article with other published results. Write a review article in the field of engineering.
- Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Reference Books:

1. Ranjit Kumar, *Research Methodology- A step by step guide for beginners*, Pearson Education, Australia, 2005.
2. Ann M. Korner, *Guide to Publishing a Scientific paper*, Bio script Press 2004.
3. T. Ramappa, "*Intellectual Property Rights Under WTO*", S. Chand, 2008

Professional Elective - 2

Principles of Data Science(21AI652)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction Data Science:** Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data	**08 Hours**
Module 2	**Describing Data:** Types of Data - Types of Variables - Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores	**08 Hours**
Module 3	**Describing Relationships:** Correlation –Scatter plots – correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations – regression towards mean.	**08 Hours**
Module 4	**Probability:** Hours Basic definitions, Probability, Bayesian versus Frequentist, Frequentist approach, Compound events, Conditional probability, The rules of probability, Collectively exhaustive events, Bayesian ideas revisited, Bayes theorem, Random variables	**08 Hours**
Module 5	**Statistics:** Basic of statistics, obtaining sample data, point estimates sample distributions, confidence intervals, hypothesis test, type I type II errors. hypothesis test for categorical variables.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain different types of data and their relationships.
- Apply mathematical concepts to data science problems
- Analyze and illustrate probability and statistical techniques

Reference Books:

1. Sinan Ozdemir *Principles of Data Science*, PACKT Publisher, First Edition, 2016.
2. Gilbert Strang *Introduction to Linear Algebra*, Wellesley-Cambridge Press, Fifth Edition, 2016.
3. Cathy O'Neil, Rachel Schutt *Doing Data Science: Straight Talk from the Frontline*, O'Reilly Media, 2013

Professional Elective – 2

Social Network Analysis (21AI653)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Social Media Analytics (SMA):** Social media landscape, Need for SMA, SMA in Small organizations, SMA in large organizations, Application of SMA in different areas. **Network fundamentals and models:** The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.	**08 Hours**
Module 2	**Making connections:** Link analysis. Random graphs and network evolution. Social contexts- Affiliation and identity. **Web analytics tools:** Click stream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis	**08 Hours**
Module 3	**Content in Social Media:** Introduction to Social Data, Defining Content-Focus on Text and Unstructured data. Finding the Right Data, Using content feature to identify topics. **Social Media Data Analysis:** Data identification, Data Analysis, The Social Analytics Process, Customizing and Modifying Tools, Visually Representing Unstructured Data, Topic Modelling.	**08 Hours**
Module 4	**Facebook Analytics:** Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post-performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. **Information Interpretation**: Social information filtering, Social media in public sector, Business use of social media, Common Visualizations, Visualization as an Aid to analytics, Creating features from text: NLP, Identifying opinion.	**08Hours**
Module 5	**Processing and Visualizing Data**: Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics. Introduction to Python Programming, Collecting and analyzing social media data; visualization and modelling pattern in social media data. **Data-Driven Innovation:** Healthcare, Policy makers, small, medium and large businesses, Social Media services online, Privacy.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Comprehend social media analytics and its significance.
- Utilize analytics tools' skills required for analyzing the effectiveness of social media.
- Identify the innovation potential and impact of social media data in organizations.

Reference Books:

1. Ganis, Avinash Kohirkar, Matthew, *Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media*, Pearson, 2016.
2. Jennifer Golbeck , *Analyzing the Social Web* , Elsevier, 2013
3. Azizi Othman, *Media Web Mining and Analysis*, Willey, 2019.
4. Marshall Sponder, *Social Media Analytics,* 2nd Edition, McGraw Hill, 2012.

Professional Elective – 2

Big Data Analytics (21AI654)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.	**08 Hours**
Module 2	Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. Hadoop Distributed File System Basics (T2): HDFS Design Features, Components, HDFS User Commands. Essential Hadoop Tools (T2): Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.	**08 Hours**
Module 3	NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	**08 Hours**
Module 4	MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.	**08 Hours**
Module 5	Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Item sets and Association Rule Mining. Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Understand fundamentals of Big Data analytics.
- Investigate Hadoop framework and Hadoop Distributed File system.
- Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
- Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.
- Use Machine Learning algorithms for real world big data.
- Analyze web contents and Social Networks to provide analytics with relevant visualization tools.

Reference Books:

1. Raj Kamal and Preeti Saxena, *Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning*, McGraw Hill Education, 2018.
2. Douglas Eadline, *Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem*, 1st Edition, Pearson Education, 2016.
3. Tom White, *Hadoop: The Definitive Guide*, 4th Edition, O'Reilly Media, 2015.
4. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, *Professional Hadoop Solutions*, 1st Edition, Wrox Press, 2014.
5. Eric Sammer, *Hadoop Operations: A Guide for Developers and Administrators*,1st Edition, O'Reilly Media, 2012.
6. Arshdeep Bahga, Vijay Madisetti, *Big Data Analytics: A Hands-On Approach*, 1st Edition, VPT Publications, 2018.

Open Elective – 2

Introduction To Internet of Things (21AI661)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies.	**08 Hours**
Module 2	**IoT Sensing and Actuation**: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Actuators, Actuator Types, Actuator Characteristics.	**08 Hours**
Module 3	**IoT Processing Topologies and Types:** Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Consideration, Sensor Cloud.	**08 Hours**
Module 4	**IoT Connectivity Technologies:** Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A,WirelessHART, RFID, NFC.	**08 Hours**
Module 5	**IoT Communication Technologies:** Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Understand the evolution of IoT, IoT networking components, and addressing strategies in IoT.
- Analyse various sensing devices and actuator types.
- Demonstrate the processing in IoT.
- Apply different connectivity technologies.
- Understand the communication technologies, protocols and interoperability in IoT.

Reference Books:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "*Introduction to IoT*", Cambridge University Press 2021.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0*. CRC Press.
3. Vijay Madisetti and Arshdeep Bahga, "*Internet of Things (A Hands-on-Approach)*",1st Edition, VPT, 2014
4. Francis daCosta, "*Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*",1st Edition, Apress Publications, 2013

Open Elective – 2

Introduction to Machine Learning (21AI662)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to machine learning:** Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications. **Understanding Data:** What is data, types of data, big data analytics and types of analytics, big data analytics framework, Descriptive statistics, univariate data analysis and visualization	**8 Hours**
Module 2	**Understanding Data:** Bivariate and Multivariate data, Multivariate statistics, Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques, **Basics of Learning Theory:** Introduction to learning and its types, Introduction computation learning theory, Design of learning system, Introduction concept learning.	**8 Hours**
Module 3	**Supervised Learning Regression:** Introduction to linear regression, Gradient descent algorithm, Polynomial regression Regularization techniques: L1 and L2 regularization, Model evaluation: mean squared error, R-squared score. **Supervised Learning:** Classification, Introduction to logistic regression, Decision trees and random forests, Support vector machines (SVM), Evaluation metrics for classification: accuracy, precision, recall, F1-score.	**8 Hours**
Module 4	**Unsupervised Learning Clustering:** Introduction to clustering algorithms, K-means clustering, Hierarchical clustering, Density-based clustering, Evaluation metrics for clustering: inertia, silhouette score. **Unsupervised Learning: Dimensionality Reduction:** Introduction to dimensionality reduction, Principal Component Analysis (PCA), t-SNE algorithm, Applications of dimensionality reduction	**8 Hours**
Module 5	**Neural Networks:** Introduction to neural networks, Basic structure of a neural network, Activation functions, Backpropagation algorithm, Overfitting and regularization techniques. **Deep Learning:** Introduction to deep learning, Convolutional Neural Networks (CNNs) for image recognition, Transfer learning **Applications of Machine Learning:** Image recognition, Natural Language Processing (NLP), Recommendation systems, Fraud detection, Predictive maintenance.	**8 Hours**

Course Outcome:

At the end of the course the student will be able to:

- Design intelligent agents for solving simple gaming problems.
- Have a good understanding of machine leaning in relation to other fields and fundamental issues and Challenges of machine learning.
- Understand data and applying machine learning algorithms to predict the outputs.
- Model the neuron and Neural Network, and to analyse ANN learning and its applications.

Reference Book:

1. S. Sridhar, M Vijayalakshmi *"Machine Learning".* Oxford ,2021.

Open Elective – 2

Introduction to Cyber Security (21AI663)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Cyber Security:** Definition of Cyber Security, Importance of Cyber Security, Cyber Security Threats and Attacks, Cyber Security Vulnerabilities. **Types of Cyber Attacks:** Phishing Attacks, Malware Attacks Denial of Service Attacks, Social Engineering Attacks.	**8 Hours**
Module 2	**Techniques for Protecting Against Cyber Attacks:** Encryption and Cryptography, Firewalls and Intrusion Detection Systems, Access Controls and Password Management, Data Backup and Recovery.	**8 Hours**
Module 3	**Legal and Ethical Issues in Cyber Security:** Privacy and Data Protection, Intellectual Property and Copyright, Cybercrime and Cyber Law, The Legal Perspectives, An Indian Perspective, Cybercrime and the Indian ITA 2000. **Introduction to Cybercrime:** Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals, Classifications of Cybercrimes,	**8 Hours**
Module 4	**Cyber offenses:** How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes. **Botnets:** The Fuel for Cybercrime, Attack Vector	**8 Hours**
Module 5	**Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks. Ethical Hacking and Penetration Testing. **Case Studies in Cyber Security:** Analysis of real-world cyber-attacks, Impact of cyber-attacks on individuals and organizations, best practices for responding to cyber-attacks.	**8 Hours**

Course Outcome:

At the end of the course the student will be able to:

- Describe the basic principles of cyber security and its importance in modern society.
- Identify common types of cyber-attacks, such as phishing, malware, and denial of service attacks, and explain how these attacks work.
- Evaluate different techniques for protecting against cyber-attacks, including encryption, firewalls, and intrusion detection systems.
- Discuss the legal and ethical issues associated with cyber security, such as privacy, intellectual property, and cybercrime.
- Analyze case studies of real-world cyber-attacks and their impact on individuals and organization.

Reference Books:

1. Raef Meeuwisse, *"Cybersecurity for Beginners*".
2. P.W. Singer and Allan Friedman, *"Cybersecurity and Cyberwar: What Everyone Needs to Know"*.
3. SunitBelapure and Nina Godbole, *"Cyber Security: Understanding Cyber Crimes, Computer. Forensics And Legal Perspectives"*, Wiley India Pvt Ltd, 2013.
4. Debra Little John Shinder and Michael Cross, *"Scene of the cybercrime"*, 2nd Edition, Syngress publishing Inc, Elsevier Inc, 2008
5. William Stallings, *"Network Security Essentials: Applications and Standards"*.
6. Michael T. Goodrich and Roberto Tamassia, *"Introduction to Computer Security"*.
7. Robert M Slade, "Software Forensics", Tata McGraw Hill, New Delhi, 2005.
8. Bernadette H Schell, Clemens Martin, *"Cybercrime",* ABC – CLIO Inc, California, 2004.
9. Nelson Phillips and Enfinger Steuart, *"Computer Forensics and Investigations"*, Cengage Learning, New Delhi, 2009.
10. Kevin Mandia, Chris Prosise, Matt Pepe, *"Incident Response and Computer Forensics"*, Tata McGraw -Hill, New Delhi, 2006

Open Elective – 2

Introduction to Web Technology (21AI664)

Semester V			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L:T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to HTML**: What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling	**08 Hours**
Module 2	**HTML Tables and Forms:** Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks	**08 Hours**
Module 3	**JavaScript:** Client-Side Scripting, what is JavaScript and What can it do? JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions.	**08 Hours**
Module 4	**PHP**: Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling	**08 Hours**
Module 5	**Managing State:** The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation, Backbone MVC Frameworks, XML Processing and Web Services, XML Processing, JSON, Overview of Web Services	**08 Hours**

Course outcomes:

At the end of the course the student will be able to:

- Adapt HTML and CSS syntax and semantics to build web pages.
- Construct and visually format tables and forms using HTML and CSS.
- Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to
- generate and display the contents dynamically.
- Appraise the principles of object-oriented development using PHP.
- Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Reference Books:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, 1st Edition, Pearson Education India.
2. Robin Nixon, *Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5*, 4thEdition, O'Reilly Publications, 2015.
3. Luke Welling, Laura Thomson, *PHP and MySQL Web Development*, 5th Edition, Pearson Education, 2016.
4. Nicholas C Zakas, *Professional JavaScript for Web Developer*, 3rd Edition, Wrox/Wiley India, 2012.
5. David Sawyer Mcfarland, *JavaScript & jQuery: The Missing Manual*, 1st Edition, O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 2014.
6. Zak Ruvalcaba Anne Boehm, *Murach's HTML5 and CSS3*, 3rd Edition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.

Open Elective – 2

Animation And Visualization (21AI665)

Semester VI			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Basics of Animations-Development:** Idea Creation, Evolving a Storyline. **Character Design:** The Evolution of 2D Character Design, The Evolution of 3D Character Design, Animation Style, Concept and Environment Design. **Project Financing:** Animation Markets, Scheduling and Budgeting, Investment, Marketing, and Distribution Possibilities.	**08 Hours**
Module 2	**Principles of Animation:** Key Poses, Breakdowns, and Inbetweens, Timing, Extreme Positions, Arcs and Paths of Action, Holds, Emphasis, Anticipation, Weight and Weighted Movement, Flexibility and Fluid Joint Movement, Overlapping Action, Generic Walks, Walk Cycles, Runs and Run Cycles, Silhouetting, Dialogue and Lip Sync, Laughter, Takes, Eyes and Expressions.	**08 Hours**
Module 3	**2D Animation Overview:** It's All about Pencils and Paper Script, The Tools of the Trade. **2D Animation Basics:** Keys, In-betweens, and Timing, Dope (Exposure) Sheets and Production Folders, Flipping and Peg Bars, Using Peg Bars.	**08 Hours**
Module 4	**Visualization Techniques:** Data visualization techniques, Information visualization techniques, Scientific visualization techniques, Introduction to visualization software. **Motion Graphics:** Introduction to motion graphics, Basic motion graphics techniques, Motion graphics software	**08 Hours**
Module 5	**3D Animation Techniques:** Introduction to 3D modelling and animation, Basic 3D modelling techniques, Texturing and lighting, Rigging and animation, Introduction to 3D animation software. **Computer-Generated Imaging:** Introduction to computer-generated imaging, 3D rendering techniques, Compositing techniques, Introduction to CGI software	**08 Hours**

Course Outcome:

At the end of the course the student will be able to:

- Understand the Basics of Animation techniques.
- Describe principles animation techniques.
- Demonstrate the functions of 2D Animation techniques.
- Apply game theory in real-time animated projects.
- Apply the models of the Game theory problems.

Reference Books:

1. Sketching for Beginners: Step-by-step Guide to Getting Started with Your Drawing.
2. Perspective Made Easy (Dover Art Instruction).
3. Roger B Myerson, *Game theory: Analysis of Conflict*, Harvard University Press, 1997.
4. Joel Watson, *An Introduction to Game Theory: Strategy*, W W Norton and Company.
5. Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V Vazirani, *Algorithmic Game Theory*, Cambridge University Press.
6. Richard Williams, *The Animator's Survival Kit*.
7. Ollie Johnston and Frank Thomas, *The Illusion of Life: Disney Animation*.
8. Prof. Sham Tickoo, *A Comprehensive Guide Learning: Autodesk*, Maya 2019.
9. Tony White, *Animation from Pencil to Pixels*, Classical Techniques for Digital Animators, Focal Press is an imprint of Elsevier.
10. Martin Osborne, *An introduction to game theory*, Oxford University Press, Indian Edition,2004.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022(As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

VII-SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	Credits
						L	T	P					
1	IPCC	21AI71	Deep Learning	AI&ML	AI&ML	2	2	2	03	50	50	100	4
2	PCC	21AI72	Natural Language Processing	AI&ML	AI&ML	2	2	0	03	50	50	100	3
3	PEC	21AI73X	Professional Elective - 3	AI&ML	AI&ML	2	2	0	03	50	50	100	3
4	PEC	21AI73X	Professional Elective - 4	AI&ML	AI&ML	2	2	0	03	50	50	100	3
5	PROJECT	21AIP74	Project work Phase – I	AI&ML	AI&ML	0	0	4	03	100		100	2
6	AEC	21AEC75X	Ability Enhancement Course-III	AI&ML	AI&ML	0	0	2		50		50	1
7	INT	21INT83	Summer Internship-II	Completed during the vacation of VI and VII semesters									
Total						08	08	08	15	350	200	550	16

Note: **PCC**: Professional Core Courses, **IPCC**: Integrated Professional Core Courses, **AI&ML**: Artificial Intelligence and Machine Learning, **PEC**: Professional Elective Course, **AEC:** Ability Enhancement Course, **PROJECT:** Project work phase-I and **INT:** Internship.

Professional Elective - 3 and Professional Elective - 4				Ability Enhancement Course	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
21AI731	Algorithms for Cluster Data	21AI735	Generative Artificial Intelligence	21AEC751	Digital Image Processing Applications
21AI732	Blockchain Technology	21AI736	Information Retrieval	21AEC752	Generative AI Applications
21AI733	Digital Image Processing	21AI737	Predictive Analytics	21AEC753	Project Management Using Git
21AI734	Fuzzy Sets Theory	21AI738	Soft Computing	21AEC754	Technical Writing with LATEX

Credit Definition:
1-hour lecture(L) per week per semester = 1 Credit
2-hour tutorial (T) per week per semester = 1 Credit
2-hour Practical/Drawing (P) per week per semester = 1 Credit

Four-credit courses are to be designed for **50** hours of Teaching-Learning process.
Three credit courses are to be designed for **40** hours of Teaching-Learning process.
Two credit courses are to be designed for **25** hours of Teaching-Learning process.
One credit course is to be designed for **15** hours of Teaching-Learning process

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Students can select any one of the professional electives offered by any department. **Selection of a professional elective is not allowed provided,**

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses, Open Electives or Professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.
- Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor.

Project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Project:
(i) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

AICTE Activity Points: *AICTE Activity Points to be earned by students admitted to BE/B.Tech., day college programme*.
In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022(As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

Artificial Intelligence and Machine Learning (AI&ML)

VIII-SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	PROJECT	21AIP81	Project work Phase - II	AI&ML	AI&ML	0	0	12	03	100	100	200	8
2	Seminar	21AIS82	Technical Seminar	AI&ML	AI&ML	Two contact hour /week for interaction between the faculty and students.			03	100		100	3
3	INT	21INT83	Summer Internship-II	Completed during the vacation of VI and VII semesters		Two contact hours /week for interaction between the faculty and students.				100		100	3
Total						0	0	16	06	300	100	400	14

Note: **AI&ML**: Artificial Intelligence and Machine Learning, **PROJECT:** Project work phase-II and **INT:** Internship

Credit Definition:
1-hour lecture(L) per week per semester = 1 Credit
2-hour tutorial (T) per week per semester = 1 Credit
2-hour Practical/Drawing (P) per week per semester = 1 Credit

Four-credit courses are to be designed for **50** hours of Teaching-Learning process.
Three credit courses are to be designed for **40** hours of Teaching-Learning process.
Two credit courses are to be designed for **25** hours of Teaching-Learning process.
One credit course is to be designed for **15** hours of Teaching-Learning process

Technical Seminar: The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skills, and involve participants in group discussions for the exchange of ideas. Each student, under the guidance of a faculty, shall choose, preferably, a recent topic of his or her interest relevant to the program of specialization.

- Carry out a literature survey and systematically organize the content.
- Prepare the report with your own sentences, avoiding a cut-and-paste act.
- Type the matter to become familiar with the use of Microsoft Excel, drawing tools, or any such facilities.
- Present the seminar topic orally and/or through PowerPoint slides.
- Answer the queries and involve yourself in debate or discussion.
- Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:
The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.
Marks distribution for CIE of the course:
Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks.
No SEE component for Technical Seminar.

CIE procedure for Project Work:

1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two seniors
faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
3) **SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25

AICTE Activity Points: AICTE Activity Points to be earned by students admitted to BE/B.Tech., day college programme
(For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines)

- Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme.
- Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to UoM. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.
- The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled.
- Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression**.**

In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

Deep Learning (21AI71)

VII Semester DEEP LEARNING			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T: P	2:2:2	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Deep Feed forward Networks**: Gradient-Based Learning, Hidden Units, Architecture Design, Back Propagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi Supervised Learning, Multi-Task Learning.	**10 Hours** **L(3):T(3):P(4)**
Module 2	**Optimization for Training Deep Models**: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks**: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Efficient Convolution Algorithms, Random or Unsupervised Features.	**10 Hours** **L(3):T(3):P(4)**
Module 3	**Sequence Modelling**: Recurrent and Recursive Nets, Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long Short-Term Memory (LSTM).	**10 Hours** **L(3):T(3):P(4)**
Module 4	**Introduction to Reinforcement Learning:** State of the art applications in Atari, Alpha Go, relation to other problems in artificial intelligence, **Markov Decision Processes (model based):** Formulation, Value Iteration (VI), Policy Iteration (PI), Linear Programming, Approximate	**10 Hours** **L(3):T(3):P(4)**
Module 5	**Dynamic Programming (approximate model based):** curse-of-dimensionality, representations, Approximate value iteration, approximate policy iteration, approximate linear program, approximation and convergence guarantees. Stochastic. **Value function learning (approximate model-free):** Temporal difference (TD learning, TD (0), TD (lambda), Q-learning, State-Action-Reward-State Algorithm (SARSA),	**10 Hours** **L(3):T(3):P(4)**

Course outcomes:

At the end of the course the students will be able to:

- **CO1**: Understand the basic concepts of Neural Network.
- **CO2**: Apply the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- **CO3**: Develop Generative models using Convolutional neural Network.
- **CO4**: Study on recent trends and applications of deep learning.
- **CO5**: Identify the model based from the model free methods. Identify stability/convergence and approximation properties of RL algorithms. Use deep learning methods to RL problems in practice.

Textbooks:

1. Deep Learning, Lan Good fellow and Yoshua Bengio and Aaron Courville, MIT Presshttps://www.deeplearn ingbook.org/, 2016.
2. Richard S. Sutton and Andrew G. Barto, Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2017. ISBN-13 978-0262039246.
3. Dimitri Bertsekas and John G. Tsitsiklis, Neuro Dynamic Programming, Athena Scientific. 1996. ISBN-13: 978-1886529106.

Reference Books:

1. Neural Networks, A systematic Introduction, Raúl Rojas, 1996.
2. Pattern Recognition and machine Learning, Chirstopher Bishop, Springer, 2007.
3. V. S. Borkar, Stochastic Approximation: A Dynamical Systems Viewpoint, Hindustan Book Agency, 2009. ISBN-13: 978-0521515924.
4. Deep Learning. Ian Goodfellow and Yoshua Bengio and Aaron Courville. MIT Press. 2016.ISBN-13: 978-0262035613.

DEEP LEARNING LABORATORY

PART	Course Content	Teaching Hours
PART A	1. Design a single unit perceptron for classification of a linearly separable binary dataset without using pre-defined models. Use the Perceptron() from sklearn. 2. Identify the problem with single unit Perceptron. Classify using Or-, And- and Xor-ed data and analyze the result. 3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. Vary the activation functions used and compare the results. 4. Build a Deep Feed Forward ANN by implementing the Backpropagation algorithm and test the same using appropriate data sets. Use the number of hidden layers >=4. 5. Design and implement an Image classification model to classify a dataset of images using Deep Feed Forward NN. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets. 6. Design and implement a CNN model (with 2 and with 4+ layers of convolutions) to classify multi category image datasets. Use the MNIST, Fashion MNIST, CIFAR-10 datasets. Set the No. of Epoch as 5, 10 and 20. Make the necessary changes whenever required. Record the accuracy corresponding to the number of epochs. Record the time required to run the program, using CPU as well as using GPU in Colab. and Test accuracy corresponding to the following architectures: a. Base Model b. Model with L1 Regularization c. Model with L2 Regularization d. Model with Dropout e. Model with both L2 (or L1) and Dropout.	**10 Hours**
PART B	7. Use the concept of Data Augmentation to increase the data size from a single image. 8. Design and implement a CNN model to classify CIFAR10 image dataset. Use the concept of Data Augmentation while designing the CNN model. Record the accuracy corresponding to the number of epochs. 9. Implement the standard LeNet-5 CNN architecture model to classify multicategory image dataset (MNIST, Fashion MNIST) and check the accuracy. 10. Implement the standard VGG-16 & 19 CNN architecture model to classify multi category image dataset and check the accuracy. 11. Implement RNN for sentiment analysis on movie reviews. 12. Implement Bidirectional LSTM for sentiment analysis on movie reviews.	**10 Hours**

Laboratory Outcomes:

The student should be able to illustrate the following operations:

- Understand and Implement Basic Deep Learning Models and Understand and Implement Backpropagation Algorithm.
- Explore Convolutional Neural Networks (CNNs) and Work with Advanced CNN Architectures
- Implement Deep Feed Forward Networks, explore Recurrent Neural Networks (RNNs) and LSTMs and Leverage GPUs for Training.

Web References:

1. Deep Learning with Python.
2. TensorFlow Tutorials.
3. PyTorch Tutorials and Understanding CNNs.

Descriptions (if any):

The programs can be implemented in Python and Data sets can be taken from standard repositor.

Natural Language Processing (21AI72)

VII Semester NATURAL LANGUAGE PROCESSING			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Need for processing of natural languages, Language processing levels, Applications of NLP, Ambiguity and uncertainty in language, Regular Expressions, NLP tasks in syntax, semantics and pragmatics, Machine Translation.	**08 Hours L(4):T(4)**
Module 2	**Morphological Processing:** Introduction to Corpus, Tokenization, Stemming, Lemmatization Inflectional and Derivational morphology, Morphological parsing, Finite state transducers, N- gram language models, practical illustrations with NLTK, **Python3**: Textual sources, APIs, social media and Web Scraping, practical illustrations with NLTK, Python3, Textual sources, APIs, social media and Web Scraping.	**08 Hours L(4):T(4)**
Module 3	**Information Retrieval**: Design features of Information Retrieval Systems, Classical, non-classical, Alternative Models of Information Retrieval, valuation Lexical Resources: World Net-Frame Net-Stemmers. **Part-of-Speech Tagging**: POS Tagger- Research Corpora.	**08 Hours L(4):T(4)**
Module 4	**Large Language Models**: History and evolution of LLMs, Neural Network Architecture Building Blocks for LLMs, LLM models, Transformer Architecture, Training and Fine-tuning LLMs-Data collection, data Preprocessing, and fine-tuning strategies., Transformer variants: BERT, GPT Architecture, XLNet.	**08 Hours L(4):T(4)**
Module 5	**Applications on Large Language Models**: Language translation, summarization, and paraphrasing. Exploring GPT-based applications-chatbots, content generation, and sentiment analysis, Advantages and Challenges of LLM, Ethical and Societal Implications	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the students will be able to:
CO1: Understand the basic terminology and theory behind underlying natural language processing.
CO2: Understand approaches inflectional and derivational morphology and finite state transducers
CO3: Understand approaches to part of speech tagging, parsing syntax and semantics in NLP.
CO4: Understand basics of large language models and fine tuning LLM
CO5: Understand the applications of BERT, GPT.

Reference Books:

1. D. Jura sky and J. H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education,2008
2. J. Allen, Natural Language Understanding, Addison Wesley, 2007.
3. Vineet Chaitanya, Rajeev Sangal. Natural Language Processing - A Paninian Perspective by Akshar Bharathi.

Professional Elective -III/IV (21AI731)

VII Semester ALGORITHMS FOR CLUSTER DATA			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**An Introduction to Cluster Analysis:** Introduction, Common Techniques Used in Cluster Analysis, Data Types Studied in Cluster Analysis, Insights Gained from Different Variations of Cluster Analysis.	**08 Hours L(4):T(4)**
Module 2	**Advanced Cluster Analysis**: Feature Selection Methods, Probabilistic Model-Based, Distance-Based Algorithms, Density and Grid Based Methods. Leveraging Dimensionality Reduction Methods. **Clustering High-Dimensional Data:** Problems, Challenges and Major Methodologies, Subspace Clustering Methods, Bi-clustering, Dimensionality Reduction Methods and Spectral Clustering.	**08 Hours L(4):T(4)**
Module 3	**A Survey of Stream Clustering Algorithms:** Introduction**,** Methods Based on Partitioning Representatives**,** Big Data Clustering, Clustering Categorical Data, Clustering Multimedia Data, Time-Series Data Clustering, Clustering Biological Data, Network Clustering.	**08 Hours L(4):T(4)**
Module 4	**Semi supervised Clustering:** Introduction, semi supervised Grap Cuts, A Unified View of Label Propagation, semi supervised Embedding, Comparative Experimental Analysis, **Cluster Ensembles**: Theory and Applications, Clustering Validation Measures, Educational and Software Resources for Data Clustering,	**08 Hours L(4):T(4)**
Module 5	**Applications of Clustering:** Clustering Gene Expression Data, Types of Gene Expression Data Clustering, Similarity Measures for Gene Expression Data. **MATLAB and C++ for Clustering:** Data Clustering in MATLAB, Clustering in C/C++, The kd-tree Data Structure	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Identify data mining problems.
CO2: Write association rules for a given data pattern.
CO3: Choose between classification and clustering solution.
CO4: Apply clustering algorithms to analyze and interpret data patterns.
CO5: Evaluate and compare the performance of different clustering algorithms.

Text Books:

1. "Algorithms for Clustering Data" by Anil K. Jain and Richard C. Dubes
2. "Data Clustering: Theory, Algorithms, and Applications" by Guojun Gan, Chaoqun Ma, and Jianhong Wu

References:

1. Handbook of Cluster Analysis" by Christian Hennig, Marina Meila, Fionn Murtagh, and Roberto Rocci.
2. "Stream Data Mining: Algorithms and Their Applications" by Joachim Bähr, Mehmet Gönen, and Michael Goebel.

Professional Elective -III/IV (21AI732)

VII Semester BLOCKCHAIN TECHNOLOGY			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Blockchain:** Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.	**08 Hours L(4):T(4)**
Module 2	**Decentralization and Cryptography:** Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Found	**08 Hours L(4):T(4)**
Module 3	**Bitcoin and Alternative Coins A:** Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins Theoretical foundations, Bitcoin limitations, Name coin, Litecoin, Primecoin, Z cash	**08 Hours L(4):T(4)**
Module 4	**Smart Contracts and Ethereum 101:** Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts	**08 Hours L(4):T(4)**
Module 5	**Alternative Blockchains:** Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Define and explain the fundamentals of Blockchain.

CO2: Illustrate the technologies of blockchain.

CO3: Describe the models of blockchain.

CO4: Analyse and demonstrate the Ethereum.

CO5: Analyse and demonstrate Hyperledger fabric.

Text Books:

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packet Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.

References:

3. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016.
4. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017.
5. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014.

Professional Elective -III/IV (21AI733)

VII Semester DIGITAL IMAGE PROCESSING			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Digital image fundamentals**: Digital Image Representation, Fundamental steps in Image Processing, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, colour models.	**08 Hours L(4):T(4)**
Module 2	**Image enhancement**: Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering, **Frequency Domain:** 2D Fourier Transform, Smoothing and Sharpening frequency domain filters.	**08 Hours L(4):T(4)**
Module 3	**Image restoration and segmentation**: Noise models, Mean filters, Order Statistics, Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum Notch filtering, Inverse filtering, Wiener filtering. **Segmentation:** Edge detection Edge Linking and Boundary detection, Region based segmentation, Morphological processing, erosion and dilation.	**08 Hours L(4):T(4)**
Module 4	**Image compression and representation:** Compression Fundamentals, Image Compression models, Error Free Compression, Lossy compression, Image Compression standards	**08 Hours L(4):T(4)**
Module 5	**Image representation and recognition:** Boundary representation, Chain Code, Polygonal approximation, signature, Boundary segments, Boundary description, Shape number Fourier Descriptor, moments, Regional Descriptors, Topological feature, Texture, Patterns and Pattern classes, Recognition based on matching.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Discuss digital image fundamentals.
CO2: Articulate image enhancement and restoration techniques.
CO3: Articulate image restoration and implementing segmentation techniques
CO4: Examining image compression Techniques and its representation
CO5: Representation and recognition of images

Text Books

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

References

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

References:

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020.
5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1st Edition, Oreily Publications, 2014.

Weblinks and Video Lectures (e-Resources):

1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials

2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao

3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE

4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k

5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Real world problem solving - applying the Django framework concepts and its integration with AJAX to develop any shopping website with admin and user dashboards.

Professional Elective -III/IV (21AI734)

VII Semester FUZZY SETS THEORY			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Historical perspective, utility of fuzzy systems, limitations of fuzzy systems, statistics and random processes, uncertainty in information, fuzzy sets and membership, chance versus fuzziness, sets as points in Hypercube. **Classical Sets and Fuzzy Sets:** classical sets, operations on them, mapping of classical sets to functions, fuzzy sets, fuzzy set operations, properties of fuzzy sets, non-interactive fuzzy sets	**08 Hours L(4):T(4)**
Module 2	**Classical Relations and Fuzzy Relations:** Cartesian Product, Crisp Relations, Cardinality of Crisp Relations, Operations on Crisp Relations, and Properties of Crisp Relations, Composition. **Fuzzy Relations;** Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, non-interactive Fuzzy Sets.	**08 Hours L(4):T(4)**
Module 3	**Membership Functions:** Features of the Membership Function, Standard Forms and Boundaries, Fuzzification, defuzzification to crisp sets, Lambda-Cuts for Fuzzy Sets, Lambda Cuts for Fuzzy Relations, Defuzzification Methods.	**08 Hours L(4):T(4)**
Module 4	**Fuzzy Arithmetic and the Extension Principle:** Crisp Functions, Mapping and Relations, Functions of fuzzy Sets, Extension Principle, Fuzzy Transform (Mapping), Practical Considerations. Fuzzy Numbers Interval Analysis in Arithmetic. **Methods of Extension:** Vertex method, DSW Algorithm, Restricted DSW Algorithm, Comparisons. Fuzzy Vectors.	**08 Hours L(4):T(4)**
Module 5	**Fuzzy Rule Based Systems:** Natural Language, Linguistic Hedges, Rule-Based Systems, Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules. Graphical Techniques of Inference.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Provide basic elements of fuzzy sets.

CO2: Differentiate between fuzzy set and classical set theory.

CO3: Apply fuzzy membership functions to solve value assignment problems.

CO4: Explain approximate methods of fuzzy arithmetic and extension principle.

CO5: Discuss the applications of fuzzy rule-based systems.

Text Books:

1. Fuzzy Logic with Engineering Applications Timothy J. Ross Wiley India International edition,2010.

References:

1. Fuzzy Logic- Intelligence, Control, and information John Yen Reza Langari Pearson Education 1st Edition, 2004
2. Fuzzy Sets and Fuzzy Logic-Theory and Applications George J. KlirBo Yuan Prentice Hall of India 1 st Edition, 2000
3. Fuzzy Mathematical approach to pattern Recognition, S K Pal, and D Dutta Majumder, John Wiley 1986
4. Neuro-fuzzy pattern recognition: methods in soft computing, S K Pal and S Mitra
5. Fuzzy set theory and its applications by H J Zimmermann, Springer Publications

Professional Elective -III/IV (21AI735)

VII Semester GENERATIVE ARTIFICIAL INTELLIGENCE			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Generative AI:** Overview of AI and generative models, Differences between discriminative and generative models, Applications of generative AI, Introduction to key concepts: probability distributions, latent variables, etc.	**08 Hours L(4):T(4)**
Module 2	**Deep Learning for Generative Models**: Neural networks refresher, Autoencoders and Variational Autoencoders (VAEs), Introduction to Generative Adversarial Networks (GANs), **Advanced Generative Models**: Deep Convolutional GANs (DCGANs), Recurrent Neural Networks (RNNs) and their generative applications, Transformer models and their generative capabilities, **Hands-on:** Building a simple generative model.	**08 Hours L(4):T(4)**
Module 3	**Applications and Evaluation of Generative AI:** Data augmentation with generative models, Generative models in design and manufacturing, Evaluation metrics for generative models, Ethical considerations and societal impacts. **Case Studies**: Image and text generation and enhancement, Natural Language Processing, Music and audio generation, Style transfer and creative arts, Healthcare and drug discovery	**08 Hours L(4):T(4)**
Module 4	**Generative AI Prompt Engineering Basics:** principles of prompt engineering, Introduction to Prompt Engineering, Techniques for Effective Prompt Engineering, Examples of successful prompts in generative AI, crafting clear and specific prompts, Utilizing context and examples in prompts, Iterative testing and refinement of prompts.	**08 Hours L(4):T(4)**
Module 5	**Capstone Project:** Project ideation and proposal, Dataset collection and Preprocessing, Model selection, training, and refinement, Presentation of projects and peer review.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Understand the principles and algorithms behind generative models.

CO2: Apply generative models to create new data instances and solve engineering problems.

CO3: Evaluate the performance of generative models in various applications.

CO4: Explore the ethical implications and responsible use of generative AI.

CO5: Develop a capstone project that incorporates generative AI techniques to address a real-world problem.

Text Books:

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

References:

1. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster
2. "GANs in Action: Deep learning with Generative Adversarial Networks" by Jakub Langr and Vladimir Bok

Online Resources:

1. TensorFlow and PyTorch documentation for practical exercises
2. ArXiv for accessing the latest research papers on generative models
3. Online courses and tutorials (Coursera, edX, Udacity)

Professional Elective -III/IV (21AI736)

VII Semester INFORMATION RETRIEVAL			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Basic Concepts, Retrieval Process Modelling Classic Information, Retrieval Set Theoretic, Algebraic and Probabilistic Models.	**08 Hours L(4):T(4)**
Module 2	**Retrieval Techniques:** Structured Text Retrieval Models, Retrieval Evaluation, Word Sense Disambiguation.	**08 Hours L(4):T(4)**
Module 3	**Querying: Languages:** Key Word-based Querying, Pattern Matching, Structural Queries, Query Operations, User Relevance Feedback, Local and Global Analysis	**08 Hours L(4):T(4)**
Module 4	**Text Operations:** Document Pre-processing, Clustering, Text Compression, Indexing and Searching, Inverted files, Boolean Queries, Sequential searching, Pattern matching.	**08 Hours L(4):T(4)**
Module 5	**User Interface & Applications:** User Interface and Visualization, Human Computer Interaction, Access Process, Starting Points, Query Specification, Context User relevance Judgment, Interface for Search. **Searching the Web Challenges:** Characterizing the Web, Search Engines, Browsing, Meta searchers, Online IR systems, Online Public Access Catalogs.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Apply information retrieval principles to locate relevant information in large collections of data and Implement features of retrieval systems for web-based search tasks.
CO2: Apply the common algorithms and techniques for information retrieval related to document indexing and query processing
CO3: Demonstrate a thorough understanding and solid knowledge of the principles and techniques of human-computer interaction
CO4: Implement graphical user interfaces with modern software tools and develop and design interactive software systems applications for real time applications
CO5: Design and develop web applications for the effective informational retrieval

Text Books:

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, Modern Information Retrieval, Pearson Education Asia, 2012.

References:

1. G.G. Chowdhury, Introduction to Modern Information Retrieval, Second Edition, Neal- Schuman Publishers, 2010.

Professional Elective -III/IV (21AI737)

VII Semester PREDICTIVE ANALYTICS			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Predictive analytics:** Business analytics: types, applications, Analytical Techniques, Tools.	**08 Hours L(4):T(4)**
Module 2	**Predictive Modelling:** Propensity Models, Cluster Models, Applications.	**08 Hours L(4):T(4)**
Module 3	**Modelling Techniques:** Statistical Modelling, Machine Learning, Empirical Bayes Method, Point Estimation.	**08 Hours L(4):T(4)**
Module 4	**Data Pre-processing:** Data Transformations for Individual Predictors, Data Transformation for Multiple Predictors, Dealing with Missing Values, Removing Predictors, Adding Predictors, Binning Predictors. Over-Fitting and Model Tuning.	**08 Hours L(4):T(4)**
Module 5	**Regression Models:** Measuring Performance in Regression Models, Linear Regression and Its Cousins, Non-Linear Regression Models, Regression Trees and Rule-Based Models. **Case Study:** Compressive Strength of Concrete Mixtures.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Understand the importance of predictive analytics, able to prepare and process data for the models.

CO2: Apply the statistical techniques for predictive models.

CO3: Comprehend the transformation of data in the predictors.

CO4: Apply regression and classification models for decision making and evaluate the performance.

CO5: Apply and build the time series forecasting models in a variety of business contexts.

Text Books:

2. Jeffrey S. Strickland, Predictive Analytics using R,2014.
3. Max Kuhn and Kjell Johnson, Applied Predictive Modelling, 1st edition Springer, 2013.

References:

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, 1st Edition Wiley, 2014.

Professional Elective -III/IV (21AI738)

VII Semester SOFT COMPUTING			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T: P	2:2:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Soft computing:** Neural networks, Symbolic Data, Genetic algorithms, Hybrid systems and its applications. (ANN, FS, GA, SI, ES, Comparing among intelligent systems) **BNN:** introduction, biological inspiration, BNN & ANN, classification, first Generation NN, perceptron, illustrative problems (2nd generation), introduction, BPN, KNN, HNN, BAM, RBF, SVM and illustrative problems.	**08 Hours L(4):T(4)**
Module 2	**Symbolic Data:** Symbolic and Classical Data, Categories, Concepts, and Symbolic Objects, Basic Descriptive Statistics: One Variate, Descriptive Statistics: Two or More Variates, Principal Component Analysis, Regression Analysis, **Cluster Analysis:** Dissimilarity and Distance Measures, Clustering Structures, Partitions, Hierarchy–Divisive Clustering, Hierarchy–Divisive Clustering.	**08 Hours L(4):T(4)**
Module 3	**Genetic algorithms:** Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, Operators, Stopping conditions for GA flow.	**08 Hours L(4):T(4)**
Module 4	**Swarm Intelligence System:** Introduction, background of SI, Ant colony system Working of ant colony optimization, ant colony for TSP. Unit commitment problem, Particle Swarm Intelligence system, Artificial bee colony system, Cuckoo search system.	**08 Hours L(4):T(4)**
Module 5	**Hybrid Systems:** Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.	**08 Hours L(4):T(4)**

Course outcomes:

At the end of the course the student will be able to:

CO1: Implement machine learning through neural networks.
CO2: Design Genetic Algorithm to solve the optimization problem.
CO3: Develop a Fuzzy expert system.
CO4: Model Neuro Fuzzy system for clustering and classification.
CO5: Understand soft computing techniques Apply the learned techniques to solve realistic problems Differentiate soft computing with hard computing techniques

Text Books:

1. Principles of Soft computing, Shivanandam, Deepa S. N, Wiley India, 2011/Reprint2014
2. Soft Computing with MATLAB Programming, N. P. Padhy, S.P. Simon, Oxford, 2015.
3. Symbolic Data Analysis: Conceptual Statistics and Data Mining, Editor(s): Edwin Diday, Monique Noirhomme-Fraiture, First published:18 January 2007.

References:

1. Neuro-fuzzy and soft computing, S.R. Jang, C.T. Sun, E. Mizutani, Phi (EEE edition), 2012.
2. Soft Computing, Saroj Kaushik, Sunita Tiwari, McGraw-Hill, 2018.

Ability Enhancement Course-III (21AEC751)

VII Semester DIGITAL IMAGE PROCESSING APPLICATIONS			
No. of Teaching hour/Week	0	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	
Total No. of Lecture hours	20	**Exam Hours**	03
L: T: P	0:0:2	**Credits**	01

PART	Course Content	Teaching Hours
PART A	1. Write a Program to read a digital image. Split and display image into 4 quadrants, up, down, right and left. 2. Write a program to show rotation, scaling, and translation of an image. 3. Read an image, first apply erosion to the image and then subtract the result from the original. Demonstrate the difference in the edge image if you use dilation instead of erosion.	**10 Hours**
PART B	4. Read an image and extract and display low-level features such as edges, textures using filtering techniques. 5. Demonstrate enhancing and segmenting low contrast 2D images	**10 Hours**

Mini Project List:

- Student should develop a mini project, some of the projects are listed and it is not limited to:

Similar to but not limited to:

- ✓ Recognition of License Plate through Image Processing.
- ✓ Recognition of Face Emotion in Real-Time.
- ✓ Detection of Drowsy Driver in Real-Time.
- ✓ Recognition of Handwriting by Image Processing.
- ✓ Detection of Kidney Stone.
- ✓ Verification of Signature.
- ✓ Compression of Colour Image.
- ✓ Classification of Image Category.
- ✓ Detection of Skin Cancer.
- ✓ Marking System of Attendance using Image Processing.
- ✓ Detection of Liver Tumour.
- ✓ IRIS Segmentation.
- ✓ Detection of Skin Disease and / or Plant Disease.
- ✓ Biometric Sensing System.
- ✓ Mobile Phone Camera-based Light Communications.
- ✓ Modelling of Perspective Distortion within Face Images & Library for Object Tracking.
- ✓ Controlling of Intelligent Traffic Light & Image Processing.
- ✓ Controlling of Pests in Agriculture Field with Image Processing.

Laboratory Outcomes:

The student should be able to illustrate the following operations:

- Image Segmentation algorithm development.
- Image filtering in spatial and frequency domain.
- Morphological operations in analyzing image structures.

Course Learning Objectives:

This course will enable students to:

CO1: Demonstrate the basic skills of image process.

CO2: Demonstrate the application development skills.

CO3: Design and develop the applications of images.

Descriptions (if any):

1. Programming tools preferred: MATLAB, SCILAB, Python, Java or any other relevant platform.
2. For Part A: Students must exhibit the results and its print copy to be attached to Lab record.
3. For Part B: Real Time Images can be used to demonstrate the work.

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

Ability Enhancement Course-III (21AEC752)

VII SEMESTER GENERATIVE AI APPLICATIONS			
No. of Teaching hour/Week	0	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	
Total No. of Lecture hours	20	**Exam Hours**	03
L: T: P	0:0:2	**Credits**	01

PART	Course Content	Teaching Hours
PART A	1. **Autoencoders:** Implement a basic autoencoder for image compression and reconstruction. **Dataset**: MNIST or CIFAR-10. 2. **Variational Autoencoders (VAEs):** Build and train a VAE to generate new images. **Dataset:** Fashion-MNIST or a subset of CelebA. 3. **Introduction to GANs**: Create a simple Generative Adversarial Network to generate digits. **Dataset**: MNIST. 4. **DCGANs**: Implement a Deep Convolutional GAN to generate higher quality images. **Dataset**: CIFAR-10. 5. **Text Generation with RNNs**: Use a Recurrent Neural Network to generate text character by character. **Dataset**: A text corpus like Shakespeare's plays or a collection of tweets. 6. **Conditional GANs:** Develop a conditional GAN to generate images conditioned on class labels. **Dataset**: MNIST or CIFAR-10 with class labels.	**10 Hours**
PART B	1. **Style Transfer**: Implement neural style transfer to apply the artistic style of one image to another. **Dataset**: A content image and a style reference image. 2. **Pix2Pix:** Use Pix2Pix (a conditional GAN) for image-to-image translation tasks. **Dataset**: Facades or Maps for translating sketches to real images. 3. **CycleGAN**: Implement CycleGAN for unpaired image-to-image translation. **Dataset**: Horse2Zebra or other available CycleGAN datasets. 4. **Text-to-Image Generation**: Build a model to generate images from textual descriptions. **Dataset**: CUB-200 (birds) with text annotations or a similar dataset. 5. **Music Generation with LSTM**: Create a Long Short-Term Memory (LSTM) network to generate musical sequences. **Dataset**: ABC notation of folk music tunes or MIDI files of simple melodies. a. Voice Synthesis with WaveNet b. Implement a WaveNet model to generate raw audio waveforms. **Dataset**: A small subset of the VCTK corpus or other available speech datasets.	**10 Hours**

Laboratory Outcomes: To provide practical experience in implementing and working with generative models. The student should be able to illustrate the following operations:

- Focus on the key learning objectives within the time constraints.
- datasets should be pre-processed if necessary to allow students to focus on the generative modeling aspects.
- Evaluate the performance of generative models in various applications.

Course Learning Objectives:

This course will enable students to:

CO1: Implementing various neural network architectures for image compression, reconstruction, and generation.
CO2: Designing and training advanced generative models for high-quality images.
CO3: Developing and applying neural network techniques for diverse applications.
CO4: Utilizing deep learning models for creative tasks like neural style transfer and text-to-image generation.
CO5: Understanding and applying soft computing techniques for solving realistic problems.

Descriptions (if any):

Software Requirements: Python programming environment with libraries such as TensorFlow, Keras, PyTorch, NumPy, Matplotlib, and Jupyter Notebooks

Ability Enhancement Course-III (21AEC753)

VII SEMESTER PROJECT MANAGEMENT USING GIT			
No. of Teaching hour/Week	0	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	
Total No. of Lecture hours	20	**Exam Hours**	03
L: T: P	0:0:2	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Version Control and Git:** Overview of version control systems, **Introduction to Git:** basic commands and workflows, setting up a GitHub account and understanding the GitHub interface, creating repositories, cloning, committing, pushing, and pulling changes	**04 Hours**
Module 2	**Collaboration and Branching Strategies:** Branching and merging workflows, Collaborative development using forks and pull requests, Code reviews and managing pull requests, Branching strategies for project management (e.g., Git Flow)	**04 Hours**
Module 3	**Issue Tracking and Project Management:** Using GitHub Issues for tracking bugs and feature requests, Labelling, filtering, and searching issues, Milestones, projects, and Kanban boards for project planning, Automating workflows with GitHub Actions	**04 Hours**
Module 4	**Advanced Git Features**: Managing project documentation with GitHub Pages, securing repositories with branch protection rules and security policies, Utilizing GitHub Actions for continuous integration (CI) and continuous deployment (CD), GitHub Advanced Security features and code scanning.	**04 Hours**
Module 5	**Open-Source Projects and Community Engagement:** Best practices for open-source project maintenance, **Engaging with the community**: issues, discussions, and contributions - Licensing and the legal aspects of open-source projects, Case studies of successful projects managed on GitHub.	**04 Hours**

Laboratory Outcomes:

The student should be able to illustrate the following operations:

- The principles and practices of project management with a focus on using GitHub as a platform for collaboration, version control, and project tracking
- manage software development projects effectively using GitHub's tools and features.
- Basic understanding of software development and version control concepts.

Course Learning Objectives:

This course will enable students to:

CO1: Understand the basics of version control and the Git workflow

CO2: Utilize GitHub for project collaboration and source code management

CO3: Implement issue tracking and project management features in GitHub

CO4: Apply best practices for maintaining and contributing to open-source projects on GitHub

CO5: Integrate external tools and services with GitHub for continuous integration and deployment.

Descriptions (if any):

Main Resource:

1. GitHub Docs (https://docs.github.com/en)

Reference Resources:

2. "Pro Git" by Scott Chacon and Ben Straub (available for free at https://git-scm.com/book/en/v2)
3. "GitHub Essentials" by Achilleas Pipinellis.

Online Tutorials and Courses:

4. GitHub Learning Lab (https://lab.github.com/)
5. GitHub Guides (https://guides.github.com/)

Ability Enhancement Course-III (21AEC754)

VII SEMESTER TECHNICAL WRITING WITH LATEX			
No. of Teaching hour/Week	0	**CIE Marks**	50
No. of Practical hours/week	2	**SEE Marks**	
Total No. of Lecture hours	20	**Exam Hours**	03
L: T: P	0:0:2	**Credits**	01

<table>
<tr><th>PART</th><th>Course Content</th><th>Teaching Hours</th></tr>
<tr><td>PART A</td><td>
1. Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.
2. Develop a LaTeX script to create a document that displays the sample Abstract/Summary
3. Develop a LaTeX script to create a simple title page of the VTU project Report [Use suitable Logos and text formatting]
4. Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]
5. Develop a LaTeX script to create a document that contains the following table with proper labels.
<table>
<tr><th rowspan="2">Sl.No</th><th rowspan="2">USN</th><th rowspan="2">Student Name</th><th colspan="3">MARKS</th></tr>
<tr><th>S1</th><th>S2</th><th>S3</th></tr>
<tr><td>1</td><td>4XX22XX001</td><td>Name 1</td><td>89</td><td>60</td><td>90</td></tr>
<tr><td>2</td><td>4XX22XX002</td><td>Name 2</td><td>78</td><td>45</td><td>98</td></tr>
<tr><td>3</td><td>4XX22XX003</td><td>Name 3</td><td>67</td><td>55</td><td>59</td></tr>
</table>
6. Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept.
</td><td>10 Hours</td></tr>
<tr><td>PART B</td><td>
7. Develop a LaTeX script to create a document that consists of the following two mathematical equations.
$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$
$$= \frac{-2 \pm \sqrt{2^2-4*(1)*(-8)}}{2*1}$$
$$= \frac{-2 \pm \sqrt{4+32}}{2}$$
$$\varphi_\sigma^\lambda A_t = \sum_{\pi \in C_t} \mathrm{sgn}(\pi)\varphi_\sigma^\lambda \varphi_\pi^\lambda$$
$$= \sum_{\tau \in C_{\sigma t}} \mathrm{sgn}(\sigma^{-1}\tau\sigma)\varphi_\sigma^\lambda \varphi_{\sigma^{-1}\tau\sigma}^\lambda$$
$$= A_{\sigma t}\varphi_\sigma^\lambda$$
8. Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document
9. Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section
</td><td>10 Hours</td></tr>
</table>

	10. Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library 11. Develop a LaTeX script to present an algorithm in the document using algorithm/algorithmic/algorithm2e library 12. Develop a LaTeX script to create a simple report and article by using suitable commands and formats of user choice.	

Course outcomes:
At the end of the course the students will be able to:

CO1: Understand the fundamental concepts of technical writing and LaTeX.
CO2: Create and format professional documents using LaTeX.
CO3: Incorporate graphics, tables, and mathematical equations into LaTeX documents.
CO4: Manage bibliographies and citations with BibTeX.
CO5: Develop a comprehensive understanding of advanced LaTeX features for professional document preparation.

References:

1. Guide to LATEX, fourth edition, Helmut Kopka, Patrick W.Daly
2. https://www.overleaf.com/learn/latex/Beamer#Reference_guide.
3. https://mirror.niser.ac.in/ctan/macros/latex/contrib/beamer/doc/beameruserguide.pdf

Textbooks:

1. "Guide to LaTeX" by Helmut Kopka and Patrick W. Daly.

Reference Textbooks:

2. "LaTeX: A Document Preparation System" by Leslie Lamport.
3. "The LaTeX Companion" by Frank Mittelbach and Michel Goossens.

Online Resources:

1. CTAN (Comprehensive TeX Archive Network) for packages and documentation.
2. Overleaf and ShareLaTeX for online LaTeX editing and collaboration.
3. LaTeX Stack Exchange for community support and Q&A.