MVJCE
CURRICULUM

FOR

Artificial Intelligence & Machine Learning
(Scheme 2020)

III SEMESTER

Course Title	**DISCRETE MATHEMATICAL STRUCTURES AND PROBABILITY**	**Semester**	03
Course Code	MVJ20MCS31	**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:

- Prepare for a background in abstraction, notation, and critical thinking for the mathematics most directly related to computer science.
- Understand and apply mathematical induction, combinatorics, discrete probability, sequence and recurrence, elementary number theory.
- Understand and apply probability distribution, sampling theory and joint probability distributions.

Module-1	L1,L2 & L3	**10 Hrs.**

Properties of the Integers: The Well Ordering Principle – Mathematical Induction.

Principles of Counting: Fundamental Principles of Counting, The Rules of Sumand Product, Permutations, Combinations – The Binomial and Multinomial Theorem, Combinations with Repetition.

Application: Distribution with repetition.

Video Link:

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

Module-2	L1,L2 & L3	**10 Hrs.**

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

Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients.

Application: Arrangement with forbidden position.

Video Link:

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- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/

Module-3	L1,L2 & L3	**10 Hrs.**

Relations: Cartesian Products, Relations, Properties of Relations, Equivalence Relations. Zero-One Matrices and Directed Graphs. Partial Orders–Hasse Diagrams and extreme elements.

Functions: Plain and One to One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.

Application: Zero-one matrix and Hasse diagram

Video Link:

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- http://academicearth.org/

Module-4	L1,L2 & L3	**10 Hrs.**

Probability Distributions: Random variables (discrete and continuous), probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.

Joint probability distribution: Joint Probability distribution for two discrete random variables ,expectation, covariance, correlation coefficient.

Application: Finding correlation between random variables.

Video Link:

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

Module-5	L1,L2 & L3	**10 Hrs.**

Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution and Chi-square distribution

Coding Theory: Coding of binary information and error detection.

Application: Testing the level of significance & the goodness of fit for large sample and small sample.

Video Link:

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

Course Outcomes:

CO1	Demonstrate the application of discrete structures in different fields of computer Science.

CO2	Solve problems using recurrence relations and generating functions.
CO3	Solving logical problem using concepts of relations and functions.
CO4	Develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, information theory and Design engineering.
CO5	Demonstrate testing of hypothesis of sampling distributions.

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition,2013.
2.	Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, , 5th Edition, PearsonEducation. 2004.

Reference Books:	
1.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
2.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
3	Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016
4	Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**DATA STRUCTURES AND APPLICATIONS**	**Semester**	03
Course Code	MVJ20AM32/MVJ20CS32	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50

No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Identify the importance of data structures & memory allocation.
- Perform operations on stacks and queues and its applications.
- Apply the operations of linked list, Trees & Graphs in various applications.
- Apply searching and sorting operations in real time applications.

Module-1	L1,L2, L3	**Hours 10**

Introduction: Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays.

Abstract Data Type, Array Operations: Traversing, inserting, deleting, searching, and sorting**,**

Array ADT :Multidimensional Arrays, Polynomials and Sparse Matrices.

Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.

Laboratory Sessions/ Experimental learning:

1. Create an array of structure which has the following members Student name, Student USN, Marks1, Marks2, Marks3. Allocate memory to store 5 students details initially. When a new student details need to be entered or to be deleted in this array, dynamically change the array size. Write a program to implement this scenario and display the result.
2. Find the bug for the following code and then Debug it

```
int minval(int *A, int n) {

int currmin;

for (int i=0; i<n; i++)

 if (A[i] < currmin)

   currmin = A[i];
 return currmin;
}
```

3. Compile the following code and debug it.

```
#include <stdio.h>
#include <string.h>
struct student
```

```
  {
    int id;
    char name[30];
    float percentage;
  };
 int main()
{
    int i;
    struct student record1 = {1, "Raju", 90.5};
    struct student *ptr;
       printf("Records of STUDENT1: \n");
       printf("  Id is: %d \n", ptr->id);
       printf("  Name is: %s \n", ptr->name);
       printf("  Percentage is: %f \n\n", ptr->percentage);
     return 0;
}
```

Real Time Applications: System memory allocation

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

1. https://nptel.ac.in/courses/106106130/
2. https://nptel.ac.in/courses/106105085/
3. https://nptel.ac.in/courses/106/106/106106127/
4. https://www.coursera.org/lecture/data-structures/arrays-OsBSF

Module-2	L1,L2, L3	**Hours 10**

Stacks: Definition, Stack Operations, Stack ADT, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression.

Recursion - GCD, Tower of Hanoi.

Queues: Definition, Array Representation, Queue Operations, Queue ADT, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues. Programming Examples.

Laboratory Sessions/ Experimental learning:

Design, Develop and Implement a menu driven Program in C for the following operations on DEQUEUE of

Integers (Array Implementation of Queue with maximum size MAX)

a. Insert an Element on to DEQUEUE

b. Delete an Element from DEQUEUE

c. Demonstrate Overflow and Underflow situations on DEQUEUE

d. Display the status of DEQUEUE

e. Exit Support the program with appropriate functions for each of the above operations

Real Time Applications: Game applications, Ticket booking applications (Eg: Train, restaurant etc)

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

- https://nptel.ac.in/courses/106106130/
- https://nptel.ac.in/courses/106102064/
- https://nptel.ac.in/courses/106105085/
- https://nptel.ac.in/courses/106/106/106106127/

Module-3	L1,L2, L3	**Hours 10**

Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials. Programming Examples

Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

Laboratory Sessions/ Experimental learning:

1.Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2 y 2 z-4yz5 +3x3 yz+2xy5 z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations

2. Debug the following code and explain the process

```
//Insert a value into an ordered linked list
void insert(lnode*& curr, int val) {
 if (curr == NULL)
   curr = new lnode(val, NULL);
 else if (lnode->val > val)
   curr = new lnode(val, curr->next);
 else {
   curr = curr->next;
   insert(curr, val);
```

}

}

Real Time Applications: Music Player, Image Viewer, Web browser, Process Management, Mechanical field

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

- https://nptel.ac.in/courses/106106130/
- https://nptel.ac.in/courses/106102064/
- https://nptel.ac.in/courses/106105085/

Module-4	L1,L2, L3	**Hours 10**

Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees- Evaluation of Expression, AVL Trees, Splay Trees, B-Tree, Programming Examples

Laboratory Sessions/ Experimental learning:

Design, Develop and Implement a menu driven Program in C for the following operations on AVL Trees

i) Construct an AVL tree by inserting the following elements in the given order.

63, 9, 19, 27, 18, 108, 99, 81.

ii)searching for a node

iii)Deleting a node

Real Time Applications: Indexing in databases, Programming Languages, Computer chess games, Computer file system, Undo function in text editor, representing city region telehone network etc.

Video link:

- https://nptel.ac.in/courses/106102064/
- http://www.digimat.in/nptel/courses/video/106106127/L50.html
- https://www.youtube.com/watch?v=ffgg_zmbaxw

Module-5	L1,L2, L3	**Hours 10**

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search, Topological Sort.

Sorting and Searching: Quick sort, Insertion Sort, Radix sort, Merge Sort, Address Calculation Sort.

Laboratory Sessions/ Experimental learning:

Sort a given set of elements using the sorting Method which divides input array in two halves, calls itself for the two halves and then merges the two sorted halves" and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and 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.

Real Time Applications: Graph Theory, E-Commerce websites, Google Maps, Face book **Video link:** • https://www.youtube.com/watch?v=hk5rQs7TQ7E&feature=youtu.be • https://nptel.ac.in/courses/106/102/106102064/

Course outcomes:	
CO1	Identify the necessity of data structure and its storage process.
CO2	Analyse the various operations performed on stack and queues for different applications.
CO3	Perform various operations on linked list for different applications**.**
CO4	Learn Trees and its applications.
CO5	Analyse the concepts of Graphs, searching, sorting & hashing in real time.

Text Books:	
1	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

Reference Books:	
1	Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
2	Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
3	Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
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.

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- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
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CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**SOFTWARE ENGINEERING**	**Semester**	03
Course Code	MVJ20AM33	**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***

- Understand principles, concepts, methods, and techniques of the software engineering approach to 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 and components.
- Gather knowledge on various software testing, maintenance methods.

Module-1	L1,L2, L3	**Hours 8**
INTRODUCTION TO SOFTWARE ENGINEERING: The Evolving nature of software engineering, Changing nature of software engineering, Software engineering Layers, The Software Processes, Software Myths. **PROCESS MODELS:** A Generic Process Model, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Spiral Model, the Unified Process, Personal and Team Process Models, the Capability Maturity Model Integration (CMMI). **Laboratory Sessions/ Experimental learning:** To write the SRS for the given real time application using report writing tools. **Applications:** In Software development process. **Video link / Additional online information:** https://nptel.ac.in/courses/106105182/		
Module-2	L1,L2, L3	**Hours 8**
REQUIREMENTS ENGINEERING: Functional and Non-Functional Requirements, The Software requirements Document, Requirements Specification, requirements Engineering, Requirements Elicitation and Analysis, Requirement Validation, Requirement Management, System Modeling: Context Models, Interaction Models, Structural Models, Behavioral Model, Model-Driven Engineering. **DESIGN CONCEPTS:** The Design Process, Design Concepts, The Design Models, Architectural Design: Software Architecture, Architectural Genres, Architectural Styles. **Applications:** In Software development process. **Video link / Additional online information:** ● https://www.coursera.org/lecture/client-needs-and-software-requirements/3-2-4-use-cases-bZNCr		
Module-3	L1,L2, L3	**Hours 8**
DESIGN AND IMPLEMENTATION: The Object Oriented Design with UML, Design Patterns, Implementation Issues, Open Source Development. User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation. **SOFTWARE TESTING STRATEGIES:** A Strategic approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing, The Art of Debugging, White-Box Testing, Black Box Testing. **Laboratory Sessions/ Experimental learning:** Using Selenium IDE write a test suite containing minimum 4 test cases. **Applications:** In Software development process. **Video link / Additional online information:** https://www.youtube.com/watch?v=T3q6QcCQZQg		
Module-4	L1,L2, L3	**Hours 8**
PRODUCT METRICS: A Frame Work for Product Metrics, Metrics for the Requirements Model, Metrics for		

Design Model, Metrics for Source Code, Metrics for Testing.

PROCESS AND PROJECT METRICES: Metrics in the Process and Project Domains, Software Measurements, Metrics for Software Quality, Risk Management: Risk verses Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinements, Risk Mitigation Monitoring and Management (RMMM), The RMMM Plan.

Laboratory Sessions/ Experimental learning: Create a project using MS projects for any real time scenario.

Applications: In Software development process.

Video link / Additional online information: https://youtu.be/tIZ1dg4pxCE

Module-5	L1,L2, L3	**Hours 8**

QUALITY MANAGEMENT: Quality Concepts, Software Quality, Software Quality Dilemma, Achieving Software Quality, Review Techniques, Reviews: A Formal spectrum, Informal Reviews, Formal Technical Reviews,

SOFTWARE QUALITY ASSURANCE: Background Issues, Elements of Software Quality Assurance, Tasks, Goals and Metrics, Software Reliability, the ISO 9000 Quality Standards.

Laboratory Sessions/ Experimental learning: Estimation of test coverage metrics using manual test metrics.

Applications: In Software development process.

Video link / Additional online information: https://nptel.ac.in/courses/110105039/

Course Outcomes:	
CO1	Understand various Process Models.
CO2	Investigate various requirements engineering and apply design concepts.
CO3	Identify numerous Software Testing Strategies.
CO4	Evaluate Process and Project Metrices.
CO5	Illustrate Quality Management and Software Quality Assurance Concepts

Text 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 Books:	
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

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CO1	2	2	2	2	2	-	-	1	2	2	2	-	2	-
CO2	2	2	2	2	2	1	-	1	2	2	2	1	2	2
CO3	2	2	2	2	2	1	-	1	2	2	2	-	3	-
CO4	1	2	2	2	2	1	-	1	2	2	2	1	2	2
CO5	1	2	2	1	2	1	2	1	2	2	2	2	1	-

High-3, Medium-2, Low-1

Course Title	**OPERATING SYSTEMS**	**Semester**	03
Course Code	MVJ20AM34/MVJ20CS34	**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***

- Introduce concepts and terminology used in OS.
- Explain threading and multithreaded systems.
- Illustrate process synchronization and concept of Deadlock.
- Introduce Memory and Virtual memory management, File system and storage techniques.

Module-1	L1,L2, L3	**Hours 8**

Introduction: What operating systems do; Computer System organization; Computer System architecture; Operating System operations; 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; System boot.

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

Module-2	L1,L2, L3	**Hours 8**
Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling. **Process Synchronization**: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.		
Module-3	L1,L2, L3	**Hours 8**
Deadlocks : Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Memory Management**: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation		
Module-4	L1,L2, L3	**Hours 8**
Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. **File System, Implementation of File System**: File system: File concept; Access methods; Directory structure; File system mounting; File sharing; **Implementing File system**: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.		
Module-5	L1,L2, L3	**Hours 8**
Mass Storage Structure-Disk Structure - Disk Attachment-Disk Scheduling-Disk Management- Swap-Space Management. **Protection**: Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems. **Case Studies:** Windows, Unix, Linux, Android.		

Course Outcomes:	
CO1	Illustrate the fundamental concepts of operating systems
CO2	Compare and illustrate various process scheduling algorithms.
CO3	Ability to recognize and resolve Deadlock problems, Memory Management techniques.
CO4	Apply appropriate memory and file management schemes.
CO5	Appreciate the need of access control and protection in Operating System and illustrate various disk scheduling algorithms.

Text Books:	
1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts 7th

	edition,Wiley-India, 2006
2	D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.

Reference Books:	
1	Tanenbaum, A., "Modern Operating Systems", Prentice-Hall of India. 2004
2	P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition,Prentice-Hall of India.

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CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	2	-

High-3, Medium-2, Low-1

Course Title	**COMPUTER ORGANIZATION AND ARCHITECTURE**	**Semester**	03
Course Code	MVJ20AM35/MVJ20CS35	**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***

- Learn the basic structure and operations of a computer.
- Learn the arithmetic and logic unit.
- Learn the different ways of communication with I/O devices & memories, memory hierarchies, cache memories and virtual memories.
- Understand & implement arithmetic process.
- Understand the processor and pipelining concepts.
- Understand parallelism and multi-core processors.

Module-1	L1,L2, L3	**Hours 8**

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance –Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.

Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.

Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division.

Text book 1: Chapter 1 – 1.1 to 1.9,Chapter2 – 2.1 to 2.10 **Text book 1: Chapter6 – 6.1 to 6.7** **Laboratory Sessions/ Experimental learning: 0.**Study of peripherals, components of a Computer System **Applications:** Basic Computer Devices **Video link :** https://nptel.ac.in/courses/106105163/		
Module-2	L2 ,L3	**Hours 8**
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits. Standard I/O Interfaces – PCI Bus, SCSI Bus, USB **Text book 1: Chapter4 – 4.1 to 4.7** **Laboratory Sessions/ Experimental learning:** Design of ALU **Applications:** input /output operations **Videolink:**https://www.youtube.com/watch?v=RkAE4zE4uSE&list=PL13FD5F00C21BBC0B&index=11		
Module-3	L1,L2, L3	**Hours 8**
Memory: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Types of cache ,Cache miss management Mapping Functions, Replacement Algorithms, Performance Considerations,(ARM Cache and Pentium cache). **Text book 1: Chapter5 – 5.1 to 5.4, 5.5** **Laboratory Sessions/ Experimental learning:** Design of Memory **Applications:** Different Types of Memory **Video link :** https://nptel.ac.in/courses/106105163/		
Module-4	L1,L2, L3	**Hours 8**
Processor : A Basic MIPS implementation – Building a Data path – Control Implementation Scheme –Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards –Exceptions. **Text book 2: Chapter 4**. **Laboratory Sessions:** Instruction scheduling **Applications:** Types of processor **Video link:** https://nptel.ac.in/courses/106106166/		
Module-5	L1,L2, L3	**Hours 8**
Parallelism: Parallel processing challenges –Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors. **Text book 2: Chapter 6**. Laboratory Sessions : Process Scheduling		

Applications: Grid and Cloud Computing **Video link:** https://nptel.ac.in/courses/106102114/	
Course Outcomes:	
CO1	Explain the basic organization of a computer system.
CO2	Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
CO3	Design and analyses simple arithmetic and logical units.
CO4	Illustrate hardwired control and micro programmed control, pipelining, embedded and other Computing systems.
CO5	Design and analyses of simple Parallelism and Multithread.

Text Books:	
1	Carl Hamacher, Zvonko Vranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, and 6).
2	David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.(Listed topics only from Chapters 4and 6).

Reference Books:	
1	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
2	John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
3	http://vlabs.iitkgp.ac.in/coa/

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**ANALOG AND DIGITAL ELECTRONICS**	**Semester**	III
Course Code	MVJ20AM36/MVJ20CS36	**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***

- Analyse the working of oscillators and use of regulators.
- Make use of simplifying techniques in the design of combinational circuits.
- Illustrate combinational and sequential digital circuits.
- Demonstrate the use of flip flops and design registers and counters.
- Design and test Analog-to-Digital and Digital-to-Analog conversion techniques.

Module-1	L2	**8 Hrs**.

Prerequisites : Basic analog Circuits

Metal Oxide Semiconductor Field Effect transistor(MOSFET): Structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier, CMOS and its applications.

Oscillators: Basic working and applications of RC Phase shift oscillator, Wien Bridge oscillator, LC oscillator, Colpitt oscillator, Crystal Oscillator.

Linear Power Supplies: Constituents of a Linear Power Supply, Designing Mains Transformer, Linear IC voltage regulators, Regulated Power Supply Parameters

Module-2	L2,L3	**8 Hrs.**

Prerequisites :Digital Electronic Fundamentals

Karnaugh maps: Minimum forms of switching functions, two and three variable Karnaugh maps, four variable karnaugh maps, Quine-McClusky Method: determination of prime implicants, The prime implicant chart, petricks method, simplification of incompletely specified functions, simplification using map-entered variables

Activity: Writing and Analyzing C program for K-maps.		
Module-3	L2,L3	**8 Hrs.**
Combinational Circuits: Multiplexer, Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU-Design and popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, **Activity:** Designing a 32-bit ALU		
Module-4	L2,L3	**8 Hrs.**
Flip-Flops and Registers: **Flip Flops:** S-R,J-K,D and T flip flops,Edge-triggered JK FLIP-FLOPs **Registers:** Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Universal Shift Register, Applications of Shift Registers. **Counters:** Asynchronous Counters, Decoding Gates, Synchronous Counters, Changing the Counter Modulus, Decade Counters, Applications of Counters. **Activity:** Implementing 2 digit counters using seven segment display		
Module-5	L2	**8 Hrs.**
D/A Conversion and A/D Conversion: **Digital to Analog converters**: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit. **Analog to digital converters:** quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D Converter ICs **Activity:** Demonstration of CODEC which houses both ADC and DAC.		
Laboratory Sessions		
• Plotting the V-I characteristics of MOSFET • Implementing adders and subtracters • Implementing the simplified equation obtained from K-maps and verify with the truth table		
Course Outcomes:		
CO1	Design and analyze analog circuits using transistors,power supply, MOSFETS,regulator IC and opamp.	
CO2	Simplify digital circuits using Karnaugh Map , POS and Quine-McClusky Methods	
CO3	Explain construction and working of data processing circuits	

CO4	Understanding the various types of latches and flip flops and building the registers and counters using flip flops.
CO5	Explain the basic principles of A/D and D/A conversion circuits and develop the same.

Text Books:	
1.	Anil K Maini, Varsha Agarwal, Electronic Devices and Circuits, Wiley, 2012.
2.	Charles H Roth and Larry L Kinney, Fundamentals of Logic design, Cengage Learning,2019.

Reference Books:	
1.	Donald P Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.
2.	M. Morris Mani, Digital Design, 4th Edition, Pearson Prentice Hall, 2008.
3.	David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 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 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.

ii. 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.

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

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

CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	1	2

High-3, Medium-2, Low-1

Course Title	**DATA STRUCTURES AND APPLICATIONS LABORATORY**	**Semester**	03
Course Code	MVJ20AML37/MVJ20CSL37	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to:

The students will be able to get practical experience in design, develop, implement, analyze and evaluation of

- Linear data structures and their applications such as stacks, queues and lists,
- Non-Linear data structures and their applications such as Trees &Graphs
- Sorting and Hashing techniques.

S No	**Experiment Name**	**RBT Level**	**Hours**
1	A courier company has number of items to be delivered to its intended customers through its salesman. The salesman visits the following cities to deliver the respective items. Write a C program, S.No | Cities | Number of items 1 | Agra | 25 2 | Chennai | 50 3 | Kolkata | 59 4 | Mumbai | 72 5 | Delhi | 12 a) To display name of cities where salesman has delivered maximum and minimum number of items b) To search the number of items to be delivered of a user supplied	**L3**	**3**

	city.		
2	Implement Knuth-Morris- Pratt pattern matching algorithm using C program.	**L3**	**3**
3	Design, Develop and Implement a menu driven Program in C with the listed operations for the data structure which follows Last In First Out (LIFO) order. (Use Array Implementation of specified DS with maximum size MAX). a. Push an Element b. Pop an Element c. Demonstrate how it can be used to check Palindrome d. Demonstrate Overflow and Underflow situations e. Display the status f. Exit Support the program with appropriate functions for each of the above operations	**L3**	**3**
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.	**L3**	**3**
5	Design, Develop and Implement a menu driven Program in C for the following operations on Ring Buffer of Integers (Use Array Implementation) a. Insert an Element on to Ring Buffer b. Delete an Element from Ring Buffer c. Demonstrate Overflow and Underflow situations on Ring Buffer d. Display the status of Ring Buffer e. Exit Support the program with appropriate functions for each of the above operations	**L3**	**3**
6	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, 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	**L3**	**3**

	c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL e. Exit		
7	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo. a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it. c. Perform Insertion and Deletion at End of DLL . d. Perform Insertion and Deletion at Front of DLL . e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit	**L3**	**3**
8	Design, Develop and Implement a menu driven C Program 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 recursively in inorder, preorder & postorder c) Search the BST for a given element (KEY) and report the appropriate message	**L3**	**3**
9	Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method	**L3**	**3**
10	Develop a C program to sort a given set of n integer elements using Quick Sort method. Run the program for varied values of n and show the results of each iteration.	**L3**	**3**
11	Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2- digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K $\rightarrow$L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space	**L3**	**3**

	L. Resolve the collision (if any) using linear probing.		

Course Outcomes:	
CO1	Analyze and Compare various linear data structures.
CO2	Code, debug and demonstrate the working nature of different types of data structures and their applications.
CO3	Implement, analyse and evaluate the searching and sorting algorithms.
CO4	Choose the appropriate data structure for solving real world problems.

Reference Books:	
1.	A M Tenenbaum, Data Structures using C, PHI, 1989
2.	Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.
3.	http://opendatastructures.org, https://donsheehy.github.io/datastructures

CIE Assessment:

Regular Lab work :20

Record 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	3	3	2	-	3	3	-	-	3	-	3	2	1	-
CO2	3	3	2	-	3	3	-	-	3	-	3	2	1	2
CO3	3	3	2	-	3	3	-	-	3	-	3	2	2	3
CO4	3	3	2	-	3	3	-	-	3	-	3	2	2	2

High-3, Medium-2, Low-1

Course Title	**ANALOG AND DIGITAL ELECTRONICS LABORATORY**	**Semester**	03
Course Code	MVJ20AML38/MVJ20CSL38	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Analog components and circuits including transistor, regulator, etc.
- Combinational logic circuits.
- Flip - Flops and their operations
- Counters and Registers using Flip-flops.
- Synchronous and Asynchronous Sequential Circuits

S No	Experiment Name	RBT Level	Hours
1	Study of transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.	**L2**	**3**
2	Design and test IC 723 voltage regulator	**L3**	**3**
3	Given a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC.	**L2**	**3**
4	Design and implement a faster way3 to add binary numbers using carry look ahead adders.	**L3**	**3**
5	a) Realization and implementation of 2-bit comparator using logic gates. b) Implementation of 4-bit magnitude comparator using IC 7485.	**L3**	**3**
6	To design and construct basic flip-flops R-S ,J-K,J-K Master slave flip-flops using gates and verify their truth table	**L3**	**3**
7	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip-flops	**L3**	**3**
8	Design and implementation of 3-bit synchronous up/down counter	**L3**	**3**
9	Design and implement a ring counter and Johnson counter using 4-bit shift register and demonstrate its working.	**L3**	**3**

10	Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.	**L3**	**3**
11	Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (n<=9) and demonstrate on 7-segment display (using IC-7447).	**L3**	**3**
12	Design 4 bit r-2r ladder DAC using opamp.	**L3**	**3**

Course Outcomes:	
CO1	Demonstrate various Electronic Devices like Cathode ray Oscilloscope, Signal generators, Digital Trainer Kit, Multimeters and components like Resistors, Capacitors, Op amp and Integrated Circuit
CO2	Examine and verify different analog circuits.
CO3	Design and demonstrate various combinational logic circuits.
CO4	Design and demonstrate various types of counters and Registers using Flip-flops
CO5	Design and demonstrate the working of DAC

Reference Books:	
1.	Donald P Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.
2.	M. Morris Mani, Digital Design, 4th Edition, Pearson Prentice Hall, 2008.
3.	David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

CIE Assessment:
Regular Lab work :20 Record 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

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

High-3, Medium-2, Low-1

Course Title	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW**	**Semester**	IV
Course Code	MVJ20CPH39/49	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	01 (L : T : P :: 1 :0 : 0)	**Total**	100
Credits	01	**Exam. Duration**	2 hrs

Course objective is to:

- To know the fundamental political codes, structure, procedures, powers, and duties of Indian

constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.

- To provide overall legal literacy to the young technocrats to manage complex societal issues in the present scenario.
- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.

Module-1	L1,L2,L3	03 Hours

Introduction to Indian Constitution

The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.

Module – II	L1,L2,L3	03 Hours

Union Executive and State Executive

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.

Module – III	L1,L2,L3	03 Hours

Elections, Amendments and Emergency Provisions

Elections, Electoral Process, and Election Commission of India, Election Laws.

Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements).

Emergency Provisions, types of Emergencies and it's consequences.

Constitutional Special Provisions:

Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward

Classes.		
Module – IV	L1,L2,L3	03 Hours
Professional / Engineering Ethics Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India) : Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. **Responsibilities in Engineering** - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.		
Module – V	L1,L2,L3	03 Hours
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.		

Course Outcomes: On completion of this course, students will be able to	
CO1	Have constitutional knowledge and legal literacy
CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO3	Understand the cyber crimes and cyber laws for cyber safety measure.

Text Books:	
1.	Constitution of India and Professional Ethics, T.S. Anupama, Sunstar Publisher
Reference Books:	
1.	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th/20th Edn., (Latest Edition) or 2008.
2.	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall of India Pvt. Ltd. New Delhi, 2004.
4.	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5.	Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

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

Course Title	**ADDITIONAL MATHEMATICS-I**	**Seme**ster	III
Course Code	MVJ20MATDIP31	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	-	**Exam. Duration**	3 HOURS

Course objective is to: ***This course aims to prepare the students***:

To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	L1,L2	8 Hrs.

Differential calculus: Recapitulation of successive differentiation -nth derivative -Leibnitz theorem and Problems, Taylor's and Maclaurin's theorem for function of one variable.

Video Link: https://users.math.msu.edu/users/gnagy/teaching/ode.pdf

Module-2	L1,L2	8 Hrs.

Integral Calculus:

Review of elementary Integral calculus, Reduction formula

$\int_0^{\frac{\pi}{2}} sin^m x\,dx$ $\int_0^{\frac{\pi}{2}} cos^m x\,dx$ $\int_0^{\frac{\pi}{2}} sin^m cos^n x\,dx$ and problems.

Evaluation of double and triple integrals and Simple Problems.

Video Link

- https://www.youtube.com/watch?v=rCWOdfQ3cwQ
- https://nptel.ac.in/courses/111/105/111105122/

Module-3	L1,L2	8 Hrs.

Vector Calculus: Derivative of vector valued functions, Velocity, Acceleration and related problems, Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities-div(φA), curl (φA), curl(grad φ), div(curl A)

Video Links:

- https://www.whitman.edu/mathematics/calculus_online/chapter16.html
- https://www.math.ust.hk/~machas/vector-calculus-for-engineers.pdf

Module-4	L1,L2,L3	8 Hrs.

Probability:

Introduction - Conditional Probability, Multiplication theorem, Independent events, Baye's theorem and Problems

Video Links:

• https://www.khanacademy.org/math/statistics-probability/probability-library • https://nptel.ac.in/courses/111/105/111105041/		
Module-5	L1,L2,L3	8 Hrs.
Differential equation: Homogeneous differential equation, Linear differential equation, Bernoulli's differential equation and Exact differential equation. **Video Link:** https://www.mathsisfun.com/calculus/differential-equations.html		
Course Outcomes:		
CO1	Apply the knowledge of Differential calculus in the modeling of various physical and engineering phenomena	
CO2	Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.	
CO3	Study on Vector calculus to understand the various solution of the Application to Engineering problems.	
CO4	Understand the basic Concepts of Probability	
CO5	Solve first order linear differential equation analytically using standard methods.	

Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition,2014.
2.	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Course Title	**UNIVERSAL HUMAN VALUES I**	**Semester**	III
Course Code	MVJ20UHV310	**CIE**	50
Total No. of Contact Hours	15	**SEE**	50
No. of Contact Hours/week	1 (L: T : P :1 : 0 :0)	**Total**	100
Credits	1	**Exam. Duration**	3 Hrs.

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

- Perceive the need for developing a holistic perspective of life
- Sensitise the scope of life – individual, family (inter-personal relationship), society and nature/existence, Strengthening self-reflection
- Develop more confidence and commitment to understand, learn and act accordingly

Module-1	L1,L2	**3 Hrs**
Welcome and Introductions: Getting to know each other (Self-exploration) **Aspirations and Concerns:** Individual academic, career, Expectations of family, peers, society, nation, Fixing one's goals (Basic human aspirations Need for a holistic perspective Role of UHV) **Self-Management:**Self-confidence, peer pressure, time management, anger, stress, Personality development, self-improvement (Harmony in the human Being) **Health:** Health issues, healthy diet, healthy lifestyle, Hostel life (Harmony of the Self and Body Mental and physical health) **Relationships:** Home sickness, gratitude, towards parents, teachers and, others Ragging and interaction, Competition and cooperation, Peer pressure (Harmony in relationship Feelings of trust, respect, gratitude, glory, love) **Society:** Participation in society (Harmony in the society) **Natural Environment:** Participation in nature (Harmony in nature/existence) **Video link:** • https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV • https://youtube.com/playlist?list=PLYwzG2fd7hzcZz1DkrAegkKF4TseekPFv **Presentation:** https://fdp-si.aicte-india.org/AicteSipUHV_download.php		
Module-2	L1,L2	**3 Hrs**
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario. **Video link:** • https://www.youtube.com/watch?v=85XCw8SU084 • https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3p Z3yA7g_OAQz • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-3	L1,L2	**3 Hrs**
Introduction to Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body. **Video link:** • https://www.youtube.com/watch?v=GpuZo495F24 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		

Module-4	L1,L2	**3 Hrs**
Introduction to Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society. **Video link:** • https://www.youtube.com/watch?v=F2KVW4WNnS8 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-5	L1,L2	**3 Hrs**
Introduction to Implications of the Holistic Understanding: Natural Acceptance of Human Values,Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies. **Video link:** • https://www.youtube.com/watch?v=BikdYub6RY0 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		

Course Outcomes: On completion of the course, students would be able to

CO1	Develop a holistic perspective about life
CO2	Explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society as an unit in nature
CO3	Become more responsible in life, and in handling problems with sustainable solutions
CO4	Have better critical ability
CO5	Become sensitive to their commitment

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi,

	2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

IV SEMESTER

Course Title	**OPERATIONS RESEARCH, NUMERICAL AND STATISTICAL METHODS**	**Semester**	IV
Course Code	MVJ20MCS41/MIS41	**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:

The purpose of this course is to make students well conversant with numerical methods to solve ordinary differential equations, complex analysis, sampling theory Operational research emerging in science and engineering.

Module-1	L1,L2,L3	**8 Hrs.**

Numerical Methods-1 : Numerical solution of Ordinary Differential Equations of first order and first degree: Modified Euler's method, Taylor's series method, Runge-Kutta method of fourth order, Predictor and Corrector method: Milne's Method and Adams-Bash forth Method.

Application: Solving Ordinary Differential Equations.

Video Links:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

Module-2	L1,L2,L3	**8 Hrs.**

Numerical Methods-2: Numerical solution of Ordinary Differential Equations of second order:Runge-Kutta method of fourth order, Predictor and Corrector method: Milne's Method and Adams Bash forth Method.

Calculus of Variations: Variation of function and Functional, variational problems. Euler's equation, Geodesics.

Application: Hanging chain problem.

Video Links:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

Module-3	L1,L2,L3	**8 Hrs.**

Operations Research-1: Introduction to Linear Programming Problem (LPP): Assumptions of LPP, Formulation of LPP and Graphical method various examples. The simplex method, Big M method and dual simplex method.

Application: Graphical solution procedure.

Video Links:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

Module-4	L1,L2,L3	**8 Hrs.**

Operations Research-2

The transportation problem: Initial Basic Feasible Solution(IBFS) by North West Corner Rule method, Matrix Minima Method, Vogel's Approximation Method.

Game Theory: The formulation of two persons, zero sum games; saddle point, maxmin and minmax principle, Solving simple games-a prototype example, Games with mixed strategies.

Application: Transportation problem.

Video Links:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

Module-5	L1,L2,L3	**8 Hrs.**

Statistical Methods

Correlation and Regression: Correlation, Regression coefficients, line of regression problems.

Curve fitting: Fitting of the curves of the form $y=ax+b, y=ax^2+bx+c, y=ae^{bx}$ by the method of least squares.

Application: Finding the best fit between two variables.

Video Links:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

Course outcomes:

CO1	Solve first and second order ordinary differential equation arising in flow problems using single step and multistep numerical methods.
CO2	Determine the extremals of functionals and solve the simple problems of the calculus of variations.

CO3	Solve the mathematical formulation of linear programming problem.
CO4	Solve the applications of transport problems and theory of games.
CO5	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.
Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition,2014.

Reference Books:	
1.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
2.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
3	Jain R. K. & Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publishing House, 2002.
4	S. D. Sharma, "Operations Research", Kedar Nath and Ram NathPublishers, Seventh Revised Edition 2014.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**ANALYSIS AND DESIGN OF ALGORITHMS**	**Semester**	04
Course Code	MVJ20AM42/MVJ20CS42	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50

No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Identify the importance of different asymptotic notation.
- Determine the complexity of recursive and non-recursive algorithms.
- Compare the efficiency of various design techniques like greedy method, backtracking etc.
- Apply appropriate method to solve a given problem.

Module-1	L1,L2 , L3	**Hours 10**

Basic Concept of Algorithms: Introduction-What is an Algorithm, Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity. Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples . Important Problem Types. Fundamental Data Structures.

Applications: developing computational tools and bioinformatics software, Mathematics.

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

- http://www.nptelvideos.com/video.php?id=1442
- https://nptel.ac.in/courses/106105085/

Module-2	L2 , L3	**Hours 10**

Simple Design Techniques – Brute force : Selection sort, Bubble sort, Sequential Search and Brute-Force String Matching , Exhaustive search –Traveling Salesman problem, Knapsack problem , Assignment Problem.

Divide and Conquer: General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum , Merge sort, Quick sort , Strassen's matrix multiplication , Advantages and Disadvantages of divide and conquer.

Applications: power distribution (electrical field), Online shopping and delivery (real time)

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

- https://nptel.ac.in/courses/106102064/
- https://www.youtube.com/watch?v=MFfD57DTDQY

Module-3	L2,L3 , L4	**Hours 10**

Decrease and Conquer approach: Topological Sort, Decrease-by-a-Constant-Factor Algorithms: Josephus Problem.

Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines.

Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm. Single source shortest paths: Dijkstra's Algorithm. Huffman Trees and Codes. **Laboratory Sessions/ Experimental learning:** Solving real time problems using Greedy Technique. **Applications:** Optimization Problems. **Video link :**https://nptel.ac.in/courses/106/106/106106131/		
Module-4	L3,L4 , L6	**Hours 10**
Dynamic Programming: General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm , Travelling Sales Person problem , Reliability design. **Laboratory Sessions/ Experimental learning:** Solving real time problems using Dynamic Programming. **Applications:** Computer Networks. **Video link:** https://nptel.ac.in/courses/106/106/106106131/		
Module-5	L4,L5 ,L6	**Hours 10**
Backtracking: General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Programme and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem. **LC Programme and Bound solution :** FIFO Programme and Bound solution. NP-Complete and NP-Hard problems: Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes. **Laboratory Sessions/ Experimental learning:** Solving real time problems using Backtracking Technique. **Applications:** To solve puzzles such as crosswords, Sudoku etc. **Video link:** https://nptel.ac.in/courses/106/106/106106131/		

Course Outcomes:	
CO1	Describe the need of algorithm and the notations used in design analysis.
CO2	Compare the efficiency of brute force, divide and conquer techniques for problem solving.
CO3	Ability to apply greedy algorithms, hashing and string matching algorithms.
CO4	Ability to design efficient algorithms using various design techniques.
CO5	Ability to apply the knowledge of complexity classes P, NP, and NP Complete and prove certain problems are NP-Complete.

Text Books:	
1	Introduction to the Design and Analysis of Algorithms, Anany Levitin:, 2rd Edition, 2009. Pearson.
2	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.

Reference Books:	
1	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education).
2	http://jeffe.cs.illinois.edu/teaching/algorithms/
3	Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities 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 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 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.
ii. 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.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**DATABASE MANAGEMENT SYSTEM**	**Semester**	04
Course Code	MVJ20AM43	**CIE**	50
Total No. of Contact Hours	40 L : T : P :: 40 : 0 : 0	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

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

- Understand the basic concepts and the applications of database systems.
- Master the basics of SQL and construct queries using SQL.
- Understand the relational database design principles.

- Analyze the basic issues of transaction processing and concurrency control.
- Familiarize with database storage structures and access techniques.

Module-1	L1,L2 ,L3	**Hours 8**

Introduction to Database System Concepts: Database-System Applications, Purpose of Database Systems, View of Data, Database Language, Database Design, Database Architecture, Database Users and Administrators.

Introduction to the Relation Models and Database Design using ER Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, Extended E-R Features.

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

- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106105175/
- https://www.youtube.com/watch?v=WSNqcYqByFk

Module-2	L2, L3	**Hours 8**

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions Nested Sub queries, Modification of the Database.

Intermediate and Advanced SQL: Join Expressions, Views , Integrity Constraints, SQL Data Types, Authorization. Functions and Procedures, Triggers, Advanced Aggregation Features.

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

- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106105175/
- https://www.youtube.com/watch?v=gGGHjYbQMvw
- https://www.youtube.com/watch?v=nc1yivH1Yac
- https://www.youtube.com/watch?v=64szTfLNu3o

Module-3	L2,L3, L4	**Hours 8**

Formal Relational Query Languages: The Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus.

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional

Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

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

- https://www.youtube.com/watch?v=64szTfLNu3o
- https://www.digimat.in/nptel/courses/video/106105175/L11.html
- https://www.youtube.com/watch?v=sjzlr0EsZL4
- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106105175/

Module-4	L3,L4 , L6	**Hours 8**

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

Transactions: Transaction Concept, a Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels.

Applications: to optimize database design

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

- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106105175/
- https://www.youtube.com/watch?v=YD8dhOmuVnY

Module-5	L4,L5, L6	**Hours 8**

Concurrency Control: Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multi version schemes.

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Nonvolatile Storage, ARIES, Remote Backup Systems.

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

- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106105175/
- https://www.youtube.com/watch?v=5ammL5KU4mo

Course Outcomes:

CO1	Identify, analyse and define database objects, enforce integrity constraints on a database using RDBMS.

CO2	Use Structured Query Language (SQL) for database manipulation.
CO3	Apply the concepts of Normalization and design database which possess no anomalies.
CO4	Describes storage and indexing like tree structured and Hash based indexing.
CO5	Develop application to interact with databases.

Text Books:	
1	Abraham Silberschatz, Henry F. Korth, S. Sudarshan, —Database System Concepts‖, 6th Edition, Tata McGraw-Hill.
2	Raghu Rama Kirshna, Johannes Gehrk, —Database Management System‖ Tata McGraw Hill 3rd Edition.

Reference Books:	
1	Database Systems, 6th edition,R Elmasri,Shamkant B.Navathe, Pearson Education.
2	Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning.
3	Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition.
4	Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.

CIE Assessment:

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

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ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**ARTIFICIAL INTELLIGENCE**	**Semester**	04
Course Code	MVJ20AM44	**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***

- Understand fundamental concepts in Artificial Intelligence.
- Understand the problem solving techniques and knowledge representation.
- Design intelligent components or programs to meet desired needs.

- Implement, and evaluate a computer-based intelligent systems.

Module-1	L1,L2 , L3	**Hours 8**
Introduction: AI problems, foundation of AI and history of AI, Intelligent agents: Agents and Environments, The concept of rationality, The nature of environments, Structure of agents, Problem solving agents, Problem formulation. **Video link / Additional online information (related to module if any):** http://nptel.ac.in/courses/106106126/		
Module-2	L2 , L3	**Hours 8**
Knowledge Representation & Reasons: Knowledge – Based Agents, The Wumpus world. **Propositional Logic:** Reasoning patterns in propositional logic - Resolution, Forward & Backward Chaining. **Inference in First order logic:** Propositional vs. first order inference, Unification & lifting, Forward chaining, Backward chaining, Resolution. **Video link / Additional online information (related to module if any):** http://nptel.ac.in/video.php?subjectId=106105079		
Module-3	L2,L3, L4	**Hours 8**
Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first search, Depth limited search, Iterative deepening depth first search bi-direction search, Comparing uninformed search strategies. Search with partial information (Heuristic search), Greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions. **Local search Algorithms:** Hill climbing, Simulated annealing search, Local beam search, Genetic algorithms. **Video link / Additional online information (related to module if any):**https://www.youtube.com/watch?v=6hmIKIWBVSI		
Module-4	L3,L4 , L6	**Hours 8**
Constrain satisfaction problems: Backtracking search for CSPs local search for constraint satisfaction problems. **Game Playing:** Games, Minimax algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, Cutting of search. **Video link / Additional online information (related to module if any):**https://nptel.ac.in/courses/106/106/106106158/		
Module-5	L4,L5 , L6	**Hours 8**
Planning: Classical planning problem, Language of planning problems, Expressiveness and extension, planning with state – space search, Forward state spare search, Backward state space search, Heuristics for state space search, Partial order planning Graphs, Planning graphs		

Learning: what is learning, Forms of learning, Inductive learning, Learning Decision Trees. **Video link / Additional online information (related to module if any):**https://www.youtube.com/watch?v=3C6ZLS-gfXU	
Course Outcomes:	
CO1	Recognize the various types and working units of an expert systems.
CO2	Interpret the logic behind the building of knowledge base and knowledge representation.
CO3	Deploy Searching Techniques to design intelligent agents
CO4	Choose various Constraint Satisfaction Problem, Game Playing techniques to use in various intelligent system designs.
CO5	Apply suitable learning methodology while designing systems based on their applications.

Text Books:	
1	Stuart Russel, Peter Norvig, (2009), Artificial Intelligence – A Modern Approach,3rd Edition, Pearson Education.
2	E.Rich and K.Knight, (2008), Artificial Intelligence , 3rd Edition, Tata McGraw Hill.

Reference Books:	
1	Patterson, (2009), Artificial Intelligence and Expert Systems, 2nd Edition, PHI.
2	Giarrantana/ Riley, (2004), Expert Systems: Principles and Programming,4th Edition, Thomson.
3	Ivan Bratka, (2000), PROLOG Programming for Artificial Intelligence. 3rdEdition – Pearson Education.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**EMBEDDED SYSTEMS**	**Semester**	04
Course Code	MVJ20AM45	**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***

- Learn the architecture and programming of ARM processor.
- Become familiar with the embedded computing platform design and analysis.
- Get thorough knowledge in interfacing concepts.
- Design an embedded system and to develop programs.

Module-1	L1,L2 ,L3	**Hours 8**

INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS : Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries – ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption. **Activity:** • Comparison of Microprocessor and Microcontroller hardware Model • Comparing the Microprocessor and Microcontroller Software Model		
Module-2	L1,L2 ,L3	**Hours 8**
EMBEDDED COMPUTING PLATFORM DESIGN : The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis – Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing. **Activity:** Writing ARM Assembly program for Embedded System Applications		
Module-3	L1,L2 ,L3	**Hours 8**
SENSOR INTERFACING WITH ARDUINO: Basics of hardware design and functions of basic passive components-sensors and actuators-Arduino code – library file for sensor interfacing-construction of basic applications. **Activity:** • Use of External interrupt0 to turn ON/OFF led connected to Pin P1.25 of ARM Processor. • Use of Software Interrupt SWI instruction in programming. • Calculating physical memory address from logical address.		
Module-4	L1,L2 ,L3	**Hours 8**
EMBEDDED FIRMWARE : Reset Circuit, Brown-out Protection Circuit-Oscillator Unit – Real Time Clock-Watchdog Timer – Embedded Firmware Design Approaches and Development Languages. **Case Study:** Digital Clock, Battery operated Smartcard Reader		
Module-5	L1,L2 ,L3	**Hours 8**
EMBEDDED C PROGRAMMING Introduction-Creating ‗hardware delays'using Timer 0 and Timer 1-Reading switches-Adding Structure to the code-Generating a minimum and maximum delay-Example: Creating a portable hardware delay- Timeout mechanisms-Creating loop timeouts-Testing loop timeouts- hardware timeouts-Testing a hardware timeout. **Case Study:** Automated Meter Reading System (AMR) and Digital Camera, Real time concepts		
Course Outcomes:		
CO1	Describe the architecture and programming of ARM processor.	

CO2	Explain the concepts of embedded systems.
CO3	Understand the Concepts of peripherals and interfacing of sensors.
CO4	Capable of using the system design techniques to develop firmware.
CO5	Illustrate the code for constructing a system.

Text Books:	
1	Marilyn Wolf, —Computers as Components – Principles of Embedded Computing System Design, Third Edition —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (unit I & II).
2	https://www.coursera.org/learn/interface-with-arduino#syllabus (Unit III) 3 .Michael J. Pont, —Embedded C, 2 nd Edition, Pearson Education, 2008.(Unit IV & V).

Reference Books:	
1	Shibu K.V, —Introduction to Embedded Systems, McGraw Hill.2014.
2	Jonathan W.Valvano, —Embedded Microcomputer Systems Real Time Interfacing, Third Edition Cengage Learning, 2012.
3	Raj Kamal, —Embedded Systems-Architecture,programming and design, 3 edition,TMH.2015.
4	Lyla, —Embedded Systems, Pearson , 2013 6. David E. Simon, —An Embedded Software Primer‖, Pearson Education,2000.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**OBJECT ORIENTED CONCEPTS**	**Semester**	04
Course Code	MVJ20AM46	**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***

- Learn fundamental features of object oriented language and JAVA
- Set up Java JDK environment to create, debug and run simple Java programs.
- Create multi-threaded programs and event handling mechanisms.
- Introduce event driven Graphical User Interface (GUI) programming using applets and swings.

Module-1	L1,L2, L3	**Hours 8**
Introduction to Object Oriented Concepts: A Review of structures, Procedure–Oriented Programming		

system, Object Oriented Programming System, Comparison of Object Oriented Language with C, Console I/O, variables and reference variables, Function Prototyping, Function Overloading. **Class and Objects:** Introduction, member functions and data, objects and functions. **Applications:** Develop a good program and connecting it with the real world **Video Link:** https://nptel.ac.in/courses/106/105/106105191/		
Module-2	L1,L2, L3	**Hours 8**
Class and Objects (contd): Objects and arrays, Namespaces, Nested classes, Constructors, Destructors. **Introduction to Java**: Java's magic: the Byte code; Java Development Kit (JDK); the Java Buzzwords, Object-oriented programming; Simple Java programs. Data types, variables and arrays, Operators, Control Statements. **Applications:** Arrays in mathematical vectors, matrices. **Video Link:** https://nptel.ac.in/courses/106/105/106105191/		
Module-3	L1,L2 ,L3	**Hours 8**
Classes, Inheritance, Exception Handling **Classes:** Classes fundamentals; Declaring objects; Constructors, this keyword, garbage collection. **Inheritance:** inheritance basics, using super, creating multi level hierarchy, method overriding. **Exception handling:** Exception handling in Java. **Applications:** Inheritance in Banking Sectors **Video Link:** https://nptel.ac.in/courses/106/105/106105191/		
Module-4	L1,L2 ,L3	**Hours 8**
Packages and Interfaces: Packages, Access Protection, Importing Packages. Interfaces. **Multi Threaded Programming:** Multi Threaded Programming: What are threads? How to make the classes threadable ; Extending threads; Implementing runnable; Synchronization; Changing **Applications:** Multithreads in Browsers, Servers **Video Link:**https://nptel.ac.in/courses/106/105/106105191/		
Module-5	L1,L2 ,L3	**Hours 8**
Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes. **Swings:** Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField; The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable. **Applications:** AWT , GUI Applications		

Video Link: https://freevideolectures.com/course/4227/nptel-programming-in-java/43	
Course Outcomes:	
CO1	Explain the object-oriented concepts and JAVA.
CO2	Develop computer programs to solve real world problems in Java.
CO3	Illustrate the use of classes, Exceptions and distinguish the usage of different types of Inheritance and constructors in real world.
CO4	Demonstrate the use of packages and to create multi-threaded programs.
CO5	Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings.

Text Books:	
1	Sourav Sahay, Object Oriented Programming with C++ , 2nd Ed, Oxford University Press,2006.
2	Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.
Reference Books:	
1	Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806.
2	Herbert Schildt, The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2003.
3	Stanley B.Lippmann, Josee Lajore, C++ Primer, 4th Edition, Pearson Education, 2005.
4	Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.
5	Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
6	E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**ANALYSIS AND DESIGN OF ALGORITHMS LAB**	**Semester**	04
Course Code	MVJ20AML47/MVJ20CSL47	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Employ various design strategies for problem solving.
- Provide exposure to measure and compare the performance of different algorithms.
- Provide design and implement various Concepts in JAVA.

S No	**Experiment Name**	**RBT Level**	**Hours**
1	Write a recursive program to a. Solve Towers-of-Hanoi problem b.GCD	**L3**	**3**
2	Write a Java program to implement the Stack using arrays. Write Push(), Pop(), and Display() methods to demonstrate its working.	**L3**	**3**

3	Implement Recursive Binary search and Linear search and determine the time required to search an element. Repeat the experiment for different values of N and plot a graph of the time taken versus N.	**L3**	**3**
4	Given a set of N integer elements which is to be sorted using Selection Sort technique. Write the program using C language as well as in Java for different values of N and observe the total time taken to sort the elements in both the languages.	**L3**	**3**
5	Write program to do the following: a. Print all the nodes reachable from a given starting node in a digraph using BFS method. b. Check whether a given graph is connected or not using DFS method.	**L3**	**3**
6	The Merge sort is one of the most common algorithms used to sort arrays. The class Merge sort implements this algorithm. However, there is a bug in the implementation of the method sort. Debug the previous implementation using the debugging options of your favourite IDE (e.g. eclipse), in order to find the error.	**L3**	**3**
7	Sort a given set of N integer elements using Quick Sort technique and Run the program for different values of N and record the time taken to sort.	**L3**	**3**
8	We are given a set of items, each with a weight and a value and we need to determine the number of each items to include in a collection so that the total weight is less than or equal to the given limit and the total value is as large as possible. Write a Java program by applying any reuse sub problem technique to find the solution.	**L3**	**3**
9	Suppose you're trying to find the shortest path from your house to various locations like Movie theatre, Gas Station,Grocery Store and Petrol pump. If we let various locations be vertices and the routes between them are edges, we can create a weighted graph representing the situation. Write a Java program to find the shortest path from your house (source) to the remaining locations.	**L3**	**3**
10	Write a Java program for the following Scenario, You have a business with several offices and you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost and it should be a spanning tree.	**L3**	**3**
11	Develop a program in Java with a given set of vertices V in a weighted graph where each edge w (u,v) can be negative, find the shortest path weights d(s,v) from every source s to all vertices in the graph. If the graph contains negative cycle, report it.	**L3**	**3**
12	Given a set of cities and distance between every pair of cities, the problem is to find	**L3**	**3**

	the shortest possible route that visits every city exactly once and returns to the starting point. Write a program to find the solution using dynamic programming method.		
13	Given a set of positive integers and an integer ‘s' write a program in Java to determine whether there is any non-empty subset whose sum is ‘s'.	**L3**	**3**
14	Write a Java program to find a path that traverses all the vertices of the given graph G exactly once and then ends at the starting vertex in a connected undirected Graph G of *n* vertices using backtracking principle.	**L3**	**3**

Course Outcomes:	
CO1	Design algorithms using appropriate design techniques (brute-force, greedy, dynamic programming, etc.)
CO2	Implement a variety of algorithms such as sorting, graph related, combinatorial, etc., in a high level language.
CO3	Analyze and compare the performance of algorithms using language features.
CO4	Apply and implement learned algorithm design techniques and data structures to solve real-world problems.
CO5	Employ various design strategies for problem solving and implement various algorithms in JAVA .

Reference Books:	
1	Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education).
2	http://jeffe.cs.illinois.edu/teaching/algorithms/

CIE Assessment:

Regular Lab work :20

Record 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	3	3	2	-	-	-	-	-	3	-	2	2	2	-
CO2	3	3	2	-	-	-	-	-	3	-	2	2	1	2
CO3	3	3	2	-	-	-	-	-	3	-	2	2	3	-
CO4	3	3	2	-	-	-	-	-	3	-	2	2	2	3
CO5	3	3	2	-	-	-	-	-	3	-	2	2	2	3

High-3, Medium-2, Low-1

Course Title	**DATABASE MANAGEMENT SYSTEM LAB**	**Semester**	04
Course Code	MVJ20AML48/MVJ20CSL48	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Learn to create and use a database.
- Be familiarized with a query language
- Have hands on experience on DDL Commands
- Have a good understanding of DML Commands and DCL commands
- Familiarize advanced SQL queries.
- Be Exposed to different applications

S No	Experiment Name	RBT Level	Hours
1	Creation of a database and writing SQL queries to retrieve information from the database.	**L3**	**3**
2	Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.	**L3**	**3**
3	Creation of Views, Synonyms, Sequence, Indexes, Save point.	**L3**	**3**
4	Creating an Employee database to set various constraints.	**L3**	**3**
5	Creating relationship between the databases.	**L3**	**3**

6	Study of PL/SQL block.	**L3**	**3**
7	Write a PL/SQL block to satisfy some conditions by accepting input from the user.	**L3**	**3**
8	Write a PL/SQL block that handles all types of exceptions.	**L3**	**3**
9	Creation of Procedures.	**L3**	**3**
10	Creation of database triggers and functions	**L3**	**3**
11	Mini project (Application Development using Oracle/ Mysql) a) Inventory Control System. b) Material Requirement Processing. c) Hospital Management System. d) Railway Reservation System. e) Personal Information System. f) Web Based User Identification System. g) Timetable Management System. h) Hotel Management System	**L3**	**3**

Course outcomes:	
CO1	Design and implement a database schema for a given problem-domain
CO2	Populate and query a database
CO3	Create and maintain tables using PL/SQL.
CO4	Prepare reports.

Reference Books:	
1	Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, McGraw Hill, 2013.
2	Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

CIE Assessment:
Regular Lab work :20 Record 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	3	3	2	-	-	-	-	-	3	-	2	2	2	-
CO2	3	3	2	-	-	-	-	-	3	-	2	2	1	2
CO3	3	3	2	-	-	-	-	-	3	-	2	2	3	-
CO4	3	3	2	-	-	-	-	-	3	-	2	2	2	3

High-3, Medium-2, Low-1

Course Title	BALIKE KANNADA	Semester	IV
Course Code	MVJ20BK39	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	1 (L: T: P 1:0:0)	Total	100
Credits	1	Exam. Duration	3 Hrs

Course objective : This course will enable students to understand Kannada and communicate in Kannada language

- Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)
- Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronounciation.
- Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
- Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)
- Activities in Kannada

CHAPTER-1
Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)
CHAPTER-2
Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronounciation
CHAPTER-3
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication)
CHAPTER-4
Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)
CHAPTER-5

Activities in Kannada

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

Course Title	SAMSKRUTHIKA KANNADA	Semester	IV
Course Code	MVJ20SK39	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	1 (L: T: P 1:0:0)	Total	100
Credits	1	Exam. Duration	3Hrs

Course Objective : This course will enable students to understand Kannada and communicate in Kannada language • Samskruthika Kannada –Parichaya (Introduction to Adalitha kannada) • Kannada Kavyagala parichaya (Kannada D Ra Bendre, Siddalingaiha) • Adalithdalli Kannada Padagalu (Kannada Kagunitha Balake, Patra Lekhana, Prabhandha) • Kannada Computer Gnyana (Kannada Shabdha Sangraha, Computer Paribashika padagalu) • Activities in Kannada.
CzsÁåAiÀÄ –1
PÀ£ÀßqÀ ¨sÁµÉ–¸ÀAQë¥ÀÛ «ªÀgÀuÉ.
CzsÁåAiÀÄ –2
¨sÁµÁ ¥ÀæAiÉÆÃUÀ¯ÁèUÀÄªÀ ¯ÉÆÃ¥ÀzÉÆÃµÀUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À ¤ªÁgÀuÉ.
CzsÁåAiÀÄ –3
¯ÉÃR£À aºÉßUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À G¥ÀAiÉÆÃU.À
CzsÁåAiÀÄ –4

¥ÀvÀæ ªÀåªÀºÁgÀ.
CzsÁåAiÀÄ -5
DqÀ½vÀ ¥ÀvÀæUÀ¼ÀÄ.
CzsÁåAiÀÄ -6
¸ÀPÁðgÀzÀ DzÉÃ±À ¥ÀvÀæUÀ¼ÀÄ
CzsÁåAiÀÄ -7
¸ÀAQÃ¥ÀÛ ¥Àæ§AzsÀ gÀZÀ£É, ¥Àæ§AzsÀ ªÀÄvÀÄÛ ¨sÁµÁAvÀgÀ
CzsÁåAiÀÄ -8
PÀ£ÀßqÀ ±À§Ý¸ÀAUÀæºÀ
CzsÁåAiÀÄ -9
PÀA¥ÀÆålgï ºÁUÀÆ ªÀiÁ»w vÀAvÀæeÁÕ£À
CzsÁåAiÀÄ -10
¥Áj¨sÁ¶PÀ DqÀ½vÀ PÀ£ÀßqÀ ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛ vÁAwæPÀ/PÀA¥ÀÆålgï ¥Áj¨sÁ¶PÀ ¥ÀzÀUÀ¼ÀÄ.
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 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. ii. 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.

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

Course Title	**ADDITIONAL MATHEMATICS-II**	**Semester**	04
Course Code	MVJ20MDSDIP41	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	-	**Exam. Duration**	3 HOURS

Course objective is to: This course viz., aims to prepare the students:

To familiarize the important tools Linear Algebra, differential Calculus, Beta and Gamma functions, 3-Dimentional Geometry and probability for analysing the engineering problems.

Module-1	L1,L2	8 Hrs.

Linear Algebra:

Introduction, Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method and problems. Eigen values and Eigen vectors of square matrix of order two and Problems

Video Link:

- https://www.math.ust.hk/~machas/matrix-algebra-for-engineers.pdf
- https://nptel.ac.in/content/storage2/courses/122104018/node18.html

Module-2	L1,L2	8 Hrs.

Differential calculus:

Tangent and normal, both Cartesian and polar forms. Increasing and decreasing functions, Maxima and Minima for a function of one variable. Point of inflections and Problems.

Beta and Gamma functions:

Beta and Gamma functions, Relation between Beta and Gamma function-simple problems.

Video Link

- https://www.youtube.com/watch?v=6RwOoPN2zqE
- https://www.youtube.com/watch?v=s6F5yjY6jWk&list=PLMLsjhQWWlUqBoTCQDtYlloI-o-9hxp11
- http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx

Module-3	L1,L2	8 Hrs.

Analytical solid geometry :

Introduction –Directional cosine and Directional ratio of a line, Equation of line in space- different forms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems.

Video Links:

- https://www.toppr.com/guides/maths/three-dimensional-geometry/
- https://www.toppr.com/guides/maths/three-dimensional-geometry/distance-between-skew-lines/

Module-4	L1,L2,L3	8 Hrs.

Probability:

Random variable, Discrete probability distribution, Mean and variance of Random Variable, Theoretical distribution- Binomial distribution, Mean and variance Binomial distribution -Problems. Poisson distribution as a limiting case of Binomial distribution, Mean and variance of Poisson distribution.

Normal Distribution-Basic properties of Normal distribution –standard form of normal distribution and Problems

Video Links:

- https://nptel.ac.in/courses/111/105/111105041/
- https://www.mathsisfun.com/data/probability.html

Module-5	L1,L2	8 Hrs.

Partial Differential equation: Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Video Link:

- http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx
- https://www.studyyaar.com/index.php/module-video/watch/233-cauchys-legendres-de-a-method- of-variation-of-parameters

Course Outcomes:

CO1	Apply the knowledge of Matrices to solve the system of linear equations and to understand the concepts of Eigen value and Eigen vectors for engineering problems.
CO2	Demonstrate various physical models ,find Maxima and Minima for a function of one variable., Point of inflections and Problems .Understand Beta and Gamma function
CO3	Understand the 3-Dimensional geometry basic, Equation of line in space- different forms, Angle between two line and studying the shortest distance.

CO4	Concepts of Probability related to engineering applications.
CO5	Construct a variety of partial differential equations and solution by exact methods.

Reference Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition,2014.
3	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

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 (10 marks)
- Assignment (10 marks)

SEE Assessment:

i. 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.
ii. 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.
iii. 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	3	3	-	2	-	-	-	-	-	-	1	1
CO2	3	3	-	2	-	-	-	-	-	-	1	1
CO3	3	3	-	3	-	-	-	-	-	-	-	1
CO4	2	2	-	3	-	-	-	-	-	-	1	1
CO5	2	2	-	2	-	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

V SEMESTER

Course Title	**TECHNICAL MANAGEMENT & ENTREPRENEURSHIP**	**Semester**	05
Course Code	MVJ20TIM51	**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:

- Describe the importance of management and functions of a manager.
- Explain the process of planning and organizing.
- Explain the requirements of direction, supervision and the methods of establishing control.
- Identify the role of entrepreneurs in the economic development of the nation and recognize the barriers of entrepreneurship.
- Explain the importance of Intellectual property protection.

Module-1	L1,L2, L3	**Hours 8**

Management: importance of management, definition, management functions, roles of a manager, levels of management, managerial skills, management and administration, management –a science or art, management – a profession, professional management v/s family management. Development of management thought; Early classical approaches, Neo classical approaches, modern approaches.

Application: Enterprises

Video Link:https://www.youtube.com/watch?v=mub7Z8Fl3ZU

Module-2	L1,L2, L3	**Hours 8**

Planning: Nature, Importance of planning, forms, types of plans, steps in planning, limitations of planning, making planning effective, planning skills, strategic planning in Indian industry.

Organizing: Organization Meaning, process of organizing, span of management principles of organizing, Departmentation, organization structure, committees, teams.

Application: Industry

Video Link:https://www.youtube.com/watch?v=pCUs3UKwYpc

Module-3	L1,L2, L3	**Hours 8**

Direction and supervision: Requirements of effective direction, giving orders, motivation, job satisfaction,

morale , organizational commitment, first level supervision or front line supervision.

Controlling: Meaning and steps in controlling , Essential of a sound control system , Methods of establishing control

Application: Industry

Video Link: https://www.youtube.com/watch?v=MufenDklR8E

Module-4	L1,L2, L3	**Hours 8**

Entrepreneurship: Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging Class. Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

Application: Industry

Video Link:https://www.youtube.com/watch?v=aozlwC3XwfY

Module-5	L1,L2, L3	**Hours 8**

Introduction to IPR, origin and concepts of IPR, Concept of property, Forms of IP protection: Patents, copyrights, trademarks, designs, Trade secrets, Traditional knowledge, Geographical indications. Basic concepts and historical background of patent system and law- National and international scenario (American & European Patent Regimes).

International Treaties/Conventions on IPR: Paris Convention, Berne convention, Madrid agreement, Rome convention, World Intellectual Property Organization (WIPO), World Trade Organization, TRIPS Agreement, Patent Co-operation Treaty

Application: Industry

Video Link: https://www.youtube.com/watch?v=hHQWCFE0J84

Practical Experiments:

Case study on Enterprises:

- Case study(Microsoft),
- Case study (Captain G R Gopinath),
- Case study(NR Narayana Murthy& Infosys)

Practical Sessions:

- Idea Generation and Opportunity Recognition
- Strategy and Business Model Analysis
- Formulation of Project

Course Outcomes:

CO1	Describe the importance of management and functions of a manager.
CO2	Explain the process of planning and principles of organizing

CO3	Identify the role of entrepreneurs in the economic development of the nation.
CO4	Compare the different leadership styles.
CO5	Apply the ethical principles related to the intellectual property protection

Text Books:	
1	Management and Entrepreneurship , N V R Naidu ,T Krishna Rao 4th reprint.
2	Law relating to Intellectual Property rights , B. L. Wadhera, 5th edition,Universal Law Publishing, 2011
Reference Books:	
1	Principles of Management, P C Tripathi, P N Reddy, 5th edition, TataMcGraw Hill, 2012
2	Dynamics of Entrepreneurial Development & Management, Vasant Desai, Himalaya publishing house, 2009

CIE Assessment:

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

CO-PO/PSO Mapping

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

CO5	2	-	-	-	-	2	-	2	-	-	2	-	1	-

High-3, Medium-2, Low-1

Course Title	**MACHINE LEARNING USING PYTHON**	**Semester**	05
Course Code	MVJ20AM52	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning.
- Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning.
- Perform statistical analysis of machine learning techniques.

Module-1	L1,L2, L3	**Hours 10**

Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning.

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

Laboratory Sessions/ Experimental learning:

To understand purpose, give real time dataset(problem) and ask to students to solve in class room.

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

- https://www.youtube.com/watch?v=rQ3oi9g8alY
- https://www.youtube.com/watch?v=h0e2HAPTGF4

Module-2	L1,L2, L3	**Hours 10**

Decision Tree Learning

Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Laboratory Sessions/ Experimental learning:

Ask students to design a Decision Tree using freely available dataset or problem in classroom.

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

- https://www.youtube.com/watch?v=qDcl-FRnwSU
- https://www.youtube.com/watch?v=FuJVLsZYkuE

Module-3	L1,L2, L3	**Hours 10**

Bayesian Learning and Evaluating Hypotheses

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.

Evaluating Hypotheses: Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis

Laboratory Sessions/ Experimental learning:

Ask the students to build Bayes Belief Networks for real time problem in class room.

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

- https://www.youtube.com/watch?v=480a_2jRdK0
- https://www.youtube.com/watch?v=E3l26bTdtxI

Module-4	L1,L2, L3	**Hours 10**

Artificial Neural Networks and Instance based Learning

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm. Instanced Based Learning:Introduction, k-nearest neighbor learning, locally weighted regression.

Laboratory Sessions/ Experimental learning:

Give real time problem and ask students to design an ANN using perceptrons.

Video link:

- https://www.youtube.com/watch?v=xbYgKoG4x2g&list=PL53BE265CE4A6C056.
- https://www.youtube.com/watch?v=BRMS3T11Cdw&list=PL3pGy4HtqwD2a57wl7Cl7tmfxfk7JWJ9Y

Module-5	L1,L2,L3	**Hours 10**

Reinforcement Learning and Deep Learning : Reinforcement Learning: Introduction, Learning Task, Q Learning.

Deep Learning: Introduction to Deep Learning-Reasons to go Deep Learning, Introduction to Convolution Networks ,Restricted Boltzmann Machines, Deep Belief Nets, Recurrent Nets.

Video link:

- https://www.youtube.com/watch?v=TIlDzLZPyhY&list=PLyqSpQzTE6M_FwzHFAyf4LSkz_IjMyjD9
- https://www.youtube.com/watch?v=iOh7QUZGyiU&list=PLqYmG7hTraZDNJre23

vqCGIVpfZ_K2RZs	

Course Outcomes:	
CO1	Identify the issues in machine learning and Algorithms for solving it.
CO2	Explain theory of probability and statistics related to machine learning.
CO3	Investigate concept learning, ANN, Bayes classifier, k nearest neighbor, Q, Learning.
CO4	Identify the difference between Machine Learning and Deep Learning and using scenario
CO5	Explain the concepts of Q learning and deep learning

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

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:

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- 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 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 set from each unit. The duration of examination is 3 hours.

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**DATA COMMUNICATION &COMPUTER NETWORKS**	**Semester**	05
Course Code	MVJ20AM53 /MVJ20CS53	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	4(L : T : P :: 3: 2 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Introduce the fundamental concepts and types of computer networks.
- Demonstrate the TCP/IP and OSI models with merits and demerits.
- Understand the difference between all communication protocols.

Module-1	L1,L2, L3	**Hours 10**

Data Communications: Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

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

- http://www.nptelvideos.in/2012/11/computer-networks.html

Module-2	L1,L2, L3	**Hours 10**

Data link layer: Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. 111 Medium Access sub layer: ALOHA, CSMA/CD, LAN – Ethernet IEEE 802.3, IEEE 802.5 – IEEE 802.11, Random access, Controlled access, Channelization.

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

- http://www.nptelvideos.in/2012/11/computer-networks.html

Module-3	L1,L2, L3	**Hours 10**

Network layer: Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols.

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

- http://www.nptelvideos.in/2012/11/computer-networks.html

Module-4	L1,L2, L3	**Hours 10**

Transport Layer: Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks. **Video link:** http://www.nptelvideos.in/2012/11/computer-networks.html		
Module-5	L1,L2, L3	**Hours 10**
Application Layer: Domain name space, DNS in internet, electronic mail, SMTP, FTP, WWW, HTTP, SNMP. **Video link: http://www.nptelvideos.in/2012/11/computer-networks.html**		

Course Outcomes:	
CO1	Interpret the basics of Computer Networks and Various Protocols.
CO2	Generalize functionalities and services of each layer of OSI model.
CO3	Explains the concept of data framing and error control mechanisms
CO4	Compares Different routing protocols
CO5	Identify the concepts of network security, Mobile and adhoc networks
Text Books:	
1	Data Communications and Networking, Behrouz A. Forouzan , Fourth Edition TMH,2006.
2	Computer Networks, Andrew S Tanenbaum, 4th Edition. Pearson Education, PHI.

Reference Books:	
1	An Engineering Approach to Computer Networks, S. Keshav, 2 nd Edition, Pearson Education.
2	Understanding communications and Networks, 3 rd Edition, W.A. Shay, Cengage Learning.
3	Computer Networking: A Top-Down Approach Featuring the Internet. James F. Kurose & Keith W. Ross, 3 rd Edition, Pearson Education.
4	Data and Computer Communication, William Stallings, Sixth Edition, Pearson Education, 2000

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**WEB TECHNOLOGIES**	**Semester**	05

Course Code	MVJ20AM54	**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***

- Understand different Internet Technologies.
- Learn java-specific web services architecture
- Understand the SQL and JDBC
- Learn the AJAX and JSON

Module-1	L1,L2, L3	**Hours 8**

Website Basics, HTML5, CSS 3, Web 2.0: Web Essentials: Clients, Servers and Communication ,The Internet, Basic Internet protocols, World wide web, HTTP Request Message , HTTP Response Message, Web Clients, Web Servers, HTML5 : Tables, Lists, Image, HTML5 control elements , Semantic elements , Drag and Drop, Audio, Video controls, CSS3: Inline, embedded and external style sheets, Rule cascading, Inheritance, Backgrounds, Border Images, Colours, Shadows, Text, Transformations

Laboratory Sessions/ Experimental learning:

1. Design HTML form for keeping student record.
2. Write a HTML code to generate following output.

   Create an html page with following specifications

   a. Title should be about my college

   b. Put the image in the background

   c. Place your College name at the top of the page in large text followed by address in smaller size

   d. Add names of courses offered each in a different color, style and typeface

   e. Add scrolling text with a message of your choice

Video link / Additional online information:

- https://www.youtube.com/watch?v=QEtWL4lWlL4
- https://www.youtube.com/watch?v=h_RftxdJTzs

Module-2	L1,L2, L3	**Hours 8**

Client side Programming: An Introduction to java Script, JavaScript DOM Model, Date and Object, Regular Expression, Exception Handling, Validation, Built-in Objects, Event Handling, DHTML with JavaScript, JSON introduction, Syntax, Function Files, Http Request, SQL.

Laboratory Sessions/ Experimental learning:

1. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
2. Write a JavaScript code that displays text "TEXT-GROWING" with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays "TEXT-SHRINKING" in BLUE color. Then the font size decreases to 5pt.

Video link / Additional online information:

- https://www.youtube.com/watch?v=uDwSnnhl1Ng&list=PLsyeobzWxl7qtP8Lo9TReqUMkiOp446cV
- https://www.youtube.com/watch?v=zPTY1hKq3SU&list=PLVlQHNRLflP-ByWEVjCZAj79kJdshKQwu

Module-3	L1,L2 , L3	**Hours 8**

Server Side Programming: Java Servlet Architecture, Servlet Life Cycle, Form GET and POST actions, Session handling, Installing and Configuring Apache Tomcat Web Server, Database Connectivity: JDBC perspectives, JDBC Program Example, JSP: Understanding Java server page, JSP Standard Tag Library (JSTL), Creating HTML form using JSP Code.

Laboratory Sessions/ Experimental learning:

1. Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following.
   a. Create a Cookie and add these four user id's and passwords to this Cookie.
   b. Read the user id and passwords entered in the Login form and authenticate with the values available in the cookies.
2. Write a JSP which insert the details of the 3 or 4users who register with the web site by using registration form. Authenticate the user when he submits the login form using the user name and password from the database.

Video link / Additional online information:

- https://www.youtube.com/watch?v=7TOmdDJc14s&list=PLsyeobzWxl7pUPF2xjjJiG4BKC9x_GY46
- https://www.youtube.com/watch?v=xve6QEgIR-0&list=PL0zysOfIRCel5BSXoslpfDawe8FyyOSZb
- https://www.youtube.com/watch?v=0pzR2FGTEhk

Module-4	L1,L2, L3	**Hours 8**

PHP: Introduction to PHP, PHP using PHP, Variables, Program Control, Built-in Functions, Form Validation, Basic command with PHP examples, Connection to server, creating Database, Selecting Database, Listing Database, listing table names Creating a table, Inserting data, deleting data and tables, altering tables.

Laboratory Sessions/ Experimental learning:

1. Write a PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.
2. Write a PHP program to display a digital clock which displays the current time of the server.

3. Write a PHP program to sort the student records which are stored in the database using selection sort.
4. Design an XML document to store information about a student in an engineering college affiliated to VTU. The information must include USN, Name, and Name of the College, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.

Video link / Additional online information :

- https://www.youtube.com/watch?v=itRkLa2kq6w
- https://www.youtube.com/watch?v=KJHYdkKtafU
- https://www.youtube.com/watch?v=G_CFRAdbXfI&list=PL_RGaFnxSHWrjkpK2zD4TWKWMWVfeYK-b

Module-5	L1,L2, L3	**Hours 8**

AJAX: Ajax client server architecture, Xml HTTP request object, Call back methods. Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, Web Services: Introduction, Java web services Basics, Creating, Publishing, Testing and Describing a web services, Database driven web service from an application.

Laboratory Sessions/ Experimental learning:

1. Creating simple application to access data base using JDBC Formatting HTML with CSS.
2. Write a Program for manipulating Databases and SQL with real time application.
3. Write a Java applet to display the Application Program screen i.e. calculator and other.

Video link / Additional online information

- https://www.youtube.com/watch?v=qk9MWbyRlhE
- https://www.youtube.com/watch?v=0pzR2FGTEhk
- https://www.youtube.com/watch?v=HgvIox6ehkM

Course Outcomes:	
CO1	Construct a basic website using HTML and Cascading Style Sheets.
CO2	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanism.
CO3	Develop server side programs using Servlets and JSP.
CO4	Construct simple web pages in PHP and to represent data in XML format.
CO5	Use AJAX and web services to develop interactive web applications.

Text Books:	
1	Deitel and Deitel and Nieto,Internet and World Wide Web, How to Program, Prentice Hall, 5th Edition, 2011.
2	Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1stEdition, Pearson Education India. (ISBN:978-9332575271)

Reference Books:	
1	Stephen Wynkoop and John Burke —Running a Perfect Website‖, QUE, 2nd Edition,1999
2	Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
3	UttamK.Roy, —Web Technologies‖, Oxford University Press, 2011.

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**COMPILER DESIGN**	**Semester**	05
Course Code	MVJ20AM551	**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***

- Learn the various parsing techniques and different levels of translation.
- Learn how to obtain specific object code from source language.
- Learn how to optimize the code and schedule for optimal performance.

Module-1	**L1, L2, L3,L4**	**Hours 8**

FRONT END OF COMPILERS: The Structure of Compiler – Lexical Analysis: Role of Lexical Analyzer, Specification and Recognition of Tokens, Syntax Analysis: Top Down Parsing, Bottom up Parsing, LR Parsers: SLR, CLR, and LALR.

Video Links : https://www.youtube.com/watch?v=yxnbvS2t_QA

Module-2	**L1,L2,L3,L4**	**Hours 8**

INTERMEDIATE CODE GENERATION: Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Syntax Directed Translation Schemes, Intermediate Languages: Syntax Tree, Three Address Code, Postfix Code, Declarations, Translation of Expressions, Type Checking, Back Patching.

Video Links: https://www.youtube.com/watch?v=EpAzj7zXrbk

Module-3	**L1,L2,L3,L4**	**Hours 8**

RUNTIME AND OBJECT CODE GENERATION: Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Issues in Code Generation - Design of Code Generator - Register Allocation and Assignment – Instruction Selection by Tree Rewriting – Optimal Code Generation for Expressions – Dynamic Programming Code Generation.

Video Links: https://www.youtube.com/watch?v=lRvaRhPsqOo

Module-4	**L1,L2,L3,L4**	**Hours 8**

CODE OPTIMIZATION: Basic Blocks and Flow Graphs – Optimization of Basic Blocks – Principal Sources of Optimizations – Data Flow Analysis – Constant Propagation – Partial Redundancy Elimination – Peephole Optimizations.

Video Links: https://nptel.ac.in/courses/106/108/106108113/

Module-5	**L1,L2,L3,L4**	**Hours 8**

SCHEDULING AND OPTIMIZING FOR PARALLELISM: Code Scheduling Constraints – Basic Block Scheduling – Global Code Scheduling - Basic Concepts in Parallelization – Parallelizing Matrix Multiplication – Iteration Spaces – Affine Array Indexes.

Video Links: https://www.youtube.com/watch?v=-yMWgtTeQgY

Course outcomes:

CO1	Design compiler phases from language specification.
CO2	Design code generators for the specified machine.

CO3	Analyze Object Code Generation techniques.
CO4	Apply the various optimization techniques.
CO5	Understand the Optimizing for Parallelism

Text Books:	
1	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, —Compilers: Principles, Techniques and Tools‖, Second Edition, Pearson Education, 2009.
2	Randy Allen, Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufmann Publishers, 2002.

Reference Books:	
1	Keith D Cooper and Linda Torczon, —Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004
2	V. Raghavan, —Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.
3	Allen I. Holub, —Compiler Design in C‖, Prentice-Hall Software Series, 1993.
4	Steven S. Muchnick, —Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**COMPUTER GRAPHICS & MULTIMEDIA**	**Semester**	05
Course Code	MVJ20AM552	**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***

- Develop an understanding and awareness how issues such as content, information architecture, motion, sound, design, and technology merge to form effective and compelling interactive experiences for a wide range of audiences and end users.
- Become familiar with various software programs used in the creation and implementation of multi- media.
- Appreciate the importance of technical ability and creativity within design practice.
- Gain knowledge about graphics hardware devices and software used.
- Understand the two-dimensional graphics and their transformations.
- Understand the three-dimensional graphics and their transformations.
- Appreciate illumination and color models.
- Become familiar with understand clipping techniques.
- Become familiar with Blender Graphics.

Module-1	**L1, L2, L3,L4**	**Hours 8**

ILLUMINATION AND COLOR MODELS: Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection. Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

Video Links : https://www.youtube.com/watch?v=ne5RVVQMVpk

Module-2	**L1,L2,L3,L4**	**Hours 8**

TWO-DIMENSIONAL GRAPHICS: Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

Video Links: https://www.youtube.com/watch?v=iWxS2zpaRjk

Module-3	**L1,L2,L3,L4**	**Hours 8**

THREE - DIMENSIONAL GRAPHICS: Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

Video Links: https://www.youtube.com/watch?v=_eVRNdGsLWc		
Module-4	**L1,L2,L3,L4**	**Hours 8**
MULTIMEDIA SYSTEM DESIGN & MULTIMEDIA FILE HANDLING: Multimedia basics − Multimedia applications − Multimedia system architecture − Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies. **Video Links**: https://www.youtube.com/watch?v=davcYvCJ63w		
Module-5	**L1,L2,L3,L4**	**Hours 8**
HYPERMEDIA : Multimedia authoring and user interface - Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems.CASE STUDY: BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures. **Video Links**: https://www.youtube.com/watch?v=fAJzLuce_ms		

Course outcomes:	
CO1	Design and Apply two, three dimensional graphics and transformations.
CO2	Apply Illumination and color models
CO3	Apply clipping techniques to graphics
CO4	Understand Different types of Multimedia File Format
CO5	Design Basic 3d Scenes using Blender

Text Books:	
1	Donald Hearn and Pauline Baker M, —Computer Graphics", Prentice Hall, New Delhi, 2007. [Unit I,II,III]
2	Andleigh, P. K and Kiran Thakrar, —Multimedia Systems and Design‖, PHI, 2003. [UNIT IV,V]

Reference Books:	
1	Judith Jeffcoate, —Multimedia in practice: Technology and Applications‖, PHI, 1998.
2	Foley, Vandam, Feiner and Hughes, —Computer Graphics: Principles and Practice‖, 2nd Edition, Pearson Education, 2003.

3	Jeffrey McConnell, —Computer Graphics: Theory into Practice‖, Jones and Bartlett Publishers,2006.
4	Hill F S Jr., "Computer Graphics", Maxwell Macmillan , 1990.
5	Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, —Fundamentals of Computer Graphics‖, CRC Press, 2010.
6	William M. Newman and Robert F.Sproull, —Principles of Interactive Computer Graphics‖, Mc Graw Hill 1978. https://www.blender.org/support/tutorials/

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**VIRTUAL REALITY**	**Semester**	05
Course Code	MVJ20AM553	**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*** • Explain understanding of this technology, underlying principles, its potential and limits and to learn about the criteria for defining useful applications. • Illustrate process of creating virtual environments.		
Module-1	**L1, L2, L3,L4**	**Hours 8**
Introduction : The three I's of virtual reality, commercial VR technology and the five classic components of a		

VR system. Input Devices : (Trackers, Navigation, and Gesture Interfaces): Three dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces **Video Links :** https://www.youtube.com/watch?v=DCQYBHz7RDs		
Module-2	**L1,L2,L3,L4**	**Hours 8**
Output Devices: Graphics displays, sound displays & haptic feedback. **Video Links:** https://www.youtube.com/watch?v=wwcd0h5d0Vs		
Module-3	**L1,L2,L3,L4**	**Hours 8**
Modeling : Geometric modeling, kinematics modeling, physical modeling, behaviour modeling, model management. **Video Links:** https://www.youtube.com/watch?v=0IgOapAtauM		
Module-4	**L1,L2,L3,L4**	**Hours 8**
Human Factors: Methodology and terminology, user performance studies, VR health and safety issues. **Video Links**: https://www.youtube.com/watch?v=_RU-XjaKWbg		
Module-5	**L1,L2,L3,L4**	**Hours 8**
Applications: Medical applications, military applications, robotics applications. **Video Links**: https://www.youtube.com/watch?v=rYWJdZ5qg6M&list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_		

Course outcomes:	
CO1	Illustrate technology, underlying principles, its potential and limits and to learn about the criteria for defining useful applications.
CO2	Explain process of creating virtual environments
CO3	Analyse & Design a system or process to meet given specifications with realistic engineering constraints.
CO4	Identify problem statements and function as a member of an engineering design team.
CO5	Utilize technical resources

Text Books:	
1	Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons.

Reference Books:

1	Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.
2	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 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)

SEE Assessment:

i. 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**SOFTWARE TESTING METHODOLOGIES**	**Semester**	05
Course Code	MVJ20AM554	**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 provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies.
- To develop skills in software test automation and management using latest tools.

Module-1	**L1, L2, L3,L4**	**Hours 8**
Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs		

Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing. **Video Links :** https://www.youtube.com/watch?v=KMj49syT8JM&list=PLyqSpQzTE6M-sBjDcT21Gpnj8grR2fDgc		
Module-2	**L1,L2,L3,L4**	**Hours 8**
Transaction Flow Testing: transaction flows, transaction flow testing techniques. Data flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing. Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability. **Video Links:** https://nptel.ac.in/courses/106/101/106101163/		
Module-3	**L1,L2,L3,L4**	**Hours 8**
Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing: overview, decision tables, path expressions, KV Charts, specifications **Video Links:** https://nptel.ac.in/courses/106/101/106101163/		
Module-4	**L1,L2,L3,L4**	**Hours 8**
State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips. **Video Links**: https://nptel.ac.in/courses/106/101/106101163/		
Module-5	**L1,L2,L3,L4**	**Hours 8**
Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner). **Video Links**: https://nptel.ac.in/courses/106/101/106101163/		
Course outcomes:		
CO1	List a range of different software testing techniques and strategies and be able to apply specific(automated) unit testing method to the projects.	
CO2	Distinguish characteristics of structural testing methods.	
CO3	Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.	
CO4	Discuss about the functional and system testing methods.	
CO5	Demonstrate various issues for object oriented testing.	

Text Books:	
1	Software Testing techniques - Baris Beizer, Dreamtech, second edition
2	Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

Reference Books:	
1	The craft of software testing - Brian Marick, Pearson Education.
2	Software Testing Techniques – SPD(Oreille)
3	Software Testing in the Real World – Edward Kit, Pearson.
4	Effective methods of Software Testing, Perry, John Wiley
5	Art of Software Testing – Meyers, John Wiley.

CIE Assessment:

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- 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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

CO4	3	3	2	3	2	-	-	-	-	-	-	2	3	-
CO5	3	3	2	3	2	-	-	-	-	-	-	2	3	1

High-3, Medium-2, Low-1

Course Title	**MACHINE LEARNING USING PYTHON LABORATORY**	**Semester**	05
Course Code	MVJ20AML56	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Make use of Data sets in implementing the machine learning algorithms
- 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**	**3**
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**	**3**
3	Develop a program to demonstrate the prediction of values of a given dataset using **Linear regression**.	**L3**	**3**
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**	**3**
5	Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate data sets.	**L3**	**3**
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**	**3**
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**	**3**
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**	**3**
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**	**3**
10	Write a program to implement ***k*-Nearest Neighbour 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**	**3**

11	Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.	**L3**	**3**

Course Outcomes:	
CO1	Understand the implementation procedures for the machine learning algorithms.
CO2	Design Java/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 :20

Record 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	1	1	-	-	-	-	-	-	2	-	1	2	-
CO2	2	1	1	-	-	-	-	-	-	2	-	1	1	3

CO3	2	1	1	-	-	-	-	-	-	2	-	1	1	2
CO4	2	1	1	-	-	-	-	-	-	2	-	1	1	1
CO5	2	1	1	-	-	-	-	-	-	2	-	1	1	3

High-3, Medium-2, Low-1

Course Title	**COMMUNICATION NETWORK LAB**	**Semester**	05
Course Code	MVJ20AML57	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Learn and use network commands.
- Learn socket programming.
- Implement and analyze various network protocols.
- Learn and use simulation tools.
- Use simulation tools to analyze the performance of various network protocols.

S No	**Experiment Name**	**RBT Level**	**Hours**

1	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.	**L3**	**3**
2	Write a program for error detecting code using CRC-CCITT (16- bits).	**L3**	**3**
3	Write a program to find the shortest path between vertices using bellman-ford algorithm.	**L3**	**3**
4	Applications using TCP sockets like: a) Echo client and echo server b) Chat c) File Transfer	**L3**	**3**
5	Simulation of DNS using UDP sockets.	**L3**	**3**
6	Write a code for simulating ARP /RARP protocols.	**L3**	**3**
7	Implementation of Stop and Wait Protocol and Sliding Window Protocol.	**L3**	**3**
8	Write a program for congestion control using leaky bucket algorithm.	**L3**	**3**
9	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.	**L3**	**3**
10	Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.	**L3**	**3**
11	Simulate simple ESS and with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets.	**L3**	**3**
12	Simulate and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.	**L3**	**3**
13	Simulate and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment	**L3**	**3**
14	Simulate and study the performance of LTE on NS2/NS3	**L3**	**3**

Web Link and Video Lectures: (Self Learning)

- https://www.youtube.com/watch?v=rurs7cdT5cc
- https://www.youtube.com/watch?v=jQerVWxOGMc
- https://www.youtube.com/watch?v=X-wAtdGS5No
- https://www.youtube.com/watch?v=Db-tV8JJ3ZQ
- https://www.youtube.com/watch?v=Yb7vcX0inbM

Course Outcomes:	
CO1	Implement various protocols using TCP and UDP.
CO2	Compare the performance of different transport layer protocols.
CO3	Use simulation tools to analyze the performance of various network protocols.
CO4	Analyze various routing algorithms
CO5	Implement error correction codes.

Reference Books:	
1	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

CIE Assessment:

Regular Lab work :20

Record 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	3	3	3	2	1	-	-	-	-	-	-	-	1	3
CO2	3	3	2	2	1	-	-	-	-	-	1	-	-	-
CO3	3	3	2	2	1	-	-	-	-	-	1	-	3	-
CO4	3	3	2	2	1	-	-	-	-	-	1	-	3	-

CO5	3	2	2	2	1	-	-	-	-	-	-	-	1	3

High-3, Medium-2, Low-1

Course Title	**WEB TECHNOLOGIES LABORATORY**	**Semester**	05
Course Code	MVJ20AML58	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

Course objective is to:

This course will enable students to get practical experience in design, develop, implement, analyze and evaluation of

- Web pages and Style sheet creation.
- Client side programming and Java script
- PHP and Database creation.

S No	Experiment Name	RBT Level	Hours
1	Create a web page with the following. a. Cascading style sheets. b. Embedded style sheets. c. Inline style sheets. Use our college information(Department of CSE) for the web pages.	**L3**	**3**
2	Design HTML form for keeping student record and validate it using Java scr	**L3**	**3**
3	Write an HTML program to design an entry form of student details and se to store at database server like SQL, Oracle or MS Access.	**L3**	**3**
4	Write a JavaScript code that displays text “TEXT-GROWING” with increa font size in the interval of 100ms in RED COLOR, when the font size rea 50pt it displays “TEXT-SHRINKING” in BLUE color. Then the font size decre to 5pt.	**L3**	**3**
5	Assume four users user1, user2, user3 and user4 having the passwords pv pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following 1. Create a Cookie and add these four user id’s and passwords to this Cool 2. Read the user id and passwords entered in the Login form and authenti with the values available in the cookies.	**L3**	**3**
6	Write a JSP which insert the details of the 3 or 4 users who register with web site by using registration form. Authenticate the user when he sub the login form using the user name and password from the database.	**L3**	**3**

7	Validate the form using PHP regular expression. PHP stores a form data database	**L3**	**3**
8	Write a PHP program to display a digital clock which displays the current of the server.	**L3**	**3**
9	Creating simple application to access data base using JDBC Formatting H with CSS.	**L3**	**3**
10	Write a Program for manipulating Databases and SQL with real application	**L3**	**3**

Course Outcomes:	
CO1	Construct Web pages using HTML/XML and style sheets.
CO2	Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
CO3	Develop dynamic web pages using server side scripting.
CO4	Use PHP programming to develop web applications
CO5	Use JDBC and SQL to develop web applications

Reference Books:	
1	Jeffrey C and Jackson, —Web Technologies A Computer Science Perspective‖, Pearson Education, 2011.
2	UttamK.Roy, —Web Technologies‖, Oxford University Press, 2011

CIE Assessment:
Regular Lab work :20 Record 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	3	3	2	-	3	3	-	-	3	-	3	2	1	-
CO2	3	3	2	-	3	3	-	-	3	-	3	2	1	2
CO3	3	3	2	-	3	3	-	-	3	-	3	2	1	2
CO4	3	3	2	-	3	3	-	-	3	-	3	2	1	3
CO5	3	3	2	-	3	3	-	-	3	-	3	2	2	3

High-3, Medium-2, Low-1

Course Title	**ENVIRONMENTAL STUDIES**	**Semester**	05
Course Code	MVJ20ENV59	**CIE**	50
Total No. of Contact Hours	20	**SEE**	50
No. of Contact Hours/week	1 (L: T: P 1 : 0 :0)	**Total**	100

Credits	1	Exam. Duration	3 Hrs.

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

- Relate to 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; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.

Prerequisites: ***Basic Science***

Module-1	**L1, L2**	**4 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**.**

Video link:

- https://nptel.ac.in/courses/127/106/127106004/

Module-2	**L1,L2**	**4 Hrs.**

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.

Natural Resource Management (Concept and case-study): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link:

- https://nptel.ac.in/courses/121/106/121106014/

Module-3	**L1**	**4 Hrs.**

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Waste; Solid waste; Hazardous waste; E-waste.

Video link:

- https://nptel.ac.in/courses/122/106/122106030/
- https://nptel.ac.in/courses/105/103/105103205/
- https://nptel.ac.in/courses/120/108/120108005/
- https://nptel.ac.in/courses/105/105/105105160/

Module-4	**L1,**	**4 Hrs.**

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

Video link:

- https://nptel.ac.in/courses/122/106/122106030/
- https://nptel.ac.in/courses/120108004/
- https://onlinecourses.nptel.ac.in/noc19_ge23/preview

Module-5	**L1,L2**	**4 Hrs.**

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001.

Video link:

- https://nptel.ac.in/courses/105/102/105102015/
- https://nptel.ac.in/courses/120/108/120108004/

Course Outcomes: On completion of the course, students would 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 and describe the realities that managers face when dealing with complex issues.

Reference Books:

1.	Principals of Environmental Science and Engineering, Raman Siva kumar, Cengage learning, Singapur, 2nd Edition, 2005
2.	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 11th Edition, 2006
3.	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1st 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:

i. 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.
ii. 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.
iii. 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	3	3	3	1	–	2	2	1	1	–	2	1
CO2	3	3	2	1	–	1	2	–	1	1	2	1
CO3	3	3	2	1	–	2	2	–	1	1	2	1
CO4	3	3	2	2	–	2	2	–	1	1	2	1

High-3, Medium-2, Low-1

Course Title	**UNIVERSAL HUMAN VALUES II - UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**	**Semester**	05
Course Code	MVJ20UHV510	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	2(L:T:P :: 16:14:0)	**Total**	100
Credits	2	**Exam. Duration**	3 Hrs.

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

- Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Prerequisites: *Universal Human Values I*

Module-1	**L1,L2**	**6 Hrs**

Review on Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario,

Value Education: Understanding Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, , Method to Fulfill the Basic Human Aspirations,

Practical Sessions: Sharing about Oneself (Tutorial 1), Exploring Human Consciousness (Tutorial 2), Exploring Natural Acceptance (Tutorial 3)

Video link:

- https://www.youtube.com/watch?v=85XCw8SU084
- https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3p Z3yA7g_OAQz
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-2	**L1,L2**	**6 Hrs**

Review on Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.

Harmony in the Human Being: Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self, Programme to ensure self-regulation and Health.

Practical Sessions: Exploring the difference of Needs of Self and Body (Tutorial 4), Exploring Sources of Imagination in the Self (Tutorial 5), Exploring Harmony of Self with the Body (Tutorial 6).

Video link:

- https://www.youtube.com/watch?v=GpuZo495F24
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-3	**L1,L2**	**6 Hrs**

Review on Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.

Harmony in the Family and Society: Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Vision for the Universal Human Order,

Practical Sessions: Exploring the Feeling of Trust (Tutorial 7), Exploring the Feeling of Respect (Tutorial 8), Exploring Systems to fulfill Human Goal (Tutorial 9).

Video link:

- https://www.youtube.com/watch?v=F2KVW4WNnS8
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-4	**L1,L2**	**6 Hrs**

Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Practical Sessions: Exploring the Four Orders of Nature (Tutorial 10), Exploring Co-existence in Existence (Tutorial 11).

Video link:

- https://www.youtube.com/watch?v=1HR-QB2mCF0
- https://www.youtube.com/watch?v=lfN8q0xUSpw
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Module-5	**L1,L2**	**6 Hrs**

Review on Natural Acceptance of Human Values,Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies.

Implications of the Holistic Understanding – a Look at Professional Ethics: Definitiveness of (Ethical) Human Conduct, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession

Practical Sessions: Exploring Ethical Human Conduct (Tutorial 12), Exploring Humanistic Models in Education (Tutorial 13), Exploring Steps of Transition towards Universal Human Order (Tutorial 14).

Video link:

- https://www.youtube.com/watch?v=BikdYub6RY0
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Course Outcomes: On completion of the course, students would be able to

CO1	Explore themselves, get comfortable with each other and with the teacher
CO2	Enlist their desires and the desires are not vague.
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
CO5	Present sustainable solutions to the problems in society and nature

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

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

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

High-3, Medium-2, Low-1

VI SEMESTER

Course Title	**FOUNDATIONS OF DATA SCIENCE**	**Semester**	06
Course Code	MVJ20AM61	**CIE**	50

Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5 (L : T : P :: 3 : 2 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- To provide strong foundation for data science and application area related to information technology and understand the underlying core concepts and emerging technologies in data science.

Module-1	**L1, L2, L3,L4**	**Hours 10**

INTRODUCTION TO DATA SCIENCE:Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist? - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

Video Links : https://www.youtube.com/watch?v=KMj49syT8JM&list=PLyqSpQzTE6M-sBjDcT21Gpnj8grR2fDgc

Module-2	**L1,L2,L3**	**Hours 10**

BIG DATA: Problems when handling large data – General techniques for handling large data – Case study – Steps in big data – Distributing data storage and processing with Frameworks – Case study.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-3	**L2,L3,L4**	**Hours 10**

MACHINE LEARNING: Machine learning – Modeling Process – Training model – Validating model – Predicting new observations –Supervised learning algorithms – Unsupervised learning algorithms.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-4	**L2,L3,L4**	**Hours 10**

DEEP LEARNING: Introduction – Deep Feed forward Networks – Regularization – Optimization of Deep Learning – Convolutional Networks – Recurrent and Recursive Nets – Applications of Deep Learning.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-5	**L2,L3,L4**	**Hours 10**

DATA VISUALIZATION :Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools – Creating an interactive dashboard with dc.js-summary.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Course outcomes:

CO1	Explore the fundamental concepts of data science.
CO2	Understand data analysis techniques for applications handling large data

CO3	Understand various machine learning algorithms used in data science process
CO4	Visualize and present the inference using various tools
CO5	Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making

Text Books:	
1	Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016
2	An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
3	Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 1st edition, 2016
4	Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O' Reilly, 1st edition, 2018

Reference Books:	
1	Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015
2	Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O'Reilly, 1st edition, 2013
3	Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**Internet of Things**	**Semester**	06
Course Code	MVJ20AM62	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5 (L : T : P :: 3 : 2 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Understand the basic concepts of IoT and device connectivity.
- Acquire knowledge in Real time data logging and data analytics on cloud.
- Explore the potential areas utilizing embedded controllers/processors in real time systems.

Module-1	L1, L2,	Hours 10
INTRODUCTION TO IOT: Introduction - User Experience design for IoT - Technology of Connected Devices - Networks : Technology of connectivity - Security and Privacy Issues **Video Links :** https://nptel.ac.in/courses/106/105/106105166/		
Module-2	**L2,L3,L4**	**Hours 10**
SMART HOME : Automating the Home - Smart Steps to Smart Home - Components for Smart Home - Smart Network - Controlling Smart Homes - Interfacing ESP8266 and Relay board - Blynk App - Arduino and libraries installation - IFTTT Applet - Case Study : Smarter Sensing with smart monitors - Smarter Protection with smart security systems - Smarter heating and cooling with smart thermostat. **Video Links:** https://www.youtube.com/watch?v=SuzRufz4hQo		
Module-3	**L1,L2,L3,L4**	**Hours 10**
WEARABLE TECH : Wearables: Fundamentals, Advancement and roadmap for future - Smart Watches, Fitness Trackers, Smart Eyewear - wearable bio and chemical sensors - wearable inertial sensors and applications - Architecture & pin diagram for Arduino - Interacting with Analog & Digital sensors - Dealing with personal data - Monitoring sensor data from cloud platform - Controlling actuator from IoT Cloud platform - Case Study : application of optical heart rate monitoring - wearable IoT enabled real time Health monitoring system. **Video Links:** https://nptel.ac.in/courses/106/105/106105166/		
Module-4	**L1,L2,L3,L4**	**Hours 10**
HEALTH CARE: Internet of Medical Things - Smart Medical Devices and Monitoring - Smart Hospitals - Smart Medical records - Insight to Raspberry Pi and Preparing Raspberry Pi board - GPIO Configuration - Programming Raspberry Pi, Internal & External representation of sensor data - parsing sensor data on import - displaying measured information on IoT Cloud platform - Controlling actuator from IoT Cloud platform - Triggering event notification - CoAP Communication - Other Communications - Case Study : Patient Record in Mobile App. **Video Links**: https://www.youtube.com/watch?v=UvQFH5RGOnU		
Module-5	**L1,L2,L3,L4**	**Hours 10**
SMART FARMING :Agricultural Internet of Things - Environmental and climatic change - Role of Arduino and Node MCU in agricultural field - interfacing with external devices - development of local web server for automation - labview / Matlab based data logger for agricultural field parameters monitoring system - Case study : Smart control for site specific management of fixed irrigation system - scilab based data logger for plant protection from fire in agriculture field - smart greenhouse monitoring system for flower plant growth. **Video Links**:https://www.youtube.com/watch?v=hAk3wwV27vg		

Course outcomes:	
CO1	Interface I/O devices, sensors & communication modules
CO2	Examine remote data and control devices
CO3	Compare the connectivity technologies and protocols in IOT
CO4	Infer Security issues in IOT
CO5	Develop real life IoT based projects

Text Books:	
1	Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are changing the world", 2015, ISBN-13 : 978-0789754004.
2	Edward Sazonov, Michael R. Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", Academic Press/Elsevier, 2014, ISBN 978-0124186620.
3	Claire Rowland, Elizabeth Goodman, Martin Chalier, Ann Light, Alfred Lui, "Designing Connected Products: UX for the Consumer Internet of Things", O'Reilly Media, Inc, 2015, ISBN 978-1449372569.
4	Rajesh Singh, Anita Gehlot, Bhupendra Singh & Sushabhan Choudhury, "Internet of Things (IoT) Enabled Automation in Agriculture",2018, ISBN : 9789387973053.

Reference Books:	
1	Perry Lea, "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing Limited, January 2018, ISBN-13 : 978-1788470599
2	Marco Schwartz, "Internet of Things with ESP8266", Packt Publishing Ltd, 2016, ISBN-13 : 978-1786468024.
3	Cuno Pfister , "Getting Started with the Internet of Things", Shroff; First edition-2015, ISBN-13 : 978-9350234136.

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

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

High-3, Medium-2, Low-1

Course Title	**Quantum Computing**	**Semester**	06
Course Code	MVJ20AM631	**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 understand the building blocks of a quantum computer.
- To understand the principles, quantum information and limitation of quantum operations formalizing
- To understand the quantum error and its correction.

Module-1	**L1, L2,**	**Hours 8**

FUNDAMENTAL CONCEPTS: Global Perspectives, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum Information, Postulates of Quantum Mechanisms. **Video Links :** https://www.youtube.com/watch?v=3yoyVCAQH4M		
Module-2	**L2,L3,L4**	**Hours 8**
QUANTUM COMPUTATION : Quantum Circuits – Quantum algorithms, Single Orbit operations, Control Operations, Measurement, Universal Quantum Gates, Simulation of Quantum Systems, Quantum Fourier transform, Phase estimation, Applications, Quantum search algorithms – Quantum counting – Speeding up the solution of NP – complete problems – Quantum Search for an unstructured database. **Video Links:** https://www.youtube.com/watch?v=OlatlIaqPj8		
Module-3	**L1,L2,L3,L4**	**Hours 8**
QUANTUM COMPUTERS : Guiding Principles, Conditions for Quantum Computation, Harmonic Oscillator Quantum Computer, Optical Photon Quantum Computer – Optical cavity Quantum electrodynamics, Ion traps, Nuclear Magnetic resonance. **Video Links:** https://www.youtube.com/watch?v=Nq4YZtINNAQ		
Module-4	**L1,L2,L3,L4**	**Hours 8**
QUANTUM INFORMATIONS: Quantum noise and Quantum Operations – Classical Noise and Markov Processes, Quantum Operations, Examples of Quantum noise and Quantum Operations – Applications of Quantum operations, Limitations of the Quantum operations formalism, Distance Measures for Quantum information. **Video Links**: https://nptel.ac.in/courses/115/101/115101092/		
Module-5	**L1,L2,L3,L4**	**Hours 8**
QUANTUM ERROR CORRECTION :Introduction, Shor code, Theory of Quantum Error –Correction, Constructing Quantum Codes, Stabilizer codes, Fault – Tolerant Quantum Computation, Entropy and information – Shannon Entropy, Basic properties of Entropy, Von Neumann, Strong Sub Additivity, Data Compression, Entanglement as a physical resource. **Video Links**:https://www.digimat.in/nptel/courses/video/115101092/L23.html		

Course outcomes:

CO1	Define and explain basic concepts in Quantum computing.
CO2	Demonstrate applications of Quantum computing.
CO3	Explain principles in the design of Quantum Computers
CO4	Discuss applications and limitations of Quantum operations
CO5	Explain theory and concepts in Quantum error correction.

Text Books:

1	Micheal A. Nielsen and Issac L. Chiang, "Quantum Computation and Quantum Information", Cambridge University Press, Fint South Asian Edition, 2002
2	Bennett C.H., Bernstein E., Brassard G., Vazirani U., The strengths and weaknesses of quantum computation. SIAM Journal on Computing.

Reference Books:	
1	Mika Hiravensalo, "Quantum computing" II edition, ACM computing classification, Springer- 2004
2	Nayak, Chetan; Simon, Steven; Stern, Ady; Das Sarma, Sankar, "Nonabelian Anyons and Quantum Computation", 2008.
3	Clarke, John; Wilhelm, Frank, "Superconducting quantum bits", 2008.
4	William M Kaminsky, "Scalable Superconducting Architecture for Adiabatic Quantum Computation", 2004.

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

CO4	3	3	2	3	2	-	-	-	-	-	-	2	3	-
CO5	3	3	2	3	3	-	-	-	-	-	-	2	3	1

High-3, Medium-2, Low-1

Course Title	**CLOUD COMPUTING**	**Semester**	06
Course Code	MVJ20AM632	**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***

- Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
- Introduce the basic ideas and principles in data center design; cloud management techniques

and cloud software deployment considerations;

- Discuss 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);
- Introduce cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;
- Discuss the variety of programming models and develop working experience in several of them.

Module-1	L1,L2 , L3	**Hours 8**

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. Introduction to big data analytics, using MapReduce/Hadoop for analyzing unstructured data, Hadoop ecosystem of tools.

Applications:

Microsoft Azure, Amazon Web Services

Video link / Additional online information :

- https://www.youtube.com/watch?v=PW-V-72MJNY

Module-2	L2 , L3	**Hours 8**

'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)

Video link / Additional online information :

- https://www.youtube.com/watch?v=ifZh5SJAujA

Module-3	L2, L3, L4	**Hours 8**

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

Video link / Additional online information :

- https://www.youtube.com/watch?v=7m3f-P-WWbg

Module-4	L3,L4 , L6	**Hours 8**

Platform and Software as a Service: Technologies and Tools for Cloud Computing- Aneka Cloud Platform- Aneka Resource Provisioning Service- Hybrid Cloud Implementation - CometCloud Architecture- Autonomic Behavior of CometCloud- Overview of CometCloud-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

Video link / Additional online information :

- https://www.youtube.com/watch?v=3KJjKY8k9Lk

Module-5	L4, L5, L6	**Hours 8**

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

Video link / Additional online information :

- https://www.youtube.com/watch?v=uj2Sb7b_Do0

Course Outcomes:

CO1	Recall the recent history of cloud computing, illustrating its motivation and evolution.

CO2	List some of 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	Define SLAs and SLOs and illustrate their importance in Cloud Computing.
CO5	List some of the common cloud providers and their associated cloud stacks and recall popular cloud use case scenarios.

Text 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.

Reference Books:	
1	Barrie Sosinsky, "Cloud Computing Bible", John Wiley & Sons, 2010.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly, 2009.

CO-PO/PSO Mapping

CIE Assessment:

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

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

High-3, Medium-2, Low-1

Course Title	**Introduction to Drones**	**Semester**	06
Course Code	MVJ20AM633	**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 make the students to understand the basic concepts of UAV systems design.

Module-1	**L1, L2, L3**	**Hours 8**
INTRODUCTION TO UAV: History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications. **Video Links :** https://www.digimat.in/nptel/courses/video/101104073/L01.html		
Module-2	**L2,L3,L4**	**Hours 8**
THE DESIGN OF UAV SYSTEMS : Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA		

and Europe- Design for Stealth--control surfaces-specifications. **Video Links:** https://www.digimat.in/nptel/courses/video/101104083/L01.html		
Module-3	**L1,L2,L3,L4**	**Hours 8**
AVIONICS HARDWARE : Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply- processor, integration, installation, configuration, and testing. **Video Links:** https://nptel.ac.in/courses/101/104/101104083/		
Module-4	**L1,L2,L3,L4**	**Hours 8**
COMMUNICATION PAYLOADS AND CONTROLS: Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting. **Video Links**: https://nptel.ac.in/courses/101/108/101108047/		
Module-5	**L1,L2,L3,L4**	**Hours 8**
THE DEVELOPMENT OF UAV SYSTEMS :Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs. **Video Links**:https://nptel.ac.in/courses/101/104/101104073/		

Course outcomes:	
CO1	Ability to design UAV system
CO2	Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3	Perform system testing for unmanned aerial vehicles
CO4	Integrate various systems of unmanned aerial vehicle.
CO5	Design micro aerial vehicle systems by considering practical limitations.

Text Books:	
1	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998
2	Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

Reference Books:	
1	Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001
2	Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007
3	Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

CIE Assessment:

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- 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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**SOCIAL NETWORK ANALYSIS**	**Semester**	06
Course Code	MVJ20AM634	**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***

- Develop the skills of Social Network Concepts and Techniques
- Represent and process Network Relations
- Familiarize with Web based Social Network Applications

Module-1	L1,L2, L3	**Hours 8**

INTRODUCTION: Analyzing the Social Web, A brief history of the Social Web, Websites discussed, Tools used.

NODES, EDGES AND NETWORK MEASURES: Basics of Network Structure, Representing Networks, Basic Network Structures and Properties.

NETWORK STRUCTURE AND MEASURES: Describing Nodes and Edges, Describing Networks

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

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod01lec05.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod01lec07.mp4

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod02lec19.mp4

Module-2	L1,L2, L3	**Hours 8**

NETWORK VISUALIZATION: Layouts, Visualizing Network features**. TIE STRENGTH**:

The role of Tie Strength, Measuring Tie Strength, Tie Strength and Network Structure, Tie Strength and Network Propagation

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

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod03lec30.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod03lec31.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod04lec40.mp4

Module-3	L1,L2 ,L3	**Hours 8**

ENTITY RESOLUTION AND LINK PREDICTION: Link Prediction, Entity Resolution, Link Prediction: Case Study – Friend Recommendation.

COMMUNITY DISCOVERY IN SOCIAL NETWORKS: Introduction to Community Discovery, Communities in Context, Quality Functions, The Kernighan-Lin algorithm, Agglomerative/Divisive Algorithms,

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

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod06lec79.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod06lec80.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod06lec81.mp4

Module-4	L1,L2 ,L3	**Hours 8**

COMMUNITY DISCOVERY IN SOCIAL NETWORKS (CONTD): Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering, Other Approaches.

MODELS AND ALGORITHMS FOR SOCIAL INFLUENCE ANALYSIS: Introduction to Social Influence, Influence Related Statistics, Social Similarity and Influence, Homophily, Existential Test for Social Influence, Influence and Actions, Influence and Interaction, Influence Maximization in Viral Marketing, Other Applications.

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

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod05lec70.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod05lec71.mp4

Module-5	L1,L2 ,L3	**Hours 8**

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation -Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced

representations.

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

- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod10lec133.mp4
- https://nptel.ac.in/content/storage2/106/106/106106169/MP4/mod12lec152.mp4

Course Outcomes:	
CO1	Understand and visualize the basic concepts of network structure and representation of Social Network Analysis
CO2	Analyze the Social Network structure and its visualize them in the form of layouts
CO3	Apply the Social Network Concepts in solving problems related to social, personal, business and international levels
CO4	Understand and Implement the algorithm for discovering communities in Social Networks
CO5	Understand the algorithm and models for social influence analysis

Text Books:	
1	Jennifer Goldbeck, "Analyzing the Social Web", Morgan Kaufmann Publications, 2013
2	Charu C. Aggarwal, "Social Network Data Analytics", Springer Publications, 2011

Reference Books:	
1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	Borko Furht, Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

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 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**ETHICAL HACKING**	**Semester**	06
Course Code	MVJ20AM641	**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***

- Understand Ethical Hacking.
- Identify how intruders escalate privileges and what steps can be taken to secure a system.
- Introduce and demonstrate hacking tools for penetration testing purposes only.

Module-1	L1,L2 ,L3	**Hours 8**

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.

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

- https://www.youtube.com/watch?v=a1xQq60EtJc

Module-2	L2,L3	**Hours 8**

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 A 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.

Applications: Understand the network protocols and port scanning techniques using Kali linux

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

- https://www.digimat.in/nptel/courses/video/106106178/L34.html

Module-3	L2,L3,L4	**Hours 8**

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

Applications:Familiarizing with different types of attacks such as sniffing, spoofing etc

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

- https://nptel.ac.in/courses/106/106/106106199/

Module-4	L3,L4,L6	**Hours 8**

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

Applications: Exploiting buffer overflow vulnerabilities

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

- https://www.youtube.com/watch?v=9dd3M2a4LKI

Module-5	L2	**Hours 8**

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.

Applications: Understand the protection mechanism to prevent against various server attacks.

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

- https://nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/

Course Outcomes:

CO1	Understand the Ethics Of Ethical Hacking.
CO2	Identify the Social Engineering Attacks.
CO3	Recognize and Detect Types of Attacks.
CO4	Manage Instrumented Fuzzying Tools and Techniques.

CO5	Collect Malware and Initial Analysis.

Text Books:	
1	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, Terron Williams, —Gray Hat Hacking The Ethical Hackers Handbook‖, 3rd Edition, 2011

Reference Books:	
1	Sharma Pankaj, —Hacking‖, APH Publishing, 2005
2	Rajat Khare, —Network Security and Ethical Hacking‖, Luniver Press, 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:

i. 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**CYBER SECURITY**	**Semester**	06
Course Code	MVJ20AM642	**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***

- Understand Ethical Hacking.
- Understand Preventing, monitoring, and responding to data breaches and cyber-attacks.
- Learn the key components of cyber security network architecture.
- Analyze cyber security architecture principles.

Module-1	L2 ,L3	**Hours 8**

A web security forensic lesson, web languages, introduction to different web attacks, overview of n-tier web applications; Web servers: Apache, IIS, database servers, introduction and overview of cybercrime, nature and scope of cybercrime, types of cybercrime: social engineering, categories of cybercrime, property cybercrime.

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

- https://nptel.ac.in/courses/106/106/106106129/

Module-2	L2,L3	**Hours 8**

Public key cryptography, RSA, online shopping, payment gateways, unauthorized access to computers, computer intrusions, white collar crimes, viruses and malicious code, internet hacking and cracking, virus attacks, pornography, software piracy, intellectual property, mail bombs, exploitation, stalking and obscenity in internet, digital laws and legislation, law enforcement roles and responses.

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

• https://www.youtube.com/watch?v=6qdmriq2tWA		
Module-3	L2,L3,L4	**Hours 8**
Web hacking basics HTTP and HTTPS URL, web under the cover overview of java security reading the HTML source, applet security, servlets security, symmetric and asymmetric encryptions, network security basics, firewalls and IDS. Investigation: Introduction to cybercrime investigation, investigation tools, e-discovery, digital evidence collection, evidence preservation, e-mail investigation, e-mail tracking, IP tracking, e-mail recovery, hands on case studies; Encryption and Decryption methods, search and seizure of computers, recovering deleted evidences, password cracking **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106/105/106105217/		
Module-4	L3,L4	**Hours 8**
Digital certificates, hashing, message digest, and digital signatures; Digital forensics: Introduction to digital forensics, forensic software and hardware, analysis and advanced tools, forensic technology and practices, forensic ballistics and photography, face, iris and fingerprint recognition, audio video analysis, windows system forensics, Linux system forensics, network forensics. **Video link / Additional online information (related to module if any):** • https://www.digimat.in/nptel/courses/video/106106178/L05.html		
Module-5	L2	**Hours 8**
Basics, secure JDBC, securing large applications, cyber graffiti; Laws and acts: Laws and ethics, digital evidence controls, evidence handling procedures, basics of Indian Evidence Act IPC and CrPC, electronic communication privacy act, legal policies. **Video link / Additional online information (related to module if any):** • https://www.youtube.com/watch?v=F7mH5vz1qEI		

Course Outcomes:	
CO1	Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.
CO2	Design, develop, test and evaluate secure software.
CO3	Develop policies and procedures to manage enterprise security risks.
CO4	Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.
CO5	Assess cyber-security risk management policies in order to adequately protect an organization

Text Books:	
1	Mc Clure, Stuart, Saumil Shah, Shreeraj Shah, —Web Hacking: Attacks and Defense‖,

	AddisonWesley Professional, Illustrated Edition, 2003.
2	Garms, Jess, Daniel Somerfield, —Professional Java Security‖, WroxPress, Illustrated Edition, 2001.

Reference Books:	
1	Nelson Phillips, EnfingerSteuart, —Computer Forensics and Investigations‖, Cengage Learning, New Delhi,2009.
2	Kevin Mandia, Chris Prosise, Matt Pepe, —Incident Response and Computer Forensics —, Tata McGraw Hill,2009
3	Robert M Slade, —Software Forensics‖, Tata McGraw Hill, New Delhi, 1st Edition,2005.

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**GREEN COMPUTING**	**Semester**	06
Course Code	MVJ20AM643	**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***

- Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
- Skill in energy saving practices in their use of hardware.
- Examine technology tools that can reduce paper waste and carbon footprint by user and to understand how to minimize equipment disposal requirements

Module-1	L1,L2, L3	**Hours 8**

FUNDAMENTALS: Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

Real Time Applications: how they keep data safe while in transit

Video link / Additional online information:

- https://nptel.ac.in/courses/106/104/106104182/
- https://www.youtube.com/watch?v=350Rb2sOc3U

Module-2	L1,L2, L3	**Hours 8**

GREEN ASSETS AND MODELING : Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

Real Time Applications: climate-smart agriculture, land restoration, groundwater management, ecosystem-based adaptation

Video link / Additional online information:

- https://nptel.ac.in/courses/110/107/110107128/
- https://nptel.ac.in/courses/110/107/110107093/

Module-3	L1,L2, L3	**Hours 8**
GRID FRAMEWORK : Virtualizing of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework. **Real Time Applications:** ChessBrain **Video link / Additional online information:** • https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee42/ • https://onlinecourses.nptel.ac.in/noc19_ee64/preview		
Module-4	L1,L2, L3	**Hours 8**
GREEN COMPLIANCE : Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future. **Real Time Applications:** Addressing Inconsistent Date Formats, Reducing False Positives in PEP Screening, Integrating Screening with Credit Card Approval Processes. **Video link / Additional online information:** • https://onlinecourses.nptel.ac.in/noc19_ee64/preview		
Module-5	L1,L2, L3	**Hours 8**
CASE STUDIES : The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector. **Real Time Applications:** The energy consumption in Torrent systems with malicious content, The use of thin client instead of desktop PC **Video link / Additional online information:** • https://nptel.ac.in/courses/106/105/106105195/ • https://nptel.ac.in/courses/106/104/106104182/		

Course Outcomes:	
CO1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
CO2	Enhance the skill in energy saving practices in their use of hardware.
CO3	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.
CO4	Understand the ways to minimize equipment disposal requirements.
CO5	Carry out multiple real time case studies.

Text Books:	
1	Bhuvan Unhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, June 2011
2	Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August 2009.

Reference Books:	
1	Bhuvan Unhelkar, Green IT Strategies and Applications-Using Environmental Intelligence, CRC Press, June 2014.
2	Woody Leonhard, Katherine Murray, Green Home computing for dummies, August 2012.
3	Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shoff/IBM rebook, 2011.
4	Carl speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.
5	Wu Chun Feng (editor), "Green computing: Large Scale energy efficiency", CRC Press, 2012.

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

CO-PO/PSO Mapping

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

CO4	3	2	3	-	-	-	-	-	-	2	3	2	2	-
CO5	3	2	3	-	-	-	-	-	-	2	3	2	1	2

High-3, Medium-2, Low-1

Course Title	**COMPUTER VISION**	**Semester**	06
Course Code	MVJ20AM644	**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***

- Focuses on development of algorithms and techniques to analyze and interpret the visible world around us.
- Understand the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.
- Explore the applications ranging from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

Module-1	L1,L2, L3	**Hours 8**

DIGITAL IMAGE FORMATION AND LOW-LEVEL PROCESSING

Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing

Video link / Additional online information:

- https://www.youtube.com/watch?v=CVV0TvNK6pk

Module-2	L1,L2, L3	**Hours 8**

DEPTH ESTIMATION AND MULTI-CAMERA VIEWS

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Video link / Additional online information:

- http://www.cse.iitm.ac.in/~vplab/computer_vision.html

Module-3	L1,L2, L3	**Hours 8**

FEATURE EXTRACTION

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Video link / Additional online information:

- https://nptel.ac.in/courses/106/106/106106046/

Module-4	L1,L2, L3	**Hours 8**
IMAGE SEGMENTATION Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection. **Video link / Additional online information:** • https://nptel.ac.in/courses/117/105/117105079/		
Module-5	L1,L2, L3	**Hours 8**
PATTERN ANALYSIS Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods. **Video link / Additional online information:** • https://www.youtube.com/watch?v=mfePdDh9t6Q		

Course Outcomes:	
CO1	Understand the concepts of Digital Image Processing.
CO2	Analyse Homography and stereopsis.
CO3	Analyse Edges and Hough Transforms.
CO4	Demonstrate the ideas of image Segmentation.
CO5	Implement the concepts of Pattern Analysis.

Text Books:	
1	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

Reference Books:	
1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3	R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
4	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

CIE Assessment:

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- 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 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.

ii. 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.

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

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	-	-	-	-	-	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO3	1	-	-	1	1	-	2	3	3	3	3	-	3	2
CO4	3	3	2	2	2	-	-	-	-	-	-	3	-	1
CO5	3	3	3	3	3	2	-	-	3	3	3	3	-	2

High-3, Medium-2, Low-1

Course Title	ARTIFICIAL INTELLIGENCE	Semester	06
Course Code	MVJ20AM651	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***

- Learn the distinction between optimal reasoning Vs. human like reasoning.
- Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- Learn different knowledge representation techniques.

Module-1	L1,L2, L3	**Hours 8**

Problem Solving by Search-I: Introduction to AI, Intelligent Agents

Problem Solving by Search –II: Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces, Searching with Non-Deterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environment .

Video link / Additional online information:

- https://www.youtube.com/watch?v=fV2k2ivttL0

Module-2	L1,L2, L3	**Hours 8**

Problem Solving by Search-II and Propositional Logic

Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions.

Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Propositional Logic: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

Video link / Additional online information:

- https://www.youtube.com/watch?v=FQWTa3XjyWg

Module-3	L1,L2, L3	**Hours 8**

Logic and Knowledge Representation

First-Order Logic: Representation, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Knowledge Representation: Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information

Video link / Additional online information:

- https://www.youtube.com/watch?v=qVyX7Xwi45I

Module-4	L1,L2, L3	**Hours 8**

Planning

Classical Planning: Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

Video link / Additional online information:

- https://www.youtube.com/watch?v=RFdZMGJHrTc

Module-5	L1,L2, L3	**Hours 8**

Uncertain knowledge and Learning

Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use,

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory.

Learning: Forms of Learning, Supervised Learning, Learning Decision Trees. Knowledge in Learning: Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming

Video link / Additional online information:

- https://www.youtube.com/watch?v=yE8oCPmKX0I

Course Outcomes:

CO1	Ability to formulate an efficient problem space for a problem expressed in natural language.
CO2	Select a search algorithm for a problem and estimate its time and space complexities.

CO3	Possess the skill for representing knowledge using the appropriate technique for a given problem
CO4	Possess the ability to apply AI techniques to solve problems of game playing, and machine learning
CO5	Understand the applications of AI, namely game playing, theorem proving, and machine learning

Text Books:	
1	Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

Reference Books:	
1	Artificial Intelligence, 3rd Edn, E.Rich and K.Knight (TMH)
2	Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3	Artificial Intelligence, Shivani Goel, Pearson Education
4	Artificial Intelligence and Expert systems – Patterson, Pearson Education

CIE Assessment:

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

i. 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.

ii. 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.

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

CO-PO/PSO Mapping

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

CO4	3	3	2	2	2	-	-	-	-	-	-	3	-	1
CO5	3	3	3	3	3	2	-	-	3	3	3	3	-	2

High-3, Medium-2, Low-1

Course Title	**WEB TECHNOLOGIES**	**Semester**	06
Course Code	MVJ20AM652	**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***

- Understand different kind of Internet Technologies.
- Learn java-specific web services architecture

Module-1	L2, L3, L4	**Hours 8**

Fundamentals: A Brief Introduction to the Internet, The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol, Security, The Web Programmer's Toolbox.

Introduction to HTML/XHTML: Origins and Evolution of HTML and XHTML, Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5,Syntactic difference between HTML and XHTML

Video link / Additional online information:

- https://www.youtube.com/watch?v=QEtWL4lWlL4

Module-2	L2, L3, L4	**Hours 8**

Cascading Style Sheets: Introduction, Levels of Style Sheets, Selector Forms, PropertyValue Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background Images, The and Tags, Conflict Resolution.

The Basics of JavaScript: Object Orientation and JavaScript, General Syntactic Characteristics, Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, An Example, Constructors, Pattern Matching Using Regular Expressions, Another Example, Errors in Scripts.

Video link / Additional online information:

- http://www.digimat.in/nptel/courses/video/106106156/L10.html

Module-3	L2, L3, L4	**Hours 8**

JavaScript and HTML Documents: The JavaScript Execution Environment, The Document Object Model, Elements Access in JavaScript, Events and Event Handling, Handling Events from Body Elements, Handling Events from Button Elements, Handling Events from Text Box and Password Elements.

Dynamic Documents with JavaScript: Introduction, Positioning Elements, Moving Elements, Element Visibility, Changing Colors and Fonts, Dynamic Content, Stacking Elements, Locating the Mouse Cursor, Reacting to a Mouse Click, Slow Movement of Elements, Dragging and Dropping Elements.

Video link / Additional online information:

- https://www.youtube.com/watch?v=3uxp7mqUIfk

Module-4	L2, L3, L4	**Hours 8**

Introduction to XML: Introduction, The Syntax of XML, XML Document Structure, Document Type Definitions, Namespaces, XML Schemas, Displaying RAW XML Documents, Displaying XML Document with CSS, XSLT Style Sheets, XML Processors, Web Services. **Video link / Additional online information:** • https://www.youtube.com/watch?v=itRkLa2kq6w		
Module-5	L2, L3, L4	**Hours 8**
Introduction to PHP: Origins and Uses of PHP, Overview of PHP, General Syntactic Characteristics, Primitives, Operations, and Expressions, Output, Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking. **Video link / Additional online information:** • https://www.nptelvideos.com/php/php_video_tutorials.php		

Course Outcomes:	
CO1	Understand the World Wide Web and XHTML related tags
CO2	Describe visual design using CSS and logic design using JavaScript.
CO3	Describe dynamic documents using DOM with elements.
CO4	Recognize extended tags by XML.
CO5	Understand a server-side scripting language using PHP.

Text Books:	
1	Robert W. Sebesta : Programming the World Wide Web, Seventh Edition, Pearson Education, 2014

Reference Books:	
1	Deitel and Deitel and Nieto, —Internet and World Wide Web - How to Program‖, Prentice Hall, 5th Edition, 2011.
2	UttamK.Roy, —Web Technologies‖, Oxford University Press, 2011

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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**FOUNDATIONS OF DATA SCIENCE**	**Semester**	06
Course Code	MVJ20AM653	**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 provide strong foundation for data science and application area related to information technology and understand the underlying core concepts and emerging technologies in data science.

Module-1	**L1, L2, L3**	**Hours 8**

Introduction: Big Data and Data Science hype and getting past the hype Datacation. Current landscape of perspectives. Skill sets needed.Statistical Inference.Populations and samples. Statistical modeling, probability distributions, Introduction to R programming.

Video Links : https://www.youtube.com/watch?v=KMj49syT8JM&list=PLyqSpQzTE6M-sBjDcT21Gpnj8grR2fDgc

Module-2	**L1,L2,L3**	**Hours 8**

Exploratory Data Analysis and the Data Science Process. Basic tools (plots, graphs and summary statistics) of EDA. Philosophy of EDA. The Data Science Process. Case Study: Real Direct (online real estate) Three Basic Machine Learning Algorithms. Linear Regression, k-Nearest Neighbors (k-NN), k-means

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-3	**L2,L3,L4**	**Hours 8**

Feature Generation and Feature Selection (Extracting Meaning From Data). Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination). Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-4	**L2,L3,L4**	**Hours 8**

Recommendation Systems: Building a User-Facing Data Product. Algorithmic ingredients of a Recommendation Engine. Dimensionality Reduction. Singular Value Decomposition. - Principal Component Analysis.

Video Links: https://nptel.ac.in/courses/106/101/106101163/

Module-5	**L2,L3,L4**	**Hours 8**
Data Visualization.Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues. Discussions on privacy, security, ethics **Video Links**: https://nptel.ac.in/courses/106/101/106101163/		

Course outcomes:	
CO1	Understand the statistical foundations of data science
CO2	Learn techniques to pre-process raw data so as to enable further analysis.
CO3	Conduct exploratory data analysis and create insightful visualizations to identify patterns
CO4	Introduce machine learning algorithms for prediction/classification and to derive insights.
CO5	Analyze the degree of certainty of predictions using statistical test and models.

Text Books:	
1	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
2	Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
3	Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.

Reference Books:	
1	Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 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)

SEE Assessment:

i. 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.

ii. 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.

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

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

High-3, Medium-2, Low-1

Course Title	**PYTHON PROGRAMMING**	**Semester**	06

Course Code	MVJ20AM654	**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***

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.

Module-1	L1,L2, L3	**Hours 8**

Conceptual introduction: topics in computer science, algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system; installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages.

Video link / Additional online information:

- https://www.youtube.com/watch?v=Y3Ri2GdYfYg&list=PLqftY2uRk7oXvERQEgATSr-KzAh8WLW_D
- https://www.youtube.com/watch?v=TqPzwenhMj0
- https://www.youtube.com/watch?v=gzDPuWKjmGQ

Module-2	L1,L2, L3	**Hours 8**

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

Video link / Additional online information:

- https://www.youtube.com/watch?v=oSPMmeaiQ68
- https://www.youtube.com/watch?v=LoIe_9cTtPE
- https://www.youtube.com/watch?v=ixdr6V2vRC4

Module-3	L1,L2, L3	**Hours 8**

Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing

dictionaries. Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

Video link / Additional online information:

- https://www.youtube.com/watch?v=ISItwlnF0eU
- https://www.youtube.com/watch?v=mzx74TdGYbg
- https://www.youtube.com/watch?v=BL5bAt8fgvU

Module-4	L1,L2, L3	**Hours 8**

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block.

Video link / Additional online information :

- https://www.youtube.com/watch?v=wp9elxZzypg

Module-5	L1,L2, L3	**Hours 8**

Graphical user interfaces; event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

Video link / Additional online information :

- https://nptel.ac.in/courses/106/106/106106182/

Course Outcomes:

CO1	Understand core programming basics - including data types, control structures, algorithm development, and program design with functions - via the Python programming language.
CO2	Demonstrate the fundamental principles of Object-Oriented Programming, as well as in depth data and information processing techniques.
CO3	Implement Python Programs using core data structures like Lists, Dictionaries
CO4	Explore real-world software development challenges
CO5	Create practical and contemporary applications.

Text Books:

1	Fundamentals of Python: First Programs- Kenneth Lambert, Course Technology, Cengage Learning, 2012, ISBN-13: 978-1-111-82270-5

Reference Books:

1	Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O'Reilly Publication
2	How to Think Like a Scientist –Learning with Python ", Allen Downey, Jeffrey Elkner, Chris Meyers, Green Tea Press, 2002, First Edition.
3	Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002, First Edition.

4	Beginning Python –From Novice to Professional, - Magnus Lie Hetland, Second Edition, A Press Publication

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**DATA SCIENCE LABORATORY**	**Semester**	06
Course Code	MVJ20AML66	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100

Credits	2	Exam. Duration	3 Hours

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

- Develop the ability to build and assess data-based models.
- Develop relevant programming abilities.
- Apply Data science concepts to solve problems in real world context.

S No	Experiment Name	RBT Level	Hours
1	Introduction to R tool for data analytics science	**L3**	**3**
2	Basic Statistics and Visualization in R	**L3**	**3**
3	K-means Clustering using R Studio	**L3**	**3**
4	Use R Functions for Association Rule Models	**L3**	**3**
5	Use R Functions for Linear Regression(Ordinary Least Squares - OLS)	**L3**	**3**
6	Use R Graphics functions to visualize the results generated with Logistic Regression	**L3**	**3**
7	Use the ODBC Connection to the "Census" database to create a training data set for Naive Bayesian Classifier from the big data.	**L3**	**3**
8	Build a Decision Tree Model based on data whose schema is composed of attributes. Predict the outcome of one attribute based on the model.	**L3**	**3**
9	Simulate Principal component analysis	**L3**	**3**
10	Simulate Singular Value Decomposition	**L3**	**3**

Course Outcomes:

CO1	Understand basics of Data Visualization
CO2	Implement visualization of distributions
CO3	Write programs on visualization of time series, proportions & associations
CO4	Apply visualization on Trends and uncertainty

Reference Books:

1	Big Data Analytics with R and Hadoop by vignesh prajapati - 2013 Packet Publishing.
2	R and data mining: examples and case studies -yanchang zhao -2012 Elsevier.

CIE Assessment:
Regular Lab work :20 Record 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, v. Writeup : 20 marks vi. Conduction : 40 marks vii. Analysis of results : 20 marks viii. Viva : 20

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

High-3, Medium-2, Low-1

Course Title	**INTERNET OF THINGS LABORATORY**	**Semester**	06
Course Code	MVJ20AML67	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Learn tools relevant to Embedded System and loT development.
- Develop simple applications using Arduino/Raspberry Pi/open platform.
- Design and develop IOT application for real world scenario.

S No	Experiment Name	RBT Level	Hours
1	Familiarization with Arduino/Raspberry Pi and perform necessary software installation.	**L3**	**3**
2	To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.	**L3**	**3**
3	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.	**L3**	**3**
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.	**L3**	**3**
5	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.	**L3**	**3**
6	To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.	**L3**	**3**
7	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.	**L3**	**3**
8	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth..	**L3**	**3**
9	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.	**L3**	**3**
10	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.	**L3**	**3**
11	To install MySQL database on Raspberry Pi and perform basic SQL queries.	**L3**	**3**
12	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.	**L3**	**3**

Course Outcomes:

CO1	Test and experiment different sensors for application development.

CO2	Develop IoT applications using Arduino/Raspberry Pi/open platform.
CO3	Explore deployment platforms for IoT applications.

Reference Books:	
1	Perry Lea, ”Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt Publishing Limited, January 2018, ISBN-13 : 978-1788470599.
2	Arshdeep Bahga and Vijay Madisetti, ”Internet of Things: A Hands on Approach” 2014.

CIE Assessment:
Regular Lab work :20 Record 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	3	3	-	-	-	-	-	-	2	-	1	2	-
CO2	2	3	3	-	-	-	-	-	-	2	-	1	1	3
CO3	2	3	3	-	-	-	-	-	-	2	-	1	1	2
CO4	2	3	3	-	-	-	-	-	-	2	-	1	1	1
CO5	2	3	3	-	-	-	-	-	-	2	-	1	1	3

High-3, Medium-2, Low-1

Course Title	**ARTIFICIAL INTELLIGENCE FOR ROBOTICS**	**Semester**	07
Course Code	MVJ20AM71	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5 (L : T : P :: 3 : 2 : 0)	**Total**	100
Credits	4	**Exam. Duration**	3 Hours

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

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and Machine learning.

Module-1	L1,L2 , L3	**Hours 10**

Introduction: Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

Problem Solving : Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic

Video link / Additional online information (related to module if any): https://www.youtube.com/watch?v=6hmIKIWBVSI

Module-2	L2 , L3	**Hours 10**

Planning: Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

Video link / Additional online information (related to module if any): https://www.youtube.com/watch?v=Mjr_V9KVo74

Module-3	L2,L3, L4	**Hours 10**

Reasoning: Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

Video link / Additional online information (related to module if any):https://www.youtube.com/watch?v=5K1to94YQtU

Module-4	L3,L4 , L6	**Hours 10**

Learning : Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.

Video link / Additional online information (related to module if any):https://www.youtube.com/watch?v=pKeVMlkFpRc

Module-5	L4,L5 , L6	**Hours 10**

AI In Robotics : Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

Video link / Additional online information (related to module if any):https://www.youtube.com/watch?v=3C6ZLS-gfXU

Course Outcomes:

CO1	Identify appropriate AI methods to solve a given problem
CO2	Formalize a given problem in the language/framework of different AI methods.
CO3	Summarize the learning methods adopted in AI.
CO4	Design and perform an empirical evaluation of different algorithms on a problem formalization

CO5	Illustrate the applications of AI in Robotic Applications.

Text Books:	
1	Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India, 2016.
2	Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison Wesley, 2002

Reference Books:	
1	David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
2	Robin Murphy, Robin R. Murphy, Ronald C. Arkin, “Introduction to AI Robotics”, MIT Press, 2000.
3	Francis.X.Govers, “Artificial Intelligence for Robotics”, Packt Publishing, 2018.
4	Huimin Lu, Xing Lu, “Artificial Intelligence and Robotics”, Springer, 2017.
5	Michael Brady, Gerhardt, Davidson, “Robotics and Artificial Intelligence”, Springer, 2012.

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 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.

ii. 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.

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

CO-PO/PSO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	3	3	3	3		2	-	-	-	-	-	2	-
CO2	3	3	3	3	3		-	-	-	-	-	-	-	-
CO3	3	3	3	3	3		2	3	3	3	3	-	2	-
CO4	3	3	3	3	3		-	-	-	-	-	3	-	2
CO5	3	3	3	3	3		-	-	3	3	3	3	2	3

High-3, Medium-2, Low-1

Course Title	**NATURAL LANGUAGE PROCESSING**	**Semester**	07
Course Code	MVJ20AM72	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	5 (L : T : P :: 3 : 2 : 0)	**Total**	100
Credits	4	**Exam Duration**	3 Hours

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

- Acquaintance with natural language processing and learn how to apply basic algorithms in this field.
- Recognize the significance of pragmatics for natural language understanding.
- Capable of describing the application based on natural language processing and to show the

points of syntactic, semantic and pragmatic processing.		
Module-1	L1,L2,L3	**Hours 10**
Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance. **N-Gram Language Models:** N-grams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, The web and stupid Backoff, Advanced Perplexity's Relation to Entropy. **Video link** : https://nptel.ac.in/courses/106/105/106105158/		
Module-2	L2,L3	**Hours 10**
Parts of Speech Tagging: English Word Classes, The Penn Tree bank part of speech Tagset, Part of Speech tagging, HMM part of speech tagging, Maximum Entropy Markov Models, Bidirectionality, Part of Speech tagging for other languages **Video link** : https://nptel.ac.in/courses/106/105/106105158/		
Module-3	L2,L3	**Hours 10**
Formal Grammars of English: Constituency, Context Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars. Syntactic Parsing: Ambiguity, CYK Parsing, Partial parsing. **Video link** : https://www.youtube.com/watch?v=6b40kKe2SFg		
Module-4	L2,L4	**Hours 10**
Dependency Parsing: Dependency Relations, Formalisms, Treebank, Transition Based Dependency Parsing, Graph based dependency parsing, Evaluation. **Representation of Sentence Meaning:** Computational Desiderata for Representations, Model – Theoretic Semantics, First Order Logic, Event and State Representations, Description Logics **Video link** : https://www.coursera.org/lecture/human-language/pragmatics-E8VXH		
Module-5	L3, L4	**Hours 10**
Semantic Parsing : Information Extraction: Named Entity Recognition, Relation Extraction, Extracting Times, Events and their times, Template Filling. Lexicons for Sentiment, Affect and Connotation: Defining Emotion, Available Sentiment and Affect Lexicons, Creating affect lexicons by human labeling, semi supervised induction of affect lexicons, supervised learning of word sentiment, Using lexicons for Sentiment Recognition **Video link**: https://www.coursera.org/lecture/text-mining-analytics/5-6-how-to-do-sentiment-analysis-with-		

sentiwordnet-5RwtX	
Course Outcomes:	
CO1	Understand the concepts of morphology, syntax, semantics and pragmatics of the language.
CO2	Understand the elements and applications of Part-of-speech tagging
CO3	Understand approaches to syntax and semantics in NLP
CO4	Provide the student with knowledge of various levels of analysis involved in NLP
CO5	Building robust systems to perform linguistic tasks with technological applications

Text Books:	
1	Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:1999
Reference Books:	
1	Natural Language Processing using Python by Steven Bird, Ewan Klien, Edward Loper, 1 st edition, O Publications, 2009.
2	Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S.Tiwary

CIE Assessment:

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**HIGH PERFORMANCE COMPUTING**	**Semester**	07
Course Code	MVJ20AM731	**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***

- Improve the system performance
- Learn various distributed and parallel computing architecture
- Learn different computing technologies

Module-1	L1,L2	**Hours 8**
Grid Computing: Data & Computational Grids, Grid Architectures And Its Relations To Various Distributed Technologies. Autonomic Computing, Examples Of The Grid Computing Efforts (Ibm). **Video link** : https://www.youtube.com/watch?v=GlobK-eWDSo		
Module-2	L2,L3	**Hours 8**
Cluster Setup & Its Advantages, Performance Models & Simulations; Networking Protocols & I/O, Messaging Systems. Process Scheduling, Load Sharing And Balancing; Distributed Shared Memory, Parallel I/O. **Video link** : https://www.youtube.com/watch?v=9J4uXnSDias		
Module-3	L2,L3,L4	**Hours 8**
Example Cluster System – Beowlf; Cluster Operating Systems: Compas And Nanos Pervasive Computing Concepts & Scenarios; Hardware & Software; Human – Machine Interface. **Video link** : https://www.youtube.com/watch?v=GlobK-eWDSo		
Module-4	L3,L4	**Hours 8**
Device Connectivity; Java for Pervasive Devices; Application Examples **Video link** : https://www.youtube.com/watch?v=bS6XqjBO99Q		
Module-5	L2,L3	**Hours 8**
Classical Vs Quantum Logic Gates; One, Two & Three Qubit Quantum Gates; Fredkin & Toffoli Gates; Quantum Circuits; Quantum Algorithms. **Video link**: https://nptel.ac.in/courses/115/101/115101092/		

Course Outcomes:	
CO1	Understanding the concepts in grid computing
CO2	Ability to set up cluster and run parallel applications
CO3	Ability to understand the cluster projects and cluster OS
CO4	Understanding the concepts of pervasive computing
CO5	Understanding the concepts of quantum computing

Text Books:	
1	"Selected Topics In Advanced Computing" Edited By Dr. P. Padmanabham And Dr. M.B. Srinivas, Pearson Education.
Reference Books:	
1	J. Burkhardt et.al: 'pervasive computing' Pearson Education
2	Marivesar:' Approaching quantum computing', Pearson Education
3	Raj kumar Buyya:'High performance cluster computing', Pearson Education
4	Neilsen & Chung L:' Quantum computing and Quantum Information', Cambridge University Press.

CIE Assessment:

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- 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 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.

ii. 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.

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

5	A networking approach to Grid Computing, Minoli, Wiley

CO-PO/PSO Mapping

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

CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	-

High-3, Medium-2, Low-1

Course Title	**BIG DATA ANALYTICS**	**Semester**	07
Course Code	MVJ20AM732	**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 the optimized business decisions in solving complex real-world problems

Module-1	L1,L2	**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. **Video link** : https://www.digimat.in/nptel/courses/video/106104189/L01.html		
Module-2	L2,L3	**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	L2,L3	**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	L2,L3	**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 InputFormat, Reading Data with custom RecordReader,-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	L2,L3	**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 querying the bigdata 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

Text Books:	
1	Seema Acharya, Subhashini Chellappan,—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.

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- 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 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.

ii. 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.

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

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	-

High-3, Medium-2, Low-1

Course Title	**PERVASIVE COMPUTING**	**Semester**	07
Course Code	MVJ20AM733	**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***

- Understand an insight into future developments in the field of pervasive computing.
- Provide an in-depth knowledge on pervasive computing and wireless networking.
- Describe the variety of pervasive services and applications.

Module-1	L1,L2	**Hours 8**
Pervasive Computing : Evolution of Pervasive Computing - Decentralization continues - Applied Pervasive computing - Pervasive computing principles - Pervasive Information Technology - Smart Cards - Smart Labels. **Video link** : https://www.youtube.com/watch?v=bS6XqjBO99Q		
Module-2	L2,L3	**Hours 8**
Embedded Controls: Smart sensors and Actuators - Smart Appliances - Appliances and Home Networking -Automotive Computing. Operating Systems: Windows CE -Palm OS - Symbian EPOC - Java Card - Windows for Smart Cards. **Video link** : http://digimat.in/nptel/courses/video/108108147/L01.html		
Module-3	L2,L3	**Hours 8**
Middleware Components: Programming Consumer Devices - Smart Card Programming - Messaging Components - Database Components. Security: The importance of security -Cryptographic patterns and methods Cryptographic Tools-Secure socket layer **Video link** : https://www.digimat.in/nptel/courses/video/117108048/L01.html		
Module-4	L2,L3	**Hours 8**
Gateways, Device Management and Synchronization : Connectivity Gateway - Wireless Gateway - Transcoding - Residential Gateway - Architecture and components of Web Application Servers - Web Sphere Application Server Web Sphere Everyplace Suite - Oracle Portal-to-Go - Tasks of Device Management Systems - Tivoli Device Support Infrastructure - User Profiles and Directory Services - Synchronization - The Challenge of Synchronizing Data - Industry Data Synchronization Standards - Today's Synchronization Solution **Video link** : https://www.digimat.in/nptel/courses/video/106105183/L40.html		
Module-5	L2,L3	**Hours 8**
Portals and Access Services: Internet Portals-Wireless Portal - Broadcasting Portal - Home Services - Communication Services - Home Automation - Energy Services - Security Services - Remote Home Healthcare Services - Travel and Business Services - Consumer Services **Video link**: https://www.youtube.com/watch?v=oxMdDsud5vg		
Course Outcomes:		
CO1	Describe the principles of pervasive technology.	
CO2	Identify the functionalities of operating systems and middleware	

CO3	Analyze the device management and synchronization techniques.
CO4	Explain the various gateways
CO5	Choose the appropriate techniques to develop various pervasive applications.

Text Books:	
1	Asoke K Talukder, Roopa R Yavagal, "Mobile computing: Technology, Applications and Service Creation", Second Edition, Tata McGraw-Hill Publishing Company Limited, 2017, ISBN 978-0070144576
2	UweHansmann, LotharMerk, Martin S. Nicklous, Thomas Stober, "Pervasive Computing.Handbook",Second edition, Springer, 2003, ISBN 978-3-642-05525-6.
Reference Books:	
1	Asoke K Taukder, Roopa R Yavagal, "Mobile Computing", Second Edition, Tata McGraw Hill Pub Co., New Delhi, 2010, ISBN 9780070144576
2	MinyiGuo, Jingyu Zhou, Feilong Tang, Yao Shen, "Pervasive Computing: Concepts, Technologies and Applications", CRC Press,2016, ISBN 9781466596276.

CIE Assessment:

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- 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 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.

ii. 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.

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

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	-

High-3, Medium-2, Low-1

Course Title	**OPERATIONS AND SUPPLY CHAIN MANAGEMENT**	**Semester**	07
Course Code	MVJ20AM734	**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***		
• To provide an insight on the operations, quality management and sampling tools and fundamentals of supply chain networks, tools and techniques.		
Module-1	L1,L2	**Hours 8**
INTRODUCTION TO OPERATIONS AND SUPPLY CHAIN MANAGEMENT : Scope and Importance-		

Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles - The Operations Function - The Evolution of Operations and Supply Chain Management – Globalization - Productivity and Competitiveness - Strategy and Operations-Operational Decision-Making Tools: Decision Analysis-Decision Analysis with and without Probabilities **Video link** :https://www.digimat.in/nptel/courses/video/110106045/L01.html		
Module-2	L2,L3	**Hours 8**
QUALITY MANAGEMENT: Quality and Value in Athletic Shoes -What Is Quality-Quality Management System-Quality Tools Quality in Services-Six Sigma-Quality Costs and Productivity-Quality Awards-ISO 9000-Statistical Process Control-Operational Decision-Making Tools: Acceptance Samp **Video link** : https://www.youtube.com/watch?v=SMOQV2CyVQo		
Module-3	L2,L3	**Hours 8**
NETWORK DESIGN AND TRANSPORTATION: Factors influencing Distribution network design – Design options for Distribution Network-– factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation **Video link** : http://www.digimat.in/nptel/courses/video/106105183/L11.html		
Module-4	L2,L3	**Hours 8**
SOURCING AND COORDINATION : Role of sourcing supply chain - supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of coordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain **Video link** : https://www.youtube.com/watch?v=Nrl0CtS1m8Y		
Module-5	L2,L3	**Hours 8**
SUPPLY CHAIN AND INFORMATION TECHNOLOGY: The role IT in supply chain- The supply chain IT frame work - Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain. **Video link**: https://www.youtube.com/watch?v=AozkKon-krk		

Course Outcomes:	
CO1	To know about the operations and fundamentals of supply chain
CO2	To understand the quality management tools and sampling process

CO3	To understand the design factors and various design options of distribution networks in industries and the role of transportation and warehousing
CO4	To understand the various sourcing decisions in supply chain
CO5	To understand the supply chain management in IT industries

Text Books:	
1	Roberta S. Russell, Bernard W. Taylor, "Operations and Supply Chain Management, 10th Edition, Wiley Publications,2019
2	Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and Operation, Pearson Education, 2010.
Reference Books:	
1	Jeremy F.Shapiro, Modeling the Supply Chain, Thomson Duxbury, 2002.
2	Srinivasan G.S, Quantitative models in Operations and Supply Chain Management, PHI, 2010
3	David J.Bloomberg , Stephen Lemay and Joe B.Hanna, Logistics, PHI 2002
4	James B.Ayers, Handbook of Supply Chain Management, St.Lucle press, 2000
5	F. Robert Jacobs (Author), Richard B. Chase, Operations and Supply Chain Management McGraw Hill 2017

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

SEE Assessment:

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CO-PO/PSO Mapping

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CO2	2	2		-	-	-	-	-	-	-	-	-	2	2
CO3	2	3	2	2	-	-	-	-	-	-	-	-	1	3
CO4	1	2	3	-	-	-	-	-	-	-	-	-	1	2
CO5	1	2	2	2	-	-	-	-	-	-	-	-	2	-

High-3, Medium-2, Low-1

Course Title	**HEALTHCARE ANALYTICS**	**Semester**	07
Course Code	MVJ20AM741	**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***

- Understand the health data formats, health care policy and standards
- Learn the significance and need of data analysis and data visualization
- Understand the health data management frameworks
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care applications

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO HEALTHCARE ANALYSIS : Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

Video link :https://www.digimat.in/nptel/courses/video/110104095/L01.html

Module-2	L2,L3	**Hours 8**

ANALYTICS ON MACHINE LEARNING : Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

Video link :https://www.digimat.in/nptel/courses/video/106105152/L01.html

Module-3	L2,L3	**Hours 8**

HEALTH CARE MANAGEMENT: IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

Video link : https://www.digimat.in/nptel/courses/video/110104095/L41.html

Module-4	L2,L3	**Hours 8**

HEALTHCARE AND DEEP LEARNING : Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

Video link : https://www.youtube.com/watch?v=W3_yaf3HvHU

Module-5	L2,L3	**Hours 8**
CASE STUDIES: Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis. **Video link:** https://www.youtube.com/watch?v=UvQFH5RGOnU		

Course Outcomes:	
CO1	Use machine learning and deep learning algorithms for health data analysis
CO2	Apply the data management techniques for healthcare data
CO3	Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications
CO4	Design health data analytics for real time applications
CO5	Design emergency care system using health data analysis

Text Books:	
1	Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
Reference Books:	
1	Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
2	Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
3	Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
4	Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

CIE Assessment:

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- 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 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.

ii. 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.

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

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	-

High-3, Medium-2, Low-1

Course Title	HEALTHCARE ANALYTICS	Semester	07
Course Code	MVJ20AM741	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***

- Understand the health data formats, health care policy and standards
- Learn the significance and need of data analysis and data visualization
- Understand the health data management frameworks
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care applications

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO HEALTHCARE ANALYSIS : Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

Video link :https://www.digimat.in/nptel/courses/video/110104095/L01.html

Module-2	L2,L3	**Hours 8**

ANALYTICS ON MACHINE LEARNING : Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

Video link :https://www.digimat.in/nptel/courses/video/106105152/L01.html

Module-3	L2,L3	**Hours 8**

HEALTH CARE MANAGEMENT: IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

Video link : https://www.digimat.in/nptel/courses/video/110104095/L41.html

Module-4	L2,L3	**Hours 8**
HEALTHCARE AND DEEP LEARNING : Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System. **Video link** : https://www.youtube.com/watch?v=W3_yaf3HvHU		
Module-5	L2,L3	**Hours 8**
CASE STUDIES: Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis. **Video link:** https://www.youtube.com/watch?v=UvQFH5RGOnU		

Course Outcomes:	
CO1	Use machine learning and deep learning algorithms for health data analysis
CO2	Apply the data management techniques for healthcare data
CO3	Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications
CO4	Design health data analytics for real time applications
CO5	Design emergency care system using health data analysis

Text Books:	
1	Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
Reference Books:	
1	Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
2	Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
3	Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
4	Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

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 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.

ii. 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.

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

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	-

High-3, Medium-2, Low-1

Course Title	NEURAL COMPUTING IN AI	Semester	07
Course Code	MVJ20AM742	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***

- Provide the most comprehensive concept of neural networks in the engineering perspective.
- Understand the important design concepts of neural architectures in different applications.
- Understand the applications associated with many different areas like recommender systems, machine translation, and reinforcement-learning.
- Gain knowledge on methodologies underlying Neuro-Fuzzy and Soft Computing.

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO NEURAL NETWORK & LEARNING : Models of a Neuron – Neural Networks Viewed as Directed Graphs – Feedback – Network Architectures – Knowledge Representation – Artificial Intelligence and Neural Networks – Error-Correction Learning – Memory-Based Learning – Hebbian Learning – Competitive Learning – Boltzmann Learning.

Video link :

Module-2	L2,L3	**Hours 8**

PERCEPTRONS : Least-Mean-Square Algorithm – Perceptron – Perceptron Convergence Theorem – Back-Propagation Algorithm – XOR Problem – Output Representation and Decision Rule – Feature Detection – Regularization Networks – Generalized Radial-Basis Function Networks

Video link :

Module-3	L2,L3	**Hours 8**

SUPPORT VECTOR MACHINES & SELF-ORGANIZING MAP: Optimal Hyperplane for Linearly Separable Patterns - Optimal Hyperplane for non separable Patterns – How to build a support vector machine for Pattern Recognition – XOR Problem Revisited – Support Vector Machines for Nonlinear Regression – Self-Organizing Map – Properties of the Feature Map – Learning Vector Quantization – Hierarchical Vector Quantization – Contextual Maps.

Video link :

Module-4	L2,L3	**Hours 8**
FUZZY SYSTEMS : Utility of Fuzzy Systems – Limitations of Fuzzy Systems – Uncertainty and Information – Fuzzy Sets and Membership – Classical Sets – Fuzzy Sets – Crisp Relations – Fuzzy Relations – Tolerance and Equivalence Relations – Fuzzy Tolerance and Equivalence Relations – Value Assignments. **Video link :**		
Module-5	L2,L3	**Hours 8**
FUZZIFICATION & DEFUZZIFICATION: Features of the Membership Function – Fuzzification – Defuzzification to Crisp Sets – λ-Cuts for Fuzzy Relations – Defuzzification to Scalars – Logic and Fuzzy Systems. **Video link:**		

Course Outcomes:	
CO1	Understand the concept of neural networks.
CO2	Acquire knowledge on the aspects of learning process.
CO3	Apply the design concepts of neural architectures.
CO4	Implement the learning process associated with many different application areas
CO5	Design the methodologies for Neuro-Fuzzy and Soft Computing applications.

Text Books:	
1	Raul Rojas, Neural Networks: A Systematic Introduction, Springer Science & Business Media, 2013
2	Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3 rd Edition, John Wiley & Sons Ltd, 2010.
Reference Books:	
1	Alianna J. Maren, Craig T. Harston, Robert M. Pap, Handbook of Neural Computing Applications, Academic Press, 2014.
2	Robert Fuller, Introduction to Neuro-Fuzzy Systems, Springer Science & Business Media, 2013.
3	James J. Buckley, Esfandiar Eslami, An Introduction to Fuzzy Logic and Fuzzy Sets, Springer Science & Business Media, 2013.
4	Simon Haykin, Neural Networks – A Comprehensive Foundation, 2nd edition, Pearson Prentice Hall,

	2005.

CIE Assessment:

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- 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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

High-3, Medium-2, Low-1

Course Title	**VISION SYSTEMS AND ROBOTICS**	**Semester**	07
Course Code	MVJ20AM743	**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***

- Learn the basics of robotics.
- Understand the robot end effectors.
- Learn the techniques used in robot mechanics.
- Learn the fundamentals of machine vision systems and robot programming.

Module-1	L1,L2	**Hours 8**

BASICS OF ROBOTICS : Introduction- Basic components of robot-Laws of robotics- classification of robot-work space - accuracy resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives.

Video link :

Module-2	L2,L3	**Hours 8**

ROBOT END EFFECTORS : Robot End effectors: Introduction- types of End effectors- Tools as end effectors - Drive system for grippers - Mechanical gripper- types of gripper mechanism- gripper force analysis and gripper design - other types of gripper- special purpose grippers.

Video link :

Module-3	L2,L3	**Hours 8**

ROBOT MECHANICS : Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation.

Video link :

Module-4	L2,L3	**Hours 8**

MACHINE VISION FUNDAMENTALS : Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation-Thresholding- edge detection- binary morphology - grey morphology - Camera calibration – Stereo Reconstruction.

Video link :

Module-5	L2,L3	**Hours 8**

V ROBOT PROGRAMMING: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- VAL language commands- motion control, hand control, program control, pick and place applications - palletizing applications using VAL, Robot

welding application using VAL program- Rapid Language - basic commands Virtual robotics - VAL-II and AML – applications of robots **Video link:**	
Course Outcomes:	
CO1	Able to know the basics of robotics.
CO2	Able to understand the concepts of robot end effectors.
CO3	Obtain forward, reverse kinematics and dynamics model of the industrial robot arm
CO4	Develop the vision algorithms.
CO5	Understand the robot programming and applications of robots.

Text Books:	
1	Carsten Steger, Markus Ulrich, Christian Wiedemann, Machine Vision Algorithms and Applications, Second edition, Weinheim, WILEY-VCH, 2018
2	John J. Craig, Introduction to Robotics - Mechanics and Control, 3 rd Edition, Pearson Education Inc, 2013.
Reference Books:	
1	Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, Industrial Robotics Technology, Programming and Applications, Second edition, 2012.
2	S.R. DEB, S.DEB, Robotics Technology and Flexible Automation, 2 nd Edition, Tata McGraw Hill Education, 2011.
3	S.K. Saha, Introduction to Robotics, 4 th Edition, Tata McGraw Hill Education, 2011.
4	Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis, Oxford University Press, Sixth impression, 2010.

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- 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 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.

ii. 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.

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

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	3	2	-	-	-	-	-	-	-	-	1	3
CO4	2	2	1	-	-	-	-	-	-	-	-	-	1	2
CO5	3	1	2	2	-	-	-	-	-	-	-	1	2	-

High-3, Medium-2, Low-1

Course Title	**DEEP LEARNING TECHNIQUES**	**Semester**	07
Course Code	MVJ20AM744	**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***

- Learn 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

Module-1	L1,L2	**Hours 8**

DEEP NETWORKS : Machine Learning Basics: Learning Algorithms – Supervised and Unsupervised learning – Feed forward Deep networks – regularization – Optimization for training Deep models.

Video link : http://www.deeplearning.net

Module-2	L2,L3	**Hours 8**

CONVOLUTIONAL NETWORKS AND SEQUENCE MODELLING : Convolutional Networks – Convolution operation – Motivation Pooling – Basic Convolution function – Algorithms – Recurrent and recursive nets : Recurrent neural networks – Bidirectional RNN – Recursive Neural networks – Auto regressive networks – Long term dependencies – Temporal dependencies – Approximate search

Video link :www.cs.toronto.edu/~fritz/absps/imagenet.pdf

Module-3	L2,L3	**Hours 8**

PROBABILISTIC MODELS AND AUTO ENCODERS : Structured Probabilistic models : Challenges of unstructured modelling – using graphs to describe model structure – Learning about dependencies – inference – Deep learning approach – Monte carlo models – Linear Factor models and Auto encoders

Video link :https://www.youtube.com/watch?v=wPz3MPl5jvY

Module-4	L2,L3	**Hours 8**

DEEP GENERATIVE MODELS : Restricted Boltzmann Machines – Deep Belief networks – Deep Boltzmann machine – Convolutional Boltzmann machine

Video link :https://www.youtube.com/watch?v=W3_yaf3HvHU

Module-5	L2,L3	**Hours 8**
APPLICATIONS: Speech, Audio and Music processing – Language modelling and Natural language processing – information retrieval – object recognition and computer vision – Multi modal and multi task learning **Video link:** http://www.deeplearning.net		

Course Outcomes:	
CO1	Use feed forward deep networks
CO2	Apply convolutional networks and sequence modelling for problem solving
CO3	Use probabilistic models and auto encoders
CO4	Use deep generative models for problem solving
CO5	Apply the deep learning techniques

Text Books:	
1	Yoshua Bengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015
2	Li Deng, Dong Yu, "Deep Learning: Methods and Applications", now publishers, 2014
Reference Books:	
1	Special Issue on deep learning for speech and language processing, IEEE Transaction on Audio, Speech and Language Processing, vol. 18, iss. 5, 2010

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 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.

ii. 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.

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

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	3	2	-	-	-	-	-	-	-	-	1	3
CO4	2	2	1	-	-	-	-	-	-	-	-	-	1	2
CO5	3	1	2	2	-	-	-	-	-	-	-	1	2	-

High-3, Medium-2, Low-1

Course Title	INTERNET OF THINGS	Semester	07
Course Code	MVJ20AM751	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***

- Understand the fundamentals of IOT
- Learn about the basics of IOT Protocol
- Illustrate Mechanism and Key Technologies in IOT
- Explain the Standard of the IOT
- Learn about the IOT Platforms design Methodology and logical design of IOT system using Python
- Develop IOT applications using Raspberry Pi and apply Cloud services for IOT systems.

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO INTERNET OF THINGS: Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies, Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Internet of things application examples: Overview, Smart metering /Advanced metering infrastructure, ehealth/ Body area networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking.

Video link : https://nptel.ac.in/courses/106/105/106105166/

Module-2	L2,L3	**Hours 8**

FUNDAMENTAL IOT MECHANISM AND KEY TECHNOLOGIES: Identification of IOT objects and services, structural aspects of the IOT, Key IOT Technologies, Evolving IOT standards overview and approaches, IETF IPv6 routing protocol for RPL Roll, Constrained application protocol, Representational state transfer, ETSI M2M, Third generation partnership Project service requirement for machine type communication, CENE\EC, IETF IPv6 over lower power WPAN, Zigbee IP(ZIP), IPSO(IP in smart object).

Video link :https://www.digimat.in/nptel/courses/video/106105166/L02.html

Module-3	L2,L3	**Hours 8**

LAYER ½ CONNECTIVITY: Wireless technologies for the IOT, WPAN technologies for IOT/M2M, Cellular and mobile network technologies for IOT/M2M. Layer3 Connectivity, IPv6 technologies for the IOT: Overview and Motivations, Address Capabilities, IPv6 protocol Overview, IPv6 Tunelling, Ipsec in IPV6 Header Compression Schemes, Quality of service in IPv6, Migration Strategies to IPv6. **Video link** : https://www.youtube.com/watch?v=dxslf8jHlAo		
Module-4	L2,L3	**Hours 8**
IOT Platforms Design Methodology: Introduction, IOT design methodology, Case Study on IOT System for Weather Monitoring, Motivation for using Python, IOT Systems- Logical design using Python: Introduction, Python data types and data structures, Control flow, Functions, Modules, Packages, File handling, Date/Time Operations, Classes. **Video link :**https://www.digimat.in/nptel/courses/video/108108098/L01.html		
Module-5	L2,L3	**Hours 8**
IOT physical devices and Endpoints: What is an IOT device, Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces. Case Studies illustrating IOT design: Home Automation. **Video link:** https://www.youtube.com/watch?v=h0gWfVCSGQQ		

Course Outcomes:	
CO1	Understands the essentials of IOT
CO2	Analyze the Concept of Web services to access/control IOT devices
CO3	Examine the design methodology of IOT and logical design using Python
CO4	Develop a Portable IOT using Raspberry
CO5	Identify Physical devices required to deploy on IOT application and connect to the cloud for real time scenarios

Text Books:	
1	A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Internet of Things, Universities Press, 2015. , ISBN:978-81-7371-954-7.
2	Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications, Wiley, 2013 ISBN:9781118473474.
Reference Books:	

1	Michael Miller, The Internet of Things, First Edition, Pearson, 2015
2	Claire Rowland, Elizabeth Goodman et.al., Designing Connected Products, First Edition, O'Reilly, 2015
3	Michael McRoberts "Beginning Arduino" , Technology in action 2nd edition.

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

SEE Assessment:

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ii. 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.

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

CO-PO/PSO Mapping

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CO2	2	2	1	3	-	-	-	-	-	-	-	-	2	2
CO3	2	3	3	2	-	-	-	-	-	-	-	-	1	3
CO4	2	2	1	-	-	-	-	-	-	-	-	-	1	2
CO5	3	1	2	2	-	-	-	-	-	-	-	1	2	-

High-3, Medium-2, Low-1

Course Title	**CYBER FORENSICS**	**Semester**	07

Course Code	MVJ20AM752	**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***

- Learn computer forensics.
- Become familiar with forensics tools.
- Learn to analyze and validate forensics data

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO COMPUTER FORENSICS: Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

Video link : https://nptel.ac.in/courses/106/106/106106129/

Module-2	L2,L3	**Hours 8**

EVIDENCE COLLECTION AND FORENSICS TOOLS: Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

Video link :https://www.youtube.com/watch?v=2ESqwX3qb94

Module-3	L2,L3	**Hours 8**

ANALYSIS AND VALIDATION : Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.

Video link : https://www.youtube.com/watch?v=s01A-yqOby8

Module-4	L2,L3	**Hours 8**

ETHICAL HACKING : Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing.

Video link :https://nptel.ac.in/courses/106/105/106105217/

Module-5	L2,L3	**Hours 8**

ETHICAL HACKING IN WEB : Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms. **Video link:** https://www.digimat.in/nptel/courses/video/106105217/L33.html	
Course Outcomes:	
CO1	Understand the basics of computer forensics
CO2	Apply a number of different computer forensic tools to a given scenario
CO3	Analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure
CO5	Implement real-world hacking techniques to test system security

Text Books:	
1	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, —Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016
2	CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.
Reference Books:	
1	John R.Vacca, —Computer Forensics‖, Cengage Learning, 2005
2	MarjieT.Britz, —Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3	AnkitFadia — Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
4	Kenneth C.Brancik —Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group–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 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.

ii. 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.

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

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	3	2	-	-	-	-	-	-	-	-	1	3
CO4	2	2	1	-	-	-	-	-	-	-	-	-	1	2
CO5	3	1	2	2	-	-	-	-	-	-	-	1	2	-

High-3, Medium-2, Low-1

Course Title	INTRODUCTION TO DRONES	Semester	07
Course Code	MVJ20AM753	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 make the students to understand the basic concepts of UAV systems design.

Module-1	**L1, L2, L3**	**Hours 8**

INTRODUCTION TO UAV: History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.

Video Links : https://www.digimat.in/nptel/courses/video/101104073/L01.html

Module-2	**L2,L3,L4**	**Hours 8**

THE DESIGN OF UAV SYSTEMS : Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe- Design for Stealth--control surfaces-specifications.

Video Links: https://www.digimat.in/nptel/courses/video/101104083/L01.html

Module-3	**L1,L2,L3,L4**	**Hours 8**

AVIONICS HARDWARE : Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply- processor, integration, installation, configuration, and testing.

Video Links: https://nptel.ac.in/courses/101/104/101104083/

Module-4	**L1,L2,L3,L4**	**Hours 8**

COMMUNICATION PAYLOADS AND CONTROLS: Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.

Video Links: https://nptel.ac.in/courses/101/108/101108047/

Module-5	**L1,L2,L3,L4**	**Hours 8**

THE DEVELOPMENT OF UAV SYSTEMS :Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

Video Links:https://nptel.ac.in/courses/101/104/101104073/

Course outcomes:

CO1	Ability to design UAV system

CO2	Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3	Perform system testing for unmanned aerial vehicles
CO4	Integrate various systems of unmanned aerial vehicle.
CO5	Design micro aerial vehicle systems by considering practical limitations.

Text Books:	
1	Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998
2	Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.

Reference Books:	
1	Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
2	Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
3	Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

CIE Assessment:

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- 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 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.

ii. 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.

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

CO-PO/PSO Mapping

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

CO3	3	3	2	3	2	-	-	-	-	-	-	2	3	-
CO4	3	3	2	3	2	-	-	-	-	-	-	2	3	2
CO5	3	3	2	3	3	-	-	-	-	-	-	2	3	3

High-3, Medium-2, Low-1

Course Title	**BIG DATA ANALYTICS**	**Semester**	07
Course Code	MVJ20AM754	**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***

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hadoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

Module-1	L1,L2	**Hours 8**

INTRODUCTION TO BIG DATA AND HADOOP Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy.

Video link : https://www.digimat.in/nptel/courses/video/106104189/L01.html

Module-2	L2,L3	**Hours 8**

HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Video link : https://www.digimat.in/nptel/courses/video/106104189/L04.html

Module-3	L2,L3	**Hours 8**

MAP REDUCE Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Video link : https://www.digimat.in/nptel/courses/video/106104189/L04.html

Module-4	L2,L3	**Hours 8**

PIG : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig

Latin, User Defined Functions, Data Processing operators. **HIVE :** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. **HBASE :** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. **Video link** : https://www.youtube.com/watch?v=qr_awo5vz0g		
Module-5	L2,L3	**Hours 8**
DATA ANALYTICS WITH R MACHINE LEARNING : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big R. **Video link**: https://nptel.ac.in/courses/110/107/110107092/		

Course Outcomes:	
CO1	Identify Big Data and its Business Implications.
CO2	List the components of Hadoop and Hadoop Eco-System
CO3	Manage Job Execution in Hadoop Environment
CO4	Develop Big Data Solutions using Hadoop Eco System
CO5	Apply Machine Learning Techniques using R.

Text Books:	
1	Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
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.

CIE Assessment:

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- 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 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.

ii. 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.

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

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	-

High-3, Medium-2, Low-1

Course Title	**ARTIFICIAL INTELLIGENCE FOR**	**Semester**	07

	ROBOTICS LABORATORY		
Course Code	MVJ20AML76	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100
Credits	2	**Exam. Duration**	3 Hours

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

- Introduce students to the basic concepts and techniques of AI and Robotics.
- Develop skills of using for solving real world problems.
- Gain experience of doing independent study and research.

S No	Experiment Name	RBT Level	Hours
1	Programming in C or Matlab to implement fuzzy logic application for autonomous robot system.	**L3**	**3**
2	Programming in C/Matlab to implement simulated annealing/genetic algorithm for solving inverse kinematic problems	**L3**	**3**
3	Programming in C/Matlab to solve traveling salesman problem using ant colony optimization algorithm	**L3**	**3**
4	Write program using Visual Prolog to create an expert system.	**L3**	**3**
5	Write program for obstacle avoidance in mobile robots using any one algorithm	**L3**	**3**
6	Implement A* algorithm to Solve 8-puzzle problem (Assume any initial configuration and define goal configuration clearly)	**L3**	**3**
7	Define the operators for controlling domestic robot; use these operators to plan an activity to be executed by the robot. For example, transferring two/three objects one over the other from one place to another. Use Means-Ends analysis with all the steps revealed	**L3**	**3**
8	Solving real time planning and scheduling problems using software like Witness/Pro-model	**L3**	**3**

Course Outcomes:

CO1	Test and experiment different problems using MATLAB.
CO2	Develop AI applications using PROLOG/777C/MATLAB.
CO3	Explore deployment platforms for Robotics applications.

Reference Books:	
1	Saeed B. Niku, Introduction to Robotics Analysis, Application, Pearson Education Asia, 2001

CIE Assessment:
Regular Lab work :20 Record 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	3	3	-	-	-	-	-	-	2	-	1	2	-
CO2	2	3	3	-	-	-	-	-	-	2	-	1	1	3
CO3	2	3	3	-	-	-	-	-	-	2	-	1	1	2
CO4	2	3	3	-	-	-	-	-	-	2	-	1	1	1
CO5	2	3	3	-	-	-	-	-	-	2	-	1	1	3

High-3, Medium-2, Low-1

Course Title	**NATURAL LANGUAGE PROCESSING LABORATORY**	**Semester**	07
Course Code	MVJ20AML77	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	3(L : T : P :: 0 : 2 : 2)	**Total**	100

Credits	2	Exam. Duration	3 Hours

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

- Introduce the fundamental concepts and techniques of natural language processing.

S No	Experiment Name	RBT Level	Hours
1	Implementing word similarity	**L3**	**3**
2	Implementing simple problems related to word disambiguation	**L3**	**3**
3	Simple demonstration of part of speech tagging	**L3**	**3**
4	Lexical analyzer.	**L3**	**3**
5	Semantic Analyzer.	**L3**	**3**
6	Sentiment Analysis.	**L3**	**3**
7	Probabilistic Parsing	**L3**	**3**
8	Probabilistic Context free Grammar	**L3**	**3**
9	Conditional Frequency Distribution	**L3**	**3**
10	Named Entity Recognition	**L3**	**3**

Course Outcomes:

CO1	Understand the fundamental concepts and techniques of natural language processing (NLP)
CO2	Understanding of the models and algorithms in the field of NLP.
CO3	Demonstrate the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
CO4	Understanding semantics and pragmatics of languages for processing

Reference Books:

1	Daniel J and James H. Martin,‖speech and language processing‖ an introduction to natural language processing, computational linguistcs& speech recognition‖prentice hall,2009
2	Lan H Written and Elbef,MarkA.Hall,‖data mining: practical machine learning tools and techiniques‖,Morgan Kaufmann,2013

CIE Assessment:

Regular Lab work :20 Record 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	3	3	-	-	-	-	-	-	2	-	1	2	-
CO2	2	3	3	-	-	-	-	-	-	2	-	1	1	3
CO3	2	3	3	-	-	-	-	-	-	2	-	1	1	2
CO4	2	3	3	-	-	-	-	-	-	2	-	1	1	1
CO5	2	3	3	-	-	-	-	-	-	2	-	1	1	3

High-3, Medium-2, Low-1