MVJCE CURRICULUM

FOR

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING(Scheme 2022)

III SEMESTER

Mathematics for Computer Science		*Semester*	*3*
Course Code	*MVJ22AI31*	*CIE Marks*	*50*
Teaching Hours/Week (L: T:P: S)	*2:2:0:0*	*SEE Marks*	*50*
Total Hours of Pedagogy	*30 hours Theory + 10 Hours Tutorial*	*Total Marks*	*100*
Credits	*03*	*Exam Hours*	*3*
Examination type (SEE)	Theory		

Course objectives: This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

Teaching-Learning Process

Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: **Probability Distributions**

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. (12 Hours)

(RBT Levels: L1, L2 and L3)

Pedagogy	Chalk and Board, Problem-based learning

Module-2: **Joint probability distribution & Markov Chain**

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. (12 Hours) **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem-based learning
Module-3: **Statistical Inference 1**	
Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. (12 Hours) **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem-based learning
Module-4: **Statistical Inference 2**	
Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. (12 Hours) **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem-based learning
Module-5: **Design of Experiments & ANOVA**	
Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. (12 Hours) **(RBT Levels: L1, L2 and L3)**	
Pedagogy	Chalk and Board, Problem-based learning

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and thesecond test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct twoassignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methodsof assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom'staxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with commonquestion papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (witha maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students must answer 5 full questions, selecting one full question from each module.Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability &Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. Peter Bruce, Andrew Bruce & Peter Gedeck "Practical Statistics for DataScientists" O'Reilly Media, Inc., 2nd edition 2020.

Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition andYear)

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons,9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", LaxmiPublication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics withApplications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand andCompany, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D.
10. Reidel PublishingCompany. Distributed by Hindustan Publishing

Corporation (India) Delhi, 1983.
11. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, (Reprint), 2003.
12. S. Ross, “A First Course in Probability”, Pearson Education India, 6th Ed., 2002.
13. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 3rd Ed.,
14. N.P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
15. Veerarajan T, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

Web links and Video Lectures (e-Resources):

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.bookstreet.in.
VTU EDUSAT PROGRAMME – 20
VTU e-Shikshana Program

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

- Programming Assignment
- Seminars

CO-PO/PSO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	OPERATINGSYSTEMS	Semester	3
Course Code	*MVJ22AI32*	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 hours practical	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	**Theory**		

Course objectives:

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
5. Role play for process scheduling.
6. Demonstrate the installation of any one Linux OS on VMware/Virtual Box

MODULE-1 **8 Hours**

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 debugging, Operating System generation; System boot.

Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)

MODULE-2 **8 Hours**

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

MODULE-3 **8 Hours**

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization.

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)

MODULE-4 **8 Hours**

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)

MODULE-5 **8 Hours**

File System, Implementation of File System: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process)
2	Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority.
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C program which demonstrates inter-process communication between a reader process and a writer process. Use mk fifo, open, read, write and close APIs in your program.
5	Develop a C program to simulate Bankers Algorithm for Deadlock Avoidance.
6	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Simulate following File Organization Techniques a) Single level directory b) Two level directory

9	Develop a C program to simulate the Linked file allocation strategies.
10	Develop a C program to simulate SCAN disk scheduling algorithm.

11	Debug a given C program
	//Moving Disk head to the inner most requested cylinder because this is Circular LOOK.
	queue[i]=queue2[0];
	
	//Copying second array queue2[] after that first one is copied, into queue []
	for(i=temp1+1,j=0;j<temp2;i++,j++)
	{
	queue[i]=queue2[j];
	}
	
	//At this point, we have the queue[] with the requests in the
	//correct order of execution as per C-LOOK algorithm.
	//Now we have to set 0th index of queue[] to be the initial headposition.
	queue[0]=headposition;
	
	// Calculating SEEK TIME. seek is initially set to 0 in the declaration part.
	
	for(j=0; j<n; j++) //Loop starts from headposition. (ie. 0th index of queue)
	{
	// Finding the difference between next position and current position.
	difference = absoluteValue(queue[j+1]-queue[j]);
	
	// Adding difference to the current seek time value
	seek = seek + difference;
	
	// Displaying a message to show the movement of disk head
	printf("Disk head moves from position %d to %d with Seek %d \n",
	queue[j], queue[j+1], difference);
	}

Course outcomes (Course Skill Set):

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

CO 1. Explain the structure and functionality of operating system

CO 2. Apply appropriate CPU scheduling algorithms for the given problem.

CO 3. Analyze the various techniques for process synchronization and deadlock handling.

CO 4. Apply the various techniques for memory management

CO 5. Explain file and secondary storage management strategies.

CO 6. Describe the need for information protection mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus. Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theorycomponent of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a

- **CIE component only. Questions mentioned in the SEE paper may include questions from the practicalcomponent**.

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

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

Web links and Video Lectures (e-Resources):

1. https://youtu.be/mXw9ruZaxzQ
2. https://youtu.be/vBURTt97EkA
3. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_
4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

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

- Assessment Methods
  - Case Study on Unix Based Systems (10 Marks)

Lab Assessment (25 Marks)

CO-PO/PSO Mapping																
CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Digital Design and Computer Organization		Semester	3
Course Code	MVJ22AI33	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- *To demonstrate the functionalities of binary logic system*
- *To explain the working of combinational and sequential logic system*
- *To realize the basic structure of computer system*
- *To illustrate the working of I/O operations and processing unit*

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Live Demo with experiments
3. Power point presentation

MODULE-1	8 Hr

Introduction to Digital Design: Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9

MODULE-2	8 Hr

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.

MODULE-3	8 Hr

Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.

Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5

MODULE-4	8 Hr

Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1

MODULE-5	8 Hr

Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance.

Text book 2: 7.1, 7.2, 8.1

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for *assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of thesyllabus and the second test after covering 85-90% of the syllabus.*
- *Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of PCC (that is for* 50 marks*).*
- *The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of PCC.*

SEE for PCC

*Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (*duration 03 hours*)*

1. *The question paper will have ten questions. Each question is set for 20 marks.*
2. *There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions),* should have a mix of topics *under that module.*
3. *The students have to answer 5 full questions, selecting one full question from each module.*
4. *Marks scored by the student shall be proportionally scaled down to 50 Marks*

The theory portion of the PCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.

Suggested Learning Resources:

Books

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

https://cse11-iiith.vlabs.ac.in/

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

Assign the group task to Design the various types of counters and display the output accordinglyAssessment

Methods

- *Lab Assessment (25 Marks)*
- *GATE Based Aptitude Test*

CO-PO/PSO Mapping																
CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	DATA STRUCTURES AND APPLICATIONS		*Semester*	*3*
	Course Code	*MVJ22AI34*	*CIE Marks*	*50*
	Teaching Hours/Week (L: T:P: S)	*3:0:0:0*	*SEE Marks*	*50*
	Total Hours of Pedagogy	*40*	*Total Marks*	*100*
	Credits	*03*	*Exam Hours*	*3*
	Examination type (SEE)	Theory		

Course objectives:

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees, and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1	8Hours

INTRODUCTION TO DATA STRUCTURES: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
Review of pointers and dynamic Memory Allocation,
ARRAYS and STRUCTURES: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
STACKS: Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

Module-2	8Hours

QUEUES: Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
LINKED LISTS : Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

Module-3	8Hours

LINKED LISTS : Additional List Operations, Sparse Matrices, Doubly Linked List.
TREES: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

Module-4	8Hours

TREES(Cont..): Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

Module-5	8Hours

	HASHING: Introduction, Static Hashing, Dynamic Hashing **PRIORITY QUEUES:** Single and double ended Priority Queues, Leftist Trees **INTRODUCTION TO EFFICIENT BINARY SEARCH TREES:** Optimal Binary Search Trees Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1

Course outcome (Course Skill Set)

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

CO 1. Explain different data structures and their applications.
CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.
CO 3. Use the concept of linked list in problem solving.
CO 4. Develop solutions using trees and graphs to model the real-world problem.
CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- *For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.*
- *The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered*
- *Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.*
- *For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.*

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

*Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (*duration 03 hours).

1. *The question paper will have ten questions. Each question is set for 20 marks.*
2. *There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions),* should have a mix of topics *under that module.*
3. *The students have to answer 5 full questions, selecting one full question from each module.*
4. *Marks scored shall be proportionally reduced to 50 marks*

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

Reference Books:

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

Web links and Video Lectures (e-Resources):

- *http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html*
- *https://nptel.ac.in/courses/106/105/106105171/*
- *http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html*
- *https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s*
- *https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html*
- *https://nptel.ac.in/courses/106/102/106102064/*
- *https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html*
- *https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html*
- *https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html*
- *https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html*
- *https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html*
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501595428077568125 59/overview

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

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test
  - MOOC Assignment for selected Module

DATA STRUCTURES LABORATORY
SEMESTER – III

Course Code	*MVJ22AIL35*	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Lab Contact Hours	28	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:

This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Dynamic memory management
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs

Descriptions (if any):

- Implement all the programs in "C" Programming Language and Linux OS.

Programs List:

1.	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create (), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2.	Develop 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.	Develop 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.	Develop 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.	Develop 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.	Develop 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.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, 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.	Develop 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.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ 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.	Develop 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.	Develop 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. 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.

Note: During the lab sessions the data structures using python codes will be demonstrated.

Laboratory Outcomes: The student should be able to:

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*
  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  d) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

	Programming using Java		*Semester*	*3*
	Course Code	MVJ22AI361	*CIE Marks*	*50*
	Teaching Hours/Week (L: T:P: S)	*2:0:2*	*SEE Marks*	*50*
	Total Hours of Pedagogy	*28 Hours of Theory + 20 Hours of Practical*	*Total Marks*	*100*
	Credits	*03*	*Exam Hours*	*03*
	Examination type (SEE)	*Theory*		

Note - Students who have undergone " Basics of Java Programming- BPLCK105C/205C" in first year are not eligible to opt this course

Course objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multi threaded programming and exceptions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programming examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

Module-1

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Chapter 2, 3, 4, 5

Module-2

Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection.

Methods and Classes: Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.

Chapter 6, 7

Module-3

	Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods. **Chapter 8, 9**

	Module-4
	Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:** 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. **Chapter 9, 10**
	Module-5
	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State. **Enumerations, Type Wrappers and Autoboxing:** Enumerations (Enumeration Fundamentals**,** The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values). **Chapter 11, 12**

Course outcome (Course Skill Set)

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

1. Demonstrate proficiency in writing simple programs involving branching and looping structures.
2. Design a class involving data members and methods for the given scenario.
3. Apply the concepts of inheritance and interfaces in solving real world problems.
4. Use the concept of packages and exception handling in solving complex problem
5. Apply concepts of multithreading, autoboxing and enumerations in program development

Programming Experiments (Suggested and are not limited to)

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.
4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
   - Two instance variables x (int) and y (int).
   - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
   - A overloaded constructor that constructs a point with the given x and y coordinates.
   - A method setXY() to set both x and y.
   - A method getXY() which returns the x and y in a 2-element int array.
   - A toString() method that returns a string description of the instance in the format "(x, y)".
   - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
   - An overloaded distance(MyPoint another) that returns the distance from this point to the given MyPoint instance (called another)
   - Another overloaded distance() method that returns the distance from this point to the origin (0,0)

   Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate polymorphism concepts by developing suitable methods, defining member data and main program.
6. Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for DivisionByZero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named mypack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook:

Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-

Hill, ISBN:9781260463422

Reference Books

1. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN:9789353162337.
2. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)

Web links and Video Lectures (e-Resources):

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/
- Java Tutorial: https://www.javatpoint.com/java-tutorial

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition and inheritance

Assessment Method

- Programming Assignment / Course Project

Data Analytics with R Programming		*Semester*	*3*
Course Code	MVJ22AI363	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	02
Examination type (SEE)	Practical		

Course objectives:

- To explore and understand how R and R Studio interactive environment.
- To understand the different data Structures, data types in R.
- To learn and practice programming techniques using R programming.
- To import data into R from various data sources and generate visualizations.
- To draw insights from datasets using data analytics techniques.

Sl.NO	Experiments
1	Demonstrate the steps for installation of R and R Studio. Perform the following: *a)* Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. *b)* Demonstrate Arithmetic and Logical Operations with simple examples. *c)* Demonstrate generation of sequences and creation of vectors. *d)* Demonstrate Creation of Matrices *e)* Demonstrate the Creation of Matrices from Vectors using Binding Function. *f)* Demonstrate element extraction from vectors, matrices and arrays **Suggested Reading** – Text Book 1 – Chapter 1 (What is R, Installing R, Choosing an IDE – RStudio, How to Get Help in R, Installing Extra Related Software), Chapter 2 (Mathematical Operations and Vectors, Assigning Variables, Special Numbers, Logical Vectors), Chapter 3 (Classes, Different Types of Numbers, Other Common Classes, Checking and Changing Classes, Examining Variables)
2	Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: *a.* Profit for each month. *b.* Profit after tax for each month (Tax Rate is 30%). *c.* Profit margin for each month equals to profit after tax divided by revenue. *d.* Good Months – where the profit after tax was greater than the mean for the year. *e.* Bad Months – where the profit after tax was less than the mean for the year. *f.* The best month – where the profit after tax was max for the year. *g.* The worst month – where the profit after tax was min for the year. **Note:** *a.* All Results need to be presented as vectors *b.* Results for Dollar values need to be calculated with $0.01 precision, but need to be presented inUnits of $1000 (i.e 1k) with no decimal points *c.* Results for the profit margin ratio need to be presented in units of % with no decimal point. *d.* It is okay for tax to be negative for any given month (deferred tax asset) *e.* Generate CSV file for the data. **Suggested Reading** – Text Book 1 – Chapter 4 (Vectors, Combining Matrices)
3	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication **Suggested Reading** – Text Book 1 – Chapter 4 (Matrices and Arrays – Array Arithmetic)
4	Develop a program to find the factorial of given number using recursive function calls. **Suggested Reading** – Reference Book 1 – Chapter 5 (5.5 – Recursive Programming) Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops),Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)

<table>
<tr><td>5</td><td>Develop an R Program using functions to find all the prime numbers up to a specified number by themethod of Sieve of Eratosthenes.
Suggested Reading – Reference Book
1 - Chapter 5 (5.5 – Recursive Programming)
Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops),Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)</td></tr>
<tr><td>6</td><td>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:
a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference.
Suggested Reading – Text Book 1 –Chapter 12 – (Built-in Datasets) Chapter 14 – (Scatterplots)
Reference Book 2 – 13.2.5 (Covariance and Correlation)</td></tr>
<tr><td>7</td><td>Develop R program to create a Data Frame with following details and do the following operations.
<table>
<tr><th>itemCode</th><th>itemCategory</th><th>itemPrice</th></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table>
a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHandand ItemReorderLvl and merge the two frames

Suggested Reading –Textbook 1: Chapter 5 (Lists and Data Frames)</td></tr>
<tr><td>8</td><td>Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram
e) Add Density curve to the histogram
Suggested Reading –Reference Book 2 – Chapter 7 (7.4 – The ggplot2 Package), Chapter 24 (Smoothingand Shading)</td></tr>
<tr><td>9</td><td>Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.
a) Find the total number rows & columns
b) Find the maximum salary
c) Retrieve the details of the employee with maximum salary
d) Retrieve all the employees working in the IT Department.
e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these</td></tr>
</table>

	details into another file "output.csv" **Suggested Reading** – Text Book 1 – Chapter 12(CSV and Tab Delimited Files)
10	Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, andcomprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, *[2]* cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors Develop R program, to solve the following: *a)* What is the total number of observations and variables in the dataset? *b)* Find the car with the largest hp and the least hp using suitable functions *c)* Plot histogram / density for each variable and determine whether continuous variables arenormally distributed or not. If not, what is their skewness? *d)* What is the average difference of gross horse power(hp) between automobiles with 3 and 4number of cylinders(cyl)? Also determine the difference in their standard deviations. *e)* Which pair of variables has the highest Pearson correlation? **References (Web links):** 1. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html 2. https://www.w3schools.com/r/r_stat_data_set.asp 3. https://rpubs.com/BillB/217355
11	Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a newcolumn to the original data set and save the data as a new CSV file. **Suggested Reading** – Reference Book 2 – Chapter 20 (General Concepts, Statistical Inference, Prediction)
Note: Data analytics part is also included in the mathematics.	
Course outcomes (Course Skill Set): At the end of the course the student will be able to: • Explain the fundamental syntax of R data types, expressions and the usage of the R-Studio IDE • Develop a program in R with programming constructs: conditionals, looping and functions. • Apply the list and data frame structure of the R programming language. • Use visualization packages and file handlers for data analysis..	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are 50 Marks*.*

The split-up of CIE marks for record/ journal and test are in the ratio 60:40*.*

- *Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students atthe beginning of the practical session.*
- *Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.*
- *Total marks scored by the students are scaled down to* 30 marks *(60% of maximum marks).*
- *Weightage to be given for neatness and submission of record/write-up on time.*
- *Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.*
- *In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.*
- *The suitable rubrics can be designed to evaluate each student's performance and learning ability.*
- *The marks scored shall be scaled down to* 20 marks *(40% of the maximum marks).*

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- *SEE marks for the practical course are 50 Marks.*
- *SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.*
- *The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.*
- *All laboratory experiments are to be included for practical examination.*
- *(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation*

rubrics shall be decided jointly by examiners.

- *Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.*
- *Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.*

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

Book:

1. Cotton, R. (2013). Learning R: A Step by Step Function Guide to Data Analysis. 1st ed. O'Reilly Media Inc.

References:

1. Jones, O., Maillardet. R. and Robinson, A. (2014). Introduction to Scientific Programming and Simulation Using R. Chapman & Hall/CRC, The R Series.
2. Davies, T.M. (2016) The Book of R: A First Course in Programming and Statistics. No Starch Press.

MVJ22SCR37– Social Connect & Responsibility		Semester	3rd
Course Code	**MVJ22SCR37 Common for all dept**	CIE Marks	**100**
Teaching Hours/Week (L:T:P: S)	0:0:3:1	SEE Marks	------
Total Hours of Pedagogy	40 hour Practical Session +15 hour Planning	Total Marks	**100**
Examination nature (No SEE – Only CIE)	For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept / Any Dept.		
Credits	01 - Credit		

Course objectives: The course will enable the students to:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. create a responsible connection with the society.
3. Understand the community in general in which they work.
4. Identify the needs and problems of the community and involve them in problem –solving.
5. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
6. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.

The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

In the following a set of activities planned for the course have been listed:

Social Connect & Responsibility – Contents

Part I:

Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II :

Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.

Part III :

Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus – Objectives,Visit, case study, report, outcomes.

Part IV:

Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V :

Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course outcomes (Course Skill Set):

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

CO1: Communicate and connect to the surrounding. CO2: Create a responsible connection with the society.

CO3: Involve in the community in general in which they work.

CO4: Notice the needs and problems of the community and involve them in problem –solving.

CO5: Develop among themselves a sense of social & civic responsibility & utilize their knowledgein finding practical solutions to individual and community problems.

CO6: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories withothers. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersion with NGOs/social sections will be a key part of the course. Will all leadto the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, basedon an in-depth understanding of a key social problem.

Duration :

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic ,and poetry) Faculty mentors has to design the evaluation system as per VTU guidelines ofscheme & syllabus.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE):

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and scheduling the socialconnect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below

Excellent : 80 to 100
Good : 60 to 79
Satisfactory: 40 to 59
Unsatisfactory and fail : <39

Special Note :

NO SEE – Semester End Exam – Completely Practical and activities based evaluation

Pedagogy – Guidelines :

It may differ depending on local resources available for the study as well as environment andclimatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Plan of Action (Execution of Activities)

Sl.NO	Practice Session Description
1	Lecture session in field to start activities
2	Students Presentation on Ideas
3	Commencement of activity and its progress
4	Execution of Activity
5	Execution of Activity
6	Execution of Activity
7	Execution of Activity
8	Case study based Assessment, Individual performance
9	Sector/ Team wise study and its consolidation
10	Video based seminar for 10 minutes by each student At the end of semester with Report.

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

Assessment Details for CIE (both CIE and SEE)

Weightage	**CIE – 100%**	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Field Visit, Plan, Discussion	10 Marks	
Commencement of activities and its progress	20 Marks	
Case study based Assessment Individual performance with report	20 Marks	
Sector wise study & its consolidation 5*5 = 25	25 Marks	
Video based seminar for 10 minutes by each student At the end of semester with Report. **Activities 1 to 5, 5*5 = 25**	25 Marks	
Total marks for the course in each semester	**100 Marks**	

For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities.

MVJCE CURRICULUM

FOR

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING(Scheme 2022)

IV SEMESTER

Analysis & Design of Algorithms		Semester	4
Course Code	**MVJ22AI41**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- *To learn the methods for analyzing algorithms and evaluating their performance.*
- *To demonstrate the efficiency of algorithms using asymptotic notations.*
- *To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.*
- *To learn the concepts of P and NP complexity classes.*

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. *Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.*
2. *Utilize video/animation films to illustrate the functioning of various concepts.*
3. *Promote collaborative learning (Group Learning) in the class.*
4. *Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.*
5. *Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.*
6. *Introduce topics through multiple representations.*
7. *Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.*
8. *Discuss the real-world applications of every concept to enhance students' comprehension.*

Module-1

INTRODUCTION: *What is an Algorithm?, Fundamentals of Algorithmic Problem Solving.*
FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY: *Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms.*
BRUTE FORCE APPROACHES: *Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.*
Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)

Module-2

BRUTE FORCE APPROACHES (contd..): *Exhaustive Search (Travelling Salesman probem and Knapsack Problem).*
DECREASE-AND-CONQUER: *Insertion Sort, Topological Sorting.*
DIVIDE AND CONQUER: *Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication.*

Chapter 3(Section 3.4), Chapter 4 (Sections 4.1,4.2), Chapter 5 (Section 5.1,5.2,5.3, 5.4)

Module-3

TRANSFORM-AND-CONQUER: *Balanced Search Trees, Heaps and Heapsort.*
SPACE-TIME TRADEOFFS: *Sorting by Counting: Comparison counting sort, Input Enhancementin String Matching: Horspool's Algorithm.*
Chapter 6 (Sections 6.3,6.4), Chapter 7 (Sections 7.1,7.2)

Module-4

DYNAMIC PROGRAMMING: *Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms.*
THE GREEDY METHOD: *Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes.*
Chapter 8 (Sections 8.1,8.2,8.4), Chapter 9 (Sections 9.1,9.2,9.3,9.4)

Module-5

LIMITATIONS OF ALGORITHMIC POWER: *Decision Trees, P, NP, and NP-Complete Problems.*
COPING WITH LIMITATIONS OF ALGORITHMIC POWER*: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NP-Hard problems (Knapsack problem).*
Chapter 11 (Section 11.2, 11.3), Chapter 12 (Sections 12.1,12.2,12.3)

Course outcome (Course Skill Set)

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

1. *Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.*
2. *Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computational problems.*
3. *Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems.*
4. *Apply greedy and input enhancement methods to solve graph & string based computational problems.*
5. *Analyse various classes (P,NP and NP Complete) of problems*
6. *Illustrate backtracking, branch & bound and approximation methods.*

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- *For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.*
- *The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered*
- *Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.*
- *For the course, CIE marks will be based on a scaled-down sum of two tests and other methodsof assessment.*

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

*Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (***duration 03 hours).**

1. *The question paper will have ten questions. Each question is set for 20 marks.*
2. *There will be 2 questions from each module. Each of the two questions under a module (witha maximum of 3 sub-questions),* **should have a mix of topics** *under that module.*
3. *The students have to answer 5 full questions, selecting one full question from each module.*
4. *Marks scored shall be proportionally* **reduced to 50 marks**

Suggested Learning Resources:

Textbooks

1. *Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian),2017, Pearson.*

Reference books

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

Web links and Video Lectures (e-Resources):

- *Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/*

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

- *Promote real-world problem-solving and competitive problem solving through group discussions to engage students actively in the learning process.*
- *Encourage students to enhance their problem-solving skills by implementing algorithms and solutions through programming exercises, fostering practical application of theoretical concepts.*

Assessment Methods -

1. *Problem Solving Assignments (Hacker Rank/ Hacker Earth / Leadcode)*
2. *Gate Based Aptitude Test*

ARTIFICIAL INTELLIGENCE		Semester	IV
Course Code	MVJ22AI42	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	
Examination nature (SEE)	Theory/		

Course objectives:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving
- Get to know approaches of inference, perception, knowledge representation, and learning

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Demonstrate ways to solve the same problem and encourage the students to come up with their own creative solutions.
8. Discuss application of every concept to solve the real world problems.

MODULE-1

Introduction: What is AI? Foundations and History of AI **Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents**.**

Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4

MODULE-2

Problem-solving: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search;

Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4

MODULE-3

Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions **Logical Agents**: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic **Text book 1**: Chapter 3-3.5,3.6 Chapter 4 – 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5
MODULE-4
First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic. **Inference in First Order Logic** :Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution Text book 1: Chapter 8- 8.1, 8.2, 8.3 Chapter 9- 9.1, 9.2, 9.3, 9.4, 9.5
MODULE-5
Uncertain Knowledge and Reasoning: Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited **Expert Systems:** Representing and using domain knowledge, ES shells. Explanation, knowledge acquisition Text Book 1: Chapter 13-13.1, 13.2, 13.3, 13.4, 13.5, 13.6 Text Book 2: Chapter 20

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

NOTE: Programs need to be implemented in python

Sl.NO	Experiments
1	Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem
2	Implement and Demonstrate Best First Search Algorithm on Missionaries-Cannibals Problems using Python
3	Implement A* Search algorithm
4	Implement AO* Search algorithm
5	Solve 8-Queens Problem with suitable assumptions
6	Implementation of TSP using heuristic approach
7	Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining
8	Implement resolution principle on FOPL related problems
9	Implement Tic-Tac-Toe game using Python

10	Build a bot which provides all the information related to text in search box
11	Implement any Game and demonstrate the Game playing strategies

Course outcomes (Course Skill Set):

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

CO1: Apply knowledge of agent architecture, searching and reasoning techniques for different applications.
CO 2. Compare various Searching and Inferencing Techniques.
CO 3. Develop knowledge base sentences using propositional logic and first order logic
CO 4. Describe the concepts of quantifying uncertainty.
CO5: Use the concepts of Expert Systems to build applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015
2. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition,Tata McGraw Hill,2013

Reference:

1. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014

Web links and Video Lectures (e-Resources)

1. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html

2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409

3. https://nptel.ac.in/courses/106/105/106105077/

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

1. Group discussion on Real world examples
2. Project based learning
3. Simple strategies on gaming, reasoning and uncertainty etc

DATABASE MANAGEMENT SYSTEM		*Semester*	*4*
Course Code	**MVJ22AI43**	*CIE Marks*	*50*
Teaching Hours/Week (L:T:P: S)	*3:0:2:0*	*SEE Marks*	*50*
Total Hours of Pedagogy	*40 hours Theory + 8-10 Lab slots*	*Total Marks*	*100*
Credits	*04*	*Exam Hours*	
Examination nature (SEE)	*Theory*		

Course objectives:

- To Provide a strong foundation in database concepts, technology, and practice.
- To Practice SQL programming through a variety of database problems.
- To Understand the relational database design principles.
- To Demonstrate the use of concurrency and transactions in database.
- To Design and build database applications for real world problems.
- To become familiar with database storage structures and access techniques.

Teaching-Learning Process

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

MODULE-1	**No. of Hours: 8**

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.
Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams,Specialization and Generalization.

Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10
RBT: L1, L2, L3

MODULE-2	**No. of Hours: 8**

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.

Textbook 1: Ch 5.1 to 5.3, Ch 8.1 to 8.5; Ch 9.1 to 9.2 Textbook 2: 3.5
RBT: L1, L2, L3

MODULE-3	**No. of Hours:8**

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.
SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL
Textbook 1: Ch 14.1 to 14.7, Ch 6.1 to 6.5
RBT: L1, L2, L3

MODULE-4	**No. of Hours:8**

SQL: Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.

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.

Textbook 1: Ch 7.1 to 7.3, Ch 20.1 to 20.6
RBT: L1, L2, L3

MODULE-5	**No. of Hours:08**

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.
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j

Textbook 1:Chapter 21.1 to 21.5, Chapter 24.1 to 24.6
RBT: L1, L2, L3

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Create a table called Employee & execute the following. **Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)** 1. Create a user and grant all permissions to theuser. 2. Insert the any three records in the employee table contains attributes EMPNO,ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. 4. Insert null values to the employee table and verify the result.
2	Create a table called Employee that contain attributes EMPNO,ENAME,JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employeetable. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. 5. Delete the employee whose Empno is 105.
3	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. **Employee(E_id, E_name, Age, Salary)** 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employeetable 3. Find the Maximum age from employee table. 4. Find the Minimum age from employeetable. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees.
4	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. **CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)**
5	Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extrct the values from the cursor. Close the cursor. **Employee(E_id, E_name, Age, Salary)**
6	Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.
7	Install an Open Source NoSQL Data base MangoDB & perform basic CRUD(Create, Read, Update & Delete) operations. Execute MangoDB basic Queries using CRUD operations.

Course outcomes (Course Skill Set):

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

- Describe the basic elements of a relational database management system
- Design entity relationship for the given scenario.
- Apply various Structured Query Language (SQL) statements for database manipulation.
- Analyse various normalization forms for the given application.
- Develop database applications for the given real world problem.
- Understand the concepts related to NoSQL databases.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum

passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

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

Mini Project:

- Project Based Learning

Analysis & Design of Algorithms Lab		Semester	4
Course Code	MVJ22AIL 44	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	2
Examination type (SEE)	Practical		

Course objectives:

- To design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
- To apply diverse design strategies for effective problem-solving.
- To Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

Sl.No	Experiments
1	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
2	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
3	a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
4	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
5	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.
6	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
7	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
8	Design and implement C/C++ Program 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.
9	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 andrecord the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
10	Design and implement C/C++ Program to 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. The elements can be read from a file or can be generated using the random number generator.
11	Design and implement C/C++ Program to 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. The elements can be read from a file or can be generated using the random number generator.
12	Design and implement C/C++ Program for N Queen's problem using Backtracking.

Course outcomes (Course Skill Set):

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

1. *Develop programs to solve computational problems using suitable algorithm design strategy.*
2. *Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical).*
3. *Make use of suitable integrated development tools to develop programs*
4. *Choose appropriate algorithm design techniques to develop solution to the computational and complex problems.*
5. *Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences.*

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks***.*

The split-up of CIE marks for record/ journal and test are in the ratio **60:40***.*

- *Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students atthe beginning of the practical session.*
- *Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.*
- *Total marks scored by the students are scaled down to* **30 marks** *(60% of maximum marks).*
- *Weightage to be given for neatness and submission of record/write-up on time.*
- *Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.*
- *In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.*
- *The suitable rubrics can be designed to evaluate each student's performance and learning ability.*
- *The marks scored shall be scaled down to* **20 marks** *(40% of the maximum marks).*

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- *SEE marks for the practical course are 50 Marks.*

- *SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.*
- *The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.*
- *All laboratory experiments are to be included for practical examination.*
- *(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners.* **OR** *based on the course requirement evaluation rubrics shall be decided jointly by examiners.*
- *Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.*
- *Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.*

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- *Virtual Labs (CSE): http://cse01-iiith.vlabs.ac.in/*

DISCRETE MATHEMATICAL STRUCTURES		Semester	IV
Course Code	**MVJ22AI451**	*CIE Marks*	*50*
Teaching Hours/Week (L:T:P:S)	*2:2:0:0*	*SEE Marks*	*50*
Total Hours of Pedagogy	*40*	*Total Marks*	*100*
Credits	*03*	*Exam Hours*	*03*
Examination type (SEE)	*Theory*		

Course objectives:

1. *To help students to understand discrete and continuous mathematical structures.*
2. *To impart basics of relations and functions.*
3. *To facilitate students in applying principles of Recurrence Relations to find the generating functions and solve the Recurrence relations.*
4. *To have the knowledge of groups and their properties to understand the importance ofalgebraic properties relative to various number systems.*

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. *In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.*
2. *State the need for Mathematics with Engineering Studies and Provide real-life examples.*
3. *Support and guide the students for self–study.*
4. *You will assign homework, grading assignments and quizzes, and documenting students' progress.*
5. *Encourage the students to group learning to improve their creative and analytical skills.*
6. *Show short related video lectures in the following ways:*
   - *As an introduction to new topics (pre-lecture activity).*
   - *As a revision of topics (post-lecture activity).*
   - *As additional examples (post-lecture activity).*
   - *As an additional material of challenging topics (pre-and post-lecture activity).*
   - *As a model solution for some exercises (post-lecture activity).*

Module-1: Fundamentals of Logic

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. The Use of Quantifiers, Quantifiers, Definitions and the Proofs of Theorems. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: Properties of the Integers

Mathematical Induction, The Well Ordering Principle – Mathematical Induction, Recursive Definitions.

Fundamental Principles of Counting: *The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition.* **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Module-3: Relations and Functions

Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.

Properties of Relations, *Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.* **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-4: The Principle of Inclusion and Exclusion

The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing isin its Right Place, Rook Polynomials.

Recurrence Relations: *First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients.* **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Module-5: Introduction to Groups Theory

Definitions and Examples of Particular Groups Klein 4-group, Additive group of Integers modulo n, Multiplicative group of Integers modulo-p and permutation groups, Properties of groups, Subgroups, cyclic groups, Cosets, Lagrange's Theorem. **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

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

1. *Apply concepts of logical reasoning and mathematical proof techniques in proving theoremsand statements.*
2. *Demonstrate the application of discrete structures in different fields of computer science.*
3. *Apply the basic concepts of relations, functions and partially ordered sets for computer representations.*
4. *Solve problems involving recurrence relations and generating functions.*
5. *Illustrate the fundamental principles of Algebraic structures with the problems related to computer science & engineering.*

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- *There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.*
- *Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks*
- *Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)*

The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

*Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (***duration 03 hours).**

1. *The question paper will have ten questions. Each question is set for 20 marks.*
2. *There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions),* **should have a mix of topics** *under that module.*
3. *The students have to answer 5 full questions, selecting one full question from each module.*

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **Ralph P. Grimaldi, B V Ramana: "Discrete Mathematical Structures an Applied Introduction",** *5th Edition, Pearson Education, 2004.*
2. **Ralph P. Grimaldi: "Discrete and Combinatorial Mathematics"**, *5th Edition, Pearson Education. 2004.*

Reference Books:

1. **Basavaraj S Anami and Venakanna S Madalli: "Discrete Mathematics – A Concept-based approach"**, *Universities Press, 2016*
2. **Kenneth H. Rosen: "Discrete Mathematics and its Applications"**, *6th Edition, McGraw Hill, 2007.*
3. **Jayant Ganguly: "A Treatise on Discrete Mathematical Structures",** *Sanguine-Pearson, 2010.*
4. **D.S. Malik and M.K. Sen: "Discrete Mathematical Structures Theory and Applications,** *Latest Edition, Thomson, 2004.*
5. **Thomas Koshy: "Discrete Mathematics with Applications"**, *Elsevier, 2005, Reprint 2008.*

Web links and Video Lectures (e-Resources):

- *http://nptel.ac.in/courses.php?disciplineID=111*
- *http://www.class-central.com/subject/math(MOOCs)*
- *http://academicearth.org/*
- *VTU e-Shikshana Program*
- *VTU EDUSAT Program.*
- **http://www.themathpage.com/**
- **http://www.abstractmath.org/**
- **http://www.ocw.mit.edu/courses/mathematics/**

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

- *Quizzes*
- *Assignments*
- *Seminar*

METRIC SPACES		Semester	IV
Course Code	**MVJ22A I452**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- Provide insight into the theory of sets
- Learn basic concepts of metric spaces
- Understand the concepts of connected sets and compact spaces

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1: Theory of Sets

Finite and infinite sets, countable and uncountable sets, cardinality of sets, Schroder-Bernstein theorem, cantor's theorem, Order relation in cardinal numbers, Arithmetic of cardinal numbers, Partially ordered set, Zorn's lemma and axioms of choice, various set-theoretic paradoxes.

(8 hours)

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2: Concepts in Metric Spaces

Definition and examples of metric spaces, Open spheres and Closed spheres, Neighborhoods, Open sets, Interior, Exterior and boundary points, Closed sets, Limit points and isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3: Complete Metric Spaces and Continuous Functions

Cauchy and Convergent sequences, Completeness of metric spaces, Cantor's intersection theorem, Dense sets and separable spaces, Nowhere dense sets and Baire's category theorem, continuous and uniformly continuous functions, Homeomorphism. Banach contraction principle. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4: Compactness

Compact spaces, Sequential compactness, Bolzano-Weierstrass property, Compactness and finite intersection property, Heine-Borel theorem, Totally bounded set, equivalence of compactness and sequential compactness. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-5: Connectedness

Separated sets, Disconnected and connected sets, components, connected subsets of R, Continuous functions on connected sets. Local connectedness and arc-wise connectedness. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

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

1. Explain basic facts about the cardinality of a set and various set-theoretic paradoxes.
2. Apply the concepts of open and closed spheres and bounded sets to solve problems.
3. Demonstrate standard concepts of metric spaces and their properties.
4. Identify the continuity of a function defined on metric spaces and homomorphism.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books

1. P.K. Jain & Khalil Ahamad, "*Metric Spaces"*. Narosa, 2019.
2. Micheal O; Searcoid, "Metric spaces". Springer-Verlag, 2009.

Reference Books:

1. Satish Shirali & Harikishan L. Vasudeva, "*Metric Spaces"*, Springer-Verlag, 2006.
2. E.T. Copson, "*Metric spaces"*, Cambridge University Press, 1988.
3. P.R. Halmos, "*Naive Set Theor*y". Springer, 1974.
4. S. Kumaresan, "*Topology of Metric spaces",* 2nd edition, Narosa, 2011.
5. G.F. Simmons, "Introduction to Topology and Modern Analysis". McGraw-Hill, 2004.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

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

- Quizzes
- Assignments
- Seminar

OPTIMIZATION TECHNIQUE		Semester	IV
Course Code	**BCS405C**	*CIE Marks*	*50*
Teaching Hours/Week (L:T:P: S)	*2:2:0:0*	*SEE Marks*	*50*
Total Hours of Pedagogy	*40*	*Total Marks*	*100*
Credits	*03*	*Exam Hours*	*03*
Examination type (SEE)	*Theory*		

Course objectives: *The objectives of the course are to fecilitate the learners to:*

- *Appreciate the importance of linear algebra in computer science and allied engineering science.*
- *Gain the knowledge of linear algebra tools and concepts to implememt them in their core domain.*
- *Improve their mathematical thinking and acquire skills required for sustained lifelong learning.*

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. *In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.*
2. *State the need for Mathematics with Engineering Studies and Provide real-life examples.*
3. *Support and guide the students for self–study.*
4. *You will assign homework, grading assignments and quizzes, and documenting students' progress.*
5. *Encourage the students to group learning to improve their creative and analytical skills.*
6. *Show short related video lectures in the following ways:*
   - *As an introduction to new topics (pre-lecture activity).*
   - *As a revision of topics (post-lecture activity).*
   - *As additional examples (post-lecture activity).*
   - *As an additional material of challenging topics (pre-and post-lecture activity).*
   - *As a model solution of some exercises (post-lecture activity).*

Module-1: VECTOR CALCULUS

Functions of several variables, Differentiation and partial differentials, gradients of vector-valued functions, gradients of matrices, useful identities for computing gradients, linearization and multivariate Taylor series.

(8 hours)

(RBT Levels: L1, L2 and L3)

Module-2: APPLICATIONS OF VECTOR CALCULUS

Backpropagation and automatic differentiation, gradients in a deep network, The Gradient of Quadratic Cost, Descending the Gradient of Cost, The Gradient of MeanSquared Error.

(8 hours)

(RBT Levels: L1, L2 and L3)

Module-3: Convex Optimization-1

Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent, Sequential search 3-point search and Fibonacci search.
(8 hours)
(RBT Levels: L1, L2 and L3)

Module-4: Convex Optimization-2

Unconstrained optimization -Method of steepest ascent/descent, NR method, Gradient descent, Mini batch gradient descent, Stochastic gradient descent. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Module-5: Advanced Optimization

Momentum-based gradient descent methods: Adagrad, RMSprop and Adam.
Non-Convex Optimization: Convergence to Critical Points, Saddle-Point methods.
(8 hours)
(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

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

1. *Apply the concepts of vector calculus to solve the given problem.*
2. *Apply the concepts of partial differentiation in machine learning and deep neural networks.*
3. *Analyze the convex optimization algorithms and their importance in computer science & engineering.*
4. *Apply the optimization algorithms to solve the problem.*
5. *Analyze the advanced optimization algorithms for machine learning .*

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- *There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.*
- *Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks*
- *Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)*
- *The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.*

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

*Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (***duration 03 hours).**

1. *The question paper will have ten questions. Each question is set for 20 marks.*
2. *There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions),* **should have a mix of topics** *under that module.*
3. *The students have to answer 5 full questions, selecting one full question from each module.*

Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. *Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.*
2. *S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015.*
3. *S. Boyd, N. Parikh, and E. Chu," Distributed optimization and statistical learning via the alternating direction method of multipliers", Foundations and Trends in Machine Learning, Now Publishers Inc.*

Reference Books:

1. *Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer, 2020.*
2. *A. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017.*
3. *F. Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc.*

Web links and Video Lectures (e-Resources):
• *https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm* • *https://www.math.ucdavis.edu/~linear/linear.pdf* • *https://www.coursera.org/learn/linear-algebra-machine-learning* • *https://nptel.ac.in/syllabus/111106051/* • *https://github.com/epfml/OptML_course* • *https://www.youtube.com/playlist?list=PL4O4bXkI-fAeYrsBqTUYn2xMjJAqlFQzX*
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • *Quizzes* • *Assignments* • *Seminar*

ALGORITHMIC GAME THEORY		Semester	IV
Course Code	**MVJ22AI 454**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- Comprehend the basics of strategic gaming and mixed strategic equilibrium.
- Enable students to develop skills on extensive gaming strategies.
- Analyze and discuss various gaming models.
- Illustrate some real-time situations.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1

Introduction to Strategic Games: What is game theory? The theory of rational choice, Strategic games; Examples: The prisoner's dilemma, Bach or Stravinsky, Matching pennies; Nash equilibrium; Examples of Nash equilibrium; Best response functions; Dominated actions.

(8 hours)

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Introduction; Strategic games in which players may randomize; Mixed strategy Nash equilibrium; Dominated actions; Pure equilibrium when randomization is allowed.
Illustration: Expert Diagnosis; Equilibrium in a single population. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Extensive games with perfect information; Strategies and outcomes; Nash equilibrium; Sub-game perfect equilibrium; Finding sub-game perfect equilibria of finite horizon games: Backward induction; Illustrations: The ultimatum game, Stackelberg's model of duopoly. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Bayesian Games**,** Motivational examples; General definitions; Two examples concerning information; Illustrations: Cournot's duopoly game with imperfect information, Providing a public good; Auctions: Auctions with an arbitrary distribution of valuations. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Competative Games: Strictly competitive games and maximization.
Repeated games: The main idea; Preferences; Repeated games; Finitely and infinitely repeated Prisoner's dilemma; Strategies in an infinitely repeated Prisoner's dilemma; Nash equilibrium of an infinitely repeated Prisoner's dilemma, Nash equilibrium payoffs of an infinitely repeated Prisoner's dilemma. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)
At the end of the course, the student will be able to:

1. Interpret the basics of strategic gaming and extensive games.
2. Analyze gaming strategies on real-time incidence.
3. Develop the models of gaming on real-time incidence.
4. Apply game theory in the real world problems.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **Martin Osborne: "An Introduction to Game Theory",** Oxford University Press, First Indian Edition, 2009, 7th impression, ISBN – 0195128958.

Reference Books:

1. **Roger B. Myerson: "Analysis of Conflict Game Theory",** Re-print Edition, Harvard University Press, 2008, ISBN – 978-0674341166.
2. **Frederick S. Hillier and Gerald J. Lieberman: "Introduction to Operations Research, Concepts and Cases",** 9th Edition; Tata McGraw Hill, 2010, ISBN – 0073376299.
3. **Joel Watson: "An Introduction to Game Theory"** Strategy, 2nd Edition, W.W. Norton &Company, 2007, ISBN – 9780393929348.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

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

- Quizzes
- Assignments
- Seminar

(Affiliated to Visvesvaraya Technological University, Belagavi
Approved By AICTE, New Delhi,
Recognized by UGC under 2(f) & 12(B).
Accredited by NBA and NAAC)

AIML DEPARTMENT 2022 SYLLABUS

Vth Semester

Course Title	**Software Engineering and Project Management**	**Semester**	**V**
Course Code	**MVJ22AI51**	**CIE**	**50**
Total No. of Contact Hours	**40**	**SEE**	**50**
No. of Contact Hours/week	**3 (L: T: P: S: 3 : 0 : 0 : 0)**	**Total**	**100**
Credits	**3**	**Exam. Duration**	**3 Hours**

Course objective: Students will be able to:

1. Outline software engineering principles and activities involved in building large software programs and identify ethical and professional issues faced by Software Engineers.
2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
3. Infer the fundamentals of object-oriented concepts, differentiate system models, use UML diagrams, apply design patterns and explain the role of DevOps in Agile Implementation.
4. Discuss various types of software testing practices and software evolution processes.
5. Recognize the importance of Project Management with its methods and methodologies and identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Module-1	**8 Hours**

Introduction: The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.
Textbook 1: Chapter 1: 1.1 to 1.3
Process Models: Prescriptive models, Waterfall model, Incremental process models, Evolutionary. process models, Specialized process models.
Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7
Requirements Engineering: Requirements Engineering Task, Initiating the Requirements Engineering process, Eliciting Requirements, developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document (Sec 4.2)
Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2

Module-2	**8 Hours**

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, Introduction to RUP and UML diagrams
Textbook 2: Chapter 1,2,3

Building the Analysis Models: Requirement Analysis, Analysis Model Approaches, Data modelling Concepts, Object Oriented Analysis, Scenario-Based modelling, Flow-Oriented Modelling, class Based. modelling, Creating a Behavioural Model.
Textbook 1: Chapter 8: 8.1 to 8.8

Module-3	**8 Hours**

Software Testing: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging.
Textbook 1: Chapter 13: 13.1 to 13.7
Agile Methodology & DevOps: Before Agile – Waterfall, Agile Development.
Self-Learning Section:
What is DevOps? DevOps Importance and Benefits, DevOps Principles and Practices, 7 Cs of DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing, How to Choose Right DevOps Tools? Challenges with DevOps Implementation.
Textbook 4: Chapter 2: 2.1 to 2.9

Module-4	**8 Hours**

Introduction to Project Management: Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.
Textbook 3: Chapter 1: 1.1 to 1.17

Module-5	**8 Hours**

Activity Planning: Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks.
Textbook 3: Chapter 6: 6.1 to 6.16
Software Economics**:** Evolution of Software Economics, Improving Software Economics, The old way and the new way. Life-Cycle Phases and Process artifacts
Textbook 3: Chapter 13: (13.1 to 13.6, 13.9, 13.11, 13.14)

Course outcomes:	
CO1	Summarize software engineering activities and analyze the role of various process models and requirement engineering.
CO2	Describe the basics of object-oriented concepts and build a system concept report and domain analysis using modeling techniques.
CO3	Illustrate real-world cases and apply agile methodology and DevOps principles.
CO4	Illustrate the role of project planning and quality management in software development.
CO5	Identify software quality parameters, quantify software using measurements and metrics, and outline practices involved in meeting software quality standards.

Textbooks:	
1.	Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2.	Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.
3.	Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.
4.	Deepak Gaikwad, Viral Thakkar, DevOps Tools from Practitioner's Viewpoint, Wiley
5.	Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.
6.	Management and Entrepreneurship, N V R Naidu, T Krishna Rao 4th reprint Willey Publications.
7.	Schaum's outline of theory and problems of software engineering, David A. Gustafson, McGraw-Hill's

Reference books:	
1.	Law relating to Intellectual Property rights, B. L. Wadhera, 5th edition, Universal Law Publishing, 2011
2..	Principles of Management, P C Tripathi, P N Reddy, 5th edition, Tata Mc Graw Hill, 2012

3.	Dynamics of Entrepreneurial Development & Management, Vasant Desai, Himalaya publishing house, 2009

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.
Quizzes/mini tests (4 marks)
Mini Project / Case Studies (8 Marks)
Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus.
Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions. One question must be asked from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		2			1	1	2	1
CO2	2	3	3	3		1			1	2	2	1
CO3	3	3	3	3	2	2			1	1	2	2
CO4	2	3	2	1		2			1	1	2	1
CO5	2	2	1	3		1			1	1	2	1

High-3, Medium-2, Low-1

Course Title	Computer Network	Semester	V
Course Code	MVJ22AI52	CIE	50
Total No. of Contact Hours	40T + 26P	SEE	50
No. of Contact Hours/week	5 (L: T : P :S: 3 :0 :2:0)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. Outline the major concepts involved in network protocols.
3. Recognize the Functions of Network layer, Router and delivery of data to host network.
4. Describe the function of mobile networking and switching.
5. Examine the Multimedia data transmission in network.

Module-1	8 Hours

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division.

Module-2	8 Hours

Data Link Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ.

Medium Access Sub Layer: Switching, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA, IEEE802 standard protocols.

Module-3	8 Hours

The Network Layer: Network layer design issues, Logical Addressing: IPV4, IPV6; Address mapping, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

Module-4	8 Hours

Transport Layer: Elements of Transport protocols: Addressing, Connection establishment, Connection release, Crash recovery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module-5	8 Hours

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls; AI in network infrastructure, Self-Healing Networks.

LABORATORY EXPERIMENTS

1. Learn to use commands like tcpdump, netstat, ifconfig, lookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine. Screen effectiveness studies.
2. Write a program for error detecting code using CRC-CCITT (16- bits).
3. Write a program to find the shortest path between vertices using the Bellman-ford algorithm.
4. Applications using TCP and UDP sockets like:
a) Chat b) File Transfer
5. Simulation of DNS using UDP sockets.

6. Write a code for simulating ARP /RARP protocols. 7. Implementation of Stop and Wait Protocol and Sliding Window Protocol. 8. Write a program for congestion control using leaky bucket algorithm. 9. Implement three nodes point – to- point networks with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped using NS 2. 10. Simulate the transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion using NS 2. 11. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination using NS 2. 12. Simulate simple ESS and with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets using NS 2.

CO1	Summarize the working of OSI model.
CO2	Describe the different function at data link layer
CO3	Illustrating the tracing and addressing the packets over the networks.
CO4	Distinguish the delivering of packets to destination network
CO5	Recognize the Functions of multimedia protocol and application layer protocol.

Textbooks	
1.	Computer Networks:5th ed by Andrew. S. Tanenbaum PHI Publication.
2.	Data Communications and Networks: 3rd ed by Behrouz A. Forouzan. TataMcGraw Hill publication.
Reference:	
3.	William Stallings, Data and Computer Communication, Tenth Edition, Pearson Education, 2013.
4.	James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.

One question must be asked from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2		2			3	2		2
CO2	3	3	3	3		2			3	2		2
CO3	3	3	3	3	3	2			3	2		2
CO4	3	2	3	3	3	2			3	2		2
CO5	3	2	2	2		2			3	2		2

Course Title	Theory of Computation	Semester	V
Course Code	MVJ22AI53	CIE	50
Total No. of Contact Hours	53	SEE	50
No. of Contact Hours/week	4 (L: T: P :S: 4: 0: 0: 0)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

1. Develop the knowledge of automata Theory as the basis of all computer science languages design
2. Examine the validations of regular expressions and their application.
3. Apply the concepts of Turing Machine and Chomskian Languages.
4. Understand the concept of Context Free Grammars and Languages.
5. Summarize the knowledge in various phases of compiler and its use.

Module-1	8 Hours

Finite Automata: Mathematical preliminaries and notations – Central concepts of automata theory – Finite automata -Deterministic Finite Automata - Nondeterministic Finite Automata – Equivalence of DFA and NFA –Finite Automata with Epsilon transitions - Application of FA

Module-2	8 Hours

Regular Expressions: Regular languages: Regular Expressions – Finite Automata and Regular Expressions –Applications of Regular Expressions - Regular Grammars, Problems on CFG, pushdown automata

Module-3	8 Hours

Regular Languages: Properties of regular languages: Pumping lemma for regular languages – Closure properties of regular languages –Equivalence and Minimization of Finite Automata. C

Module-4	8 Hours

Context Free Grammar: Context Free languages: Context Free Grammars – Parse Trees - Ambiguity in Grammars and languages– Applications of Context Free Grammars – Pushdown automata (PDA) – Languages of a PDA -Equivalence of PDA ‘s and CFG ‘s, Conversion of PDA to CFG, Conversion of CFG to PDA

Module-5	8 Hours

Context Free Languages: Properties of Context Free Languages: Normal Forms (CNF, GNF) for Context Free Grammars - Pumping lemma for CFL ‘s - Closure properties of CFL

Turing Machines: Types of Turing Machines, Turing Machines- Programming Techniques for Turing Machines – Multitype Turing Machines.

Course outcomes:

CO1	Construct finite automata for given pattern and find its equivalent regular expressions.
CO2	Design and simplify context free grammar and find equivalent pushdown automata for given language.
CO3	Design Turing Machines for any Languages.
CO4	Derive whether a problem is decidable or not.

CO5	Understand the basic concepts of Compiler Design
Textbooks:	
1.	Hopcroft J E, Motwani R and Ullman J D, Introduction to Automata Theory, Languages and Computations, Second Edition, Pearson Education, 2012.
2.	Rich Eiane—Automata Computability and Complexity: Theory and Applications, Second Edition, PHI, 2003.
Reference Books:	
3	Padma Reddy.A, —Finite Automata and Formal Languages: A Simple Approach.
4	Raghavan V, Principles of Compiler Design, Third Edition, Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi, 2009

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.
Quizzes/mini tests (4 marks)
Mini Project / Case Studies (8 Marks)
Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus.
Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2								2
CO2	2	2	3	2								2
CO3	2	2	3	2								2
CO4	2	2	3	2								2
CO5	2	2	3	2								2

High-3, Medium-2, Low-1

Course Title	**Data Visualization Lab**	**Semester**	**V**
Course Code	**MVJ22AIL54**	**CIE**	**50**
Total No. of Contact Hours	**26**	**SEE**	**50**
No. of Contact Hours/week	**2 (L: T: P :S: 0: 0: 2: 0)**	**Total**	**100**
Credits	**1**	**Exam. Duration**	**3 Hours**

Course Objectives: This course will enable students to

- Effective use of Business Intelligence (BI) technology (Tableau) to apply data visualization
- To discern patterns and relationships in the data.
- To build Dashboard applications.
- To communicate the results clearly and concisely.
- To be able to work with different formats of data sets.

Sr.No	Experiment Name	RBT Level	Hours
1	Understanding Data, what is data, where to find data, Foundations for building Data Visualizations, Creating Your First visualization?	L1	2
2	Getting started with Tableau Software using Data file formats, connecting your Data to Tableau, creating basic charts (line, bar charts, Tree maps), Using the Show me panel.	L2	2
3	Tableau Calculations, Overview of SUM, AVR, and Aggregate features, Creating custom calculations and fields.	L3	2
4	Applying new data calculations to your visualizations, Formatting Visualizations, Formatting Tools and Menus, Formatting specific parts of the view	L2	2
5	Editing and Formatting Axes, Manipulating Data in Tableau data, Pivoting Tableau data.	L1	2
6	Structuring your data, Sorting and filtering Tableau data, Pivoting Tableau data.	L1	2
7	Advanced Visualization Tools: Using Filters, Using the Detail panel, using the Size panels, customizing filters, Using and Customizing tooltips, Formatting your data with colors.	L2	2
8	Creating Dashboards & Storytelling, creating your first dashboard and Story, Design for different displays, adding interactivity to your Dashboard, Distributing & Publishing your Visualization.	L2	2
9	Tableau file types, publishing to Tableau Online, Sharing your visualizations, printing, and Exporting.	L3	2
10	Creating custom charts, cyclical data and circular area charts, Dual Axis charts.	L3	2

Course outcomes:	
CO1	Understand How to import data into Tableau.
CO2	Understand Tableau concepts of Dimensions and Measures.
CO3	Develop Programs and understand how to map Visual Layouts and Graphical Properties.
CO4	Create a Dashboard that links multiple visualizations
CO5	Use graphical user interfaces to create Frames for providing solutions to real world problems.
Reference Books:	
1	Microsoft Power BI cookbook, Brett Powell, 2nd edition.
2	R Programming for Data Science by Roger D. Peng (References)
3	The Art of R Programming by Norman Matloff Cengage Learning India.

Course Title	Computer Vision	Semester	V
Course Code	MVJ22AI551	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T: P :S: 3: 0: 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objectives: This course will enable students to

1.Computer Vision focuses on the development of algorithms and techniques to analyze and interpret the visible world around us.

2.This requires understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.

3. Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision.

Module-1:	8 Hrs

Overview of computer vision and its applications: Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation

Image Processing: Pixel transforms, color transforms, histogram processing, histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening, blurring and noise removal

Module-2:	8 Hrs

Feature detection: edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations.

Segmentation: Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized cut

Module-3:	8 Hrs

Camera calibration: camera models; intrinsic and extrinsic parameters; radial lens distortion; direct parameter calibration; camera parameters from projection matrices; orthographic, weak perspective, affine, and perspective camera models

Module-4:	8 Hrs

Motion representation: the motion field of rigid objects; motion parallax; optical flow, the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation

Motion tracking: statistical filtering; iterated estimation; observability and linear systems; the Kalman filter

Module-5:	8Hrs

Object recognition and shape representation: alignment, appearance-based methods, invariants, image eigenspaces

Course outcomes:

CO1	Learn fundamentals of computer vision and its applications
CO2	Understand the basic image processing operations to enhance, segment the images.
CO3	Understand the analyzing and extraction of relevant features of the concerned domain problem
CO4	Understand and apply the motion concepts and its relevance in real time applications
CO5	Apply the knowledge in solving high level vision problems like object recognition, image classification etc.

Reference Books:

1	Computer Vision: Algorithms and Applications, R. Szeliski, Springer, 2011.
2	Introductory techniques for 3D computer vision, E. Trucco and A. Verri, Prentice Hall, 1998

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3					2	3	3
CO2	1	3	3	2	2					2	3	3
CO3	2	2	2	2	3					2	3	3
CO4	2	2	2	2	2					2	3	3
CO5	1	2	3	2	2					2	3	3

Course Title	Information Theory and Coding	Semester	V
Course Code	MVJ22AI552	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T: P :S: 3: 0: 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objectives: This course will enable the students to:

1. Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of information and Order of a source

2 Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms

3. Model the continuous and discrete communication channels using input, output and joint probabilities

4. Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes

5. Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

Module-1: Information Theory	**8 hrs**

Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Mark off Sources

(Section 4.1, 4.2 of Text 1)

Module-2: Source Coding	**8 hrs**

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm (Sections 4.3, 4.3.1 of Text 1), Shannon Fano Encoding Algorithm (Section 2.15 of Reference Book 4)

Source coding theorem, Prefix Codes, Kraft McMillan Inequality property KMI, Huffinan codes (Section 2.2 of Text 2)

Module-3: Information Channels:	**8 hrs**

Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, Binary Symmetric Channel, System Entropies. (Section 4.4, 4.5, 4.51,4.5.2 of Text 1)

Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, (Section 2.5, 2.6 of Text 2)

Binary Erasure Channel, Muroga's Theorem (Section 2.27, 2.28 of Reference Book4)

Module-4: Error Control Coding	**8hrs**

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities ofLinear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.

Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

(Sections 9.1, 9.2,9.3,9.3.1,9.3.2,9.3.3 of Text 1)

Module-5: Convolution Codes	**8hrs**

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm) (Section 8.5-Articles 1,2 and 3, 8.6-Article 1of Text 2)

Course outcomes:

CO1	Learn fundamentals of computer vision and its applications
CO2	Understand the basic image processing operations to enhance, segment the images.
CO3	Understand the analyzing and extraction of relevant features of the concerned domain problem
CO4	Understand and apply the motion concepts and its relevance in real time applications
CO5	Apply the knowledge in solving high level vision problems like object recognition, image classification etc.

Reference Books:

1	Digital Conummications- Fundamentals andApplications, Bernard Sklar, SecondEdition, Pearson Education, 2016, ISBN: 9780134724058.
2	Information Theory and Coding, HariBhat, Ganesh Rao, Cengage, 2017
3	Error Correction Coding, Todd K Moon,Wiley Std. Edition, 2006

TextBooks:

1	Digital andAnalog Communication Systems, K. Sam Shanmugam, John Wtley India Pvt Ltd, 1996.
2	Digital Communication, Simon Haykin, John Wtley India Pvt Ltd, 2008.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

.**SEE Assessment:**

i. Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

i. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3					2	3	3
CO2	1	3	3	2	2					2	3	3
CO3	2	2	2	2	3					2	3	3
CO4	2	2	2	2	2					2	3	3
CO5	1	2	3	2	2					2	3	3

Course Title	**Nonlinear Control Techniques**	**Semester**	**V**
Course Code	**MVJ22AI553**	**CIE**	**50**
Total No. of Contact Hours	**40**	**SEE**	**50**
No. of Contact Hours/week	**3 (L : T : P :S: 3: 0: 0 : 0)**	**Total**	**100**
Credits	**3**	**Exam. Duration**	**3 Hours**

Course objectives: This course will enable students to

To introduce the need and concept of nonlinear system.

- To Identify and describe key characteristics of non-linear systems• To Apply analytical and numerical techniques to detect and study limit cycles in various systems.
- To Define Lyapunov stability and its importance in analyzing the behavior of nonlinear systems.
- To Understand the Centre Manifold Theorem and its significance in simplifying the analysis of nonlinear systems.
- To Design stabilizing controllers based on exact feedback linearization and other methods.

Module-1:	**8hrs**

Introduction - Characteristics of nonlinear systems - Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis.

Module-2:	**8hrs**

periodic orbits - limit cycles-Poincare-Bendixson criterionBendixson criterion. Existence and uniqueness of solutions, Lipschitz condition.

Module-3:	**8hrs**

Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method

Module-4:	**8hrs**

Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilisation- Analysis of feedback systems- Circle Criterion – Popov Criterion.

Module-5:	**8hrs**

Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling.

Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control.

Course outcomes:

CO1	Learn fundamentals of Analyzing behaviors and phenomena in nonlinear systems
CO2	Identify and analyze periodic solutions in various types of nonlinear systems.
CO3	Understand the concepts of local stability and stability in the small.
CO4	Apply the Centre Manifold Theorem to analyze the local behavior of nonlinear systems.
CO5	Evaluate the limitations and benefits of linearization-based control design.

Textbooks:	
1	Alberto Isidori, “Nonlinear Control Systems: An Introduction”, Springer-Verlag
2	Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
3	Jean-Jacques E. Slotine and Weiping Li, “Applied Nonlinear Control”, Prentice-Hall, NJ, 1991.
References:	
1	M. Vidyasagar, “Nonlinear Systems Analysis”, Prentice-Hall, India, 1991, 2. Shankar Sastry, “Nonlinear System Analysis, Stability and Control”, Springer, 1999

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. One question must be asked from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	2	2
CO2	2	2	2	2	2	2	-	-	-	-	2	2
CO3	2	2	2	2	2	-	-	-	-	-	2	2
CO4	2	2	2	2	2	-	-	-	-	-	2	2
CO5	1	2	3	2	2	-	-	-	-	-	2	2

Course Title	Distributed Systems	Semester	V
Course Code	MVJ22AI554	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T : P :S: 3: 0: 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course Learning Objectives: The students will be able to	
1	Understand fundamental concepts in Distributed systems.
2	Understand the problem-solving techniques and knowledge representation.
3	Design intelligent components or programs to meet desired needs.
4	Implement, and evaluate a computer-based distributed systems.
5	Understand fundamental concepts in Distributed systems.

Module1	8 Hrs
Distributed Systems: Characterization of Distributed Systems: Introduction, Examples of DS, Resource sharing and the Web, Challenges System Models: Architectural Models, Fundamental Models	
Module2	**8 Hrs**
Files and APIs: For complete syllabus and results, class timetable and more pls download iStudy. It's a light weight, easy to use, no images, no pdfs platform to make students life easier.	
Module3	**8 Hrs**
Operating System Support: Introduction, The OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture Distributed File Systems: Introduction, File Service architecture, Sun Network File System	
Module4	**8 Hrs**
Time and Global States: Introduction, Clocks, events, and process status, synchronizing physical clocks, Logical time and logical clocks, Global states Coordination and Agreement: Introduction, Distributed mutual exclusion, Elections	
Module5	**8 Hrs**
Inter-process Communication: Introduction, The API for the Internet Protocols, External Data Representation and Marshalling, Client-Server Communication, Group Communication, Case Study: IPC in UNIX.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the mechanism of IPC between distributed objects
CO2	Describe the distributed file service architecture and the important characteristics of SUN NFS.
CO3	Discuss concurrency control algorithms applied in distributed transactions

Textbooks:	
1.	George Coulouris, Jean Dollimore and Tim Kindberg: Distributed Systems – Concepts and Design, 5th Edition, Pearson Publications, 2009

References:	
1.	T Andrew S Tanenbaum: Distributed Operating Systems, 3rd edition, Pearson publication, 2007
2.	Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008
3.	Sunita Mahajan, Seema Shan, Distributed Computing, Oxford University Press,2015

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

i. **SEE Assessment:**

ii. The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

v. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3	-	-	-	-	2	3	3
CO2	1	3	3	2	2	-	-	-	-	2	3	3
CO3	2	2	2	2	3	-	-	-	-	2	3	3
CO4	2	2	2	2	2	-	-	-	-	2	3	3
CO5	1	2	3	2	2	-	-	-	-	2	3	3

Course Title	Essence of Research Methodology and IPR	Semester	V
Course Code	MVJ22RMI57	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T : P :S: 3: 0: 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course Learning Objectives: The students will be able to

1	Give an overview of the research methodology and explain the technique of defining a research problem.
2	Explain various research designs and their characteristics.
3	Explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
4	Explain several parametric tests of hypotheses.
5	Discuss leading International Instruments concerning Intellectual Property Rights.

Module1	8 Hrs

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Module2	8 Hrs

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Reviewing the literature: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed

Module3	8 Hrs

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data.

Module4	8 Hrs

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis

Module5	8 Hrs

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The

Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Co, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course Outcomes: After completing the course, the students will be able to	
CO1	To give an overview of the research methodology and explain the technique of defining a research problem
CO2	To explain various research designs and their characteristics
CO3	To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections
CO4	To explain several parametric tests of hypotheses
CO5	To discuss leading International Instruments concerning Intellectual Property Rights.
References Books:	
1.	Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018
2.	Study Material (For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013
3.	Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

mester End Examination (SEE):

tal marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course

contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO5	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

High-3, Medium-2, Low-1

Course Title	Environmental Studies	Semester	V
Course Code	MVJ22ENV58	CIE	50
Total No. of Contact Hours	26	SEE	50
No. of Contact Hours/week	2 (L: T : P :S: 2: 0: 0 : 0)	Total	100
Credits	2	Exam. Duration	2 Hours

Course Learning Objectives: The students will be able to

1	Relate interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes
2	Study drinking water quality standards and to illustrate qualitative analysis of water.
3	Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation, and societal stability.

Module1	6 Hrs
Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development. **Ecosystems (Structure and Function):** Forest, Desert, Rivers, Ocean **Biodiversity:** Types, Hot spots; Threats and Conservation of biodiversity, Deforestation**.**	

Module2	6 Hrs
Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, Tidal and Wind. **Natural Resource Management (Concept and case-study):** Disaster Management, Sustainable Mining and Carbon Trading.	

Module3	6 Hrs
Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects:** Bio-medical Waste, Solid waste, Hazardous waste and E-waste.	

Module4	6 Hrs
Global Environmental Concerns (Concept, policies, and case-studies): Global Warming, Climate Change, Acid Rain, Ozone Depletion and Fluoride problem in drinking water.	

Module5	6 Hrs
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems.	

Course Outcomes: After completing the course, the students will be able to

CO1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
CO2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem

CO5	Describe the realities that managers face when dealing with complex issues.
Reference Books:	
1.	Raman Siva kumar, "Principals of Environmental Science and Engineering", 2nd Edition, Cengage learning, Singapur.
2.	G.Tyler Miller, "Environmental Science – working with the Earth", 11th Edition, Jr. Thomson Brooks /Cole publications, California.
3.	Pratiba Singh, Anoop Singh & Piyush Malaviya, "Environmental and Ecology", 1st Edition , ACME Learning Pvt. Ltd. New Delhi.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students must answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have an internal choice in which both questions cover the entire unit having same complexity in terms of COs and Bloom's taxonomy level.

VI SEMESTER 2022 SYLLABUS

Semester VI

Natural Language Processing		Semester	VI
Course Code	**MVJ22AI61**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 20 Hours Practical**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**3**
Examination type (SEE)	**Theory**		

Course objectives: The students will be able to

1. Understand the concept of natural language processing, its challenges, and applications.
2. Understand the concepts of words form using morphology analysis.
3. Acquire the knowledge of syntax and semantics related to natural languages and implement them.
4. Ability to design and analyze various NLP algorithms.
5. Understand and apply knowledge of machine learning techniques used in NLP.

Teaching-Learning Process

Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1: Introduction to NLP	**8 hrs**

Introduction: Origin of Natural Language Processing (NLP), Challenges of NLP, NLP Applications, Processing Indian Languages.

Module-2: Words, Word Forms and Parsing	**8 hrs**

Morphology fundamentals; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Named Entities. **Parsing:** Definite clause grammars; shift-reduce parsing; chart parsing' Shallow Parsing, Statistical Parsing, Maximum Entropy Models; Random Fields, Scope Ambiguity and Attachment Ambiguity resolution, Approaches to discourse, generation.	
Module-3: Language Modeling and Part of Speech Tagging	**8 hrs**
Language Modeling and Part of Speech Tagging: Markov models, N-grams, estimating the probability of a word, and smoothing, Parts-of-speech, examples, and its usage.	
Module-4: Machine Translation	**8 hrs**
Machine Translation: Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation. **Video link:** https://www.youtube.com/watch?v=2XUhKpH0p4M&list=PLeo1K3hjS3uuvuAXhYjV2lMEShq2UYSwX&index=12	
Module-5: Meaning and Other Applications	**8 hrs**
Meaning: Lexical Knowledge Networks, WorldNet Theory; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors. Other Applications: Sentiment Analysis; Text Entailment; Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR. Text-classification. **Video link:** https://www.youtube.com/watch?v=ZeoqOybAzdc&list=PLeo1K3hjS3uuvuAXhYjV2lMEShq2UYSwX&index=26	

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Create a corpus of minimum five files with minimum of 5 sentences in each file, search for a given pattern using regular expression from the corpus and list all the sentences that have the searched pattern by highlighting the first occurrence of the patter for each sentence and also print the name of the file each sentence belongs to
2	Write a program that takes a DFA and a string as an input and checks for the validity of the string
3	Write a program that takes an NFA and a string as an input and checks for the validity of the string using DFS/BFS strategy.
4	Explore NLTK/Spacy and any other equivalent tools of the following fundamentals: a) Perform sentence and word tokenization b) Remove stop words in a text. c) Remove punctuation. d) Tag the words in a given text using POS tagger. e) Stemming and Lemmatization.
5	Write a program for predicting next word in the sequence using n-grams.
6	Write a program to create and read an input file, perform basic cleanup operations on the text in the file like removing HTML tags. URLs, remove the duplicate texts. perform spelling correction and remove the additional spaces. Finally write the cleaned text into an

	output file.
7	Write a program to read an input file, delete the odd numbers in texts and replace the even numbers with their equivalent words. Finally write the updated test into an output file.
8	Write a program that takes CFG for a language and a sentence belongs to a language as an input and generates parse tree for the same using various parsers available in NLTK and Spacy.
9	Write a program to Extract names, emails, and phone numbers from a text.
10	Write a program to retrieve the information from a text file using verb/noun keywords as a search query.

Course Outcomes:

CO1: Analyze natural language text.
CO2: Define the importance of natural language processing.
CO3: Understand and apply the concepts of text mining.
CO4: Illustrate information retrieval techniques.
CO5: Evaluate various NLP algorithms.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed tohave satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests,each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods.
  mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second testafter covering 85-90% of the syllabus. Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theorycomponent of IPCC (that is for **25 marks)**.
- The student must secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluationof the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**

- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers forthe course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximumof 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scoredby the student shall be proportionally scaled down to 50 Marks.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a

CIE component only. Questions mentioned in the SEE paper may include questions from the practicalcomponent.

Suggested Learning Resources:

Textbooks:

1. **Jurafsky D. and Martin H. J,** Speech, and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Prentice Hall (2014), 2nd ed.
2. **Manning D. C. and Schütze H.,** Foundations of Statistical Natural Language Processing MIT Press (1999) 1st ed. Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition andYear)

Reference Books:

1. **Dale R., Moisl H. and Somers H.,** Handbook of Natural Language Processing, CRC Press (2010), 2nd ed.
2. **Bird S., Klein E. and Loper E.,** Natural Language Processing with Python, Oreilly Publication (2009), 2nd ed.

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

- Programming Assignment
- Project-based Assignment

CO-PO/PSO Mapping														
CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	3	1	-	1	-	-	-	-	-	-	2	-	-
CO2	2	2	3	3	2	-	-	-	-	-	-	2	-	2
CO3	2	2	3	2	2	1	-	1	-	-	-	2	-	2
CO4	2	2	2	3	2	1	-	1	1	1	-	2	-	2
CO5	2	3	2	3	3	1	-	1	1	1	-	2	-	1

Course Title	MACHINE LEARNING	Semester	VI
Course Code	MVJ22AI62	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T: P: 3: 0: 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: ***This course will enable students to***

1. Understand machine learning and problems relevant to machine learning.
2. Differentiate supervised, unsupervised and reinforcement learning.
3. Apply data-preprocessing methods such as data cleaning, transformation, reduction, and scaling.
4. Apply various regression and classification techniques and evaluate them.
5. Perform statistical analysis of machine learning techniques.
6. Understand ANN concepts and apply them on various datasets to understand how it's working.

Teaching-Learning Process Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Show working of various ML/DL models in MATLAB.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1	Hours 8

Introduction: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning, and Reinforcement learning.

Data Pre-processing: Need of Data Pre-processing, Data Pre-processing Methods: Data Cleaning, Data Integration, Data Transformation, Data Reduction; Feature Scaling (Normalization and Standardization), Splitting dataset into Training and Testing set.

Show Data Visualization problem examples using MATLAB.

Module-2	Hours 8

Regression: Linear Regression, Multiple Linear Regression and Polynomial Regression, Evaluating Regression Model's Performance (RMSE, Mean Absolute Error, Correlation, RSquare), Regularization Methods

Classification: Need and Applications of Classification, Logistic Regression, Decision tree.

Case study of classification and regression algorithms using MATLAB.

Module-3	Hours 8

Classification (Contd..): Tree induction algorithm – split algorithm based on information theory, split algorithm based on Gini index; Random Forest classification, Naïve Bayes algorithm; K-Nearest Neighbors (K-NN), Support Vector Machine (SVM), Evaluating Classification Model's Performance (Sensitivity, Specificity, Precision, Recall, etc.)

Clustering: Need and Applications of Clustering, Partitioned methods, Hierarchical methods, Density-based methods.

Case study of classification and clustering algorithms using MATLAB.

Module-4	Hours 8

Association Rules Learning: Need and Application of Association Rules Learning, Basic concepts of Association Rule Mining, Naïve algorithm, Apriori algorithm.

Module-5	Hours 8

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptron, Backpropagation algorithm.

Course outcomes:

CO1 Identify the issues in machine learning and Algorithms for solving it.
CO2 Evaluate the probability and statistics related to machine learning.
CO3 Investigate and apply concept learning of all Machine Leaning Algorithms.
CO4 Identify the difference between the real time application of Machine Learning and Deep Learning using real time scenarios.
CO5 Understand and apply the concepts of deep learning.

Textbooks:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2014) 3rd Edition.
3. Vijayvargia Abhishek, Machine Learning with Python, BPB Publication (2018)

Reference Books:

1 Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics

2 Ethem Alpaydın, Introduction to machine **learning, second edition, MIT press.**

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks tobe awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 markscovering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.

One question must be asked from each unit. The duration of examination is 3 hours.

CO/PO MAPPING														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	1	-	-	1	1	-	2	-	1
CO2	3	3	3	1	2	1	-	-	1	1	1	2	1	1
CO3	2	2	2	1	3	-	-	-	1	1	1	2	2	3
CO4	3	2	3	2	1	-	-	-	1	2	3	2	1	1
CO5	3	2	3	2	2	-	-	-	1	2	3	2	1	2

Semester: VI
Professional Elective II

Course Title	**Blockchain Technology**	**Semester**	**VI**
Course Code:	**MVJ22AI631**	**CIE Marks**	**50**
Total No. of Contact Hours	**40**	**SEE Marks**	**50**
No. of Contact Hours/week	**L: T:P:S: 3:0:0:0**	**TOTAL**	**100**
Credits	**3**	**EXAM DURATION**	**3 hrs**

Course Learning Objectives: The students will be able to

1	Understand the functional/operational aspects of cryptocurrency ecosystem. Understand emerging abstract models for Blockchain Technology.
2	Understand how blockchain systems (mainly Bitcoin and Ethereum) work and how to apply secure interaction with them.
3	Identify and evaluate major research challenges and technical gaps existing between theory and practice in cryptocurrency domain
4	Design, build, and deploy smart contracts and distributed applications.

Teaching-Learning Process
Pedagogy (General Instructions):
Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1	**Hours 8**

Basics: Distributed Database, Two General Problem, Byzantine General problem, and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Applications: Telecommunications, finance, universities

Module-2	**Hours 8**

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public

blockchain.

Applications: Government, healthcare

Module-3	**Hours 8**

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Applications: Decentralized Applications, Encrypted messaging applications

Module-4	**Hours 8**

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.

Applications: Peer - to - peer payment application.

Module-5	**Hours 8**

Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange,

Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service, and future of Blockchain.

Course Outcomes:

CO1	Understand how blockchain systems work and how to securely interact with them
CO2	Evaluate emerging abstract models for Blockchain Technology and its real-world applications
CO3	Interpret various consensus algorithms and differentiate its field of application .
CO4	Design, build, and deploy smart contracts and distributed applications.
CO5	Analyze the local and global regulations associated with the Cryptocurrency.

Textbooks:

1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
Reference Books:	
1	Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
2	DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
3	Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory andconsists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks.

covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five questions.

iii. One question must be asked from each unit. The duration of the examination is 3 hours.

CO-PO/PSO Mapping

CO-PO/PSO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2	2
CO2	3	2	-	-	-	-	-	-	-	-	2	3	2	-
CO3	3	3	1	-	2	-	1	-	-	-	-	3	2	1
CO4	3	3	3	2	3	-	-	1	-	-	-	3	3	3
CO5	3	2	-	-	2	-	-	2	-	-	-	3	1	1

High-3, Medium-2, Low-1

Semester: VI Professional Elective II			
Course Title	**CLOUD COMPUTING**	**Semester**	**VI**
Course Code:	**MVJ22AI632**	**CIE Marks**	**50**
Total No. of Contact Hours	**40**	**SEE Marks**	**50**
No. of Contact Hours/week	**L: T:P:S: 3:0:0:0**	**TOTAL**	**100**
Credits	**3**	**EXAM DURATION**	**3 HRS**

Course Learning Objectives: The students will be able to	
1	To understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
2	To understand and apply the basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations;
3	To understand and analyze the different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS);
4	To understand and analyze cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;
5	To analyze and create the variety of programming models and develop working experience in several of them.

Teaching-Learning Process Pedagogy
(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

UNIT-I	**L1, L2**	**8 Hrs**

Introduction to Cloud Computing: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud

Applications:

Microsoft Azure, Amazon Web Services

UNIT-II	8 Hrs

Integration as a Service' Paradigm for the Cloud Era:

An Introduction, The Onset of Knowledge Era, The Evolution of SaaS , The Challenges of SaaS Paradigm, Approaching the SaaS Integration Enigma, New Integration Scenarios, The Integration Methodologies, SaaS Integration Products and Platforms , SaaS Integration Services, Businesses-to-Business Integration (B2Bi) Services, A Framework of Sensor- Cloud Integration, SaaS Integration Appliances, Issues for Enterprise Applications on the Cloud, Transition Challenges, Enterprise Cloud Technology and Market Evolution, Business Drivers Toward a Marketplace for Enterprise Cloud Computing, The Cloud Supply Chain

Laboratory Sessions/ Experimental learning:

1. Installation and Configuration of Hadoop.

Applications: PAAS (Facebook, Google App Engine)

UNIT-III	8 Hrs

Virtual Machines Provisioning and Migration Services:

Introduction and Inspiration- Background and Related Work-Virtual Machines Provisioning and Manageability-Virtual Machine Migration Services- VM Provisioning and Migration in Action–Provisioning in the Cloud Context- The Anatomy of Cloud Infrastructures-Distributed Management of Virtual Infrastructures - Scheduling Techniques for Advance Reservation of Capacity- Capacity Management to meet SLA Commitments- RVWS Design and Cluster as a Service: The Logical Design

Laboratory Sessions/ Experimental learning:

Implementation of Para-Virtualization using VM Ware 's Workstation/ Oracle 's Virtual Box and Guest O.S

Applications:

Hardware Virtualization, Operating system Virtualization, Server Virtualization, Storage Virtualization

UNIT-IV	8 Hrs

Platform and Software as a Service**:** Technologies and Tools for Cloud Computing- Aneka Cloud Platform-Aneka Resource Provisioning Service- Hybrid Cloud Implementation – Comet Cloud Architecture- Autonomic Behavior of Comet Cloud- Overview of Comet Cloud-based Applications- Implementation and Evaluation-Workflow Management Systems and Clouds- Architecture of Workflow Management Systems - Utilizing Clouds for Workflow Execution- Case Study: Evolutionary Multi objective Optimizations- Visionary thoughts for Practitioners

Laboratory Sessions/ Experimental learning:

Create an application (Ex: Word Count) using Hadoop Map/Reduce.

Applications: Schedule book

UNIT-V	8 Hrs

MapReduce Programming Model and Implementations**:** MapReduce Programming Model- Major MapReduce Implementations for the Cloud- The Basic Principles of Cloud Computing-A Model for Federated Cloud Computing- Traditional Approaches to SLO Management- Types of SLA- Life Cycle of SLA- SLA Management in Cloud- Automated Policy-based Management- The Current State of Data Security in the Cloud-Data Privacy and Security Issues-Producer Consumer Relationship-Cloud Service Life Cycle

Laboratory Sessions/ Experimental learning:

Create your resume in a neat format using google and zoho cloud Programs on PaaS

Applications: Network Storage, Google Apps and Microsoft office online

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall the recent history of cloud computing, illustrating its motivation and evolution.
CO2	Analyze the enabling technologies in cloud computing and discuss their significance.
CO3	Articulate the economic benefits as well as issues/risks of the cloud paradigm for businesses as well as cloud providers
CO4	Understand SLAs and SLOs and analyze their importance in Cloud Computing.
CO5	Recall some of the common cloud providers and their associated cloud stacks and compare popular cloud use case scenarios.

Textbooks/Reference Books	
1.	Cloud Computing, Principles and Paradigms, Rajkumar Buyya, James Broberg, Wiley Publication
2.	Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in tests, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO/PSO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	1	1	2	-	-	-	-	-	1	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO3	1	-	-	1	1	-	2	3	3	3	3	-	2	-
CO4	3	3	2	2	2	-	-	-	-	-	-	3	-	-
CO5	3	3	3	3	3	2	-	-	3	3	3	3	2	1

Semester: VI Professional Elective II			
Course Title	**Human-centered AI**	**Semester**	**VI**
Course Code	**MVJ22AI633**	**CIE**	**50**

Total No. of Contact Hours	**40**	**SEE**	**50**
No. of Contact Hours/week	**L: T:P:S: 3:0:0:0**	**Total**	**100**
Credits	**3**	**Exam: Duration**	**3 Hours**

Course Learning Objectives: The students will be able to

1	To understand the history of AI and responsible AI.
2	To understand and analyse HCAI framework and how it is human-centred.
3	To understand different types of recommender systems and its application in HCAI.
4	To understand explainable AI and to analyse its societal impact.
5	To understand AI ethics and designing its moral agents.

Teaching-Learning Process Pedagogy
(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

UNIT-I	**8 Hrs**

Introduction to HCAI:

Brief history of social control of technology from WWII until the present time, The current wave of legislation and ethical guidelines for AI, AI Ethics challenges, Brief introduction to the notion of Trustworthy AI, Responsible AI, Human-Centred AI, The background of Artificial Intelligence (AI), Basic notions: Autonomy, Adaptability, Interaction, Who or what is responsible for decisions and actions by AI systems?, What is Human-Centred Artificial Intelligence (HCAI)?, The United Nation's Sustainable Development Goals, What makes HCAI different from AI: Process, Product, The basic concepts of HCAI

UNIT-II	**8 Hrs**

HCAI framework and Design Metaphors: Motivation behind the HCAI Framework, rising above the levels of automation, Defining Reliable, Safe and Trustworthy systems, Two-dimensional HCAI Framework, what is Human-Centred Design? Design guidelines and examples, Design metaphors: Intelligent Agents and Supertools, Teammates and Tele-bots, Assured autonomy and control centres, Social Robots and active appliances

UNIT-III	**8 Hrs**

Short Introduction to recommender systems: Content-Based Recommendation, Collaborative Filtering, Hybrid Approaches, Model- vs Memory-Based, Item- vs User-Based, Evolution of Recommender Systems.

UNIT-IV	**8 Hrs**

Explainable AI: Explainable AI: Current state and some thought for the future A Journey towards Explainable AI and its Societal Implications, the need of interpreting AI systems, Understanding Interpretability and Explainability, Traditional interpretable models, Explaining the black box, Model-specific algorithms, Model-agnostic algorithms, Counterfactual explanations, evaluating explanation methods, Enhancing human-AI collaboration.

UNIT-V	**8 Hrs**
AI ethics and responsible AI: A high-level overview of AI Ethics, Ethical decision-making, Ethical theories, Ethics in practice, implementing ethical reasoning, Responsible research and innovation, The ART of AI: Accountability, Responsibility, Transparency, Approaches to ethical reasoning by AI, designing artificial moral agents, implementing ethical deliberation, Levels of ethical behaviour, The ethical status of AI systems, Ensuring Responsible AI in practice	

Course Outcomes: After completing the course, the students will be able to	
CO1	To understand the history of AI and responsible AI.
CO2	To understand HCAI framework and analyse how it is human-centred.
CO3	To understand different types of recommender systems and its application in HCAI.
CO4	To understand explainable AI and its societal impact.
CO5	To apply and analyse different approaches of ethical AI.

Textbooks/Reference Books	
1.	Shneiderman, Ben, *Human-Centered AI* (Oxford, 2022; online edn, Oxford Academic, 17 Fe 2022), https://doi.org/10.1093/oso/9780192845290.001.0001, accessed 4 June 2024.
2.	Virginia Dignum, Responsible Artificial Intelligence, Springer Cham, https://doi.org/10.1007/978-3-030-30371-6.

Continuous Internal Evaluation (CIE):
Theory for 50 Marks
CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in tests, quizzes and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):
Total marks: 50+50=100
SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO/PSO Mapping														
CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	1	1	-	-	3	1	3	1	1	-	2	-	-
CO2	1	1	-	-	-	2	1	3	1	1	-	2	-	-
CO3	1	2	2	-	-	2	-	3	1	1	-	2	-	-
CO4	1	1	1	1	-	3	-	3	1	1	-	2	-	-
CO5	1	1	1	1	-	2	-	3	1	1	-	2	-	-

Semester: VI Professional Elective II			
Course Title	**Time Series Analysis**	**Semester**	**VI**
Course Code:	**MVJ22AI634**	**CIE Marks**	**50**
Total No. of Contact Hours	**40**	**SEE Marks**	**50**
No. of Contact Hours/week	**L: T:P:S: 3:0:0:0**	**TOTAL**	**100**
Credits	**3**	**EXAM DURATION**	**3 hrs**

Course Learning Objectives: The students will be able to

1	Understand the characteristics of time series data and their applications in different domains.
2	Learn various time series models and techniques for analyzing and forecasting time series data.
3	Develop skills in model identification, estimation, and diagnostic checking.
4	Apply time series analysis methods to real-world data sets using statistical software.
5	Interpret and communicate results obtained from time series analysis effectively.

Teaching-Learning Process Pedagogy
(General Instructions):
Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-I	**8 Hrs**
Introduction to Time Series Analysis: Time series data definition, Qualities of time series information, Time series analysis applications, Time Series Elements, and (partially) Decomposition	
Module-II	**8 Hrs**
Stationarity and Time Series Components: Seasonality, cyclical elements, and trends, Methods of decomposition: multiplicative and additive models, The meaning of stationarity	
Module-III	**8 Hrs**
Time Series Modeling Autocorrelation function (ACF) and partial autocorrelation function (PACF): Models of moving averages (MAs), Models of Autoregressive (AR) ARIMA models, or autoregressive integrated moving averages, Model Determination and Approximation (In part)	
Module-IV	**8 Hrs**

Forecasting and Model Evaluation: Jenkins-Box technique, Model selection standards: BIC and AIC, estimating parameters and fitting models, Methods for Diagnostic Checking and Forecasting	
Module-V	**8 Hrs**
Advanced Topics and Applications: SARIMA models (seasonal ARIMA models), Transfer function models, extended memory functions, Uses and Examples, Examine and Combine	

Course Outcomes: After completing the course, the students will be able to	
CO1	Showcase your ability to analyze time series data using relevant statistical approaches such as decomposition, trend analysis, and seasonal adjustment.
CO2	Use several time series models, including as ARIMA, SARIMA, and exponential smoothing, to reliably estimate future values and assess the uncertainty of such projections.
CO3	Evaluate the stationarity of time series data and apply the appropriate modifications to accomplish it.
CO4	Implement time series models with statistical software such as R or Python, and effectively analyze the findings.
CO5	Utilize time series analysis techniques to analyze real-world datasets from a variety of fields, including environmental sciences, finance, and economics, and make intelligible findings to aid in decision-making.

Textbooks/Web Links	
1.	"Time Series Analysis and Its Applications: With R Examples" by Robert H. Shumway and David S. Stoffer I**SBN:** 978-3319524511.
2.	"Time Series Analysis: Forecasting and Control" by George E.P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, and Greta M. Ljung **ISBN:** 978-1118675021

Reference Books	
1.	"The Analysis of Time Series: An Introduction" by Chris Chatfield ISBN: 978-1584883173
2.	"Time Series: Theory and Methods" by Peter J. Brockwell and Richard A. Davis ISBN: 978-1441903198
3.	"Time Series Analysis: With Applications in R" by Jonathan D. Cryer and Kung-Sik Chan ISBN: 978-0387759586

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. The test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in tests, quizzes and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students must answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO/PSO Mapping																
CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SEMESTER -6TH **INTRODUCTION TO DATA STRUCTURES**			
Course code	**MVJ22AI641**	**CIE**	**50**
Total No. of Contact Hours: L:T:P:S	**3:0:0:0**	**SEE**	**50**
No. of Contact Hours/week	**4**0	**Total**	**100**
Credits	**3**	**Exam. Duration**	**3**

COURSE OBJECTIVES: ***This course will enable students to***

1. Discuss the fundamental concepts and principles of data structures.
2. Understand the importance of data structures in computer programming and problem solving.
3. A compressive overview of various data structures such as arrays, linked lists, stacks, queues, trees and graphs.
4. Prepare the students for advanced courses in algorithms and data analysis.

Module 1	**8hrs**

Introduction: Data Structures definition, classification of data structures, Arrays – Definition, Declaration, Types of arrays, Structures , Pointers.

Textbook 2 : chapter 2

Module 2	**8hrs**

Stacks- definition, implementation of stacks using arrays, operations of stacks.

Queues- Introduction, Types of queues, Linear queue using arrays, operations on linear queue, circular queue. Limitation of linear queue, Linear Queue vs circular queue.

Textbook 2: chapter 3

Module 3	**8hrs**

Linked List -Linked-list and its types- singly linked lists- doubly-linked lists- circular linked lists, Applications of Linear Data Structures.

Textbook 1: Chapter3:3.2.1, 3.2.2, 3.2.5, 3.2.6

Module 4	**8hrs**

Non Linear Data Structures: Trees – Introduction, Terminologies, Representation of trees, Types of Trees, Application of trees , Binary Tree – Representation, Traversal techniques, Binary Search trees – Tree Construction, Expression trees. Application of Binary search tree.

Textbook 1: Chapter4:4.1-4.4-4.4.7, Chapter6:6.3,6.4

Module 5	**8hrs**

Graphs: Introduction, terminologies, Representation of graphs, connected graph, graph traversal techniques, Application of graphs in data structures.
Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extensible Hashing.
Textbook 1: Chapter9: 9.1-9.3,9.5, Chapter 5

Course outcomes: Students will be able to	
CO1	Evaluate the performance and efficiency of different operations on arrays, stacks, queues, and circular queues.
CO2	Understand and implement the different types of linked list.
CO3	Understand basic concepts of trees and implement basic operations on trees.
CO4	Demonstrate the representation and traversal techniques of graphs and their applications.
CO5	Apply and analyze the concepts of Hashing in storing data.

Textbooks:	
1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2011
2	Fundamentals of Data structures, Ellis Horowitz, sartaj sahni,
3	Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures & Algorithms, Pearson Education, New Delhi, 2006

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.
Quizzes/mini tests (4 marks)
Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.

One question must be set from each unit. The duration of examination is 3 hours.

CO-PO MAPPING

COPO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	3	3	-	-	-	1	-	-	2	1	2
CO2	2	2	2	3	2	-	-	-	1	-	-	2	-	2
CO3	2	2	2	3	2	-	-	-	1	-	--	2	-	1
CO4	3	2	2	3	2	-	-	-	1	-	-	2	2	1
CO5	3	2	2	3	2	-	-	-	1	-	-	2	2	-

SEMESTER -6TH

FUNDAMENTALS OF OPERATING SYSTEMS

Course code	**MVJ22CD642**	**CIE**	**50**
Total No. of Contact Hours: L:T:P:S	**3:0:0:0**	**SEE**	**50**
No. of Contact Hours/week	**4**0	**Total**	**100**
Credits	**3**	**Exam. Duration**	**3**

COURSE OBJECTIVES: ***This course will enable students to***

1. Understanding the fundamental concepts of operating systems.
2. Analyse the exchanging data between different process.
3. Discuss the deadlock mechanism in operating systems.
4. Recognize the importance of process and memory management.
5. Outline the features of files and file management systems.

Module 1	**8hrs**

The Basics: An overview: Introduction to operating systems, components of an operating systems, Evolution of operating system, architecture of operating system, Functions of operating system.

Textbook 1: Chapter 1: 1.1-1.4

Module 2	**8hrs**

Operating system services, user and operating system interface, system calls and services, operating system structure, **Process:** Introduction, Process management, OS view of processes. Process states. **Interrupts:** Interrupts in operating systems, Interprocess communication, types of interprocess communications.

Textbook 1: Chapter 2: 2.1- 2.8, Chapter 3: 3.1-3.6

Module 3	**8hrs**

Deadlocks: what is Deadlock, Deadlock Characteristics, resource management, conditions of deadlock – Handling Deadlocks, deadlock avoidance, Deadlock Detection, Deadlock Recovery.

Textbook 1: Chapter 8: 8.3 – 8.8

Module 4	**8hrs**

Process scheduling: Concept of Process Scheduling, operation on Processes scheduling, Scheduling criteria.

Memory Management: Memory organization in operating system, Memory Hierarchy, Memory Management Strategies. Contiguous Memory Allocation, Non-contiguous Memory Allocation.

Textbook1: Chapter 3:3.3, Chapter 9: 9.1, 9.2

Module 5	**8hrs**

File and Database Systems: File concept, Access methods, Data Hierarchy, Directory Structure, File Protection, File System Structure. File access control.

Textbook 1: Chapter 14:14.2- 14.7, 14.14

Course outcomes: Students will be able to	
CO1	Understand the architecture for OS and basic concepts of OS.
CO2	Understand the process and inter-process communication.
CO3	Apply suitable methods to handle and avoid deadlock.
CO4	Analyze and solve problems related to process management, memory management.
CO5	Implementing various file operations and directories.

Textbooks:	
1	"Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, 10th ed.
2	"Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos,5th ed.
3	"Operating Systems: Internals and Design Principles" by William Stallings,7th ed

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.

One question must be set from each unit. The duration of examination is 3 hours.

CO-PO MAPPING												
COPO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**
CO2	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**
CO3	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**
CO4	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**
CO5	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**3**

Course Title	**MOBILE APPLICATION DEVELOPMENT**	**Semester**	**06**
Course Code	**MVJ22AI643**	**CIE**	**50**
Total No. of Contact Hours	**40**	**SEE**	**50**
No. of Contact Hours/week	**3 (L: T: P :: 3 : 0 : 0)**	**Total**	**100**
Credits	**3**	**Exam. Duration**	**3 Hours**

Course objective is to: ***This course will enable students to***

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1.	To understand concepts of Mobile Technology
2.	Understand the development process and have edge over mobile user interface (UI) design.
3.	Understand various UI development tools, Application design interfaces and
4.	creating basic app on Android platform.

Module-1	**Hours 8**

Introduction: Introduction to mobile application - Market values for mobile applications System requirements for mobile application Mobile application development architecture.

Video link / Additional online information (related to module if any):

https://www.tutorialspoint.com/android/ Online

Module-2	**Hours 8**

Designing Applications using Android: Developing user interfaces -Layout -Input Controls and Events- Menus - Dialogs, Notifications and Toasts

Applications: Design a Simple Calculator App

Module-3	**Hours 8**
Multimedia & Services: Lifecycle of a Service - Managing Services GPS location API Playing audio, video.	
Module-4	**Hours 8**
Technology I Android: Introduction Establishing the development environment Android architecture Activities and views Interacting with UI Persisting data using SQLite Packaging and deployment.	
Module-5	**Hours 8**
Technology II IOS: Introduction to Objective C IOS features UI implementation Touch frameworks Data persistence using Core Data and SQLite.	

Course Outcomes:	
CO1	Define and meet system requirements for developing mobile applications.
CO2	Design and implement user interfaces for Android applications using layouts, input controls, menus, dialogs, notifications, and toasts.
CO3	Develop, deploy and maintain the Android Applications.
CO4	Develop and interact with UI components, manage activities, and views in Android
CO5	Implement data persistence in iOS applications using Core Data and SQLite.

CO-PO MAPPING

COPO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	-	-	-	-	-	-	-	3
CO2	3	2	3	-	1	-	-	-	-	-	-	3
CO3	3	2	3	-	-	-	-	-	-	-	-	3
CO4	3	2	3	-	1	-	-	-	-	-	-	2
CO5	3	2	3	-	1	-	-	-	-	-	-	2

Textbooks:	
1	Jeff McW herter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
2	David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development:
Reference Books:	
1	James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012
2	Charlie Collins, Michael Galpin and Matthias Kappler,

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.
uizzes/mini tests (4 marks)
Mini Project / Case Studies (8 Marks)
ctivities/Experimentations related to courses (8 Marks)

SEE Assessment:

estion paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
t B also covers the entire syllabus consisting of five questions having choices and may contain. sub-divisions, each carrying 16 marks. Students must answer five full questions.
uestion must be set from each unit. The duration of the examination is 3 hours.

Course Title	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**Semester**	**VI**
Course Code	**MVJ22AI644**	**CIE Marks**	**50**
Total Number of Contact Hours	**40**	**SEE Marks**	**50**
Number of Contact Hours/Week	**3:0:0**	**Total**	**100**
Credits	**3**	**Exam duration**	**3 Hrs**

Course Learning Objectives: This course will enable students to:

- Identify the problems where AI is required and the different methods available.
- Comparison analysis of different AI techniques available.
- Understand and apply various learning algorithms.

Module – 1	**8 Hrs**

What is artificial intelligence? Problems, Problem Spaces, and search
TextBook1: Ch 1, 2

Module – 2	**8 Hrs**

Knowledge Representation Issues, Using Predicate Logic, representing knowledge using Rules
TextBoook1: Ch 4, 5 and 6.

Module – 3	**8 Hrs**

Symbolic Reasoning under Uncertainty, Statistical reasoning
TextBoook1: Ch 7, 8

Module – 4	**8 Hrs**

Heuristic search techniques: Generate and test, Hill Climbing, Best First Search, ProblemReduction, Constraint Satisfaction, Means-ends Analysis.

Weak Slot- and- Filler Structures: Semantic Nets, Frames.

Strong slot-and Filler Structures- Conceptual Dependency, Scripts.

Module – 5	**8 Hrs**

Learning, Expert Systems.
TextBook1: Ch 17 and 20

Course outcomes: The students should be able to:

- **CO1:** Identify and analyze AI based problems.
- **CO2:** Apply various techniques to solve AI problems.
- **CO3:** Understand AI learning and analyze various learning techniques.
- **CO4:** Understand and analyze the working of AI based expert systems.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textb o o k s :

1. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
4. Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems", Oxford University Press-2015

CO-**PO/PSO Mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	1	1	2	-	-	-	2	-	-
CO2	2	-	-	-	-	1	1	2	-	-	-	2	1	1
CO3	2	2	2	2	-	1	1	2	2	1	-	2	1	1
CO4	2	2	2	2	-	1	1	2	2	1	-	2	1	1

Course Title	**PROJECT PHASE 1**	**Semester**	**VII**
Course Code	**MVJ22CSP65**	**CIE**	**50**
Total No. of Contact Hours	**L: T: P:: 0 : 0 : 4**	**SEE**	**-**
No. of Contact Hours/week	**-**	**Total**	**50**
Credits	**2**	**Exam. Duration**	**-**

Course Objective:

1. To support independent learning.
2. To develop interactive, communication, organization, time management, and presentation skills. To impart flexibility and adaptability.
3. To expand intellectual capacity, credibility, judgment, intuition.
4. To train students to present the topic of project work in a seminar without any fear, face.
5. audience confidently, enhance communication skill, involve in group discussion to present, and exchange ideas.

Project Work Phase - I: Each student of the project batch shall be involved in carrying out the project work.
jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

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

CO1	Describe the project and be able to defend it.
CO2	Learn to use modern tools and techniques.
CO3	Develop skills to work in a team to achieve common goals. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation:

Internal Marks: The Internal marks (50 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

CIE Marks Breakup for Malor Project during VI Semester:

Relevance of the Topic	10 Marks
Report	20 Marks
Evaluation by Guide	25 Marks
Presentation	30 Marks
Viva- Voce	15 Marks
Total	100 Marks

CO-**PO/PSO Mapping**														
CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	2	2	2	3	3	2	1	1	2	1	1	2	2	1
CO 2	2	2	2	3	3	2	1	1	2	1	2	2	1	3
CO 3	2	2	2	3	3	2	1	1	2	1	2	2	1	2
CO 4	2	2	2	3	3	2	1	1	2	1	2	2	1	1
CO 5	2	2	2	3	3	2	1	1	2	1	2	2	1	3

Course Title	**MACHINE LEARNING LABORATORY**	Semester	VI
Course Code	MVJ22AIL66	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	2 (L: T: P 0: 0: 2)	Total	100
Credits	1	Exam. Duration	3 Hours

Course objective is to: *This course will enable* ***students to***

1 Make use of Data sets in implementing the machine learning algorithms

2 Implement the machine learning concepts and algorithms in any suitable language of choice.

S No	**Experiment Name**	**RBT Level**	Hours
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	L3	2
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	L3	2
3	Develop a program to demonstrate the prediction of values of a given dataset using Linear regression.	L3	2

4	Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	L3	2
5	Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate data sets.	L3	2
6	Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	L3	2
7	Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	L3	2
8	Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	L3	2
9	Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using ***k*-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	L3	2
10	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	L3	2
11	Implement the non-parametric Locally Weighted Regression algorithm to fit data points. Select appropriate data set for your experiment and draw graphs.	L3	2

Course Outcomes:	
CO1	Understand the implementation procedures for the machine learning algorithms.
CO2	Design Python programs for various Learning algorithms.
CO3	Apply appropriate data sets to the Machine Learning algorithms.
CO4	Identify and apply Machine Learning algorithms to solve real world problems.

CO5	Perform statistical analysis of machine learning techniques.

Reference Books:

1	Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

CIE Assessment:

Regular Lab work :20Record

writing :5

Lab Tests (Minimum 2 tests shall be conducted for 15 marks and average of two will be taken)

Viva 10 marks

SEE Assessment:

Examinations will be conducted for 100 marks and scaled down to 50. The weightage shall be,

i. Writeup: 20 marks
ii. Conduction: 40 marks
iii. Analysis of results: 20 marks
iv. Viva: 20-

CO–PO/PSO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	–	–	1	1	1	–	2	2	2
CO2	2	2	1	1	1	–	–	1	1	1	–	2	2	3
CO3	2	2	1	1	1	–	–	1	1	1	–	2	2	2
CO4	2	2	1	1	1	–	–	1	1	1	–	2	2	3
CO5	2	2	1	1	1	–	–	1	1	1	–	2	2	3

VII SEMESTER 2022 SYLLABUS

SEMESTER VII

Deep Learning and Reinforcement Learning		Semester	VII
Course Code	MVJ22AI71	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	04	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

- Learn to feed-forward deep networks.
- Understand convolutional networks and sequence modelling.
- Study probabilistic models and auto encoders.
- Expose the students to various deep generative models.

Study the various applications of deep learning.

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

5. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
6. Use of Video/Animation to explain functioning of various concepts.
7. Encourage collaborative (Group Learning) Learning in the class.

Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1: Introduction	**8 hrs**
Introduction: History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation. Activation Functions & Parameters: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters/s Hyper-parameters	
Pedagogy	Chalk and Board, Problem-based learning
Module-2: Auto-Encoders & Regularization	**8 hrs**

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization	
Pedagogy	Chalk and Board, Problem-based learning
Module-3: Deep Learning Model	**8 hrs**
Deep Learning Models:Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Introduction to RNNs KNN, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Deep Learning Applications:Image Processing, Natural Language Processing, Speech recognition, Video Analytics	
Pedagogy	Chalk and Board, Problem-based learning
Module-4: INTRODUCTION AND MULTI ARMED BANDITS	**8 hrs**
Reinforcement Learning Primitives: Introduction,Basics of RL, Defining RL Framework, Probability Basics: Probability Axioms,Random Variables, Probability Mass Function, Probability Density Function, CumulativeDistribution Function and Expectation. Introduction to Agents, Intelligent Agents – ProblemSolving – Searching, Logical Agents.	
Pedagogy	Chalk and Board, Problem-based learning
MODULE-5: FINITE MARKOV DECISION PROCESS	**8 hrs**
Finite Markov Decision Process:Basics, The Agent-Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and optimal Value Functions, Optimality and Approximation. DYNAMIC PROGRAMMING Dynamic Programming:Definition, Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous dynamic programming, Generalized Policy Iteration, Efficiency of dynamic programming.	
Pedagogy	Chalk and Board, Problem-based learning

COURSE OUTCOMES	
CO1	Understand the fundamentals of deep learning and the main research activities in this field.
CO2	Remember architectures and optimization methods for deep neural network training.
CO3	Implement, apply, and test relevant learning algorithms in TensorFlow.
CO4	Understand the fundamentals of Reinforcement learning.
CO5	Understand the finite markov decision process.

SNO	EXPERIMENT
1	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
2	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
3	Writea programto construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API.
4	Write a program to implement Continuous Bag of Words Model using KNN Algorithm (using Python).
5	Build an image classification model to detect if the person has cancer or not.
6	Build a chatbot to identify the context the user is asking and then provide it with the relevant answer.
7	Implement a Human Face Recognition Model and determine the accuracy in detecting the bounding boxes of the human face

8	Build a model that takes an image as input and determines whether the image contains a picture of a dog or a cat.
9	Implement Q-learning algorithm to navigate a grid world and learn an optimal policy.
10	Implement Asynchronous dynamic programming in python

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests. Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks
SEE Assessment:
The question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for a total of 20 marks covering the whole syllabus. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions. One question must be asked from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 1 0	PO1 1	PO1 2
CO1	3	2	2	-	1	2	_	-	-	-	2	2
CO2	3	2	2	-	1	2	-	-	-	-	2	2
CO3	3	2	2	-	1	2	-	-	-	-	2	2
CO4	3	2	3	-	1	2	-	-	-	-	2	2
CO5	3	3	3	3	1	2	1	1	1	1	2	2

TEXT BOOK:

1	Yoshua Bengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press,2015
2	Miguel Morales, Grokking Deep Reinforcement Learning, Manning Publications, 2020.

REFERENCE BOOK

1	Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An Introduction, Second Edition, MIT Press, 2019.
2	Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020. 4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018.

Machine learning II		Semester	VII
Course Code	**MVJ22AI72**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 20 Hours Practical**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**3**
Examination type (SEE)	**Theory**		

Course objectives:

- Understand eigenvalues, eigenvectors, and their significance in linear algebra and concepts related to singular value decomposition (SVD)
- Understanding Bayesian Approaches
- Understand the theoretical foundations of machine learning and how learning algorithms adapt based on observed errors.
- Understand the motivation behind using genetic algorithms (GAs) for solving complex problems and Understand the basics of reinforcement learning (RL).
- Explore how prior knowledge can enhance learning

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1.Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.

2.Use of Video/Animation to explain functioning of various concepts.

3.Encourage collaborative (Group Learning) Learning in the class.

4.Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1: Matrix Analysis	**8 hrs**

Matrix Analysis: Eigen analysis, Rank Analysis, and Spectral Graph Theory, Probability: Exponential family of distribution, Sufficient Statistics, Overview of Statistical Estimation: MLE, MAP, and Bayes Principle

Machine Learning Theory:Foundational Aspects of Learning, PAC Learning, VC Dimension, Learnability ,Structural and Empirical Risk ,Minimizing Risk: Minimizing the VC dimension, Minimal Complexity Machines, Data Augmentation

Pedagogy	Chalk and Board, Problem-based learning

Module-2: Bayesian learning	**8 hrs**

Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.

Pedagogy	Chalk and Board, Problem-based learning

Module-3: Computational learning theory and Instance-Based Learning-	**8 hrs**

Computational learning theory –

Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.

Instance-Based Learning-

Introduction, k-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

Pedagogy	Chalk and Board, Problem-based learning

Module-4: Genetic Algorithms	**8 hrs**

Genetic Algorithms –

Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.

Learning Sets of Rules –

Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.

Reinforcement Learning –

Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

Pedagogy	Chalk and Board, Problem-based learning

Module-5: Analytical Learning	**8 hrs**

Analytical Learning-1-

Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

Analytical Learning-2-

Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.

Combining Inductive and Analytical Learning –

Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

Pedagogy	Chalk and Board, Problem-based learning

Sno	**EXPERIMENTS**

1	The probability that it is Friday and that a student is absent is 3%. Since there are 5 school days in a week, the probability that it is Friday is 20%. What is theprobability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)
2	Extract the data from database using python
3	Implement k-nearest neighbours classification using python
4	Given the following data, which specify classifications for nine Combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)
5	The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset
6	Implement linear regression using python
7	Implement naive baye's theorem to classify the English text
8	Implement an algorithm to demonstrate the significance of genetic algorithm
9	Implement the finite words classification system using Back-propagation algorithm
10	Carry out the performance analysis of classification algorithms on a specific dataset.

COURSE OUTCOMES	
CO1	Understand the theoretical foundations of machine learning.
CO2	Understand the foundations of Bayesian inference.
CO3	Understand a very broad collection of machine learning algorithms and problems.
CO4	Explore a practical example to see how GAs work.
CO5	Determining how to use explanations to guide search processes.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

MiniProject/CaseStudies(8Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

The question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

One question must be asked from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/ PO	PO 1	PO2	PO3	PO 4	PO 5	PO6	PO 7	PO8	P O 9	PO1 0	PO11	PO12
CO1	3	2	2	2	1	2	_	-	-	-	2	2
CO2	3	2	2	2	1	2	-	-	-	-	2	2
CO3	3	2	2	2	1	2	-	-	-	-	2	2
CO4	3	2	3	2	1	2	-	-	-	-	2	2
CO5	3	2	2	2	1	2	-	-	1	1	2	2

TEXTBOOK:

1	"Matrix Analysis for Statistics" by James R. Schott

2	https://archive.org/details/BolstadWilliamM.CurranJamesMIntroductionToBayesianStatistics2016Wiley
3	An Introduction to Genetic Algorithms By Melanie Mitchell
4	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron.

Data Security and Privacy		Semester	VII
Course Code	MVJ22AI73	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 20 Hours Practical	Total Marks	100
Credits	04	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives: Students will be able to:

- understand the fundamentals of database systems, data analysis, and security, including data storage and representation, exploratory data analysis, authentication and authorization, and database security measures to protect data from unauthorized access and threats.
- understand and implement techniques for protecting individual privacy and anonymity in data
- Understand fundamentals of Differential Privacy (DP), including its formalism, mechanisms, and properties, and to learn how to apply DP concepts.
- understand various adversarial attacks on AI/ML systems, including poisoning, evasion, and backdoor attacks.
- understand the fundamental concepts and principles of privacy, legal and ethical issues in computer security

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

8. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
9. Use of Video/Animation to explain functioning of various concepts.
10. Encourage collaborative (Group Learning) Learning in the class.
11. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE I: Fundamentals of Data Privacy & Security	**8 hrs**
Databases and Exploratory Data Analysis,Data Representation and Storage, Authentication and Authorization,Database Security	
Pedagogy	Chalk and Board, Problem-based learning

MODULE 2: Anonymization	**8 hrs**
Linkage and re-identification attacks, k-anonymity, l-diversity, t-closeness, Implementing anonymization. Anonymizing complex data, Privacy and anonymity in mobile environments.	
Pedagogy	Chalk and Board, Problem-based learning

MODULE 3: Differential Privacy (DP)	**8 hrs**
Formalism and interpretation of DP, Fundamental DP mechanisms and properties Interactive and non-interactive DP, DP for complex data, Local Differential Privacy (LDP)	
Pedagogy	Chalk and Board, Problem-based learning

Module-4: Security and Privacy in AI and Machine Learning (AI/ML)	**8 hrs**
Adversary modeling in AI/ML, Poisoning, evasion, and backdoor attacks, Test-time attacks: Model inversion, model stealing, membership inference, adversarial examples. Architectures and algorithms for privacy-preserving machine learning.	
Pedagogy	Chalk and Board, Problem-based learning

Module-5: Privacy, Legal and Ethical Issue:	8 hrs
Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, E-Mail Security, Impacts on Emerging Technologies. Legal and Ethical Issues in Computer Security: Protecting Programs and Data, Information and the Law, Rights of Employees and employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security.	

Pedagogy	Chalk and Board, Problem-based learning.

COURSE OUTCOME: Students will be able to

CO1	design, implement, and secure database systems, perform exploratory data analysis, and ensure data privacy and security through authentication, authorization, and database security measures.
CO2	design and implement privacy-preserving data analysis techniques, including anonymization, differential privacy, and secure data sharing, to protect individual privacy and anonymity in various data settings.
CO3	apply the principles of Differential Privacy to design and analyze privacy-preserving algorithms and systems, ensuring robust privacy guarantees for individual data in various applications.
CO4	Identify, analyze, and develop countermeasures against various adversarial attacks on AI/ML systems, including data poisoning, evasion, and backdoor attacks, to ensure the security and robustness of machine learning models.
CO5	Evaluate the privacy, legal, and ethical implications of computer security practices and technologies, and design solutions that balance security with individual privacy rights and ethical considerations.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of examination is 3 hours.

Suggested Learning Resources:

Textbooks:

1.Data Privacy and Security by Salomon, David, Springer, 2003. (Module III)

2.Security in Computing by Charles Pfleeger, Shari Lawrence Pfleeger, 5th Edition, PHI,2015. (Module IV)

Reference Books:

1. Information Security: Principles and Practice by Mark Stamp, Wiley Inter Science,2011.

2.Computer Security: Art and Science by Matt Bishop, First Edition, Addison Wesley,2002.

- Programming Assignment
- Case Studies

CO-PO/PSO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PO
CO1	2	2	2	-	-	-	-	1	2	2	2	-	2	-
CO2	2	2	2	-	-	1	-	1	2	2	2	1	2	2
CO3	2	2	2	2	1	1	-	1	2	2	2	-	3	-
CO4	1	2	2	2	1	1	-	1	2	2	2	1	2	2
CO5	1	2	2	1	1	1	2	1	2	2	2	2	1	-

Iot Analytics	Semester	VII

Course Code	MVJ22AI741	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	**Theory**		

Course learning objectives: Students will be able to-

- Understand the integration of IoT, cloud, and big data for enabling IoT analytics and addressing its associated challenges.
- Interpret and compare development tools and open-source frameworks for building and deploying IoT analytics applications.
- Review and understand tools for IoT semantics and data streaming analytics.
- Use IoT analytics applications with a focus on data analytics for smart buildings and energy efficiency.
- Analyze IoT analytics applications and challenges in the context of smart cities, including cloud and edge-based solutions.

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

- Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE I: IoT Analytics Enablers, IoT, Cloud and Big Data Integration for IoT Analytics	**8 hrs**

Introduction, IoT data and big data, challenges of IOT analytics applications, IOT analytics lifecycle and techniques, conclusions.
IoT, Cloud and Big Data Integration for IoT Analytics

Introduction, cloud based IOT platforms, data analytics for the IOT, Data collection using low power,

Lawrence radios, WAZIUP software platform, iKaaS software platform.

Pedagogy	Chalk and Board, Problem-based learning

MODULE 2: Development tools for IOT analytics applications, Open-Source Framework	**8 hrs**

Introduction, VITAL architecture for IoT Analytics, VITAL development environment, Development Examples.

Open-Source Framework

Introduction, Architecture for IoT Analytics- as-a-Service, Sensing - as-a-Service Infrastructure Anatomy, Scheduling, Metering and Service Delivery, Sensing - as-a-Service Example, From Sensing - as-a-Service to IoT Analytics- as-a-Service.

Pedagogy	Chalk and Board, Problem-based learning

MODULE 3: A Review of Tools for IoT Semantics and Data Streaming Analytics	**8 hrs**

Introduction, Related Work, Semantic Analytics, Tools and Platforms, A Practical Use Case.

Pedagogy	Chalk and Board, Problem-based learning

Module-4: IoT Analytics Application and Case Studies, Data Analytics in Smart Buildings	**8 hrs**

Data Analytics in Smart Buildings Introduction, Addressing Energy Efficiency in Smart Buildings, A proposal of a general architecture for management systems of smart buildings, IoT based system for Energy Efficiency in Smart Buildings, Evaluation and Results

Pedagogy	Chalk and Board, Problem-based learning

Module-5: IoT Analytics for Smart Cities	8 hrs

Introduction, Cloud based IoT Analytics, Cloud based city platform, new challenges towards Edge based solutions, Edge based IoT Analytics, Use case of Edge based data analytics

Pedagogy	Chalk and Board, Problem-based learning.

Course Outcomes:

CO 1:	Identify IoT data challenges and lifecycle and apply cloud-based platforms and data analytics techniques for IoT applications.
CO 2:	Understand VITAL architecture and development environments and implement Sensing-as-a-Service and IoT Analytics-as-a-Service frameworks.
CO 3:	Interpret and apply semantic analytics tools and platforms to practical IoT use cases.
CO 4:	**E**valuate and design IoT-based systems for energy efficiency in smart buildings and understand the general architecture for smart building management systems.
CO 5:	Create and implement cloud and edge-based IoT analytics solutions for smart cities and address related challenges through practical use cases.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of examination is 3 hours.

Textbooks And Reference Books:

1. John Soldatos (Editor), Building Blocks for IoT Analytics Internet of Things Analytics, River Publishers Series in Signal, Image and Speech Processing

CO-PO/PSOMapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	2	2	-	-	-	-	-	-	3	1	2
CO3	3	2	1	1		-	-	2	-	-	-	3	-	3
CO4	2	1	1	3	2	2	2	2	-	-	-	3	2	3
CO5	3	2	2	2	2	1	1	1				3	2	2

BUSINESS ANALYTICS		Semester	VII
Course Code	**MVJ22AI742**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3**
Examination type (SEE)	**Theory**		
Course objectives: The student should be able to			

1. Identify solutions, assessments, and validation to a broad range of situations by eliciting, planning, monitoring, and analyzing enterprise requirements.
2. Analyse professional maintaining high standards of practice, making ethical/legal judgments and decisions, and sustaining professional standing through a commitment to life-long learning.
3. Demonstrate effective use of written, verbal, and non-verbal communication, employing relevant knowledge, skills, and judgment in a business setting.

Teaching-Learning Process Pedagogy
(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1: INTRODUCTION TO BUSINESS ANALYTICS	**8 hrs**
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration	
Pedagogy	Chalk and Board, Problem-based learning
Module-2: BUSINESS INTELLIGENCE	**8 hrs**
Data Warehouses and Data Mart – Knowledge Management -Types of Decisions – Decision Making Process – Decision Support Systems – Business Intelligence -OLAP – Analytic functions	
Pedagogy	Chalk and Board, Problem-based learning
Module-3:HR & SUPPLY CHAIN ANALYTICS	**8 hrs**
Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain – Applying HR Analytics to make a prediction of the demand for hourly employees for a year.	
Pedagogy	Chalk and Board, Problem-based learning
Module-4: MARKETING & SALES ANALYTICS	**8 hrs**
Marketing Strategy, Marketing Mix, Customer Behaviour -selling Process – Sales Planning -Analytics applications in Marketing and Sales – predictive analytics for customers' behaviour in marketing and sales.	

Pedagogy	Chalk and Board, Problem-based learning

Module-5: Decision support and Data Visualization	**8 hrs**

DSS- Executive and enterprise support- Automated decision support - Web analytics- Datamining-Applied artificial intelligence - Visual analysis: Data concepts – Data Dashboards -Data exploration & visualization - Scorecards

Pedagogy	Chalk and Board, Problem-based learning

Course outcomes:

CO1	Develop critical thinking skills to analyze business problems and make data-driven decisions.
CO2	Apply analytics techniques to solve complex business problems across different functional areas.
CO3	Effectively communicate analytical findings and recommendations to stakeholders using visualizations and reports.
CO4	Understand ethical considerations related to data collection, analysis, and decision-making in business analytics.

CO-PO/PSOMapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2				3	-	3	2	2	1	3	-	-
CO2	3	2		3		-	-	-	1	2	-	3	1	2
CO3	2	2	1	-		-	-	-	-	3	-	3	-	3
CO4	2	1	1	3		2	2	-	-	2	-	3	-	3

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and
- consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of the examination is 3 hours.

TEXT AND REFERENCE BOOKS

i. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
ii. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
iii. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
iv. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
v. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.
vi. Umesh R Hodeghatta and Umesha Nayak, Business Analytics Using R - A Practical ApproachApress, 2017.

	SOFT COMPUTING	Semester	VII
Course Code	**MVJ22AI743**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3**
Examination type (SEE)	**Theory**		

Course Learning Objectives: The students will be able to :

- Understand the fundamentals of soft computing, including machine learning and computational intelligence, and equip them with the knowledge and skills to apply soft computing techniques to real-world problems, such as sales forecast prediction using back propagation networks.
- understanding of artificial neural networks (ANNs), including their architecture, training, and applications, to enable them to design and implement ANNs to solve real-life problems, including natural language processing.
- Analyze the principles and concepts of fuzzy logic, enabling them to design and apply fuzzy inference systems and controllers to solve real-world problems, including those that involve uncertainty and ambiguity.
- analyze the fundamental concepts and procedures of Genetic Algorithms (GA), including encoding, initialization, selection, and genetic operators, to enable them to design and apply GA to solve optimization and search problems.
- Analyze the principles and applications of computational intelligence paradigms, including swarm intelligence and particle swarm optimization, to enable them to design and apply these techniques to solve complex optimization and search problems.

Module-1	8 HRS

INTRODUCTION TO SOFT COMPUTING:

Evolution of Computing, Concept of computing systems. Soft Computing Constituents, From Conventional AI to Computational Intelligence, Machine Learning Basics, Some applications of soft computing techniques

Real Time Applications: Framework for predicting analytics on sales forecast using back propagation network

Pedagogy	Chalk and Board, Problem-based learning

Module-2	**8 hrs**

NEURAL NETWORKS:
Biological neurons and it's working, Simulation of biological neurons to problem solving. Architecture-: Single Layer and Multilayer -Feed Forward Networks-Training and Learning methods, Applications of ANNs to solve some real-life problems.
Real Time Applications: Natural Language processing using artificial neural networks.

Video link:

- https://nptel.ac.in/courses/106/106/106106184/

Pedagogy	Chalk and Board, Problem-based learning

Module-3	**Hours 8**

FUZZY LOGIC:
Introduction to Fuzzy logic, Fuzzy Sets, Membership Functions, Operations on Fuzzy sets, Fuzzy Rules and Fuzzification and Defuzzification, Fuzzy Inference Systems, Fuzzy logic controller design, Some applications of Fuzzy logic.
Real Time Applications:

- Traffic Simulation System Based on Fuzzy Logic
- Fuzzy logic rule based medical diagnosis system.

Video link:

- https://onlinecourses.nptel.ac.in/noc20_ma48/

https://nptel.ac.in/courses/111/102/111102130/

Pedagogy	Chalk and Board, Problem-based learning

Module-4	**Hours 8**

Basic Concepts – Working Principle – Procedures of GA – Flow Chart of GA - Genetic

Representation: (Encoding) Initialization and Selection – Genetic Operators: Encoding,

Pedagogy	Chalk and Board, Problem-based learning

Module-5: Hybrid Systems	8 hrs

COMPUTATIONAL INTELLIGENCE:
Computational Intelligence Paradigms, Swarm Intelligence Techniques, Basic Particle Swarm Optimization, Applications.
Real Time Applications: Hybrid Computational Intelligence Systems for Real World Applications
Video link:
https://nptel.ac.in/courses/106/106/106106126/

Pedagogy	Chalk and Board, Problem-based learning

Course outcomes:

CO1	Apply soft computing techniques, including machine learning and computational intelligence, to solve real-world problems, such as sales forecast prediction, and develop effective solutions using back propagation networks and other soft computing methods.
CO2	Design, train, and deploy artificial neural networks (ANNs) to solve complex real-life problems, including natural language processing, and develop practical solutions using ANN architectures and algorithms.
CO3	Analyze and apply fuzzy logic principles to develop fuzzy inference systems and

	controllers that effectively solve real-world problems, handling uncertainty and ambiguity in areas like control systems, decision-making, and expert systems.
CO4	Analyze and apply Genetic Algorithm (GA) concepts and procedures to design and implement effective solutions for optimization and search problems, leveraging encoding, initialization, selection, and genetic operators to drive efficient problem-solving.
CO5	Analyze and apply computational intelligence paradigms, including swarm intelligence and particle swarm optimization, to develop innovative solutions for complex optimization and search problems, leveraging the collective intelligence of swarm systems to drive efficient problem-solving.

Text/Reference Books:	
1	Fuzzy Logic: A Practical approach, F. Martin, Mc neill, and Ellen Thro, AP Professional, 2000.
2	Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
3	Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Nikola K. Kasabov, MIT Press, 1998.
4	An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
5	Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
6	Soft Computing, D. K. Pratihar, Narosa, 2008.
7	Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.
8	Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
9	Real World Applications of Computational Intelligence, Mircea Gh. Negoita, Bernd Reusch, Part of the Studies in Fuzziness and Soft Computing book series (STUDFUZZ, volume 179)

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and

consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.

One question must be asked from each unit. The duration of the examination is 3 hours.

CO-PO/PSO Mapping

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO 2	2	2	2	2	2	-	-	-	-	-	-	-	3	2
CO 3	2	2	2	2	1	-	-	-	-	-	-	-	3	2
CO 4	2	2	2	2	1	-	-	-	-	-	-	-	3	2
CO 5	2	2	2	2	1	-	-	-	-	-	-	-	3	2

Course Title	BIG DATA ANALYTICS	Semester	07
Course Code	MVJ22AI744	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L: T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam Duration	3 Hours

Course objective is to: This course will enable students to

- The scope and essentiality of Big Data and Business Analytics.
- The technologies used to store, manage, and analyze big data in a Hadoop ecosystem.
- The techniques and principles in big data analytics with scalability and streaming capability.
- The hypothesis on optimized business decisions in solving complex real-world problems.

Module-1	**Hours 8**

INTRODUCTION TO BIG DATA: Characteristics of Data,Evolution of Big Data,Definition of Big Data,Challenges with Big Data, Traditional Business Intelligence (BI) versus Big Data. Big data analytics: Classification of Analytics, Importance and challenges facing big data, Terminologies Used in Big Data Environments, The Big Data Technology Landscape,industry examples of big data

Video link : https://www.digimat.in/nptel/courses/video/106104189/L01.html

Module-2	Hours 8

INTRODUCTION TO HADOOP: Introducing Hadoop, RDBMS versus Hadoop,Distributed Computing Challenges, History and overview of Hadoop, Use Case of Hadoop,Hadoop Distributors,Processing Data with Hadoop, Interacting with Hadoop Ecosystem

Video link: https://www.digimat.in/nptel/courses/video/106104189/L04.html

Module-3	Hours 8

THE HADOOP DISTRIBUTED FILESYSTEM: Hadoop Distributed File System (HDFS): The Design of HDFS, HDFS Concepts, Basic Filesystem Operations, Hadoop Filesystems. The Java Interface- Reading Data from a Hadoop URL, Reading Data Using the Filesystem API, Writing Data. Data Flow- Anatomy of a File Read, Anatomy of a File Write, Limitations.

Video link: https://www.digimat.in/nptel/courses/video/106104189/L04.html

Module-4	Hours 8

UNDERSTANDING MAP REDUCE FUNDAMENTALS: Map Reduce Framework: Exploring the features of Map Reduce, Working of Map Reduce, Exploring Map and Reduce Functions, Techniques to optimize Map Reduce jobs, Uses of Map Reduce. Controlling MapReduce Execution with Input Format, Reading Data with custom Record Reader, -Reader, Writer, Combiner, Partitioners, Map Reduce Phases,Developing simple MapReduce Application.

Video link: https://www.digimat.in/nptel/courses/video/106104189/L06.html

Module-5	Hours 8

INTRODUCTION TO PIG: Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, Getting started with Pig Latin, working with operators in Pig, Working with functions in Pig.

Video link: https://www.youtube.com/watch?v=qr_awo5vz0g

Course Outcomes:

CO1	Explain the evolution of big data with its characteristics and challenges with traditional business intelligence.
CO2	Explain the big data technologies used to process and query the big data in Hadoop, MapReduce and Pig.
CO3	Make use of appropriate components for processing, scheduling, and knowledge extraction from large volumes in distributed Hadoop Ecosystem
CO4	Develop a Map Reduce application for optimizing the jobs.
CO5	Develop applications for handling huge volume of data using Pig Latin

Textbooks:

1	Seema Acharya, Subhashini Chellappan,F―BigData and Analytics,Wiley Publications,2nd Edition, 2014 DT Editorial Services,―BigData, Dream Tech Press,2nd Edition,2015.
2	Tom White,―Hadoop:The Definitive Guide,O'Reilly,3 rd Edition,2012.
3	Big Data Black Book, dream tech publications, 1st Edition, 2017.

Reference Books:

1	Michael Minelli, Michele Chambers,Ambiga Dhiraj, ―Big Data,Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Wiley CIO Series, 1stEdition,2013.
2	Rajiv Sabherwal, Irma Becerra- Fernandez, ―Business Intelligence –Practice, Technologies and Management, John Wiley, 1st Edition,2011
3	Arvind Sathi, ―Big Data Analytics: Disruptive Technologies for Changing the Game, IBM Corporation, 1st Edition,2012.

CO-PO/PSO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		-	-	-	-	-	-	-	-	-	2	-
CO2	2	2		-	-	-	-	-	-	-	-	-	2	2
CO3	2	3	2	2	-	-	-	-	-	-	-	-	1	3
CO4	1	2	3	-	-	-	-	-	-	-	-	-	1	2
CO5	1	2	2	2	-	-	-	-	-	-	-	-	2	-

Introduction to DBMS		Semester	VII
Course Code	MVJ22AI751	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

To learn the fundamentals of data models and to conceptualize and depict a database system using ER diagram. To make a study of SQL and relational database design. To understand the internal storage structures using different file and indexing techniques will help in physical DB design. To know the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure.

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

- Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE I: INTRODUCTION AND CONCEPTUAL MODELING	**8 hrs**

Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model – Relational Model – Relational Algebra.IoT, Cloud and Big Data Integration for IoT Analytics

Pedagogy	Chalk and Board, Problem-based learning

MODULE 2: RELATIONAL MODEL	**8 hrs**

SQL – Data definition- Queries in SQL- Updates- Views – Integrity and Security – Relational Database design – Functional dependencies and Normalization for Relational Databases (up to BCNF).

Pedagogy	Chalk and Board, Problem-based learning

MODULE 3: NON-RELATIONAL MODEL	**8 hrs**

Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases

Pedagogy	Chalk and Board, Problem-based learning

Module-4:DATA STORAGE AND QUERY PROCESSING	**8 hrs**

Record storage and Primary file organization- Secondary storage Devices- Operations on FilesHeap File- Sorted Files- Hashing Techniques – Index Structure for files –Different types of Indexes- B-Tree - B+ Tree – Query Processing.

Pedagogy	Chalk and Board, Problem-based learning

Module-5: TRANSACTION MANAGEMENT	**8 hrs**

Transaction management -Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability- Serializability and Schedules – Concurrency Control – Types of Locks- Two Phases locking- Deadlock- Time stamp-based concurrency control – Recovery Techniques – Concepts- Immediate Update- Deferred Update - Shadow Paging.

Pedagogy	Chalk and Board, Problem-based learning.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of examination is 3 hours.

Textbooks And Reference Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Seventh Edition, McGraw-Hill, 2021

Course Title	**INTRODUCTION TO DBMS**	**Semester**	07
Course Code	**MVJ22AI752**	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3(L:T:P::3:0:0)	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course Learning Objectives: The students will be able to

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in database
- Design and build database applications for real world problems

Module-1	**Hours 8**

INTRODUCTION AND CONCEPTUAL MODELING:

Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model – Relational Model – Relational Algebra.IoT, Cloud and Big Data Integration for IoT Analytics

Module-2	**Hours 8**

RELATIONAL MODEL:

SQL – Data definition- Queries in SQL- Updates- Views – Integrity and Security – Relational Database design – Functional dependencies and Normalization for Relational Databases (up to BCNF).

Module-3	**Hours 8**

NON-RELATIONAL MODEL:

Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases

Module-4	**Hours 8**

DATA STORAGE AND QUERY PROCESSING:

Record storage and Primary file organization- Secondary storage Devices- Operations on FilesHea File- Sorted Files- Hashing Techniques – Index Structure for files –Different types of Indexes- B-Tree - B+ Tree – Query Processing

Module-5	**Hours 8**

TRANSACTION MANAGEMENT:

Transaction management -Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability- Serializability and Schedules – Concurrency Control – Types of Locks- Two Phases locking- Deadlock- Time stamp-based concurrency control – Recovery Techniques – Concepts- Immediate Update- Deferred Update - Shadow Paging.

Course outcomes:

CO1	Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
CO2	To make a study of SQL and relational database design, Design and normalize relational databases
CO3	Explore non-relational database models.
CO4	Manage data storage and query processing
CO5	Handle transaction management and concurrency control

Text/Reference Books:

1	**A**braham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Seventh Edition, McGraw-Hill, 2021
2	Pramod J. Sadalage and Martin Fowler –"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 2012
3	Shannon Bradshaw, Eoin Brazil Kristina Chodorow – "MongoDB: The Definitive Guide",
4	3rd Edition, 2019 Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th

	Edition, 2017, Pearson.

CO-PO/PSO Mapping

CO-PO/PSO Mapping														
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	2	-	1	-	-	1	-	2	-	-	2	3
CO 2	3	2	2	1	-	-	-	-	-	-	-	1	2	2
CO 3	2	3	1	3	2	1	1	1	-	1	-	2	2	1
CO 4	3	2	2	-	2	2	-	-	-	-	2	1	2	2
CO 5	3	2	3	3	2	1	2	1	2	-	1	2	2	2

High-3, Medium-2, Low-1

INTRODUCTION TO ALGORITHMS		Semester	VII
Course Code	MVJ22AI752	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	**Theory**		

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

- Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module 1	**8 Hours**

Module 1: The Role of Algorithms in Computing: Algorithms, kinds of problems are solved by algorithms, Algorithms as a technology, Efficiency, Data structures, Technique, Hard problems.

Textbook 1: Chapter 1

Pedagogy	Chalk and Board, Problem-based learning

Module 2	**8 Hours**

Module 2: Getting Started Insertion sort, analyzing algorithms, Analysis of insertion sort, Worst-case and average-case analysis, Designing algorithms.

Textbook 1: Chapter 2,3

Pedagogy	Chalk and Board, Problem-based learning

Module 3	8Hours
Module 3: Growth of Functions Growth of Functions, Asymptotic notation, Comparison of functions, Standard notations and common functions, Functional iteration **Textbook 1**: Chapter 4,5,6	
Pedagogy	Chalk and Board, Problem-based learning

Module 4	8 Hours
Module 4: Recurrences The substitution method, The recursion-tree method, The master method, Proof of the master theorem, The proof for exact powers **Textbook 1 Chapter 7,8,9**	
Pedagogy	Chalk and Board, Problem-based learning

Module 5	8 Hours
Module 5: Probabilistic Analysis and Randomized Algorithms The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables **Textbook 1: Chapter 10,11**	
Pedagogy	Chalk and Board, Problem-based learning.

Course Objectives: Students will be able to :

- Understand the role of algorithms in computing, including their applications, efficiency, data structures, techniques, and challenges.
- Interpret and understand the insertion sort algorithm, including worst-case and average-case scenarios, and to understand the basics of designing algorithms.
- Differentiate the growth of functions, asymptotic notation, and the comparison of functions using standard notations.
- Use different methods for solving recurrences, including the substitution method, recursion-tree method, and master method, along with proofs for the master theorem.
- Analyze probabilistic techniques and randomized algorithms, including the hiring problem, indicator random variables, and their applications.

Course outcomes	
CO1	Identify and apply appropriate algorithms to solve various computational problems, evaluate their efficiency, and understand the role of data structures and techniques in algorithm development.
CO2	Analyze and evaluate the insertion sort algorithm in different scenarios and apply principles of algorithm design to develop efficient solutions.
CO3	Analyze the growth of functions using asymptotic notation, compare functions, and apply standard notations and common functions in algorithm analysis.
CO4	Analyze recurrences using various methods, understand the master theorem, and apply these techniques to analyze the efficiency of recursive algorithms.
CO15	Execute probabilistic analysis to analyze algorithms, understand randomized algorithms, and use indicator random variables effectively in algorithmic analysis.
Textbooks:	
1	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
2	Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
3	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)
4	Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
LINKS **https://archive.nptel.ac.in/courses/106/105/106105164/**	

CO-PO/PSO Mapping

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO 2	2	2	2	2	2	-	-	-	-	-	-	-	3	2
CO 3	2	2	2	2	1	-	-	-	-	-	-	-	3	2
CO 4	2	2	2	2	1	-	-	-	-	-	-	-	3	2
CO 5	2	2	2	2	1	-	-	-	-	-	-	-	3	2

SOFTWARE ENGINEERING		Semester	VII
Course Code	MVJ22AI753	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objective is to: ***This course will enable students to***

- Understand principles, concepts, methods, and techniques of the software engineering approachto producing quality software (particularly for large, complex systems).
- Impart skills in the design and implementation of efficient software systems across disciplines.
- Familiarize engineering practices and standards used in developing software products andcomponents. Gather knowledge on various software testing, maintenance methods.

Teaching-Learning Process Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

- Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module-1	**8 Hours**

FUNDAMENTALS OF SOFTWARE ENGINEERING AND REQUIREMENTS ENGINEERING

Software Engineering Fundamentals; Software processes: Software life-cycle models; Software requirements and specifications: Requirements elicitation; Requirements analysis modeling techniques; Functional and non-functional requirements.

Laboratory Sessions/ Experimental learning:

To write the SRS for the given real time application using report writing tools.

Applications: In Software development process.

Pedagogy	Chalk and Board, Problem-based learning

Module-2	**8 Hours**

SOFTWARE DESIGN

Fundamental design concepts and principles; Design characteristics; System Models - Context, Behavioral, Data and, Object models.

Laboratory Sessions/ Experimental learning:

Draw a class diagram, object diagram, use case diagram, Sequence diagram and activity diagram forthe given real time application using rational rose tool.

Applications: In Software development process.

Pedagogy	Chalk and Board, Problem-based learning

Module-3	**8 Hours**

SOFTWARE VALIDATION AND MAINTENANCE

Software validation: Validation planning; Testing fundamentals, including test plan creation and test case generation; Black-box and white-box testing techniques; Unit, integration, validation, and system testing; Object-oriented testing; Inspections.

Laboratory Sessions/ Experimental learning:

Using Selenium IDE write a test suite containing a minimum of 4 test cases.

Applications: In Software development process.

Pedagogy	Chalk and Board, Problem-based learning

Module-4	**8 Hours**

COMPONENT BASED SOFTWARE ENGINEERING

Engineering of Component-Based Systems; The CBSE Process; Domain Engineering; Component-Based Development; Classifying and Retrieving Components; Economics of CBSE

Laboratory Sessions/ Experimental learning: Create a project using MS projects for any real timescenario.

Applications: In Software development process.

Pedagogy	Chalk and Board, Problem-based learning

Module-5	**8 Hours**

SOFTWARE QUALITY PROCESS IMPROVEMENT Overview of Quality management and Process Improvement; Overview of SEI -CMM, ISO 9000, CMMI, PCMM, TQM and Six Sigma; Overview of CASE tools. Software tools and environments: Programming environments; Project management tools.

Laboratory Sessions/ Experimental learning: Estimation of test coverage metrics using manualtest metrics.

Applications: In Software development process.

Pedagogy	Chalk and Board, Problem-based learning.

Course outcomes:

CO1	Comprehend software development life cycle and Prepare SRS document for a project
CO2	Apply software design and development techniques
CO3	Identify verification and validation methods in a software engineering project
CO4	Apply on Component based software development process.
CO5	Involve in continuous learning to solve issues of process and software product using. the advanced CASE tools and techniques.

Text/Reference Books :

1	Ian Sommerville, "Software Engineering", 9th Edition, Addison- Wesley, 2011
2	R. S. Pressman, Software Engineering, a practitioner's approach, McGraw Hill,7th Edition, 2010
3	Rajib Mall, “Fundamentals of Software Engineering”, PHI Publication, 3rd edition, 2009
4	Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars, and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests.

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

- Question paper for the SEE consists of two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of examination is 3 hours.

Textbooks And Reference Books:

1. Roger S. Pressman (2011), Software Engineering, A Practitioner's approach, 7 th edition, McGraw Hill International Edition, New Delhi.

2. Sommerville (2001), Software Engineering, 9 th edition, Pearson education, India

REFERENCE BOOK:

1. K. K. Agarval, Yogesh Singh (2007), Software Engineering, 3rd edition, New Age International Publishers, India.

2. Lames F. Peters, Witold Pedrycz(2000), Software Engineering an Engineering approach, John Wiely & Sons, New Delhi, India

3. Shely Cashman Rosenblatt (2006), Systems Analysis and Design, 6th edition, Thomson Publications, India

ETHICAL HACKING		Semester	VII
Course Code	**MVJ22AI754**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**3**
Examination type (SEE)	**Theory**		

Course objectives:

- Learn the skills to become responsible and effective ethical hackers, navigating the ethical and legal landscape of cybersecurity.
- Understand various types of attacks, including social engineering, physical penetration, and insider attacks, to understand how to identify vulnerabilities, conduct simulated attacks, and develop effective defenses to protect organizations from these threats.
- Apply the knowledge and skills to identify and mitigate various web application security threats, including content-type attacks, web application security vulnerabilities, and VoIP attacks, to protect their organization's digital assets from exploitation.
- Analyze advanced reverse engineering techniques, including ethical reverse engineering, source code analysis, and fuzzing, to identify and mitigate software vulnerabilities, particularly browser-based vulnerabilities, and develop effective mitigation strategies.
- Analyze the reverse engineer malware, using techniques such as honeynet technology, deobfuscation, and reverse engineering, to understand malware behavior and develop effective countermeasures.

Teaching-Learning Process Pedagogy

(General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

- Lecturer methods (L) need not to be only traditional lecture method, but alternative effective

teaching methods could be adopted to attain the outcomes.

- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE I:	**8 hrs**

Ethics Of Ethical Hacking: Why you need to Understand Your Enemy's Tactics? Recognizing The Gray Areas in Security – Vulnerability Assessment – Penetration Testing. Ethical Hacking and the Legal System: Understanding Individual Cyberlaws – 18 USC Section 1029, 1030, 2510 – Digital Millennium Copyright Act (DMCA) – Cyber Security Enhancement Act 2002. Proper and Ethical Disclosure: CERT's Current Process – Full Disclosure Policy – Organization for Internet Safety

Applications: In-class activity to understand the penetration testing methodologies.

Pedagogy	Chalk and Board, Problem-based learning

MODULE 2	**8 hrs**

Social Engineering Attacks: How A Social Engineering Attack Works? – Conducting A Social Engineering Attack – Common Attacks used in Penetration Testing – Defending Against Social Engineering Attacks. Physical Penetration Attacks: Why Physical Penetration is important – Conducting a Physical Penetration – Common Ways into A Building. Insider Attacks: Why Simulating an Insider Attack is Important – Conducting an Insider Attack – Defending against Insider Attack.

Pedagogy	Chalk and Board, Problem-based learning

MODULE 3	**8 hrs**

Understanding and Detecting Content-Type Attacks: How do Content-Type Attacks work? - Which File Formats are Being Exploited Today? - Tools to Detect Malicious PDF Files – Tools to test your Protections against Content-Type Attacks – How to protect your Environment from Content-Type Attacks. Web Application Security Vulnerabilities: Overview of Top Web Application Security Vulnerabilities – SQL Injection Vulnerabilities – Cross-Site Scripting Vulnerabilities. VoIP Attacks.

Pedagogy	Chalk and Board, Problem-based learning

Module-4	**8 hrs**

Passive Analysis: Ethical Reverse Engineering – Why Bother with Reverse Engineering? – Source Code Analysis. Advanced Reverse Engineering: Overview of Software Development Process – Instrumentation Tools – Fuzzing – Instrumented Fuzzying Tools and Techniques. Finding New Browser Based Vulnerabilities. Mitigation Alternatives.

Pedagogy	Chalk and Board, Problem-based learning

Module-5	**8 hrs**

Collecting Malware and Initial Analysis: Malware – Latest Trends in Honeynet Technology – Catching Malware – Initial Analysis of Malware. Hacking Malware: Trends in Malware – DeObfuscating Malware – Reverse Engineering Malware.

Pedagogy	Chalk and Board, Problem-based learning.

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- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions.
- One question must be asked from each unit. The duration of examination is 3 hours.

Course Outcomes: Student will be able to,

CO1	Conduct ethical hacking and penetration testing, identifying vulnerabilities and weaknesses, while adhering to ethical standards and legal frameworks to protect digital assets and organizations.
CO2	Design and implement effective defenses against various types of attacks, including social engineering, physical penetration, and insider attacks, to protect organizations from potential threats and vulnerabilities.
CO3	Identify and mitigate web application security threats, including content-type attacks, vulnerabilities, and VoIP attacks, to ensure the security and integrity of their organization's digital assets.
CO4	Utilize advanced reverse engineering techniques to identify and mitigate software vulnerabilities, developing effective strategies to enhance browser security and protect against exploitation.
CO5	Develop effective countermeasures to detect, prevent, and respond to malware threats, enhancing their organization's overall cybersecurity posture.

Textbooks And Reference Books:

3. Roger S. Pressman (2011), Software Engineering, A Practitioner's approach, 7 th edition, McGraw Hill International Edition, New Delhi.

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CO3	3	3	1	2	-	-	-	-	-	1	-	3	-	2
CO4	3	3	3	3	-	3	2	2	2	2	-	3	2	-
CO5	3	3	3	3	-	3	2	2	3	2	-	3	2	-