Course Title	Discrete Math & Probability Theory	Semester	III
Course Code	MVJ20MIS31	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 2 : 2 : 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	12 Hours

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

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

Application: Distribution with repetition.

Video Link:

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	12 Hours

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:

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	12 Hours

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

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:

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	12 Hours

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:

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	12 Hours
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, decoding and error detection. Application: Testing the level of significance & the goodness of fit for large sample and small sample. Video Link: 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	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.

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

3.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
4.	Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007
5.	Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016.

CIE Assessment:

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

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists 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 Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	2	3	0	3	0	0	0	0	0	0	1	1
CO3	2	3	0	3	0	0	0	0	0	0	1	1
CO4	3	3	0	3	0	0	0	0	0	0	1	1
CO5	3	3	0	3	0	0	0	0	0	0	1	1

High-3, Medium-2, Low-1

Course Title	Data Structure	Semester	III
Course Code	MVJ20IS32	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:

Understand the various techniques of sorting and searching

Design and implement arrays, stacks, queues, and linked lists

Understand the complex data structures such as trees and graphs

Module-1	L1,L2,L3	12 Hours

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Laboratory Sessions/ Experimental learning:

Implementation of searching Techniques

Applications: Array data type used in a programming language to specify a variable that can be indexed. Array data structure is used for arrangement of items at equally spaced and sequential addresses in computer memory makes it easier to perform operations like sorting, merging, traversal, retrievals

Video link / Additional online information :

https://www.tutorialspoint.com/data_structures_algorithms/array_data_structure.htm

Module-2	L1,L2,L3	12 Hours

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis.

ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Laboratory Sessions/ Experimental learning:

Stack ADT to perform push and pop operations.

Stack ADT for Expression Evaluation

Array Implementation of Queue ADT

Applications: Expression Handling , Backtracking Procedure

Video link / Additional online information :

https://www.tutorialspoint.com/data_structures_algorithms/stack_algorithm.htm

https://www.tutorialspoint.com/data_structures_algorithms/dsa_queue.htm

Module-3	L1,L2,L3	12 Hours

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis

Laboratory Sessions/ Experimental learning:

Implementation of linked list techniques(SLL,DLL,CLL)

Applications: The cache in your browser that allows you to hit the BACK button where a linked list of URLs can be implemented. A linked list would be a reasonably good choice for implementing a linked list of file names, undo functionality in Photoshop

Video link / Additional online information :

https://www.tutorialspoint.com/data_structures_algorithms/linked_list_algorithms.htm

https://www.tutorialspoint.com/data_structures_algorithms/doubly_linked_list_algorithm.htm

Module-4	L1,L2,L3	12 Hours
Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with Complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis. Laboratory Sessions/ Experimental learning: Develop a program to create a Binary Search Tree and to Traverse the tree. Applications: Store hierarchical data, like folder structure, organization structure, XML/HTML data. Binary Search Tree is a tree that allows fast search, insert, delete on a sorted data. It also allows finding closest item. Heap is a tree data structure which is implemented using arrays and used to implement priority queues. Video link / Additional online information : https://www.tutorialspoint.com/data_structures_algorithms/tree_data_structure.htm https://www.tutorialspoint.com/data_structures_algorithms/binary_search_tree.htm		
Module-5	L1,L2,L3	12 Hours
Introduction to graph – types of graphs - Graph representations - Traversal algorithms- Depth First Search (DFS) and Breadth First Search (BFS) - Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting. Laboratory Sessions/ Experimental learning: Implement shortest path Algorithms Applications: The link structure of a website could be represented by a directed graph: the vertices are the web pages available at the website and a directed edge from page A to page B exists if and only if A contains a link to B. Graph colouring concept can be applied in job scheduling problems of CPU, jobs are assumed as vertices of the graph and there will be an edge between two jobs that cannot be executed simultaneously and there will be one-one relationship between feasible scheduling of graphs. Video link / Additional online information : https://www.tutorialspoint.com/data_structures_algorithms/graph_data_structure.htm		

Course outcomes:	
CO1	Implement all the operations of linear data structures to store and retrieve the given data.
CO2	Create a hierarchical data structure to represent the given data using tree data structure.
CO3	Compare efficiency of various searching techniques using different tree data structures.
CO4	Apply stack, Queue, Lists, Trees and Graph concepts in problem solving
CO5	Implement all data structures in a high-level language for problem solving

Reference Books:	
	Seymour Lipschutz and Vijayalakshmi Pai G A, –Data Structures‖, Tata McGraw Hill, New Delhi, 2013.
	Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015

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SEE Assessment:
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Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. One question must be set from each unit. The duration of examination is 3 hours.
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CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO2	3	3	3	2	3	0	0	0	0	2	0	0
CO3	3	3	2	2	3	0	0	0	0	2	0	0
CO4	3	3	2	2	3	0	0	0	0	2	0	0
CO5	3	3	3	2	3	0	0	0	0	2	0	0

High-3, Medium-2, Low-1

Course Title	Analog and Digital Electronics	Semester	III
Course Code	MVJ20IS33	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is 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 flipflops and design registers and counters.

Design and test Analog-to-Digital and Digital-to-Analog conversion techniques.

Module-1	L1,L2,L3	12 Hours

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

Laboratory Sessions/ Experimental learning:

Plotting the V-I characteristics of MOSFET

Applications:

FET,s are the basic elements in constructing memory devices. Oscillators' gives an ides of generating clock signals. Regulated power supplies help in regulating power in electronic products.

Video link / Additional online information :

https://www.youtube.com/watch?v=lNuS8mddhs0

Module-2	L1,L2,L3	12 Hours

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,

Laboratory Sessions/ Experimental learning:

Writing and Analysing C program for K-maps.

Applications: Karnaugh maps are used for many small design problems. It gives a great deal of insight to digital logic circuits.

Video link / Additional online information :

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105185/lec20.pdf-

Module-3	L1,L2,L3	12 Hours

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

Laboratory Sessions/ Experimental learning:

Designing a 32-bit ALU

Applications: These components are used as a fundamental element in processor, communication devices etc.

Video link / Additional online information :

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106102062/lec11.pdf

Module-4	L1,L2,L3	12 Hours
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. Laboratory Sessions/ Experimental learning: Implementing 2-digit counters using seven segment display Applications: Registers are use in processors for performing operations. Counters are used as Digital clocks, Frequency counters, Binary counters etc. Video link / Additional online information : https://www.youtube.com/watch?v=Gc3DL-tmr-g		
Module-5	**L1,L2,L3**	**12 Hours**
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 Laboratory Sessions/ Experimental learning: Demonstration of CODEC which houses both ADC and DAC. Applications: DACs are commonly used in music players to convert digital data streams into analog audio signals. They are also used in televisions and mobile phones to convert digital video data into analog video signals. ADCs are used in music recording, Digital signal processing, Scientific Instruments etc. Video link / Additional online information : https://www.youtube.com/watch?v=wa7pIviT-do-		

Course outcomes:	
CO1	Design and analyse 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.
Reference 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,2020.
3.	Donald P Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.
4	M. Morris Mani, Digital Design, 4th Edition, Pearson Prentice Hall, 2008.
5	David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

CIE Assessment:
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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.

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	2	0	0	0	0	0	0	0	1
CO2	3	3	2	2	0	0	0	0	0	0	0	1
CO3	3	3	3	2	0	0	0	0	0	0	0	1
CO4	3	3	2	2	0	0	0	0	0	0	0	1
CO5	3	3	3	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Course Title	Data Communication	Semester	III
Course Code	MVJ20IS34	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Discuss the digital data communication techniques.

Gain knowledge on basic concepts of data communication layers, protocols and performance.

Understand a few representative protocols and network components.

Introduce the functions of different layers from deployed examples.

Introduce standards employed in computer networking.

Module-1	L1,L2,L3	12 Hours

Data Communications, Networks, The Internet, Protocol sand standards, Network Models-Reference models OSI, TCP/IP Model, Addressing, Data &Signal-Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission impairment, Data Rate Limits, Performance.

Laboratory Sessions/ Experimental learning:

Write a code simulating PING and TRACEROUTE commands

Applications: Resource sharing such as printers and storage devices.

Video link / Additional online information :

http://nptel.ac.in/courses/106105082/

Module-2	L1,L2,L3	12 Hours

Digital to Digital Conversions, Analog to Digital Conversions, Transmission Modes, Analog Transmission-Digital to Analog conversion, Analog to Analog conversion, Multiplexing- FDM, WDM, STDM, Statistical TDM, Spread Spectrum, Guided Media-

Twisted pair cable, Co-axial cable, Fiber optic cable, Unguided media-Wireless-Radio waves, Microwaves, Infrared.

Laboratory Sessions/ Experimental learning:

Create a socket for HTTP for web page upload and download.

Applications: Cellular telephony, video conferencing, digital TV

Video link / Additional online information :

http://nptel.ac.in/video.php?subjectId=106105081

Module-3	L1,L2,L3	12 Hours

Circuit switched networks, Datagram networks, Virtual circuit networks, Structure of a Switch-Structure of Circuit Switches & Packet Switches, Data Link Layer-Detection and Correction-Introduction, Block Coding-Error Detection and Correction, Hamming Distance, Minimum Hamming Distance, Linear Block Codes, Cyclic Codes- CRC, Polynomials, Checksum.

Laboratory Sessions/ Experimental learning:

Applications using TCP and UDP Sockets like

a. DNS

b. SNMP

c .File Transfer

Applications: Connection between different devices using logical connections

Video link / Additional online information :

http://www.computerscienceonline.org/courses/

Module-4	L1,L2,L3	12 Hours

Data Link Layer – Data Link Control- Framing, Flow and error control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point-to-Point Protocol- Framing, Transition phases, Multiple Access- Random access-Aloha, CSMA, CSMA/CD, CSMA/CA,

Controlled access- reservation, polling, token passing, Channelization - FDMA,TDMA,CDMA.

Laboratory Sessions/ Experimental learning:

Implementation of Stop and Wait Protocol and Sliding Window Protocol.

Applications: media access control (MAC) layer, source and destination addresses

Video link / Additional online information :

https://www.youtube.com/view_play_list?p=32DBC269EF768F74

Module-5	L1,L2,L3	12 Hours

Wired LANs: Ethernet – Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LANs- IEEE 802.11, Bluetooth - Architecture, Bluetooth layers, Radio layer, Baseband layer, L2CAP Connecting Devices–Hub, Repeater, Bridges, Transparent Bridges, Switches, Router, and Gateway.

Laboratory Sessions/ Experimental learning:

Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS

Applications: Internet Access.

Video link / Additional online information :

https://nptel.ac.in/courses/106105082/#

Course outcomes:	
CO1	Analyze OSI and TCP network models and the layers associated functionalities
CO2	Analyze and apply different types of signal conversion techniques in physical layer
CO3	Analyze and apply different types of error detection and correction mechanisms.

CO4	Analyze flow control and Error control mechanism using standard data link layer protocols and Compare different categories of Medium Access protocols
CO5	Analyze different protocols used for Ethernet and various connecting devices used in networks.

Reference Books:	
1.	Data Communication and Networking, Behrouz A. Forouzan, McGraw-Hill, 5thEdition,2012.
2.	Data and Computer Communication, WilliamStallings,10th Edition,PearsonEducation,2014.
3.	Introduction to Data Communications and Networking–Wayne Tomasi, Pearson Education,2009.(Latest Edition)

CIE Assessment:
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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.

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CO3	0	3	3	0	0	0	0	0	0	0	0	2
CO4	0	0	3	0	0	0	0	0	0	0	0	2
CO5	0	3	2	0	0	0	0	0	0	0	0	2

High-3, Medium-2, Low-1

Course Title	Computer Organization & Architecture	Semester	III
Course Code	MVJ20IS35	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

distinguish between the various ISA styles

trace the execution sequence of an instruction through the processor

compare different approaches used for implementing a functional unit

understand the fundamentals of memory and I/O systems and their interaction with the processor

Module-1	L1,L2,L3	12 Hours

Functional unit, Basic operational concepts, Bus structures, Software, Performance, Data Representation. Fixed Point Representation. Floating – Point Representation. Instruction codes. Computer Registers Computer instructions– Instruction cycle. Memory – Reference Instructions. Input – Output and Interrupt. STACK organization. Instruction formats. Addressing modes.

Laboratory Sessions/ Experimental learning:

Familiarization with assembly language programming

Applications: Computer system.

Video link / Additional online information :

https://nptel.ac.in/courses/106/106/106106166/

Module-2	L1,L2,L3	12 Hours
Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input –Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus. Introduction to standard serial communication protocols like RS232, USB, IEEE1394 Laboratory Sessions/ Experimental learning: Interfacing - DAC, ADC, keyboard-display modules Applications: Monitors, keyboards. Video link / Additional online information: https://drive.google.com/file/d/0B-ITW-kTxwdfSVExbzZlMUFFVFU/view		
Module-3	**L1,L2,L3**	**12 Hours**
Cache Coherence, Shared Memory Multiprocessors. Control memory, Address sequencing, micro program example, design of control unit Hard wired control. Micro programmed control, Virtual Memory. Laboratory Sessions/ Experimental learning: Processor design Applications: High end workstations. Video link / Additional online information: https://drive.google.com/file/d/0B-ITW-kTxwdfcV9ma2JxbUc0RUk/view		
Module-4	**L1,L2,L3**	**12 Hours**
Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit Decimal Arithmetic operations. Laboratory Sessions/ Experimental learning: Implementation of booth algorithm		

Applications: Radar,Sonar Video link / Additional online information: https://nptel.ac.in/courses/106/106/106106166/		
Module-5	L1,L2,L3	12 Hours
Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Data hazards – Instruction hazards, Vector Processing, Array Processors. Cache coherence and MESI protocol – Clusters – Non-Uniform Memory Access – Vector Computation Laboratory Sessions/ Experimental learning: Introduction to embedded system. Applications: DSP,Microprocessor Video link / Additional online information: https://drive.google.com/file/d/0B-ITW-kTxwdfNGlMQlNSSVlQeEE/view		

Course outcomes:	
CO1	Demonstrate the fundamental organization of a computer system
CO2	Analyse various issues related to memory hierarchy.
CO3	Examine various, inter connection structures of multi processors.
CO4	Formulate and solve problems related to computer arithmetic, performance of systems
CO5	Demonstrate parallel computing and concepts of pipeline

Reference Books:	
1.	M. Morris Mano, Computer System Architecture, 3rd edition, Prentice- Hall of IndiaPvt. Ltd., 1999.
2.	Carl Hamacher : "Computer Organization ", Fifth Edition, Mc Graw Hill
3.	William Stallings: "Computer Organisation and Architecture", Pearson Education

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CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	3	2	0	0	0	2	0	0	0	1
CO2	0	3	3	2	0	0	0	2	0	0	0	2
CO3	0	3	3	2	0	0	0	2	0	0	0	3
CO4	0	3	3	2	0	0	0	2	0	0	0	2
CO5	0	3	3	2	0	0	0	2	0	0	0	3

High-3, Medium-2, Low

Course Title	Software Engineering	Semester	III
Course Code	MVJ20IS36	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

To understand the phases in a software project

To understand fundamental concepts of requirements engineering and Analysis Modeling.

To understand the various software design methodologies

To learn various testing and maintenance measures

Module-1	L1,L2, L3	12 Hours

What is software engineering? Software Development Life Cycle, Essential characteristics of socio technical systems, Emergent System Properties, Systems Engineering, Functional and Non-functional requirements, User Requirements, System Requirements, Interface Specification, Documentation of the software requirements, Feasibility study, Requirements elicitation and analysis, Requirements Validations, Requirements Management.

Laboratory Sessions/ Experimental learning:

Identifying the Requirements from Problem Statements

Applications: Software Project

Video link / Additional online information :

https://nptel.ac.in/courses/106/105/106105182/

http://vlabs.iitkgp.ernet.in/se/

Module-2	L1,L2, L3	12 Hours
Process and Project, Component Software Processes, Software Development Process Models: Waterfall Model, Prototyping, Spiral model, Iterative Development, Rational Unified Process, The RAD Model, Time boxing Model. Rapid Software Development: Agile methods; Plan-driven and agile development, Extreme programming Laboratory Sessions/ Experimental learning: Demonstration of Process Models Applications: Software Project Video link / Additional online information : https://nptel.ac.in/courses/106/105/106105182/ http://vlabs.iitkgp.ernet.in/se/		
Module-3	L1,L2, L3	12 Hours
Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components Laboratory Sessions/ Experimental learning: Modeling UML Use Case Diagrams and Capturing Use Case Scenarios Applications: System Design Video link / Additional online information : https://nptel.ac.in/courses/106/105/106105182/ http://vlabs.iitkgp.ernet.in/se/		

Module-4	L1,L2, L3	12 Hours
Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging. Laboratory Sessions/ Experimental learning: Designing Test Suites. Applications: System Testing Video link / Additional online information : https://nptel.ac.in/courses/106/105/106105182/ http://vlabs.iitkgp.ernet.in/se/		
Module-5	L1,L2, L3	12 Hours
Software Implementation Techniques: Coding Practices, Refactoring, Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering. Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model . Laboratory Sessions/ Experimental learning: Cost estimation of Project Applications: Successful development of the project's procedures of initiation, planning, execution, regulation and closure Video link / Additional online information : https://nptel.ac.in/courses/106/105/106105182/ http://vlabs.iitkgp.ernet.in/se/		

Course outcomes:	
CO1	Identify the key activities in software engineering
CO2	Compare different process models.
CO3	Apply requirements engineering process and analysis modeling.
CO4	Apply systematic procedure for software design and deployment.
CO5	Compare and contrast various testing techniques and apply software implementation techniques

Reference Books:	
1.	Roger S. Pressman, "Software Engineering – A Practitioner‟s Approach", Seventh Edition, Mc Graw-Hill International Edition, 2010.
2.	Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
3.	Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009.
4.	Pankaj Jalote, "Software Engineering", Narosa 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:
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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	2	0	0	0	0	0	0	0	0	0
CO2	2	2	0	0	0	0	0	0	0	0	0	0
CO3	2	0	1	0	3	0	0	0	0	0	0	0
CO4	2	2	0	2	0	1	0	1	0	0	3	3
CO5	1	2	0	0	0	0	0	0	0	0	0	3

High-3, Medium-2, Low-1

Course Title	Data Structure Lab	Semester	III
Course Code	MVJ20ISL37	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

Implement linear and non-linear data structures

Understand the different operations of search trees

Implement graph traversal algorithms

Get familiarized to sorting and searching techniques

Sl No	Experiment Name	RBT Level	Hours
1	Implementation of searching algorithms a) Linear Search b) Binary Search	L3	4
2	Implementation of sorting algorithms a) Insertion sort b) Selection sort c) Quick sort d) Merge sort	L3	4
3	a) Array implementation of List ADT b) Linked list implementation of List ADT	L3	4
4	a) Array implementation of Stack ADT b) Linked list implementation of Stack ADT	L3	4
5	a) Array implementation of queue ADT b) Linked list implementation of queue ADT	L3	4
6	Program to create a Binary Search Tree and to traverse the tree.	L3	4
7	Program to compute the shortest path from a single source	L3	4
8	Program to construct a graph and perform graph traversal (BFS, DFS)	L3	4

9	Program to construct a minimum spanning tree using: a) Prims Algorithm b) Kruskal's Algorithm	L3	4
10	Development of a Mini project/Present a case Study	L3	4

Course outcomes:	
CO1	Compute the time and space complexity of searching and sorting algorithms with asymptotic notations.
CO2	Implement all the operations of linear data structures to store and retrieve the given data.
CO3	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data
CO4	Create a hierarchical data structure to represent the given data using tree data structure.
CO5	Design graph algorithms to compute the shortest path of the given graph and to identify the Minimum spanning tree.

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, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	0	0	0	0	2	0	0
CO2	3	3	3	2	3	0	0	0	0	2	0	0
CO3	3	3	2	2	3	0	0	0	0	2	0	0
CO4	3	3	2	2	3	0	0	0	0	2	0	0
CO5	3	3	3	2	3	0	0	0	0	2	0	0

High-3, Medium-2, Low-1

Course Title	Analog & Digital Electronics Lab	Semester	III
Course Code	MVJ20ISL38	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is 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

Sl 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.	L3	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.	L3	3
4	A) Realization and implementation of 2-bit comparator using logic gates. b) Implementation of 4-bit magnitude comparator using IC 7485.	L3	3
5	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
6	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops	L3	4

7	Design and implementation of 3-bit synchronous up/down counter	L3	4
8	Design and implement a ring counter and Johnson counter using 4-bit shift register and demonstrate its working.	L3	3
9	Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.	L3	4
10	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

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

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,

Write-up : 20 marks

Conduction : 40 marks

Analysis of results : 20 marks

Viva : 20 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	0	0	0	0	0	0	0	0
CO2	3	3	2	2	0	0	0	0	0	0	0	0
CO3	3	3	3	2	0	0	0	0	0	0	0	0
CO4	3	3	2	2	0	0	0	0	0	0	0	0
CO5	3	3	3	2	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW	Semester	III/IV
Course Code	MVJ20CPH39/49	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	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 technograts 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	RBT Level 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	RBT Level 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	RBT Level 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	RBT Level 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	RBT Level 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 (40 marks each), the final IA marks to be awarded will be the average of three tests Assignment (10 marks)
SEE Assessment:
Question paper for the SEE consists one part. It is compulsory and consists of objective type 1 mark each for total of 50 marks covering the whole syllabus. Ten questions must be set from each unit. The duration of examination is 3 hours.

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

High-3, Medium-2, Low-1

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_Kt6jqzA3pZ3yA7g_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

Scheme of Evaluation

Details		Marks
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	10
Self-Assessment + Assessment by peers		20
Activities / Experimentations related to courses/Assignment		10
Mini Projects / Case Studies		10
Semester End Examination	SEE (50)	50
Total		100

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

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

High-3, Medium-2, Low-1

Course Title	Additional Mathematics-I (Common to all branches)	Semester	III
Course Code	MVJ20MISDIP301	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	-	Exam. Duration	3hrs

Course objective is to: This course viz., 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	8Hrs.

Differential calculus: Recapitulations of successive differentiations -nth derivative -Leibnitz theorem and Problems, Mean value theorem -Rolle's theorem, Lagrange's Mean value theorem , Cauchy's theorem and Taylor's theorem for function of one variables.

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 Simples Problems.

Video Link:

https://www.youtube.com/watch?v=rCWOdfQ3cwQ

https://nptel.ac.in/courses/111/105/111105122/

Module-3	L1,L2	8Hrs.

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 Link: 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 Link:** 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: Homogenous 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 change of order 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 to Application to Engineering problems.
CO4	Understand the basic Concepts of Probability
CO5	Solve first order linear differential equation analytically using standard methods.

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.

Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
2.	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)Assignments (10 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	2	3	0	3	0	0	0	0	0	0	1	1
CO3	2	2	0	2	0	0	0	0	0	0	1	0
CO4	3	2	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	2	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	Numerical Methods, Operations Research & Statistics	Semester	IV
Course Code	MVJ20MIS41	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 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, sampling theory and Operational research emerging in science and engineering.

Module-1	L1,L2, L3	12 Hours

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-Bashforth 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	12 Hours

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 Bashforth 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	12 Hours

Operations Research-1

Introduction to Linear Programming Problem (LPP): Prototype example, Assumptions of LPP, Formulation of LPP and Graphical method various examples. The simplex method, Big M method, Two phase 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	12 Hours

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	12 Hours
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 numerical methods.
CO2	Determine the extremals of functional 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.

Reference Books:	
	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
	S. D. Sharma, "Operations Research", Kedar Nath and Ram Nath Publishers, Seventh Revised Edition 2014.
	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.

	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.

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CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	0	1
CO2	3	2	0	3	0	0	0	0	0	0	0	0
CO3	3	3	0	2	0	0	0	0	0	0	0	0
CO4	2	3	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	3	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Course Title	Design & Analysis of Algorithm	Semester	IV
Course Code	MVJ20IS42	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:

Explain various computational problem-solving techniques.

Apply appropriate method to solve a given problem.

Describe various methods of algorithm analysis

Module-1	L1,L2, L3	12 Hours

Introduction to Algorithms: The role of algorithms in computing, Growth of functions, Asymptotic notations, Designing and Analysing algorithms-an Introduction using insertion sort. Review on the Math needed for algorithm design and analysis.

Laboratory Sessions/ Experimental learning:

Implement insertion sort and test its efficiency

Applications: Develop a realistic model for the input to the program. Analyse the unknown quantities, assuming the modelled input. Calculate the total running time by multiplying the time by the frequency for each operation, then adding all the products.

Video link / Additional online information :

https://www.tutorialspoint.com/data_structures_algorithms/asymptotic_analysis.htm

Module-2	L1,L2, L3	12 Hours

Divide and Conquer: Solving recurrences – The Substitution method, Recurrence Tree method and Master's method, Multiplying large integers, Binary Search, Sorting [Merge Sort and Quick Sort], Selection in linear time [Expected and Worst-case], Strassen's algorithm for Matrix Multiplication, The maximum sub-array problem.

Laboratory Sessions/ Experimental learning:

Implement maximum sub array algorithm and test their correctness and efficiency

Applications: Closest Pair of Points, Strassen's Multiplication, Karatsuba Algorithm, Cooley-Tukey Algorithm

Video link / Additional online information :

https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_

divide_conquer_htm

Module-3	L1,L2, L3	12 Hours

Greedy Algorithms: Characteristics of Greedy algorithms, The problem of making change, Greedy algorithms for Scheduling, Minimum Spanning Trees – Kruskal's Algorithm and Prim's Algorithm, Greedy Algorithms for finding the shortest paths in a Graph, The Knapsack problem Amortized Analysis:

The accounting method, The potential method.

Laboratory Sessions/ Experimental learning:

Implement Knapsack Algorithm using Greedy method.

Applications: Dijkstra's Algorithm, Google Map

Video link / Additional online information :

https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_

greedy_method_htm

Module-4	L1,L2, L3	12 Hours

Dynamic Programming: Calculating the binomial co-efficient, the problem of making change,

The Knapsack problem, Chained matrix multiplication, Finding the shortest paths in a Graph, Reformulating Dynamic programming algorithms using recursion and memory functions.

Laboratory Sessions/ Experimental learning:

Implement single source shortest path algorithm.

Applications: Logistic/Transportation Problems

Video link / Additional online information :
https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_
dynamic_programming_htm

Module-5	L1,L2, L3	12 Hours

Backtracking: N-Queen's Problem -Graph colouring.
Branch and Bound: Assignment Problem - Traveling Salesman Problem. Computability classes – P, NP, NP-complete and NP-hard.
Laboratory Sessions/ Experimental learning:
Implement graph colouring Problem
Applications: Electrical Engineering, Robotics, Artificial Intelligence, Materials Engineering, Solving Puzzles

Video link / Additional online information :
https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_
p_np_class_htm

Course outcomes:	
CO1	Analyze the correctness of algorithms using induction and loop invariants.
CO2	Construct algorithms using design paradigms like divide and conquer, greedy and dynamic programming for a given problem.
CO3	Analyze how the performance of an algorithm is affected based on the choice of data structures the algorithm uses.
CO4	Construct graph-based algorithms to solve engineering problems.
CO5	Outline P and NP problems with the help of backtracking and branch and bound techniques

Reference Books:	
	Introduction to the Design and Analysis of Algorithms, Anany Levitin:, 2rd Edition, 2009.Pearson.

	Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press
	Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein – Introduction to Algorithms, Third edition, PHI, 2010.

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CO2	3	3	3	2	3	0	0	0	0	2	0	0
CO3	3	3	2	2	3	0	0	0	0	2	0	0
CO4	3	3	2	2	3	0	0	0	0	2	0	0
CO5	3	3	3	2	3	0	0	0	0	2	0	0

High-3, Medium-2, Low-1

Course Title	Microcontroller & Embedded Systems	Semester	IV
Course Code	MVJ20IS43	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Explain the fundamentals of ARM based system, basic hardware components, selection methods and attributes of an ARM Controller.

Program ARM controller using the various instructions.

Explain the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller.

Identify the Embedded System Design applications.

Explain the real time operating system for the embedded system design.

Module-1	L1,L2, L3	12 Hours

Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions

Laboratory Sessions/ Experimental learning:

ARM Processor and Sample programs using Simulator.

Comparison of Microprocessor and Microcontroller hardware Model

Comparing the Microprocessor and Microcontroller Software Model

Applications: ARM Design

Video link / Additional online information :

https://developer.arm.com/architectures/platform-design/embedded-systems

https://www.youtube.com/watch?v=JPfG0UQd3x4

https://bnmbiw.wordpress.com/2013/01/27/chapter-1-arm-embedded-systems/

Module-2	L1,L2, L3	12 Hours

Introduction to the ARM Instruction Set : Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants

ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling

Laboratory Sessions/ Experimental learning:
ARM assembly language programming

Applications: Writing Assembly code
Video link / Additional online information :
https://iitd-plos.github.io/col718/ref/arm-instructionset.pdf
https://www.slideshare.net/MathivananNatarajan/arm-instruction-set-60665439
https://www.scribd.com/document/401460874/ARM-Architecture

Module-3	L1,L2, L3	12 Hours

Exception, Interrupt Handling : Exception handling,Interrupts,Interrupt handling Schemes

Memory Management Unit : The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy, Moving from MPU to an MMU,How Virtual Memory Works, Details of ARM MMU

Laboratory Sessions/ Experimental learning:
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.

Applications: Estimation of CPU & Memory Performance

Video link / Additional online information :

https://www2.seas.gwu.edu/~bhagiweb/cs211/lectures/cache1.pdf

https://developer.arm.com/docs/den0024/a/the-memory-management-unit

https://www.youtube.com/watch?v=IyRNk5SMEpM

Module-4	L1,L2, L3	12 Hours

Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems

Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (on board and external types), Embedded firmware, Other system components.

Laboratory Sessions/ Experimental learning:

Mini project

Case Study: Digital Clock, Battery operated Smartcard Reader

Applications: Displaying digits on a 7-segment LED interface

Video link / Additional online information :

https://www.slideshare.net/MoeMoeMyint/introduction-to-embedded-system-chapter-2-4th-portion

https://shrishailbhat.com/2018/02/28/arm-microcontroller-embedded-systems-embedded-system-components/

https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/EMBEDDED%20SYSTEMS%20DESIGN.pdf

Module-5	L1,L2, L3	12 Hours

Real Time Operating System (RTOS) based Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX

Threads with an example program), Thread pre-emption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS

Case Study: Automated Meter Reading System (AMR) and Digital Camera, Real time concepts

Applications: Modern electronic systems

Video link / Additional online information :

https://www.geeksforgeeks.org/mutex-lock-for-linux-thread-synchronization/
http://digitalthinkerhelp.com/real-time-operating-system-rtos-examples-applications-functions/

Course outcomes:	
CO1	Describe the architectural features and instructions of ARM microcontroller
CO2	Develop Assembly Programs in ARM for Embedded applications.
CO3	Describe the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller
CO4	Interface external devices and I/O with ARM microcontroller.
CO5	Demonstrate the need of real time operating system for embedded system applications
Reference Books:	
1.	Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developer's guide, Elsevier, Morgan Kaufman publishers, 2008.
2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.
3.	Raghunandan...G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication, 2019

4.	The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd., 1st edition, 2005.
5	Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
6	Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

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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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CO1	3	0	0	0	0	0	0	0	0	0	0	0
CO2	3	2	1	0	0	0	0	0	0	0	0	0
CO3	0	0	2	3	0	0	0	0	0	0	0	0
CO4	0	0	2	3	0	0	0	0	0	0	0	0
CO5	0	0	3	0	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	Object Oriented Programming Concepts	Semester	IV
Course Code	MVJ20IS44	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Learn fundamental features of object-oriented language and JAVA

Design, write, debug, run C++ and Java Programs

Develop console -based applications using C++

Develop console & windows applications using Java.

Introduce event driven Graphical User Interface (GUI) programming using applets and swings

Module-1	L1,L2, L3	12 Hours

Overview of OOPs Principles , Introduction to classes & objects , Instantiating and Using Classes with objects , Data Members , Member Functions , this Pointer , Constructor & Destructor , Control, Structures , Arrays in C++ .

Laboratory Sessions/ Experimental learning:

Introduction to OOP lab (Simple C program) - Classes and Objects.

Applications: Building a secure program using data hiding concept . Using same function or same operator having different purposes

Video link / Additional online information :

http://ee402.eeng.dcu.ie/introduction/chapter-1---introduction-to-object-oriented-programming

https://introprogramming.info/english-intro-csharp-book/read-online/chapter-20-object-oriented-programming-principles/

Module-2	L1,L2, L3	12 Hours

Derived Class and Base Class , Derived Class Constructors , Overriding Member Functions , Public and Private Inheritance , Types of Inheritance: Single, Multi-Level, Multiple, Hierarchical and Hybrid , Virtual Base Classes , Abstract Classes.

Laboratory Sessions/ Experimental learning:

Programs using constructor, inheritance

Applications: Reuse of existing class to derive a new class such that the redundant code is eliminated, which saves time and cost of program.

Video link / Additional online information :

https://isocpp.org/wiki/faq/private-inheritance

https://www.programiz.com/cpp-programming/public-protected-private-inheritance

https://balututorial.com/inheritance-in-c-with-example-program/

Module-3	L1,L2, L3	12 Hours

Pointers , this Pointer , Pointers to Objects and Derived Classes , Function Overloading , Operator Overloading , virtual function,

Friend Function , Static Function ,Streams: Stream Classes - Unformatted I/O Operations - Formatted Console I/O Operation.

Laboratory Sessions/ Experimental learning:

Program using function overloading, friend function

Applications: Dynamic linkage or late binding on the function

Video link / Additional online information :

https://www.cet.edu.in/noticefiles/285_OOPS%20lecture%20notes%20Complete.pdf

https://www.programiz.com/cpp-programming/friend-function-class

https://www.ntu.edu.sg/home/ehchua/programming/cpp/cp6_Inheritance.html

Module-4	L1,L2, L3	12 Hours
Java Basics , Classes and Objects , Inheritance, Interfaces , Abstract Class , packages , Exception handling, Type casting Laboratory Sessions/ Experimental learning: Programs using Java class/object, Package, interface Applications: Partial abstraction with abstract classes. Total abstraction with interfaces Video link / Additional online information : https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/ https://www.edureka.co/blog/object-oriented-programming/		
Module-5	**L1,L2, L3**	**12 Hours**
Garbage Collections , Java Utility Classes , I/O Classes and Interfaces, Multithreading, Java swing basics Laboratory Sessions/ Experimental learning: Programs using thread concept, Java swing Applications: Partitioning the work of a project based on thread/objects. Video link / Additional online information : https://www.studytonight.com/java/garbage-collection.php https://beginnersbook.com/ 13/05/java-interface/ https://www.javatpoint.com/java-swing		

Course outcomes:	
CO1	Design class and objects for real world scenario.
CO2	Apply Inheritance concept to obtain code reusability.
CO3	Create applications to manipulate data from files using functions and streams
CO4	Develop console applications using Java OOPS.

CO5	Develop GUI application using Java library classes.

Reference Books:	
1.	E Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing, New Delhi, 2011
2.	Sourav Sahay, Object Oriented Programming with C++ , 2nd Ed, Oxford University Press,2006
3.	Robert Lafore, Object Oriented Programming in C++, Galgotia Publication, 2010.
4.	Herbert Schildt, Java: The Complete Reference, Eleventh Edition, McGraw-Hill Education,2018
5.	D.T. Editorial Services ,Java 8 Programming Black Book , second edition, Dreamtech Press,2015

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CO2	0	2	2	0	3	0	0	0	0	0	0	0
CO3	0	2	1	0	3	0	0	0	0	0	0	0
CO4	0	1	2	0	3	0	0	0	0	0	0	0
CO5	0	1	2	0	3	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	Operating System	Semester	IV
Course Code	MVJ20IS45	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Provide an understanding on the various components of an Operating System

The course focuses on fundamental problems and optimal solutions for resource management in operating systems such as process, disk and memory management

The course will introduce design principles and trade-offs in the design of Operating Systems.

Explain inter-process communication.

The course will also introduce the interface for interacting with a contemporary Operating system such as Linux.

Module-1	L1,L2, L3	12 Hours

Introduction to operating systems, What operating systems do; Computer System organization; Computer System architecture; Operating System operations; Process management; Memory management; Storage management; Protection and Security; 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. Process Management Process concept; Process scheduling; Operations on processes.

Case study:-IPC System

Laboratory Sessions/ Experimental learning:

Implementing process scheduling algorithms

Applications: Computer system.

Video link / Additional online information:

https://nptel.ac.in/courses/106108101/

Module-2	L1,L2, L3	12 Hours

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors. CPU Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling

Laboratory Sessions/ Experimental learning:

Implementing process scheduling algorithms

Applications: spell-check, response to keyboard, formatting

Video link / Additional online information :

https://www.smartzworld.com/notes/operating-systems-pdf-vtu-os/

Module-3	L1,L2, L3	12 Hours

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

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

CASE STUDY: ARM architecture

Laboratory Sessions/ Experimental learning:

Implement Bankers algorithm for Dead Lock Avoidance

Applications: Traffic gridlock

Video link / Additional online information :

https://www.smartzworld.com/notes/operating-systems-pdf-vtu-os/

Module-4	L1,L2, L3	12 Hours

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. File System, File concept; Access methods; Directory and disk structure; File system mounting; File sharing; Protection;

Case study's: NFS and WAFL File system

Laboratory Sessions/ Experimental learning:

Implement all page replacement algorithms

Applications: scientific applications

Video link / Additional online information :

https://www.smartzworld.com/notes/operating-systems-pdf-vtu-os/

Module-5	L1,L2, L3	12 Hours

Secondary Storage Structures, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability-Based systems.

Linux overview – Kernel Architecture – Process, memory, file and I/O management – Inter Process communication and synchronization – Security. Case study of UNIX.

Laboratory Sessions/ Experimental learning:

Implementing disk scheduling algorithm

Applications: NAS, Hard disk

Video link / Additional online information :

https://nptel.ac.in/courses/106108101/

Course outcomes:	
CO1	Recognize the important computer system resources and the role of operating system in their management policies and algorithms.
CO2	Understand various scheduling algorithms.
CO3	Familiar with principles of deadlock and its prevention. To understand the concepts of file system interface.
CO4	Identify use and valuate the storage management policies with respect to different storage Management technologies
CO5	Identify the need to create the special purpose operating system.

Reference Books:

1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts,Ninth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2005.
2.	A.S.Tanenbaum, Operating System : Design and Implementation,Prentice Hall of India, 1989.
3.	J.L.Galvin and A.Silberschatz, Operating System Concepts,Addison-Wesley, 1998

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CO2	0	3	2	2	0	0	2	0	2	2	0	2
CO3	0	3	2	2	0	0	2	0	2	2	0	2
CO4	0	2	2	2	0	0	2	0	2	2	0	3
CO5	0	3	2	2	0	0	2	0	2	2	0	2

High-3, Medium-2, Low-1

Course Title	Theory of Computation	Semester	IV
Course Code	MVJ20IS46	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

- Acquire knowledge of Automata Theory as the basis of all computer science languages design
- Understand the concept of Context Free Grammars and Languages
- Understand the concepts of Turing Machine and Chomskian Languages
- Acquire knowledge of Decidability.
- Enrich the knowledge in various phases of compiler ant its use

Module-1	L1,L2, L3	12 Hours

- Introduction - Basic Mathematical Notation and techniques - Finite State systems - Basic Definitions
- Finite Automaton - DFA & NDFA –Finite Automation with Epsilon Moves- Regular Languages- Regular Expression - Equivalence of NFA and DFA - Equivalence of NDFAs with and without Epsilon moves - Equivalence of finite Automaton and regular expressions - Minimization of DFA- Pumping Lemma for Regular sets- Problem based on Pumping Lemma.

- Laboratory Sessions/ Experimental learning:
- Problems on DFA/NFA, regular expression, Pumping Lemma
- Applications: Text processing, compilers, and hardware design. Recognizing the pattern using regular expressions.

Video link / Additional online information :

- https://www.youtube.com/watch?v=NeI1oOFlVtU
- https://www.youtube.com/watch?v=_Z3XdgpE64
- https://www.geeksforgeeks.org/regular-languages-and-finite-automata-gq/

Module-2	L1,L2, L3	12 Hours

Grammar Introduction - Types of Grammar - Context Free Grammars and Languages - Derivations andLanguages-Ambiguity-Relationshipbetweenderivationandderivationtrees-Simplificationof CFG - Elimination of Useless symbols - Unit productions - Null productions –Normal forms-problems based on CNF & GNF - Pushdown Automata – Definitions-Moves-Instantaneousdescriptions-Deterministicpushdownautomata-Equivalenceof Pushdown Automata and CFL-Pumping Lemma for CFL Problem based on Pumping Lemma.

Laboratory Sessions/ Experimental learning:

Problems on CFG, pushdown automata

Applications: CFGs can be used in programming languages, to study human language and in Artificial Intelligence

.

Video link / Additional online information :

https://www.youtube.com/watch?v=ocLRMFr0TMI

https://www.geeksforgeeks.org/ambiguity-in-context-free-grammar-and-context-free-languages/

https://www.cis.upenn.edu/~jean/gbooks/tcbookpdf2.pdf

Module-3	L1,L2, L3	12 Hours

Definitions of Turing machines – Models – Computable languages and functions – Techniques for Turing machine construction – Multi head and Multi tape Turing Machines - The Halting problem – Partial Solvability – Problems about Turing machine- Chomskian hierarchy of languages.

Laboratory Sessions/ Experimental learning:

Problems on Turing Machine, Halting Problem

Applications: Designing the parsing phase of a compiler (Syntax Analysis).

Video link / Additional online information :

https://www.javatpoint.com/automata-turing-machine

https://nptel.ac.in/courses/106/106/106106049/

https://www.geeksforgeeks.org/halting-problem-in- theory-of-computation/

Module-4	L1,L2, L3	12 Hours

Unsolvable Problems and Computable Functions – Recursive and recursively enumerable languages – Universal Turing machine.

MEASURING AND CLASSIFYING COMPLEXITY: Time and Space Complexity- Tractable and Intractable problems- Tractable and possibly intractable problems - Polynomial time reductions.

Laboratory Sessions/ Experimental learning:

Problems on Computational Complexity

Applications: Measuring Time and Space Complexity.

Video link / Additional online information

:https://nptel.ac.in/courses/106/104/106104227/

https://nptel.ac.in/content/storage2/courses/106103015/module1/lec1/1.htm

Module-5	L1,L2, L3	12 Hours

Introduction to Compiling - The grouping of phases - Compiler construction tools. The role of the lexical analyzer - Input buffering - Specification of tokens - Recognition of tokens - A language for specifying lexical analyzer.

Laboratory Sessions/ Experimental learning:

Problems on lexical analysis

Applications: Designing lexical analyzer of a compiler.

Video link / Additional online information :

http://www.vssut.ac.in/lecture_notes/lecture1422914957.pdf

https://rmd.ac.in/dept/cse/notes/6/CD/unit1.pdf

Course outcomes:

CO1	Construct finite automata for given pattern and find its equivalent regular expressions.

CO2	Design and simplify context free grammar and find equivalent pushdown automata for given language.
CO3	Design Turing Machines for any Languages
CO4	Derive whether a problem is decidable or not.
CO5	Understand the basic concepts of Compiler Design

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

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	1	0	2	0	0	0	0	0	0	0	0	2
CO2	2	1	2	0	0	0	0	0	0	0	0	0
CO3	1	0	2	0	0	0	0	0	0	0	0	2
CO4	1	0	2	0	0	0	0	0	0	0	0	2
CO5	1	0	2	0	0	0	0	0	0	0	0	2

High-3, Medium-2, Low-1

Course Title	Design & Analysis of Algorithm Lab	Semester	IV
Course Code	MVJ20ISL47	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

Understanding the basic algorithm techniques

Solve different algorithmic technique problems

Synthesize the efficiency of the algorithms in common engineering design situation

Sl No	Experiment Name	RBT Level	Hours
1	Implementation of Binary Search Trees	L3	4
2	Implementation of merge and quick sort algorithms and test their correctness and efficiency	L3	4
3	Implementation of Floyd-Warshall Algorithm and test their efficiency	L3	4
4	Implementation of 0/1 Knapsack problem using (a) Dynamic Programming method (b)Greedy method.	L3	4
5	(a) Implementation of all-Pairs Shortest Paths problem (b) Implementation of Travelling Sales Person problem	L3	4
6	Implementation and analysis of running time of eight-queen problem	L3	4
7	Implementation of insertion and topological sorting and test their efficiency.	L3	4
8	Program to find a subset of a given set S = {Sl, S2,.....,Sn} of *n* positive integers	L3	4
9	Program to find all Hamiltonian Cycles in a connected undirected Graph	L3	4
10	Mini Project /Case Presentation	L3	4

Course outcomes:

CO1	Analyze the complexities of various problems
CO2	Apply different algorithmic design paradigms and methods of analysis
CO3	Analyzing the different complexity for different algorithmic techniques
CO4	Implement various algorithms in a high-level language
CO5	Compare the performance of different algorithms for same problem

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, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	0	0	0	0	2	0	0
CO2	3	3	3	2	3	0	0	0	0	2	0	0
CO3	3	3	2	2	3	0	0	0	0	2	0	0
CO4	3	3	2	2	3	0	0	0	0	2	0	0
CO5	3	3	3	2	3	0	0	0	0	2	0	0

High-3, Medium-2, Low-1

Course Title	Microcontroller & Embedded Systems Lab	Semester	IV
Course Code	MVJ20ISL48	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

- Develop Assembly language programs for any real time scenario using Arm Microcontroller
- Demonstrate various real time application using ARM Microcontroller hardware.

Sl No	Experiment Name	RBT Level	Hours
1	Write a program to find the sum of first 10 integer numbers.	L3	2
2	Write a program to find factorial of a number.	L3	3
3	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM	L3	3
4	Write a program to find the square of a number (1 to 10) using look-up table.	L3	3
5	Write a program to find the largest/smallest number in an array of 32 numbers	L3	3
6	Write a program to arrange a series of 32 bit numbers in ascending/descending order	L3	3
7	Write a program to count the number of ones and zeros in two consecutive memory locations	L3	3
8	Write an ARM assembly program that checks if a 32-bit number is a palindrome. Assume that the input is available in r 3. The program should set r 4 to 1 if it is a palindrome, otherwise r 4 should have 0. A palindrome is a number which is the same when read from both sides. For example, 1001 is a 4 bit palindrome.	L3	3
9	Display “Hello World” message using Internal UART	L3	3

10	Interface and Control a DC Motor	L3	3
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction	L3	3
12	Interface a DAC and generate Triangular and Square waveforms.	L3	3
13	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in Between	L3	3
STUDY EXPERIMENT Interface a 4x4 keyboard and display the key code on an LCD		L3	2

Course outcomes:	
CO1	Describe the internal architecture of microcontroller systems, including counters, timers, ports, and memory
CO2	Develop programs using ARM7TDMI/LPC2148.
CO3	Test programs using ARM7TDMI/LPC2148
CO4	Conduct experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.
CO5	Interface a microcontroller system to user controls and other electronic systems.

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, Write-up : 20 marks Conduction : 40 marks

Analysis of results : 20 marks

Viva : 20 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	0	0	0	0	0	0	0	0	0	0	0
CO2	3	2	1	0	0	0	0	0	0	0	0	0
CO3	0	0	2	3	0	0	0	0	0	0	0	0
CO4	0	0	2	3	0	0	0	0	0	0	0	0
CO5	0	0	3	0	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	BALIKE KANNADA	Semester	IV
Course Code	MVJ20BK49	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	3Hrs

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
cheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
ASSIGNMENT		20
Semester End Examination	SEE (50)	50
Total		100

Course Title	SAMSKRUTHIKA KANNADA	Semester	IV
Course Code	MVJ20SK49	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	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.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
ASSIGNMENT		20
Semester End Examination	SEE (50)	50
Total		100

Course Title	Additional Mathematics-II (Common to all branches)	Semester	IV
Course Code	MVJ20MISDIP401	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 and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analysethe engineeringproblems.

Module-1	L1,L2	8Hrs.

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 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, sub tangent and subnormal 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 functions, Properties of Beta function and Gamma function ,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	8Hrs.

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 Link:
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 Link:

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

Module-5	L1,L2,L3	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-Dimentional 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.

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.
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

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)
- Assignments (10 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 Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	2	0	0	0	0	0	0	1	1
CO2	3	3	0	2	0	0	0	0	0	0	1	1
CO3	3	3	0	3	0	0	0	0	0	0	0	1
CO4	2	2	0	3	0	0	0	0	0	0	1	1
CO5	2	2	0	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Course Title	Technical Management & Entrepreneurship	Semester	V
Course Code	MVJ20TIM51	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 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 and supervision and Explain 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	12 Hours

Syllabus Content:

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	12 Hours

Syllabus Content:

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	12 Hours
Syllabus Content: 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	12 Hours
Syllabus Content: 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	12 Hours
Syllabus Content: 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:	L3	20 Hours
Case study on Enterprises: Case study (Microsoft), Case study (Captain G R Gopinath), Case study (N R 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/Reference 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

3.	Principles of Management, P C Tripathi, P N Reddy, 5th edition, TataMcGraw Hill, 2012
4.	Dynamics of Entrepreneurial Development & Management, Vasant Desai, Himalaya publishing house, 2009

CIE Assessment:

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

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Computer Network	Semester	V
Course Code	MVJ20IS52	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*

Understand the Computer Networks and Data Transmissions

Learn Functions of different protocols in networked computers

Get details about Functions of Network layer, Router and deliver of data to host network

Learn the function of mobile networking and switching

Multimedia data transmission in network

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Application Layer: Principals of network applications, Network Application Architecture, Processing Communicating. Transport Services Available to Applications, Transport Services provided by the Internet, Application-Layer Protocols.

The Web and HTTP: Overview of HTTP – Non-Persistent and Persistent Connections – HTTP Message Format – User-Server Interaction: Cookies – Web Caching.

Internet's Directory Service: Service Provided by DNS, Overview of How DNS Works, DNS Records and Messages – Peer-to-Peer File Distribution.

Application: Web Programming

Video Link:

https://www.geeksforgeeks.org/basics-computer-networking/

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers. Overview of the Transport Layer in the Internet – Multiplexing and Demultiplexing: Connectionless Transport: UDP, UDP segment Structure, UDP Checksum,

Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N, Selective Repeat, Connection-Oriented Transport TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Time out, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control: The Causes and the Costs of Congestion Approaches to Congestion Control.

Application:

Video Link:

https://www.guru99.com/types-of-computer-network.html

Module-3	L1,L2,L3	12 Hours

Syllabus Content:

The Network Layer: What's inside a Router – Input Processing – Switching – Output Processing – Where Does Queuing Occur? – Routing Control plane – Ipv6, A Brief foray into IP Security.

Routing Algorithms: The Link-State (LS) Routing Algorithm – The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing – Routing in the Internet – Intra -AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter/AS Routing: BGP, Broadcast Routing Algorithms - Multicast.

Application: Router Programming – Simulation , Hands-on simulation – Sensor Networks (Simulation)

Video Link:

https://lecturenotes.in/notes/15491-note-for-computer-network-cn-by-vtu-rangers

Module-4	L1,L2,L3	12 Hours

Syllabus Content:

An Overview of Cellular Network Architecture – 3G Cellular Data Networks: Extending the Internet to Cellular subscribers, On to 4GLTE, Mobility Management: Principles – Addressing -Routing to a mobile node - Mobile IP - Managing mobility in cellular Networks – Routing calls to a Mobile user – Handoffs in GSM – Wireless and Mobility: Impact on Higher - Layer Protocols.

Application: Ad hoc Networks Video Link: https://www.geeksforgeeks.org/basics-computer-networking/		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: **Multimedia Networking:** Types of multimedia Networking Application – streaming stored Video: UDP streaming – Http Streaming – Adaptive Streaming and DASH. **Network support for Multimedia:** Quality-of-Service Guarantees: Resource Reservation and Call Admission. Application: Video Link: https://www.guru99.com/types-of-computer-network.html		
Practical Experiments: 1. Study of LAN cables and other related devices. 2. Establishing LAN by assigning IP Address. 3. Implementation of FTP using java. 4. Implementation of TCP using java. 5. Implementation of UDP using java.		

Course outcomes:	
CO1	Establish LAN and assigning IP address to each node
CO2	Can apply different protocols to transfer data between computers
CO3	Know how the network deliver the packets to destination network
CO4	Know how switch happing between mobile towers and Functions of mobile networks
CO5	Guess the problems in audio/video transfer through network

Text/Reference Books:	
1.	Data Communication and Networking, Forth Edition, Behrouz A. Forouzan, , Mc Graw Hill.

2.	James F. Kurose and Keith W. Ross, Computer Networks A Top Down Approach, Sixth Edition, Pearson
3.	William Stallings, Data and Computer Communication, Tenth Edition, Pearson Education, 2013.
4.	Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Prentice Hall/Pearson

CIE Assessment:

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

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists 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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Python Programming	Semester	V
Course Code	MVJ20IS53	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 (L : T : P :: 3 : 1 : 1)	Total	100
Credits	4	Exam. Duration	3 Hours

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

Learn fundamental features of object-oriented language

Design, write, debug, run Python Programs

Develop console -based applications using Python

Develop console & windows applications using Python.

Introduce event driven Graphical User Interface (GUI) programming using Python built in functions

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Why should you learn to write programs, Introduction to Python, Variables, expressions and statements, Conditional execution, Functions.

Application:

In learning and implementing small project process

Video Link:

https://www.py4e.com/

http://greenteapress.com/wp/think-python/

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Iteration, Strings, Files.

Application:

Pattern recognition and Reading resultant column in supervised learning data set

Video Link: https://www.codecademy.com/learn/learn-python http://www.tutorialspoint.com/python/		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: Lists, Dictionaries, Tuples, Regular Expressions. Application: Handling query languages and Managing Large set of data with respect to database Video Link: https://www.programiz.com/python-programming/class https://www.udemy.com/course/web-scraping-with-python-beautifulsoup/		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: Classes and objects, Classes and functions, Classes and methods. Application: Designing games and puzzles Video Link: https://datatofish.com/json-string-to-csv-python/ https://automatetheboringstuff.com/		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Networked programs, Using Web Services, Using databases and SQL. Application: Music composition and movie development Video Link:		

http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf https://www.datacamp.com/community/tutorials/reading-and-editing-pdfs-and-word-documents-from-python
Practical Experiments: Programs related to Basic concepts of Python like Operators, Control flow and Iterations. Programs related to Functions, Strings, Files, Lists and Multi-Dimension Lists Installation and use of special Modules like pip, Wiki etc. Implementation of Python Program with a Database.

Course outcomes:	
CO1	Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
CO2	Demonstrate proficiency in handling Strings and File Systems.
CO3	Implement Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

Text/Reference Books:	
1.	Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf)
2.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2ndEdition, Green Tea Press, 2015. (http://greenteapress.com/thinkpython2/thinkpython2.pdf)
3.	Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014

CIE Assessment:
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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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Database Management System	Semester	V
Course Code	MVJ20IS54	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

- Provide Key Knowledge in database system concepts, applications and advantages.
- To get knowledge about SQL programming
- Design a database as redundant and error free
- Students can build a database application for real world problems
- Can derive the knowledge or pattern from real world data

Module-1	L1,L2,L3	12 Hours

Introduction: Database-System Applications – Purpose of Database – View of Data – Database Languages – Relational Databases – Database Design – Data Storage and Querying – Transaction Management – Database Architecture – Data mining and Information Retrieval – Specialty Databases – Database Users and Administrators.

Introduction to Relational Model: Structure of Relational Database – Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Operations – Relational Algebra.

Application: This module will give basic knowledge of database and SQL.

Video Link: https://www.youtube.com/watch?v=X9bQsAoqmfI

Module-2	L1,L2,L3	12 Hours

Introduction to SQL: Overview of the SQL Query Languages – SQL Definition – Basic Structure of SQL Queries – Additional Basic Operations – Set Operations – Null Values – Aggregate Functions - Nested Subqueries – Modification of Database.

Intermediate SQL: Join Expressions – Views – Integrity Constraints – SQL Data types and Schemas – Authorization.

Advanced SQL: Functions and Procedures – Triggers.

Application: Students can learn more complex queries and can design error free database using constraints.

Video Link: https://www.youtube.com/watch?v=fRMv14j5XJU

Module-3	L1,L2,L3	12 Hours

Relational Database Design: Features of Good Relational Designs – Atomic Domains and First Normal Form – Decomposition Using Functional Dependencies – Functional-Dependency Theory – Algorithm for Decomposition – 2nd Normal Form, 3rd Normal Form, Boyce Codd Normal Form Decomposition using Multivalued Dependencies – 4th Normal Form and domain Key Normal Form.

Application: Students can learn how to divide the table without any data lose and can execute queries without any anomalies.

Video Link: https://www.youtube.com/watch?v=Ko_LE3TNO64&t=1s

https://www.youtube.com/watch?v=p62he-WUp9E

Module-4	L1,L2,L3	12 Hours

Transaction: Transaction Concept – A Simple Transaction Model – Transaction Atomicity and Durability – Transaction Isolation – Serializability – Isolation Levels – Implementation of Isolation Level –

Concurrency Control: Lock-Based Protocol – Timestamp-Based Protocols – Validation-Based Protocol.

Advanced SQL: Accessing SQL From a Programming Language.

Application design and Development: Application Programs and User Interfaces – Web Fundamentals – Servlet and JSP

Application: Students can develop a web-based application for accessing database.

Video Link: https://www.youtube.com/watch?v=w83Ug6IwVTw

https://www.youtube.com/watch?v=Thm0xW9oTow

https://www.youtube.com/watch?v=C_J6K8DodS8

Module-5	L1,L2,L3	12 Hours
Data Warehousing, Data Mining, and Information Retrieval: Data Warehousing and Mining – Data Warehousing – Data Mining – Classification – Association Rules – Data mining algorithms using Weka Tools. Application: Students can develop an application using JAVA with Weka for data mining operations. Video Link: https://www.youtube.com/watch?v=XlbM9ibjUuM		

Practical Experiments
Accessing Database through JDBC (Hands-On)
Clustering – Using Weka tool (Hands-On)
Classification using Weka tool (Hands-On)
Machine Learning algorithms using Weka tool (Hands-On)

Course outcomes:	
CO1	Understand the database requirements of real-world problems
CO2	Querying the data according to different requirements
CO3	Design database for real world problems like bank, commercial shops
CO4	Develop application program to real world problems
CO5	Database mining to derive pattern among different data sets

Text/Reference Books:	
1.	Database System Concepts, Sixth Edition, by Abraham Silberschatz, Henery F. Korth, S. Sundarshan
2.	Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
3.	Database Management System, Ramakrishnan and Gehrke, 3rd Edition, Mc-GrawHill, 2013.
4.	Data Mining Concepts and Techniques, Second Edition, by Jiawei Han and Micheline Kamber, Elsevier.

CIE Assessment:
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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 Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	2	2	3	3	2	2	2	3	2
CO2	3	3	3	2	2	3	2	2	2	2	2	1
CO3	2	3	3	2	2	3	2	2	1	1	2	2
CO4	2	3	3	2	2	2	2	1	1	1	2	2
CO5	2	3	2	3	1	1	2	2	1	2	2	1

High-3, Medium-2, Low-1

Course Title	Advanced JAVA & J2EE	Semester	V
Course Code	MVJ20IS551	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 0 : 1)	Total	100
Credits	3	Exam. Duration	3 Hours

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

Construct client-server applications using Java socket API

Identify the need for advanced Java concepts like Enumerations and Collections

Make use of JDBC to access database through Java Programs

Adapt servlets to build server side programs

Demonstrate the use of JavaBeans to develop component-based Java software

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Enumerations, Autoboxing and Annotations(metadata): Enumerations, Enumeration fundamentals, the values() and value Of() Methods, java enumerations are class types, enumerations Inherits Enum, example, type wrappers, Autoboxing, Autoboxing and Methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of Warning. Annotations, Annotation basics, specifying retention policy, Obtaining Annotations at run time by use of reflection, Annotated element Interface, Using Default values, Marker Annotations, Single Member annotations, Built-In annotations

Application:

choices on a menu, rounding modes, command line flags, etc.

Autoboxing & Auto unboxing:

Annotations

Video Link: https://www.youtube.com/watch?v=vJ-Zn4fo0MQ&t=608s

Module-2	L1,L2,L3	12 Hours
Syllabus Content: **The collections and Framework**: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, Accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working With Maps, Comparators, The Collection Algorithms, Why Generic Collections, The legacy Classes and Interfaces, Parting Thoughts on Collections. Application: Writing an application Video Link: https://www.youtube.com/watch?v=Ma7u6KEKzPE		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: String Handling :The String Constructors, String Length, Special String Operations, String Literals, String Concatenation, String Concatenation with Other Data Types, String Conversion and toString( ) Character Extraction, charAt( ), getChars( ), getBytes( ) toCharArray(), String Comparison, equals( ) and equalsIgnoreCase( ), regionMatches( ) startsWith( ) and endsWith( ), equals( ) Versus == , compareTo( ) Searching Strings, Modifying a String, substring( ), concat( ), replace( ), trim( ), Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer , StringBuffer Constructors, length( ) and capacity( ), ensureCapacity( ), setLength( ), charAt( ) and setCharAt( ), getChars( ),append( ), insert( ), reverse( ), delete( ) and deleteCharAt( ), replace( ), substring( ), Additional StringBuffer Methods, StringBuilder Application: Datatype Video Link: https://www.youtube.com/watch?v=N63JCXwdd14		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies;		

Session Tracking. Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects

Application: java-based web application.

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

Module-5	L1,L2,L3	12 Hours

Syllabus Content:

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– InetAddress class – URL class-TCP sockets - UDP sockets, Java Beans –RMI.

Application: Connecting, storing, retrieving data between program and any database.

Video Link: https://www.youtube.com/watch?v=Cq4lwVE2Fzk

Practical Experiments:

1. Program to demonstrate working of Inet Address class and the methods of the InetAddress class for Java Networking
2. Program to demonstrate how to apply event handling mechanism to JCheckBox Swing Components :
3. Program to demonstrate JDBC
4. Program to demonstrate RMI
5. Program to demonstrate SERVLETS
6. Program to demonstrate JSP

Program to demonstrate JAVA BEANS

Course outcomes:

CO1	Interpret the need for advanced Java concepts like enumerations and collections in developing modular and efficient programs
CO2	Build client-server applications and TCP/IP socket programs
CO3	Illustrate database access and details for managing information using the JDBC API
CO4	Describe how servlets fit into Java-based web application architecture
CO5	Develop reusable software components using Java Beans

Text/Reference Books:	
1.	Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007.
2.	Jim Keogh: J2EE-TheCompleteReference, McGraw Hill, 2007.
3.	Stephanie Bodoff et al: The J2EE Tutorial, 2nd Edition, Pearson Education,2004.
4.	Uttam K Roy, Advanced JAVA programming, Oxford University press, 2015.
5.	Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007.

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 Mapping

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

High-3, Medium-2, Low-1

Course Title	System Software	Semester	V
Course Code	MVJ20IS552	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: Understand the role of system software in improving the system performance. Design Assembler, Linker, Loader and Macro processor		
Module-1	L1,L2,L3	12 Hours
Syllabus Content: System Software Vs. Application Software, SIC & SIC/XE Architecture, Addressing modes, SIC & SIC/XE Instruction set, Assembler Directives and Programming-Traditional CISC Machine – RISC Machine. Application: Flexible access to memory, easy access to variables, arrays, records, pointers, and other complex data types Video Link: https://www.youtube.com/watch?v=HkQKTkw6-Rw		
Module-2	L1,L2,L3	12 Hours
Syllabus Content: Basic Functions of Assembler-Assembler output format -Header, Text and End Records-Assembler data structures, two pass assembler algorithm, and Machine dependent assembler features. Application: Conversion of assembly language into machine code Video Link: https://www.youtube.com/watch?v=GL4rrAAdSGs		
Module-3	L1,L2,L3	12 Hours

Syllabus Content:

Machine Independent assembler features - program blocks, Control sections, Assembler design options- Algorithm for Single Pass assembler, Multi pass assembler, Implementation example of MASM Assembler

Application: Generation of object program

Video Link: https://www.youtube.com/watch?v=JXAzbmFTL2Q

Module-4	L1,L2,L3	12 Hours

Syllabus Content:

Basic functions of loader, Machine dependent loader feature, Machine Independent loader features, Bootstrap Loaders, Loader design options- Linker: Introduction, Relocation and Linking concepts, Design a linker, Self relocating program linking for overlays.

Application: Submission of ipa files to app store on Windows, Mac, and Linux systems

Video Link: https://www.youtube.com/watch?v=sFFg_-ekc0o

https://www.youtube.com/watch?v=vosmW_6MXjM

Module-5	L1,L2,L3	12 Hours

Syllabus Content:

Basic macro processor functions - Macro Definition and Expansion - Macro Processor Algorithm and data structures - Machine-independent macro processor features - Concatenation of Macro Parameters.

Generation of Unique Labels - Conditional Macro Expansion - Keyword Macro Parameters – Macro within Macro - Implementation example - MASM Macro Processor.

Application: Processing any kind of text

Video Link: https://www.youtube.com/watch?v=N0gLU8ka7Jo

Practical Experiments:

- Writing various LEX programs
- Writing various YACC programs

Course outcomes:

CO1	Explore the machine architecture of SIC, SIC/XE, CISC and RISC.

CO2	Compare the features of one pass, two pass and multipass assembler in terms of performance and analyze the suitable assembler for the given program.
CO3	Design and Implement assembler programs
CO4	Analyze the features of loaders and linkers
CO5	Implement the algorithm and data structure of machine independent macro processors

Text/Reference Books:	
1.	Leland L Beck and D Manjula, System Software - An Introduction to Systems Programming,
2.	Pearson Education 2011.
3.	Srimanta Pal,Systems Programming,Oxford University Press, 2011
4.	John R. Levine,Linkers & Loaders, Morgan Kauffman, 2003
5.	John J.Donovan,Systems Programming,Tata McGraw-Hill, 1991

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	1	2	2	2								
CO3		2	3									
CO4	1	2	3	3								
CO5	1		2	2								

High-3, Medium-2, Low-1

Course Title	Unix shell programming	Semester	V
Course Code	MVJ20IS553	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Learn about operating system and interact through commands.

Understand texting based command and shell programming

Work with process and files

Understand how networking and client/server system works.

Learn 'perl' script cording

Module-1	L1,L2,L3	12 Hours

Unix Components/Architecture – Environment and Structure – Posix and Single Unix Specification – Login Prompt – Unix Commends and Structure – Commands Arguments Options – Basic Commands & Combining commands – *date, passwd,* and *cal* Command - Types of commands and locating it – man command – Unix online manual page – Knowing user terminal – displaying – setting – managing the non-uniform behaviour of terminals and keyboards – Root Login, etc/passwd and etc/shadow files – command for add, modify and delete users

Unix Files: File types - Organization - hidden files and standard directories – Parent and child relationship - Home Directory – File path with various options – Directory commands – *cat, mv, rm cp, wc* commands – *od, cmp* and *comm, diff* commands – File attributes and Permission – Directory Permission

Application: Students will get awareness about opensource platforms, Unix OS and commands.

Video Link: https://www.youtube.com/watch?v=3DA1grSp4mU

Module-2	L1,L2,L3	12 Hours

vi-basics – input mode command – navigation commands – searching for pattern (/ and ?) search and replace (:S) – shells interpretive cycle – Removing special meanings of wild cards – three standard files and redirections – connecting

commands: PIPE, Splitting the output: tee – 'grep' and 'sed' command – command substitution – basic and extended regular expressions – examples involving different regular expression.

Shell Programming: Ordinary and environment variables – The .profile, .read and readonly commands – Command line arguments – logical operators – for conditional execution – exit and exit status of a command – test command and its shortcut – Control Statements – loop statements – 'if' statement examples – 'case' statement – sort command and its options – set and shift command – handling positional parameter – two special files /dev/null and dev/tty – Head and tail commands – cut and paste commands – unmask and default file permission.

Application: Students can learn basic Unix command and 'vi' editor for text processing.

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

Module-3	L1,L2,L3	12 Hours

The Process: The process and control – creating parent and child process – ps command its options – background processes – corn command crontab files – kill and find commands – batch command and priority – 'nice' command. Process identifiers – fork, vfork, exit, wait, waitpid, wait3, wait4 functions – race conditions – exec functions – changing user IDs and Group IDs – Interpreter Files – System function – Process Accounting – User Identification – Process times – I/O Redirection.

Process Relationship: Terminal login – network logins – process groups – sessions – Controlling Terminal – tcgetpgrp and tcsetpgrp functions – Job Control – Shell Execution of programs – Orphaned process groups.

Application: Students can learn process related commands and User privileges

Video Link: https://www.youtube.com/watch?v=9YRxhlvt9Zo

Module-4	L1,L2,L3	12 Hours

Inter-process Communication: Overview of IPC methods – Pipes – popen – pclose functions – Coprocesses, FIFOs – System V IPC – Message Queues – Semaphores. Shared Memory – Client-Server Properties – Stream Pipes – Passing File descriptors – An open server-Version 1, Client-Server Connection Functions.

Application: Students can learn how schedule process for run and inter-process

communication. Video Link: https://www.youtube.com/watch?v=lcRqHwIn5Dk		
Module-5	L1,L2,L3	12 Hours
Structure of Perl script – Variables – Operators – String Handling functions – Range operators – lists and arrays - @variables and splice operators – File and File handling functions – Regular Expressions – simple and multiple search patterns – match and substitute operators – defining and using subroutines. Application: Students can learn to write shell script in Unix environment. Video Link:https://www.youtube.com/watch?v=ELp9ytLjupE&list=PLGqiLyfegVYDeHVG0qigvOK5liPnDi4B9		
Practical experiments: Basic Unix commands Unix Shell Programming		
Course outcomes:		
CO1	Easily interact with Unix shell through commands	
CO2	Easily can work with text 'vi' editor for text processing	
CO3	Create and execute programs to read/write data from files	
CO4	Client/Server communication through network	
CO5	Wirte 'perl' script for unix operating system	
Text/Reference Books:		
1.	Sumitabha Das., Unix Concepts and Applications., 4th Edition., Tata McGraw Hill	
2.	Terrence Chan Unix System Programming Using C++ , PHI, 1999.	
3.	W.Richard Stevens, Stephen A. Rago, Advanced Programming in the UNIX Environment , 3rd edition, Pearson Education /PHI, 2005.	
4.	Behrouz A. Forouzan, Richard F. Gilberg: Unix and Shell Programming – Cengage Learning – India Edition 2009	
5.	M.G. Venkatesh Murth: Unix and Shell Programming, 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:
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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Information Coding Techniques	Semester	V
Course Code	MVJ20IS554	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understand error–control coding.

Understand encoding and decoding of digital data streams.

Be familiar with the methods for the generation of these codes and their decoding techniques.

Be aware of compression and decompression techniques.

Learn the concepts of multimedia communication

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding – Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

Application: Data Compression

Video Link: https://www.youtube.com/watch?v=0hdhiXuCtBo

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

Application: Video Mail

Video Link: https://www.youtube.com/watch?v=aKl17gw_nfU

Module-3	L1,L2,L3	12 Hours
Syllabus Content: Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes. Application: Attack detection Video Link: https://www.youtube.com/watch?v=NuqJglzI6o8		
Module-4	**L1,L2,L3**	**12 Hours**
Syllabus Content: Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards. Application: sms Video Link: https://www.youtube.com/watch?v=JsTptu56GM8		
Module-5	**L1,L2,L3**	**12 Hours**
Syllabus Content: Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards. Application: speech coding and speech synthesis Video Link: https://www.youtube.com/watch?v=lWH-Oh5KnNY		
Practical Experiments: Hands on: Application of Error control coding Hands on: Program on image compression		

Hands on: Application of Modulation Techniques Hands on: Application of Channel capacity Theorem Hands on: Speech coding	
Course outcomes:	
CO1	Design an application with error–control.
CO2	Use compression and decompression techniques.
CO3	Apply the concepts of multimedia communication
CO4	Apply compression and decompression techniques.
CO5	Use the concepts of multimedia communication

Text/Reference Books:	
1.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2001.
2.	Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002;
3.	Mark Nelson, "Data Compression Book", BPB Publication 1992.
4.	Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	2	3		2							
CO2	2	2	3	3	2							
CO3	3		2	2								
CO4	3		2	3								
CO5	3	3	3	3	3							

High-3, Medium-2, Low-1

Course Title	Computer Network Lab	Semester	V
Course Code	MVJ20ISL56	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

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

Learn different network types and basic networking commands

Functions of different data transmission protocols

Client/Server communication model

IP address and address resolving

To get knowledge about web development

Sl No	Experiment Name	RBT Level	Hours
1	Understating the function of Network related hardware corresponding to OSI or TCP/IP protocol stack (Router, Switch, Repeater, Ethernet etc.,) Interconnecting computers to learn different topologies c)Networking commands	L3	4
2	Establishing LAN by assigning IP addresses (Students should establish LAN by connecting devise using hardware)	L3	4
3	Program to access local, remote and web server IP addresses	L3	4
4	Implementation of socket program for Echo/Ping/Talk Commands	L3	4
5	Implementation of program for Remote Command Execution	L3	4
6	Program for CRC and Hamming code for error handling	L3	4
7	Program to simulate sliding window protocol	L3	4
8	Client/Server Data Transmission using TCP Client/Server Data Transmission using FTP Client/Server Data Transmission using UDP	L3	4
9	Chat application using TCP	L3	4
10	Implementation of Address Resolution Protocol (ARP)	L3	4

Course outcomes:	
CO1	Establish LAN by assigning IP address
CO2	Work with networking Commands
CO3	Write a program using TCP/UDP for data transmission between systems
CO4	Write a program to design Client/Server communication
CO5	Design and Web and develop an web application

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, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20

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

High-3, Medium-2, Low-1

Course Title	Operating System & Shell Programming Lab	Semester	V
Course Code	MVJ20ISL57	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

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

Learn about operating system and interact through commands.

Understand texting based command and shell programming.

Work with process and files

Understand how networking and client/server system works.

Learn 'perl' script coding.

Sl No	Experiment Name	RBT Level	Hours
1	Write a program to implement CPU scheduling algorithm for first come first serve scheduling.	L3	4
2	Write a program to implement CPU scheduling algorithm for shortest job first scheduling.	L3	4
3	Implement all file allocation strategies.	L3	4
4	Implement Bankers algorithm for Dead Lock Avoidance	L3	4
5	Implement the all page replacement algorithms a) FIFO b) LRU c) LFU	L3	4
6	Use of Basic UNIX Shell Commands: ls, mkdir, rmdir, cd, cat, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit	L3	4
7	Basic programs using iterative and conditional statements in Unix Simple programs to illustrate all looping statements Display odd and even number using all the looping statements. All types of conditional statements	L3	4
8	Write a shell script to create a file. Follow the instructions	L3	4

	Input a page profile to yourself, copy it into other existing file; Start printing file at certain line Print all the difference between two file, copy the two files. Print lines matching certain word pattern.		
9	a. Write a shell programs to sort any given numbers b. Write a shell programs to sort list of given names	L3	4
10	Write a Shell programs using function.	L3	4

Course outcomes:	
CO1	Easily interact with Unix shell through commands
CO2	Easily can work with text 'vi' editor for text processing
CO3	Create and execute programs to read/write data from files
CO4	Client/Server communication through network
CO5	Wirte 'perl' script for unix operating system

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, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	1	1	0	1	1	1
CO2	2	2	1	1	1	1	1	1	1	1	2	1
CO3	3	2	1	1	1	0	1	1	1	1	2	2
CO4	2	2	1	2	1	1	0	1	1	0	1	1
CO5	2	3	2	1	1	1	1	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	Database Management System Lab	Semester	V
Course Code	MVJ20ISL58	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

- To understand the functions of database system
- Query processing and execution to retrieve data
- Get the idea about complex query execution
- get the knowledge about database and programming connection
- Get the knowledge about data mining algorithms

Sl No	Experiment Name	RBT Level	Hours
1	a. Study of User privileges b. Experiments on All Data Definition Language (create, modify, drop table etc.,)	L3	4
2	Experiments on All Data Manipulation Language (Insert, Delete, Update)	L3	4
3	Experiments on Nested Sub-queries and Inner Queries	L3	4
4	Experiments on All types of Joins	L3	4
5	Experiment on Cursor, Assertion and Triggers	L3	4
6	Experiments on PL\SQL and Procedure and Function	L3	4
7	Implementation of Normal forms – (The faculty should give some set of attributes and students should solve by different normal forms)	L3	4
8	Front-end & Back-end application 1 (Front end – any programming language, Back-end – any database software)	L3	4
9	Front-end & Back-end application 2 (GUI Based)	L3	4
10	Front-end & Back-end application 3 (GUI based application for shops, etc.,)	L3	4

11	Implementation of Data mining Algorithms 1 – using Weka or Orange		
12	Implementation of Data mining Algorithms 2 – using Weka or Orange		
13	Implementation of Data mining Algorithms 3 – using Weka or Orange		

Course outcomes:	
CO1	Create table, insert data using sql commands
CO2	Execute queries for acquire data from database
CO3	Develop a program for commercial shop bill maintenance
CO4	Develop a web application to remote data processing
CO5	Implement data mining algorithms for derive patterns in data

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, Write-up : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20 marks

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

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ20ENV59	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 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.	
C03	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic mponents.	

CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that

Scheme of Evaluation		
Details		Marks
Assessment by Faculty mentor (Classroom Evaluation)	CIE (50)	10
Self-Assessment + Assessment by peers		20
Activities / Experimentations related to courses/Assignment		10
Mini Projects / Case Studies		10
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Environmental Studies Benny Joseph Tata Mc Graw – Hill. 2nd Edition, 2012
2.	Environmental Studies S M Prakash Pristine Publishing House, Mangalore 3rd Edition, 2018. 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.

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	V
Course Code	MVJ20UHV510	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	2 (L : T : P :: 2 : 0 : 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_Kt6jqzA3pZ3yA7g_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

Scheme of Evaluation

Details		Marks
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	10
Self-Assessment + Assessment by peers		20
Activities / Experimentations related to courses/Assignment		10
Mini Projects / Case Studies		10
Semester End Examination	SEE (50)	50
Total		100

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

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

High-3, Medium-2, Low-1

Course Title	Artificial Intelligence	Semester	VI
Course Code	MVJ20IS61	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*

Identify the problems where AI is required and the different methods available.

Compare and contrast different AI techniques available.

Define and explain learning algorithms.

Design different learning algorithms for improving the performance of AI systems.

Implement projects using different AI learning techniques.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

What is artificial intelligence, Problems, Problem Spaces and search, Heuristic search technique.

Application:

Solving various AI based problems.

Video Link:

http://www.nptelvideos.in/2012/11/artificial-intelligence.html

https://www.cualit.com/artificial-intelligence-practical-use-cases/

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Knowledge Representation Issues, Using Predicate Logic, Representing knowledge using Rules.

Application:

Developing information about the objects

Video Link: http://www.nptelvideos.in/2012/11/artificial-intelligence.html https://www.cualit.com/artificial-intelligence-practical-use-cases/		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: Symbolic Reasoning under Uncertainty, Statistical reasoning, Weak Slot and Filter Structures. Application: Connecting one concept to another , combining ideas about data. Video Link: http://www.nptelvideos.in/2012/11/artificial-intelligence.html https://www.cualit.com/artificial-intelligence-practical-use-cases/		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: Strong slot-and-filler structures, Game Playing. Application: Designing Smart Games Video Link: http://www.nptelvideos.in/2012/11/artificial-intelligence.html https://www.cualit.com/artificial-intelligence-practical-use-cases/		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Natural Language Processing, Learning, Expert Systems. Application: Sentiment analysis		

Video Link: http://www.nptelvideos.in/2012/11/artificial-intelligence.html https://www.cualit.com/artificial-intelligence-practical-use-cases/	
Course outcomes:	
CO1	Identify the AI based problems.
CO2	Apply techniques to solve problems
CO3	Define learning and explain various learning techniques.
CO4	Discuss expert systems
CO5	Implement projects using different AI learning techniques.
Text/Reference Books:	
1.	E. Rich , K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
2.	Stuart Russel, Peter Norvig, "Artificial Intelligence: A Modern Approach" , 2nd Edition, Pearson Education, 2003.
3.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
4.	G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)	
SEE Assessment:	
Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3		2							
CO2	2	3	3	3	2							
CO3		2	2	2								
CO4		2	2	3								
CO5	3	3	3	3	3							

High-3, Medium-2, Low-1

Course Title	Internet of Things	Semester	VI
Course Code	MVJ20IS62	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*

Assess the genesis and impact of IoT applications, architectures in real world.

Illustrate diverse methods of deploying smart objects and connect them to network.

Compare different Application protocols for IoT.

Infer the role of Data Analytics and Security in IoT.

Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Application:

Connecting Smart Things

Video Link:

1. https://www.postscapes.com/internet-of-things-technologies/
2. https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT
3. https://www.iotforall.com/iot-ebooks/

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Application: Designing Smart Circuits Video Link: 1. https://www.postscapes.com/internet-of-things-technologies/ 2. https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT 3. https://www.iotforall.com/iot-ebooks/		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. Application: Data transmission using wireless technology Video Link: 1. https://www.postscapes.com/internet-of-things-technologies/ 2. https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT 3. https://www.iotforall.com/iot-ebooks/		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment Application: Designing Smart Systems Video Link: 1. https://www.postscapes.com/internet-of-things-technologies/ 2. https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT 3. https://www.iotforall.com/iot-ebooks/		

Module-5	L1,L2,L3	12 Hours

Syllabus Content:

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Application:

Securing and handling Smart systems

Video Link:

1. https://www.postscapes.com/internet-of-things-technologies/
2. https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT
3. https://www.iotforall.com/iot-ebooks/

Course outcomes:

CO1	Interpret the impact and challenges posed by IoT networks leading to new architectural models.
CO2	Compare and contrast the deployment of smart objects and the technologies to connect them to network.
CO3	Appraise the role of IoT protocols for efficient network communication.
CO4	Elaborate the need for Data Analytics and Security in IoT.
CO5	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Text/Reference Books:

1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for

	the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2.	Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017
3.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on- Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
4.	Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

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

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

High-3, Medium-2, Low-1

Course Title	Data Mining	Semester	VI
Course Code	MVJ20IS631	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Gather and analyze large sets of data to gain useful business understanding

Understand the data mining functionalities, technologies and steps in pre-processing the data

Learn data mining algorithms, methods and tools

Module-1	L1, L2, L3	12 Hours

Raw data to valuable information-Lifecycle of Data - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data marts - Overview of the components - Metadata in the data warehouse - Basic elements of data warehousing - Principles of dimensional modelling: Star schema, Snowflake schema and Galaxy schema.

Application:

Identify the potential risk of default and manage and control collections

Performance analysis of each product, service, interchange, and exchange rates

Store and analyze information about faculty and students

Maintain student portals to facilitate student activities

Video Link:

https://www.youtube.com/watch?v=8lHpioyvSng

Module-2	L1,L2,L3	12 Hours

Introduction to Data Mining Systems, Knowledge Discovery Process -Data Objects and attribute types, Statistical description of data, Data Preprocessing- Data Cleaning, Data Integration and Transformation, Data Reduction.

Application:

Financial Analysis

Telecommunication Industry.

Intrusion Detection

Retail Industry

Higher Education

Video Link:

https://www.youtube.com/watch?v=QRZlYzxEFDg

Module-3	L1,L2,L3	12 Hours

Market Basket Analysis, Frequent Item sets, Closed Itemsets, Association Rules, Frequent Itemset Mining Methods- Apriori algorithm, Generating Association rules from Frequent Itemsets, A Pattern- Growth Approach for mining frequent Itemsets, Mining Frequent Itemsets using the Vertical Data Format.

Application:

Market Basket Analysis

Medical Diagnosis:

Census Data

Protein Sequence

Video Link:

https://www.youtube.com/watch?v=RiFrbyiYpRs

Module-4	L1,L2,L3	12 Hours

Classification and Prediction ,Basic Concepts, Decision Tree Induction, Bayesian Classification ,Rule Based Classification, Classification by Back propagation , Support Vector Machines, Lazy learners.

Application:

Sentiment Analysis

Email Spam Classification

Document Classification

Image Classification

Video Link:

https://www.youtube.com/watch?v=gkagE_fE2sk

Module-5	L1,L2,L3	12 Hours

Types of Data in Cluster Analysis , Data similarity and dissimilarity measures ,A Categorization of Major Clustering Methods -Partitioning Methods-K-means, K-medoids , Hierarchical Methods-Agglomerative vs Divisive, Distance measures, BIRCH, Clustering High-Dimensional Data- Outlier Analysis and Detection.

Application:

Clustering analysis

In the field of biology, it can be used to derive plant and animal taxonomies.

Identification of areas of similar land use in an earth observation database.

Video Link:

https://www.youtube.com/watch?v=2QTeuO0C-fY

Experimental Part:

Apriori Algorithm for market Basket Analysis

Bayesian Classification

Decision Tree Induction Algorithm

Frequent Pattern-Growth Algorithm

Course outcomes:

CO1	Design data warehouse by applying principles of dimensional modelling and ETL concepts
CO2	Analyze various data pre-processing techniques for efficient data mining.
CO3	Apply association rule mining for finding hidden and interesting patterns in data.
CO4	Apply statistical procedure, machine learning and neural network based classification algorithms for data prediction
CO5	Apply clustering algorithms for the application and generalizations for real time problems

Text/Reference Books:	
1.	Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2.	Paulraj Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley, 2010
3.	Alex Berson, Stephen J Smith, Data warehousing, Data mining, and OLAP, Tata McGraw Hill edition, 2007
4.	Pang-Ning Tan, Michael Steinbach and Vipin Kumar,Introduction to Data Mining, Pearson Education, 2007
5.	G. K. Gupta ,Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006

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

High-3, Medium-2, Low-1

Course Title	Web Technology	Semester	VI
Course Code	MVJ20IS632	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 0 : 1)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Teach students HTML and CSS for designing web pages.

Introduce students to the basics of JavaScript as a programming language.

Familiarize students with the Document Object Model and enable them to create dynamic web pages that react to user input.

Teach students about installing and configuring Apache Server and incorporating backend support for their web pages.

Introduce students to the newer features available as part of the HTML standard

Module -1	L1,L2,L3	12 Hours

Introduction, UI Design and UX : Internet, WWW, Web Servers and Browsers, URLs, MIME, HTTP, Basic Markup, Images, Hyperlinks, Lists, Tables, Forms, DataList, Canvas, Audio and Video, Geo-Location, Local Storage, Web Workers, Offline Web Applications, Drag and Drop.HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats

Application: To deliver data (HTML files, image files, query results) on the World Wide Web.

Video Link:

https://www.freecodecamp.org/

https://developer.mozilla.org/en-US/docs/Web/CSS

Module -2	L1,L2,L3	12 Hours

Style Sheets: CSS Introduction to Cascading Style Sheets-Features-Core Syntax-Style

Sheets and HTML Style Cascading and Inheritance-Text Properties-Box Model Normal Flow Box Layout-Beyond the Normal Flow-Other Properties-Case Study. Client- Side Programming: Application: Describing the presentation of Web pages, including colors, layout, and fonts Video Link: https://www.vogella.com/tutorials/CSS/article.html https://nptel.ac.in/courses/106/105/106105084/		
Module - 3	L1,L2,L3	12 Hours
JavaScript: Introduction to Client-Side Scripting, JavaScript Basics, Screen Input and Keyboard Output, Functions, Objects, Inheritance, Hoisting, Arrays, JavaScript Objects, Accessing and Modifying DOM, Events and Event Handlers - Load, Mouse, Synthetic Events, Key and Form Related Events, Event Bubbling, Cookies. Application: Web Sites, Web Server Applications, Mobile Apps, Games Platform Video Link: https://www.udemy.com/courses/development/web-development/ https://javascript.info/hello-world#modern-markup		
Module-4	L1,L2,L3	12 Hours
PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVERArray, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions, PHP Error Reporting, PHP Error and Exception Handling Application: e-Commerce Applications. Web Pages and Web-Based Applications Video Link: http://www.nptelvideos.com/video.php?id=2142&c=27 http://www.nptelvideos.com/video.php?id=2131&c=27 http://www.nptelvideos.com/video.php?id=2116&c=27		
Module-5	L1,L2,L3	12 Hours

Bootstrap: Grid Systems, Layout, Tables and Forms, Buttons and Images, Progress Bar, Navigations. jQuery: Usage, Selecting DOM Elements, Getting and Setting Attributes, Changing Styles, File Handling and System Calls, Arrays, Cookies, Sessions, Database Access.

Application: Bootstrap is a front-end framework used to create modern websites and web apps

Video Link:

https://getbootstrap.com/docs/4.5/examples/

https://www.w3schools.com/bootstrap/bootstrap_buttons.asp

Practical Experiments:

Create a web page with the following. a. Cascading style sheets. b. Embedded style sheets. c. Inline style sheets. Use our college information for the web pages.

JavaScript to design a simple calculator

Java script to Validate the Registration, user login, user profile and payment by credit card pages

PHP program to display a digital clock which displays the current time of the server..

PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors

Course outcomes:

CO1	Outline the basic concepts of information and web architecture.
CO2	Design solutions for programming questions using JavaScript
CO3	Study Hyper Text markup language and create websites using HTML, CSS Codes.
CO4	Setup a web server and host a website with back end support.
CO5	Incorporate the latest HTML features in the web pages designed by them with fallback options wherever required.

Text/Reference Books:

1.	Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2.	Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education

3.	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.
4.	Marty Hall and Larry Brown,"Core Web Programming" Second Edition, Volume I and II, Pearson Education, 2001
5.	Bates, "Developing Web Applications", Wiley, 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:

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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Information Storage Management	Semester	VI
Course Code	MVJ20IS633	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understand data creation, the amount of data being created, the value of data to a business, challenges in data storage and data management

Understand solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

Understand the storage architecture and available technologies.

Learn to establish & manage data center.

Learn security aspects of storage & data center.

Module-1	L1,L2,L3	12 Hours

Introduction to Information Storage- Information Storage, Data, Types of Data, Big Data, Information, Storage, Evolution of Storage Architecture, Data Centre Infrastructure, Core Elements, Key characteristics for Data Centre Elements, Managing Data center, Virtualization and Cloud Computing. Data Centre Environment -Application, DBMS, Host, OS, Memory Virtualization, Device Driver, Volume Manager, File System, Compute Virtualization, Connectivity Physical Components of Connectivity, Interface protocols- IDE/ATA and Serial ATA, SCSI and Serial SCSI, Fiber Channel, Internet Protocol, Storage Application:

Identifying information storage systems

Video Link:

https://nptel.ac.in/courses/106/108/106108058/

Module-2	L1,L2,L3	12 Hours
Data Protection: RAID - Implementation of RAID, Software RAID, Hardware RAID, RAID Array Components, RAID Techniques- Striping, Mirroring, Parity; RAID LevelsRAID 0, RAID 1, Nested RAID, RAID 3, RAID 4, RAID 5, RAID 6, RAID Impact on Disk Performance, Application IOPS and RAID Configurations, RAID Comparison, Hot Spares. Application: Configuration of RAID Models Video Link: https://nptel.ac.in/courses/106/108/106108058/		
Module-3	**L2,L3**	**12 Hours**
Intelligent Storage System - Components of an Intelligent Storage System, Front End, Cache- Structure of Cache, Read Operation with Cache, Write Operation with Cache, Cache Implementation, Cache management, Cache Data Protection, Back End, Physical Disk, Storage Provisioning- Traditional Storage Provisioning, LUN Expansion: Meta LUN, Virtual Storage Provisioning, LUN Masking, Types of Intelligent Storage Systems- High end Storage Systems, Mid Range Storage Systems. Application: Working of cache memory Video Link: https://nptel.ac.in/courses/106/108/106108058/		
Module-4	**L2,L3**	**12 Hours**
Network-Attached Storage - General-Purpose Servers vs. NAS Devices, Benefits of NAS, File Systems and Network File Sharing- Accessing a File System, Network File Sharing; Components of NAS, NAS I/O Operations, NAS Implementations- Unified NAS, Unified NAS Connectivity, Gateway NAS, Gateway NAS Connectivity, Scale Out NAS, Scale Out NAS Connectivity, NAS File-Sharing Protocols- NFS, CIFS; Factors Affecting NAS Performance, File Level Virtualization.		

Application: Storage devices as servers. Video Link: https://nptel.ac.in/courses/106/108/106108058/		
Module-5	L2,L3	12 Hours
Backup Purpose- Disaster Recovery, Operational Backup, Archival, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments- Server Based and Server less Backup, NDMP- Based Backup; Backup Targets- Backup to Tape, Physical Tape Library, Limitations of Tape; Backup to Disk, Backup to Virtual Tape, Data Deduplication for Backup- Data Deduplication Methods, Data Deduplication Implementation, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture Application: Data Backup to avoid data loss. Video Link: https://nptel.ac.in/courses/106/108/106108058/		
CASE STUDY	L3	20 Hours
cloud computing Parallel SCSI Remote Replication Securing and Managing Storage Infrastructure Exploring AWS		

Course outcomes:	
CO1	Select from various storage technologies to suit for required application.
CO2	Apply security measures to safeguard storage & farm
CO3	Analyse QoS on Storage.
CO4	Describe the different role in providing disaster recovery and business continuity capabilities.
CO5	Distinguish different remote replication technologies.

Text/Reference Books:	
1.	Information Storage and Management, Second Edition, EMC Education Services, Wiley India Edition
2.	Storage Networks Explained, Ulf Tropan, Rainer Erkens, Wofgang Muller, Wiley, ISBN: 9788126518326
3.	Robert Spalding, –Storage Networks: The Complete Reference–, Tata McGraw Hill , Osborne, 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:

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 Mapping

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

High-3, Medium-2, Low-1

Course Title	LAW FOR ENGINEERS	Semester	VI
Course Code	MVJ20IS634	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 0 : 1)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

Outline the commercial context for engineering processes and business models that are socially responsible and environmentally sustainable.

Channelize thinking towards basic understanding of the legal concepts and its implications for engineers.

Acquaint with latest intellectual property rights and innovation environment with related regulatory framework

Module-1	L1,L2,L3	8 Hours

Origin of Environmental Law, Concept of Pollution – Sources of Pollution, Types of Pollution, and Effects of pollution. Nature and Scope of Environmental Law – Importance. Case Study.

Application: Environmental Law:

Video Link:https://www.digimat.in/nptel/courses/video/110106081/L01.html

Module-2	L2,L3	8 Hours

Provisions of various labor laws – workmen's compensation Act 1923; Disablement, Total Permanent disablement, Temporary disablement, Formula for compensation; Minimum wages act, 1948; Payment of bonus act, 1965; Weekly holidays Act, 1942; Payment of wages Act, 1936; employees Insurance Act, 1948.

Application: Labour Law

Video Link:https://www.digimat.in/nptel/courses/video/110106081/L01.html

Module-3	L2,L3	8 Hours
A brief introduction to criminal liability of Engineers as per the Indian Penal Code. Application: Indian Penal Code Video Link: https://www.digimat.in/nptel/courses/video/110106081/L01.html		
Module-4	**L2,L3**	**8 Hours**
IPR and Law of Torts: Definition, categories of torts, Breach of Duty and Damages. Concept of Property, Types of Property; Introduction to IPR; Types of IPR: Copyrights, Patents, Trademarks, Designs, Trade Secrets, Plant Varieties and Geographical Indications; Infringement of IPRs and Remedies available under the Indian Law. Application: IPR Video Link:https://www.digimat.in/nptel/courses/video/110106081/L01.html		
Module-5	**L2,L3**	**8 Hours**
Business Organizations and E-Governance: Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development. Applications: G2C, G2B,G2G Video link / Additional online information (related to module if any): https://www.digimat.in/nptel/courses/video/110105083/L01.html		

Course outcomes:	
CO1	Enumerate the principles of sustainable development
CO2	Discuss the significance of various legislations pertaining to engineers
CO3	Understand legal systems relevant for engineering
CO4	Understand codes of conduct, conflicts of interest and other ethical dilemmas
CO5	Correlate role of engineers with different organizations and governance models

Text/Reference Books:	
1.	B.S. Patil, Legal Aspects of Building and Engineering Contracts
2.	Ratanlal and Dhirajlal&: The Law of Torts.
1	S. Shantha Kumar- Introduction to Environmental Law.
2	Cornish W. R. (2008), Intellectual Property Rights, Patents, Trademarks, Copyrights & Allied Rights, Sweet & Maxwell
3	Madhavan Pillai - Labour and Industrial Laws.
4	Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/eGovernance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	3	2	-	-	-	-	3
CO2	3	2	2	2	3	3	2	-	-	-	-	3
CO3	3	2	2	1	3	3	2	-	-	-	-	3
CO4	3	2	2	2	3	3	2	-	-	-	-	3
CO5	3	2	2	1	3	3	2	-	-	-	-	3

High-3, Medium-2, Low-1

Course Title	Unix System Programming	Semester	VI
Course Code	MVJ20IS641	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Explain the fundamental design of the Unix operating system.

Familiarize with the systems calls provided in the Unix environment.

Design and build an application/service over the Unix operating system.

Familiarize with signals and daemon process characteristics.

Explain inter-process communication.

Module-1	L1,L2,L3	12 Hours

UNIX and ANSI Standards: The ANSI C Standard, The ANSI/ISO, C++ Standards, Difference between ANSI C and C++, The POSIX Standards, The POSIX.1 FIPS Standard, The X/Open Standards. UNIX and POSIX APIs: The POSIX APIs, The UNIX and POSIX Development Environment, API Common Characteristic.

Application: Operating system

Video Link: https://www.youtube.com/watch?v=hy4OeVCLGZ4

Module-2	L1,L2,L3	12 Hours

File Types, The UNIX and POSIX File System, The UNIX and POSIX File Attributes, Inodes in UNIX System V, Application Program Interface to Files, UNIX Kernel Support for Files, Relationship of C Stream Pointers and File Descriptors, Directory Files, Hard and Symbolic Links. UNIX File APIs: General File APIs, File and Record Locking, Directory File, APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs.

Application: Organizing and storing large data

Video Link: https://www.youtube.com/watch?v=HIXzJ3Rz9po

Module-3	L1,L2,L3	12 Hours

The Environment of a UNIX Process: Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions, UNIX Kernel Support for Processes. Process Control: Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 Functions, Race Conditions, exec Functions, Changing User IDs and Group IDs, Interpreter Files, system Function, Process Accounting, User Identification, Process Times, I/O Redirection. Process Relationships: Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tcgetpgrp and tcsetpgrp Functions, Job Control, Shell Execution of Programs, Orphaned Process Groups Application: booting of the system Video Link: https://www.youtube.com/watch?v=4bfzEyb4YD0		
Module-4	L1,L2,L3	12 Hours
The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction, The SIGCHLD Signal and the waitpid Function, The sigsetjmp and siglongjmp Functions, Kill, Alarm, Interval Timers, POSIX.lb Timers. Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Client-Server Model. Application: Communication Video Link: https://www.youtube.com/watch?v=X8VDJHzrHRE		
Module-5	L1,L2,L3	12 Hours
Overview of IPC Methods, Pipes, popen, pclose Functions, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores, Shared Memory, Client-Server Properties, Stream Pipes, Passing File Descriptors, An Open Server-Version 1, Client-Server Connection Functions. Application: Data flow, Communication Video Link: https://www.youtube.com/watch?v=W0BX6geRCDQ		

Practical Experiments: program to demonstrates inter-process communication. Programs using mkfifo, open, read, write and close APIs. program to check whether the region is locked or not. If the region is locked, print pid of the process which has locked. If the region is not locked, lock the region with an exclusive lock, read the last 50 bytes and unlock the region. program to illustrate the race condition.	L3	20 Hours

Course outcomes:	
CO1	Understand and reason out the working of Unix system and POSIX standards
CO2	Understand the UNIX file system and build an application/service over the Unix operating system
CO3	Demonstrate the Unix process environment and process control
CO4	Explain signals and daemon process characteristics.
CO5	Understand and write UNIX programs on inter-process communication.

Text/Reference Books:	
1.	Unix System Programming Using C++ - Terrence Chan, PHI, 1999.
2	Advanced Programming in the UNIX Environment - W.Richard Stevens, Stephen A. Rago, 3nd Edition, Pearson Education / PHI, 2005.
3	Advanced Unix Programming- Marc J. Rochkind, 2nd Edition, Pearson Education, 2005.
4	The Design of the UNIX Operating System - Maurice.J.Bach, Pearson Education / PHI, 1987.
5	Unix Internals - Uresh Vahalia, Pearson Education, 2001.

CIE Assessment:
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semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Virtual Reality	Semester	VI
Course Code	MVJ20IS642	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Explain this technology, underlying principles, its potential and limits

Knowledge about devices involved

Learn about the criteria for defining useful applications.

Illustrate process of creating virtual environments

Applications of Virtual Reality

Module-1	L1,L2,L3	12 Hours

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.

Application: Students can understand the basics of Virtual Reality.

Video Link: https://nptel.ac.in/courses/106/106/106106138/

Module-2	L1,L2,L3	12 Hours

Output Devices: Graphics displays, sound displays & haptic feedback.

Application: Students can get knowledge about the hardware involved in virtual reality.

Video Link: https://www.youtube.com/watch?v=Z1jQ62VDVSo

Module-3	L1,L2,L3	12 Hours

Modeling: Geometric modelling, kinematics modeling, physical modeling, behaviour modeling, model management

Application: Students will get the knowledge about various modeling techniques.

Video Link: https://www.youtube.com/watch?v=dF4QEfj61XQ		
Module-4	L1,L2,L3	12 Hours
Human Factors: Methodology and terminology, user performance studies, VR health and safety issues. Application: Students will learn impact of virtual reality of real life. Video Link: https://www.youtube.com/watch?v=8DvwtzdNK5U		
Module-5	L1,L2,L3	12 Hours
Medical applications, military applications, robotics applications Application: Students can get the knowledge about the applications of virtual reality. Video Link: https://www.youtube.com/watch?v=fJES5HYMOg0		
Practical Experiments/Research paper Study: Mobile Augmented Reality Based Experiments Simulating Educational Physical Experiments in Augmented Reality Web based Virtual Reality	L3	20 Hours

Course outcomes:	
CO1	Illustrate technology, underlying principles
CO2	Explain process of creating virtual environments
CO3	Explain its potential and limits and to learn about the criteria for defining useful applications.
CO4	Simulate physical experiments
CO5	Explain future research scope of virtual reality

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

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

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

High-3, Medium-2, Low-1

Course Title	Cryptography and Information Security	Semester	VI
Course Code	MVJ20IS643	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 0 : 1)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understand the basics of computer security concepts.

Understand the security risk and prepare the plans to avoid security exploitation.

Understand the cryptography and various algorithms.

Learn various cloud security for data protection.

Understand various kinds of wireless communication and its threat.

Module-1	L1,L2,L3	12 Hours

Overview: Computer Security Concepts, Requirements, Architecture, Trends, Strategy. Perimeter Security: Firewalls, Intrusion Detection, Intrusion Prevention Systems, Honeypots. User Authentication: Password, Password - Based, Token - Based, Biometric, Remote User Authentication. Access Control: Principles, Access Rights, Discretionary Access Control, UNIX File Access Control, Role Based Access Control. Internet Authentication Applications: Kerberos, X.509, PKI.

Application: Authentication

Video Link: https://www.youtube.com/watch?v=_44CHD3Vx-0

Module-2	L1,L2,L3	12 Hours

Human Factors: Security Awareness, Training and Education, Organization Security Policy, Employment Practices and Policy. IT Security Management and Risk Assessment: IT Security Management, Risk Assessment, Analysis of IT Security Controls. Plans and Procedures: IT Security Management Implementation, Security Controls, Plan, Implementation of Controls.

Application: Prevention of application security defects and vulnerabilities

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

Module-3	L1,L2,L3	12 Hours
Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Digital Signatures, Random Numbers, Symmetric Encryption. Message Confidentiality: DES, AES, Stream Ciphers, Cipher Block Modes of Operation, Key Distribution. Public Key Cryptography and Message Authentication: Asymmetric Encryption, Secure Hash Functions, HMAC, RSA, Diffie Hellman Algorithm. Internet Security Protocols: SSL, TLS, IPSEC, S/ MIME. Application: Authentication, Confidentiality, Security Token Video Link: https://www.youtube.com/watch?v=h8YRvQY7lcs		
Module-4	**L1,L2,L3**	**12 Hours**
Cloud Security: Cloud Computing Service Models and Layers, Security Issues in Cloud Computing. Bluetooth Security: Bluetooth Protocol Stack, Multiple Security Modes. Mobile Security: Security Concepts, Requirements, Architecture. Application : Web access Video Link : https://www.youtube.com/watch?v=36zducUX16w		
Module-5	**L1,L2,L3**	**12 Hours**
Wireless Network Security: Wireless Communications and 802.11 WLAN Standards Wireless Protected Access (WPA), IEEE 802.1x, 802.11i/ WPA2, Wireless Network Threats, ZigBee Security, Wireless Mesh Network Security. Application: Access control, transmission of data over long distance Video Link: https://www.youtube.com/watch?v=yBgcYT1riz8		
Practical Experiments:	**L3**	**20 Hours**
program to perform encryption and decryption program to implement the BlowFish algorithm logic Case Study: Digital Signature Case Study: Java Security Features/ Matlab Security Features Case Study: Authentication in Kerberos		
Course outcomes:		

CO1	Explain authentication and its application.
CO2	Choose Cryptography Algorithms based on the application domain of the network.
CO3	Write code to implement various Encryption/ Decryption algorithms.
CO4	Explain Bluetooth security and mobile security.
CO5	Apply Authentication Protocols and Processes.

Text/Reference Books:	
1.	Computer Security: Principles and Practice", William Stallings, Lawrie Brown, Indian Edition, Pearson, 2010.

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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 Mapping

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

High-3, Medium-2, Low-1

Course Title	GREEN COMPUTING	Semester	VI
Course Code	MVJ20IS644	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 0 : 1)	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

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Module-1	L1,L2,L3	12 Hours

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	12 Hours

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	12 Hours
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	12 Hours
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	12 Hours
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/
Practical Experiments: Naive Blockchain construction, Memory Hard algorithm Hashcash implementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction, Toy application using Blockchain, Mining puzzles

Course outcomes:	
CO1	Learn design principles of Bitcoin and Ethereum and Nakamoto consensus.
CO2	Explain the Simplified Payment Verification protocol.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO5	Evaluate security, privacy, and efficiency of a given blockchain system.

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.

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

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

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Wireless Sensor & Adhoc Network	Semester	VI
Course Code	MVJ20IS651	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

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

Understand the design issues in ad hoc and sensor networks.

Learn the different types of MAC protocols.

Be familiar with different types of ADHOC routing protocols.

Be expose to the TCP issues in ADHOC networks.

Learn the architecture and protocols of wireless sensor networks.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

Application: Television remote control, Wi-Fi, Cell phones, wireless power transfer, computer interface device

Video Link: http://coset.tsu.edu/lab35/

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based

protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11 Application: Enhancing Learning Using Modular Wireless Sensor Networking (WSN) Video Link: http://faculty.cs.tamu.edu/ajiang/sensor.pdf		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks. Application: Video Link: https://link.springer.com/chapter/10.1007/978-3-642-11723-7_34		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4 Application: An Experimental Study of Low-Power Wireless Sensor Networks Video Link: https://hal.inria.fr/hal-01147346/file/main.pdf		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues. Application: Research study on choosing an experimentation platform for wireless sensor networks Video Link: https://www.youtube.com/watch?v=3V19nPxpMp8&lc=Ugij232bvNB14ngCoAEC		

Practical Experiments:
An Experimental Study of Low-Power Wireless Sensor Networks
Enhancing Learning Using Modular Wireless Sensor Networking (WSN)
Research study on choosing an experimentation platform for wireless sensor networks

Course outcomes:	
CO1	Explain the concepts, network architectures and applications of ad hoc and wireless sensor networks
CO2	Analyze the protocol design issues of ad hoc and sensor networks
CO3	Design routing protocols for ad hoc networks with respect to some protocol design issues
CO4	Design routing protocols for wireless sensor networks with respect to some protocol design issues
CO5	Evaluate the QoS related performance measurements of ad hoc and sensor networks

Text/Reference Books:	
1.	C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008, 89
2.	Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
3.	Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
4.	Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
5.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.

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 Mapping

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CO1		2										2
CO2		2		2								
CO3					2						2	
CO4			2									
CO5					2							

High-3, Medium-2, Low-1

Course Title	TCP/IP Protocol Suit	Semester	VI
Course Code	MVJ20IS652	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: *This course will enable students to*		
Protocols and standards Know about host resolving protocols and packet deliver To understand the functions of UDP, TCP protocols To get the knowledge about network management protocols To get the knowledge about FTP		
Module-1	L1,L2,L3	12 Hours
Syllabus Content: Standards – Internet – History- OSI model – Protocol suite – Addressing – Transmission media – Local Area and Wide Area Networks – Switching – Connecting devices – IP addressing Application: Identify the IP address of an existing web check Video Link: https://www.youtube.com/watch?v=Jlc4E5zxCHQ		
Module-2	L1,L2,L3	12 Hours
Syllabus Content: Subnetting – Supernetting – IP packets – Delivery – Routing – Routing model – Routing table – Datagram – Fragmentation – Checksum – IP Design – ARP – RARP – Internet control message protocol – Internet group management protocol Application: Relieve network congestion Video Link: https://www.youtube.com/watch?v=Ct4PU6CyvTQ		

Module-3	L1,L2,L3	12 Hours
Syllabus Content: User Datagram protocol – UDP operation – Use – UDP design – TCP services – Flow control – Error control – TCP operation and design – connection – Transition diagram – Congestion control. Application: Routing update protocols Video Link: NPTEL: https://www.youtube.com/watch?v=f1y25BfOH9I		
Module-4	**L1,L2,L3**	**12 Hours**
Syllabus Content: Concurrency – BOOTP – DHCP – Domain name system – Name space – Distribution – Resolution – Messages – Telnet – Rlogin – Network Virtual Terminal – Character Set – Controlling the server – Remote login. Application: Automate the process of configuring devices on IP networks Video Link: NPTEL: https://www.youtube.com/watch?v=8LeqAH_ppsA		
Module-5	**L1,L2,L3**	**12 Hours**
Syllabus Content: File Transfer Protocol – Connections – Communication – Simple Mail Transfer Protocol – Simple Network Management Protocol – Hyper Text Transfer Protocol – Transaction – Request and Response messages. Application: Network protocol for transferring files between computers over a TCP/IP Video Link: NPTEL: https://www.youtube.com/watch?v=6uzEsZNUfmk		
Hands on experiment : Implementation of Client server technology. Implementation of online result system(Using tomcat server/servlet) Demo using remote file access.		

CCNA – certification course	
Course outcomes:	
CO1	Importance of standards for data transmission
CO2	Know about how the node to node data transmission occur
CO3	Get knowledge about where and how to use TCP and UDP protocols
CO4	Get the knowledge about Network administration
CO5	How to use FTP for transfer files between systems.

Text/Reference Books:	
1.	Behrouz A. Forouzan, "TCP/IP Protocol Suite", Tata McGraw Hill Edition 2000.
2.	Douglas E. Comer, David L. Stevens, "Internetworking with TCP/IP – Volume I, II and III", Prentice-Hall of India Pvt. Ltd., 2nd Edition 1994

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2										2
CO2			2									
CO3		2			2						2	
CO4				2								
CO5						2						

High-3, Medium-2, Low-1

Course Title	Programming Language Principles	Semester	VI
Course Code	MVJ20IS653	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Learn constructs in a language.

Understand data, data types, and basic statements and understand call-return Statements, ways of implementing them.

Design a new construct/ language.

Choose appropriate language for real world problem solving, based on the required features.

Evaluate various language design features considering the programming paradigm.

Module -1	L1,L2,L3	12 Hours

Reasons for Studying, Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Programming Paradigms – Imperative, Object Oriented, Functional Programming, Logic Programming, Programming Language Implementation – Compilation and Virtual Machines, Programming Environments. Names, Binding, Type Checking and Scopes: Names, Variables, Binding of Attributes to Variables, Type Bindings, Type Inferencing, Type Checking, Strong Typing

Application: Developing application or System Software's.

Video Link:

https://www.freecodecamp.org/news/what-exactly-is-a-programming-paradigm/

https://nptel.ac.in/courses/106/102/106102067/

Module -2	L1,L2,L3	12 Hours
Type Equivalence, Scope, Scope and Lifetime, Referencing Environments. Data types: Introduction, Primitives, Character, User Defined, Array, Associative, Record, Union, Pointer and Reference Types, Design and Implementation Issues Related to These Types, Names, Variable, Concept of Binding, Type Checking, Strong Typing, Type Compatibility, Named Constants, Variable Initialization. Expressions and Statements: Short Circuit Evaluation, Mixed Mode Assignment, Assignment Statements, Cascading Operators. Application: Developing application or System Software's Video Link: https://www.digimat.in/nptel/courses/video/106102067/L40.html		
Module - 3	**L1,L2,L3**	**12 Hours**
Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, Guarded Commands. Subprograms and Blocks: Fundamentals of Subprograms, Scope and Lifetime of Variable, Static and Dynamic Scope, Design Issues of Subprograms and Operations, Local Referencing Environments, Parameter Passing Methods, Overloaded Subprograms, Generic Subprograms, Parameters that are Subprogram Names. Application: Developing application or System Software's Video Link: https://www.digimat.in/nptel/courses/video/106102067/L22.html		
Module-4	**L1,L2,L3**	**12 Hours**
Design Issues for Functions, User Defined Overloaded Operators, Co-Routines and Function Closures. Abstract Data types: Abstractions and Encapsulation, Introduction to Data Abstraction, Design Issues, Object Oriented Concepts with Reference to Java and Python. Application: Developing application or System Software's Video Link: https://nptel.ac.in/courses/106/105/106105153/		

Module-5	L1,L2,L3	12 Hours
Exception handling: Exceptions, Specifications, Exception Propagation. Logic Programming Language: Introduction and Overview of Logic Programming, Basic Elements of Prolog, Application of Logic Programming. Functional Programming Languages: Introduction, Fundamentals of FPL, Applications of Functional Programming Languages and Exploration of the Features, Comparison of Functional and Imperative Languages. Application: Developing application or System Software's Video Link: https://nptel.ac.in/courses/106/105/106105191/ https://www.vssut.ac.in/lecture_notes/lecture1424085009.pdf		
Practical Experiments: Programs on Array Programs on Function Programs on Control Structure Programs on overloaded operators Programs on Object Oriented Concepts with Reference to Java and Python.		

Course outcomes:	
CO1	Choose a particular language for problem solving depending on the application domain.
CO2	Analyze and compare programming language concepts.
CO3	Analyze the implementation issues related to a language design.
CO4	Identify the language design features of any language and evaluate them.
CO5	Identify language features required for supporting various paradigms.

Text/Reference Books:	
1.	Concepts of Programming Languages", Robert W Sebesta, Pearson Education, 10th Edition, 2012

2.	Programming Language Pragmatics", Michael L Scott, Elsevier, 3rd Edition, 2009.
3.	Programming Languages Design and Implementation", Pratt, Zelkowitz, Prentice Hall/ Pearson Education, 4th Edition, 2001.

CIE Assessment:

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

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists 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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Free and Open-Source Software	Semester	VI
Course Code	MVJ20IS654	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Learn about Open Source Software

Open Source Software Licensing

Legal Issues and Software Licensing

Software Development models in Open Source Software

Open Source Software Practice

Module -1	L1,L2,L3	12 Hours

Open Source Licensing, Contract, and Copyright Law: Basic Principles of Copyright Law - Contract and Copyright - Open Source Software Licensing - Issues with Copyrights and Patents - The Open Source Definition – Warranties.

The MIT, BSD, Apache, and Academic Free Licenses: The MIT (or X) License - The BSD License - The Apache License, v1.1 and v2.0 17 - The Academic Free License - Application and Philosophy.

The GPL, LGPL, and Mozilla Licenses: GNU General Public License -

GNU Lesser General Public License - The Mozilla Public License 1.1 (MPL 1.1) - Application and Philosophy

Application: Make the informed decision to choose the right budget friendly software to meet the required need by understanding open source rules and copyrights.

Video Link:

https://www.gnu.org/licenses/license-list.en.html

Module -2	L1,L2,L3	12 Hours
The Q Public License - Artistic License (Perl) - Creative Commons Licenses. Non-Open Source Licenses: Classic Proprietary License - Sun Community Source License - Microsoft Shared Source Initiative Application: Make the informed decision to choose the right budget friendly software to meet the required need for office automation, web design, content management Video Link: https://doc.qt.io/qt-5/licenses-used-in-qt.html		
Module - 3	**L1,L2,L3**	**12 Hours**
Entering Contracts - Statutory Developments Related to Software Contracts - The Self-Enforcing Nature of Open Source and Free Software Licenses - The Global Scope of Open Source and Free Software Licensing - The "Negative Effects" of Open Source and Free Software Licensing - Community Enforcement of Open Source and Free Software Licenses - Compatible and Incompatible Licensing: Multiple and Cross Licensing Application: Make the informed decision to choose the right budget friendly software to meet the required need by understanding complete legal terms and conditions and its impact if a open source software is selected. Video Link: https://resources.whitesourcesoftware.com/blog-whitesource/open-source-licenses-explained		
Module-4	**L1,L2,L3**	**12 Hours**
Models of Open Source and Free Software Development – Forking - Choosing an Open Source or Free Software License - Drafting Open Source Licenses Application: Make the informed decision to choose the right budget friendly software to meet the required need by understanding complete legal terms and		

conditions and its impact if a open source software is selected for software development and its commercial use.

Video Link:
https://moqod.com/understanding-open-source-and-free-software-licensing/

Module-5	L1,L2,L3	12 Hours

MySQL – Open Source Tools: - Joomla-components-themes-template-webpage design.

Programming Language: Intro to Python Data types-data structures- Subroutines-Python-files-object oriented programming using Python.

Application: Office automation, web design, content management ,Data Science

Video Link:
https://eprints.qut.edu.au/13673/1/open_source_book.pdf

Practical Experiments:

Hands-On (Linux software installation)

Hands-On training - Python

Hands-On (My Sql install ,create a schema, Create Table etc)

Develop Web Application with MVC Architecture Using only Open Source Software or Tools.

Do a market Survey and arrive top 3 most used open source Databases and Scripting Languages also list down five pros and cons for each open source Software.

Course outcomes:

CO1	Distinguish the different between Free and Non-Free Software
CO2	Licensing about open source software
CO3	Consequences of pirated software
CO4	Open source software development models
CO5	Can develop database and programming using Python.

Text/Reference Books:	
1.	Andrew M. St. Laurent, Understanding Open Source and Free Software Licensing, O'relly media, 2011.
2.	Larry Ullman, PHP and MySQL for Dynamic Web Sites: Visual QuickPort Guide, 2011, 4th Edition, Peachpit Press.
3.	Dr. Martin Jones, Python for complete beginners, 2015, First edition, Create Space Independent Publishing Platform.
4.	Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, OReilly Media, 2009.

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

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

High-3, Medium-2, Low-1

Course Title	Artificial Intelligence Laboratory	Semester	VI
Course Code	MVJ20ISL66	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

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

Demonstrate PROLOG in AI

Compare and contrast different AI techniques available.

Demonstrate learning algorithms

Design different learning algorithms for improving the performance of AI systems.

Implement projects using different AI learning techniques.

Sl No	Experiment Name	RBT Level	Hours
1	Study of PROLOG.	L3	4
2	Write simple fact for the statements using PROLOG.	L3	4
3	Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below	L3	4
4	Write a program to solve the Monkey Banana problem.	L3	4
5	WAP in turbo PROLOG for medical diagnosis and show the advantage and disadvantage of green and red cuts.	L3	4
6	WAP to implement factorial, Fibonacci of a given number.	L3	4
7	Write a program to solve 4-Queen problem.	L3	4
8	Write a program to solve traveling salesman problem	L3	4
9	Write a program to solve water jug problem using LISP	L3	4
10	Implement mini project using PROLOG	L3	4

Course outcomes:

CO1	Demonstrate PROLOG commands
CO2	Apply AI search Models and Generic search strategies.

CO3	Write Logic for representing Knowledge and Reasoning of AI systems.
CO4	Design different learning algorithms for improving the performance of AI systems.
CO5	Implement projects using different AI learning techniques.

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,

Write-up : 20 marks

Conduction : 40 marks

Analysis of results : 20 marks

Viva : 20

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Internet of Things Laboratory	Semester	VI
Course Code	MVJ20ISL67	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

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

Install IoT applications and handling IoT tools.

Illustrate the methods of deploying smart objects and connect them to network.

Compare different Application protocols for IoT.

Infer the role of Data Analytics and Security in IoT.

Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Sl No	Experiment Name	RBT Level	Hours
1	Create a program that blinks the LED on the Arduino development board. Create a program that blinks the LED on the Raspberry Pi development board using	L3	4
2	Create a program that sensor can able to communicate with the attached PC. Use a serial terminal for the communication. Create a program that displays data from the sensor in regular intervals in a compact format.	L3	4
3	Develop one-one connection from the available sensors and actuators and create code that will display the sensed data on the PC using Arduino	L3	4
4	Attach the radio unit to the board. The radio uses SPI bus. Identify and connect the appropriate pins. Take care about interference between sensor and the radio! And Check the	L3	4

	operation of the communication at the gateway. Check that the communication is working bidirectionally.		
5	Creating a virtual device: Login to devicehub.net and create a project then create a virtual device. Add the corresponding sensor and actuator to the virtual device. Take note of the IDs and data required for accessing the virtual devices. Examine how the virtual sensors and actuators can be reached using MQTT protocol.	L3	4
6	Create a connection from an MQTT capable device/software with an MQTT broker then send and receive data using it. The PCs have MQTTfx installed but other software can be used as well. Send and receive messages to/from the virtual device. The format and channel of the messages are detailed in the syllabus.	L3	4
7	Develop a program that your Raspberry Pi interact with online services through the use of public APIs and SDKs.	L3	4
8	Develop Python-based IDE (integrated development environments) for the Raspberry Pi. Trace and debug Python code on the device	L3	4
9	Develop a project using IoT devices and Cloud for automation	L3	4
10	Developing a simple automation project using Arduino Uno Or Raspberry Pi for Agriculture irrigation using various related sensors	L3	4

Course outcomes:	
CO1	Learn and understand IoT applications and tools
CO2	Interfacing Sensor and Actuator with Arduino and Raspberry Pi development board.
CO3	Implementing IoT device by interfacing communication modules

CO4	Developing real tome examples using Python
CO5	Elaborate the use of smart objects for designing smart systems

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, Writeup : 20 marks Conduction : 40 marks Analysis of results : 20 marks Viva : 20
CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Machine Learning	Semester	VII
Course Code	MVJ20IS71	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 (L : T : P :: 4 : 1 : 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	12 Hours

Syllabus Content:

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.

Application:

Designing Supervised Learning Problems

Video Link:

http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/091117.pdf

http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

Module-2	L1,L2,L3	12 Hours
Syllabus Content 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. Application: Designing Supervised Learning Problems Video Link: http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/091117.pdf http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/index.html		
Module-3	**L1,L2,L3**	**12 Hours**
Syllabus Content: Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptron's, Backpropagation algorithm Application: Solving real time problems like Automatic Vehicle Design etc. Video Link: https://becominghuman.ai/understanding-decision-trees-43032111380f https://onlinecourses.science.psu.edu/stat507/node/59/		

Module-4	L1,L2,L3	12 Hours
Syllabus Content: Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm. Application: Cognitive detection, Sentimental analysis Video Link: https://onlinecourses.science.psu.edu/stat507/node/59/ https://towardsdatascience.com/naive-bayes-in-machine-learning-f49cc8f831b4		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Evaluating Hypothesis: Motivation, estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning . Application: Understanding and designing Unsupervised learning Problems. Video Link: https://becominghuman.ai/understanding-decision-trees-43032111380f https://towardsdatascience.com/naive-bayes-in-machine-learning-f49cc8f831b4		
Course outcomes:		
CO1	Identify the problems for machine learning. And select the either supervised, unsupervised or reinforcement learning.	
CO2	Explain theory of probability and statistics related to machine learning	
CO3	Investigate concept learning, ANN, Bayes classifier, k nearest neighbor, Q, Question	

CO4	Identify and apply Machine Learning algorithms to solve real world problems
CO5	Perform statistical analysis of machine learning techniques.
Text/Reference Books:	
1.	Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
3.	Ethem Alpaydın, Introduction to machine learning, second edition, MIT press

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests Quizzes/mini tests (4 marks) Mini Project / Case Studies (8 Marks) Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3	3	3							
CO2	3		3		3							
CO3	3	3	3	3								
CO4	3	3	3									
CO5	3	3	3	3								

High-3, Medium-2, Low-1

Course Title	Bigdata & Hadoop	Semester	VII
Course Code	MVJ20IS72	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	5 (L : T : P :: 4 : 1 : 0)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to:

Understand Hadoop Distributed File system and examine MapReduce Programming

Explore Hadoop tools and manage Hadoop with Ambari

Appraise the role of Business intelligence and its applications across industries

Assess core data mining techniques for data analytics

Identify various Text Mining techniques

Module-1	L1,L2,L3	12 Hours

Hadoop Distributed File System Basics, Running Example Programs and Benchmarks, Hadoop MapReduce Framework, MapReduce Programming

Application: Students can get awareness of Distributed File System (Hadoop File System)

Video Link: https://www.youtube.com/watch?v=DpgGXN5ubk0

Module-2	L1,L2,L3	12 Hours

Essential Hadoop Tools, Hadoop YARN Applications, Managing Hadoop with Apache Ambari, Basic Hadoop Administration Procedures.

Application: Students can learn Hadoop YARN utility working model.

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

Module-3	L1,L2,L3	12 Hours

Business Intelligence Concepts and Application, Data Warehousing, Data Mining, Data Visualization

Application: Students can apply knowledge on Business Data. **Video Link:** https://www.youtube.com/watch?v=NOIfMY0KajE		
Module-4	L1,L2,L3	12 Hours
Decision Trees, Regression, Artificial Neural Networks, Cluster Analysis, Association Rule Mining. **Application:** Students can learn various algorithm related Machine Learning. **Video Link:** https://www.youtube.com/watch?v=guVvtZ7ZClw https://www.youtube.com/watch?v=3MnVCX94jJM		
Module-5	L1,L2,L3	12 Hours
Text Mining, Naïve-Bayes Analysis, Support Vector Machines, Web Mining, Social Network Analysis **Application:** Students can learn machine learning algorithms. **Video Link:** https://www.youtube.com/watch?v=efR1C6CvhmE		
Practical Experiments/hands on: To setup and install Hadoop in Pseudo-Distributed Mode Exploring various shell commands in Hadoop. Implement the following file management tasks in Hadoop: Adding Files and Directories, Retrieving Files, Deleting Files Practical example of handling files in HDFS Practical example of Map Reduce		

Course outcomes:	
CO1	To setup and install Hadoop in Pseudo-Distributed Mode
CO2	Exploring various shell commands in Hadoop.
CO3	Implement the following file management tasks in Hadoop: Adding Files and Directories, Retrieving Files, Deleting Files

CO4	Practical example of handling files in HDFS
CO5	Practical example of Map Reduce

Text/Reference Books:	
1.	Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351.
2.	Anil Maheshwari, "Data Analytics", 1st Edition, McGraw Hill Education, 2017. ISBN-13: 978- 9352604180.
3.	Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, 2015.ISBN-13: 978-9352130672.
4.	Boris Lublinsky, Kevin T.Smith, Alexey Yakubovich,"Professional Hadoop Solutions", 1stEdition, Wrox Press, 2014ISBN-13: 978-8126551071.
5.	Eric Sammer,"Hadoop Operations: A Guide for Developers and Administrators",1stEdition, O'Reilly Media, 2012.ISBN-13: 978-9350239261.

CIE Assessment:

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

Quizzes/mini tests (4 marks)

Mini Project / Case Studies (8 Marks)

Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

Question paper for the SEE consists 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2		2							
CO2	3	1	2	1	3							
CO3	3	3	3									
CO4	3	3	2									
CO5	3	3		2	1							

High-3, Medium-2, Low-1

Course Title	Data Science Using R	Semester	VII
Course Code	MVJ20IS731	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understanding R for data science

Learn about requirement of data analysis

Can understand how machine learning algorithm works

How to visualize the data

Real world data analysis

Module -1	L1,L2,L3	12 Hours

What You Will Learn – What You Won't Learn – Prerequisites – Running R Code.

Data Visualization: Introduction – First Steps – Aesthetic mapping – Common Problems – Facets – Geometric Objects – Statistical Transformations – Position adjustments – Coordinate systems – Layered Grammar of Graphics.

Workflow Basics: Coding Basics – What's in a name? – Calling Functions – Exercises.

Data Transmission: Introduction – Filter rows with filter() – Arrange rows with arrange() – Select Columns with select() – Add new variables with mutate() – Grouped summaries with summarise() – Grouped mutates.

Workflow: Scripts.

Application: Data visualization can be used in storytelling of insight obtained from Bigdata.

Video Link:

https://nptel.ac.in/courses/111/104/111104100/

Module -2	L1,L2,L3	12 Hours
Exploratory Data Analysis: Introduction – Questions – Variation – Covariation – Patterns and models. Introduction: What is Data science? Big Data and Data Science Hype – Getting Past the Hype – Why Now: Datafication– The Current Landscape – A Data science Profile – Thought Experiment: Meta-Definition – What is a Data Scientist, Really? In Academia – In Industry Application: Banking, Health care, Transport, Manufacturing, Agriculture etc Video Link: https://www.digimat.in/nptel/courses/video/106106179/L08.html		
Module - 3	**L1,L2,L3**	**12 Hours**
Statistical Thinking in the Age of Big Data – Exploratory Data Analysis – The Data Science Process – Thought Experiment: How Would you Simulate Chaos? Algorithms: Machine Learning Algorithms – Three Basic Algorithms – Exercise: Basic Machine Learning Algorithms – Summing It All Up – Though Experiment: Automated Statistician. Application: Recommendation Systems(You tube) Video Link: https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/		
Module-4	**L1,L2,L3**	**12 Hours**
Thought Experiment: Learning by Example – Naïve Bayes – Fancy It Up: Laplace Smoothing – Comparing Naïve Bayes to K-NN – Sample Code in Bash – Scraping the Web: API and Other Tools – Jake's Exercise: Naïve Bayes for Article Classification. Data Visualization and Fraud Detection: Data Visualization History - What Is Data Science, Redux? - A Sample of Data Visualization Projects - Mark's Data Visualization Projects - Data Science and Risk - Data Visualization at Square - Ian's Thought Experiment - Data Visualization for the Rest of Us		

Application: Spam filter can be applied to get rid of unwanted spam messages in Email and SMS. Video Link: https://www.youtube.com/watch?v=9YXojHh_ZPY		
Module-5	L1,L2,L3	12 Hours
Social Network Analysis at Morning Analytics - Social Network Analysis - Terminology from Social Networks - Thought Experiment – Morning side Analytics - More Background on Social Network Analysis from a Statistical Point of View - Data Journalism Data Engineering: MapReduce, Pregel, and Hadoop Application: To find out the trending news for the day, Trending hash tags in face book or Twitter Video Link: https://www.youtube.com/watch?v=uEFbdGlSAfQ		
Practical Experiments: YouTube Data Analysis Machine Learning algorithms – Hands-On Training Share Market Analysis - Hands-On Training Fraud Analysis of Trade document using Data Science Identifying Revenue drop from customer behavior pattern in Banking Industry		

Course outcomes:

CO1	R programming for data science
CO2	Analyze the data
CO3	Machine learning algorithms
CO4	Visualize the different data with different form
CO5	Interpret, analytic and visualize read world data

Text/Reference Books:

1.	Hadley Wickham and Garrett Grolemund , R for Data Science, Publisher: O'Reilly Media

2.	Cathy O'Neil and Rachel Schutt, Doing Data Science Straight Talk from the Frontline, Publisher: O'Reilly Media
3.	Ricardo Anjoleto Farias, Nataraj Dasgupta, Vitor Bianchi Lanzetta, Hands-On Data Science with R, O'reilly, 2018.

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	2	3					2		
CO2	3	3	3	2	3					2		
CO3	3	3	2	2	3					2		
CO4	3	3	2	2	3					2		
CO5	3	3	3	2	3					2		

High-3, Medium-2, Low-1

Course Title	Deep Learning	Semester	VII
Course Code	MVJ20IS732	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Gain knowledge in Machine Learning Basics

Understand and apply Optimization on Deep Models and Networks

Understand and analyze Recurrent and Recursive Networks

Understand the representation of neural networks in machine learning.

Module-1	L1,L2,L3	12 Hours

Introduction : Historical Trends in Deep Learning -Linear Algebra: Scalars - Vectors - Matrices - Tensors - Matrices - Norms – Eigen decomposition -Probability and Information Theory: Random variable and distributed Probability - Bayes Rule - Information Theory and structured probabilistic models.

Application:

Self Driving Cars

News Aggregation and Fraud News Detection

Natural Language Processing

Virtual Assistants

Entertainment

Visual Recognition

Video Link:

https://www.youtube.com/watch?v=njKP3FqW3Sk&list=PLtBw6njQRU-rwp5__7C0oIVt26ZgjG9NI

Module-2	L1,L2,L3	12 Hours
Numerical Computation: Overflow and Underflow - Gradient based Optimization - Constrained Optimization - Learning Algorithms: Capacity – Over fitting - Under fitting - Bayesian Classification -Supervised - unsupervised algorithms - Building machine learning algorithm. Application: Traffic prediction: Speech Recognition Image Recognition Video Link: https://www.youtube.com/watch?v=hjh1iknScg		

Module-3	L1,L2,L3	12 Hours
Deep Feed forward Networks : Gradient based learning - Hidden Units - Architectural design - Back Propagation algorithms - Regularization for deep learning: Dataset Augmentation - Noise Robustes –Semi supervised learning -Multitask learning - Adserial training. Application: Process modeling and control Target Recognition Machine Diagnostics Portfolio Management Medical Diagnosis Video Link: https://www.youtube.com/watch?v=oJNHXPs0XDk		

Module-4	L1,L2,L3	12 Hours
Optimization for training Deep Models: Challenges in Neural Networks optimization - Basic Algorithms - Algorithms Adaptive learning Rates - Approximate Second Order Methods - Optimization Strategies and Meta Algorithms -Convolutional Networks: Motivation - Structured Output - Unsupervised features - Neuroscientific basics for Convolutional Networks. Application: Decoding Facial Recognition Analysing Documents Historic and Environmental Collections Understanding Climate Video Link: https://www.youtube.com/watch?v=10Su2eSDs1M		
Module-5	**L1,L2,L3**	**12 Hours**
Computational graphs - Recurrent Neural networks - Bidirectional RNN - Deep Recurrent Networks - Echo State Networks - Practical Methodology - Applications: Large Scale Deep Learning – Computer Vision - Speech Recognition - Natural language Processing, Case studies in classification, Regression And deep networks. Application: Speech Recognition Generating Image Descriptions Video Tagging Text Summarization Call Center Analysis Face detection, OCR Applications as Image Recognition Other applications like Music composition		

Video Link: https://www.youtube.com/watch?v=fCMutAkBXBU
Practical Learning: Building Deep learning project/Case Study

Course outcomes:	
CO1	Analyze Deep learning Mathematical Models
CO2	Explore the Basic fundamentals of Machine Learning Algorithms
CO3	Elucidate the Deep Feed forward Networks
CO4	Apply knowledge for Optimization on Deep Models and Convolutional Networks
CO5	Elucidate the Recurrent and Recursive Networks and Natural language Processing

Text/Reference Books:	
1.	Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classication. Wiley-Interscience. 2nd Edition.2001
2.	Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.
3.	Russell, S. and Norvig, N. Articial Intelligence: A Modern Approach. Prentice Hall Series in Articial Intelligence. 2003.
4.	Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995
5.	Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.

CIE Assessment:
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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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Blockchain Technology	Semester	VII
Course Code	MVJ20IS733	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

Understand how blockchain systems (mainly Bitcoin and Ethereum) work,

To securely interact with them,

Design, build, and deploy smart contracts and distributed applications,

Integrate ideas from blockchain technology into their own projects.

List and describe differences between proof-of-work and proof-of-stake consensus.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

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

Application: Elliptic Curve Digital Signature

Video Link:

https://www.youtube.com/watch?v=jTwOeWgP2eU&list=PLbRMhDVUMngfxxy

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions

and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public Blockchain. Application: Supply chain and logistics monitoring Video Link: https://www.youtube.com/watch?v=eS39tn5Cy20		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Application: Approval of transactions on a chain. Video Link: https://www.youtube.com/watch?v=CdyDoCk8IKs		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin Application : Writing code that controls money, and build. Cryptocurrency exchange. Video Link: https://www.youtube.com/watch?v=bEHBBLHEeAE		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain. Application: Real-time IoT operating systems, Personal identity security Video Link: https://www.youtube.com/watch?v=u5AbhtoNMYs&list=PLbRMhDVUMngfxxy		

Practical Experiments:
Naive Blockchain construction, Memory Hard algorithm Hashcash implementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction, Toy application using Blockchain, Mining puzzles

Course outcomes:	
CO1	Learn design principles of Bitcoin and Ethereum and Nakamoto consensus.
CO2	Explain the Simplified Payment Verification protocol.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO5	Evaluate security, privacy, and efficiency of a given blockchain system.

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

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

High-3, Medium-2, Low-1

Course Title	NATURAL LANGUAGE PROCESSING	Semester	VII
Course Code	MVJ20IS734	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to: This course will enable students to

Learn the fundamentals of natural language processing

Understand the use of CFG and PCFG in NLP

Understand the role of semantics of sentences and pragmatics

Gain knowledge in automated Natural Language Generation and Machine Translation

Module-1	L1,L2,L3	12 Hours

INTRODUCTION: Origins and challenges of NLP – Language Modelling: Grammar-based LM, Statistical LM –Regular Expressions, Finite-State Automata – English Morphology, Transducers forlexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum EditDistance values of real symmetric matrices: Jacobi and Givens method.

Laboratory Session: Word Analysis

Applications: Text to Speech conversion

Video link : https://nptel.ac.in/courses/106/105/106105158/

Module-2	L1,L2,L3	12 Hours

WORD LEVEL AND SYNTACTIC ANALYSIS: Ngrams Models of Syntax - Counting Words - Unsmoothed Ngrams-Smoothing-Back off Deleted Interpolation – Entropy – EnglishWord Classes - Tag sets for English-Part of Speech Tagging-RuleBased Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging -Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

Laboratory Session: Morphological Analyzer for a given word

Applications: Speech to text conversion

Video link :

https://nptel.ac.in/courses/106/105/106105158/

Module-3	L1,L2,L3	12 Hours
CONTEXT FREE GRAMMARS: Context-Free Grammars, Grammar rules for English, Tree banks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures Laboratory Sessions: Chunking for a given sentence Applications: Compiler Video link : https://www.youtube.com/watch?v=6b40kKe2SFg		
Module-4	**L1,L2,L3**	**12 Hours**
SEMANTICS AND PRAGMATICS: Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus-Representing Linguistically Relevant Concepts – SyntaxDriven Semantic Analysis - Semantic Attachments –Syntax Driven Analyzer- Robust Analysis – Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation - Information Retrieval. Laboratory Session: Pragmatic Analysis of a given sentence Applications: Sentiment Analysis Video link : https://www.coursera.org/lecture/human-language/pragmatics-E8VXH		
Module-5	**L1,L2,L3**	**12 Hours**
LANGUAGE GENERATION AND DISCOURSEANALYSIS: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Co reference Resolution – Resources: Porter Stemmer, Lemmatize, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, and British National Corpus (BNC). Laboratory Session: Sentiment analysis on movie database Applications: Sentiment analysis Videolink:https://www.coursera.org/lecture/text-mining-analytics/5-6-how-to-do-sentiment-analysis-with-sentiwordnet-5RwtX		

Course outcomes:	
CO1	To tag a given text with basic Language features.
CO2	To design an innovative application using NLP components
CO3	To implement a rule-based system to tackle morphology/syntax of a language
CO4	To design a tag set to be used for statistical processing for real-time applications
CO5	To compare the use of different statistical approaches for different types of NLP 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:	
	Steven Bird, Ewan Klein and Edward Loper, –Natural Language Processing with Python, First Edition, OReilly Media, 2009.
	Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S.Tiwary
	Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
CIE Assessment:	
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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	2	2								2	
CO2	3	3	3									
CO3	3	3	3									
CO4	3	3	3								2	
CO5	2	2	2									

High-3, Medium-2, Low-1

Course Title	Unified Object Oriented Modelling & Design	Semester	VII
Course Code	MVJ20IS741	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 1 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understand Object Oriented Programming, Object Oriented Analysis and Modelling using the Unified Modeling Language (UML).

Familiarize themselves with the models used in UML, including static as well as dynamic (behavioural) models.

Appreciate the importance of system architecture and system design in product development.

Understand the important design principles including GRASP and SOLID.

Understand design Patterns and their use in software development.

Module-1	L1,L2,L3	12 Hours

Introduction, Use Cases and Class Models: Introduction to Object Oriented Programming – OOP Principles, Class Fundamentals, Declaring and Assigning Objects, Reference Variables, Introducing Methods, Constructors and Destructors, Introduction to Modelling, Introduction to UML, Use Case Models,

Application: System Modeling

Video Link: https://www.youtube.com/watch?v=RMuMz5hQMf4

Module-2	L1,L2,L3	12 Hours

Class Models and Dynamic Models: Class Modelling, Object Constraint Language, Advanced Class Modeling, Activity Models, Sequence Models, ATM Case Study: Application Class / Interaction Models, State Models, Advanced State Models, Relationship between Class and State Models.

Application: System Modeling

Video Link: https://www.youtube.com/watch?v=Omp4RbHbB0s

Module-3	L1,L2,L3	12 Hours
System and Class Design: System Design, Class Design, Implementation Models, Object Oriented Languages, Database Design. Application: System Design Video Link : https://www.youtube.com/watch?v=IGqAbuxCOXI		
Module-4	L1,L2,L3	12 Hours
Object Oriented Design Principles: GRASP (General Responsibility Assignment Software Patterns) and SOLID (Single Responsibility, Open-Closed, Liskov Substitution, Interface Segregation, Dependency Inversion). Application : System Design Video Link : https://www.youtube.com/watch?v=Uc2qv44cNo0		
Module-5	L1,L2,L3	12 Hours
Design Patterns: What Design Patterns Are, How Design Patterns Solve Problems, How to Select a Design Pattern, How to Implement a Design Pattern, Introduction to Widely Used Design Patterns including Creational, Structural, and Behavioural Patterns. Object Oriented Design Principles Application: System Pattern Video Link: https://www.youtube.com/watch?v=NU_1StN5Tkk		
Practical Experiments:	L3	20 Hours
UML Diagrams for ATM System UML Diagrams for Hospital Management System UML Diagrams for College Management System		

Course outcomes:	
CO1	Use the concepts of classes and objects in Object Oriented Programming. Use UML to model a complex system by defining actors and use cases.

CO2	Construct Class Models and analyze the dynamics of a system using Activity, Sequence, State and Process models.
CO3	Depict the architecture of a software system by using component and deployment models and design a database based on a class model.
CO4	Use GRASP and SOLID principles in the design of software.
CO5	Apply software design patterns in a variety of situations.

Text/Reference Books:	
1.	Object-Oriented Modeling and Design with UML", Michael R Blaha, James R Rumbaugh, 2nd Edition, Pearson.
2	"The Complete Reference Java2", Herbert Schildt, 5th Edition, TATA McGRAW HILL.
3	"Applying UML and Patterns", Craig Larman, 3rd Edition, Pearson.
4	"The Unified Modeling Language User Guide", Grady Booch, James Rumbaugh and Ivar Jacobso, 2nd Edition, Pearson.
5	"Design Patterns Elements of Reusable Object-Oriented Software", Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Pearson.
6	"Core Java", Cay S Horstmann, Tenth Edition, Pearson Education, 2016.
7	"Unified Object Oriented Modeling, Analysis & Design", Dr. Sanchari Saha, Cengage Publisher, 2018

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

High-3, Medium-2, Low-1

Course Title	Information Retrieval & Visualization	Semester	VII
Course Code	MVJ20IS742	CIE	50
40 L : T : P :: 3 : 1 : 0	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Learn classical techniques of Information Retrieval and Evaluation

Learn how to query and process

Get an idea about how the different IR algorithms works.

Understand Web Crawler and its functions.

Realize the applications of Information Retrieval

Module-1	L1,L2	8 Hours

Basic Concepts – Retrial Process – Modelling – Classic Retrieval – Set Theoretic, Algebraic and Probabilistic Models.

Retrieval Techniques: Structured Retrieval Models – Retrieval Evaluation – Word Sense Disambiguation.

Application:

Using retrieval Techniques for searching information.

Video Link:

https://www.youtube.com/playlist?list=PLMyP8LIIL3ht_WV4EXjN-uD3EPEK3hIyu

Module-2	L2,L3	12 Hours

Languages – Key Word-based Querying – Pattern Matching – Structural Queries – Query Operations – User Relevance Feedback – Local and Global Analysis.

Document Pre-Processing – Clustering – Text Compression – Indexing and Searching – Inverted Files – Boolean Queries – Sequential Searching – Pattern Matching.

Application:

Analyzing query and document formatting for searching.

Video Link:

https://www.youtube.com/playlist?list=PLMyP8LIIL3ht_WV4EXjN-uD3EPEK3hIyu

Module-3	L2,L3	8 Hours

Overview of Retrieval Models –Boolean Retrieval – The Vector Space Model – Probabilistic Models – Information Retrieval as Classification – BM25 Ranking Algorithm – Complex Queries and Combining Evidence – Web Search – Machine Learning and Information Retrieval.

Application: Select and ranks relevant documents

Video Link: https://www.slideshare.net/mounialalmas/introduction-to-information-retrieval-models

Module-4	L2,L3	8 Hours

Deciding what to search – Crawling the Web – Directory Crawling – Document Feeds – conversion problem – Storing the Documents – Detecting Duplicates – Remove noise.

Application:

Develop application data

Video Link:

https://www.youtube.com/playlist?list=PLMyP8LIIL3ht_WV4EXjN-uD3EPEK3hIyu

Module-5	L2,L3	8 Hours

Searching the Web – Challenges – Characterizing the Web – Search Engines – Browsing – Meta-searchers – Online IR systems – Online Public Access Catalogs.

Digital Libraries: Introduction – Architectural Issues – Document Models – Representations and Access – Prototypes and Standards.

Case Study: Google, Yahoo and Bing Search engines

Application:

Interpret overall working of a search engine. Video Link: https://www.youtube.com/playlist?list=PLMyP8LIIL3ht_WV4EXjN-uD3EPEK3hIyu		
Practical Experiments/ Case Study:	L3	20
Experiments related to Ontology and Semantic Web Experiments related to Semantic Web Services Cast Study: Google Page Ranking Algorithm		

Course outcomes:	
CO1	Rank the document using classical ranking methods
CO2	Querying documents by delivering keywords
CO3	Implement ranking algorithms for rank the documents
CO4	Know how the crawler works
CO5	Know how the web search, online IR systems and search engines works

Text/Reference Books:	
1.	Ricardo Baeza-Yate, Berthieri Ribeiro-Neto, Modern Information Retrieval, Pearson Education Asia, 2012.
2.	W.Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines – Information Retrieval in Practice, Pearson Education, 2015
3.	Grossman, David A. Frieder, Ophir, Information Retrieval Algorithms and Heuristics, 2nd Edition, Springer
4.	G.G. Chowdhury, Introduction to Modern Information Retrieval, Second Edition, Neal-Schuman Publishers, 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 Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3									2		
CO3	3	3								2		
CO4	3	3								2		2
CO5	3	3								2		2

High-3, Medium-2, Low-1

Course Title	Software Testing	Semester	VII
Course Code	MVJ20IS743	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Understand HTML and CSS for designing web pages.

Understand basics of JavaScript as a programming language.

Understand the Document Object Model and enable them to create dynamic web pages that react to user input.

Understand installing and configuring Apache Server and incorporating backend support for their web pages.

Get exposure to the newer features available as part of the HTML standard

Module-1	L1,L2,L3	12 Hours

Syllabus Content: Basics of Software Testing: Basic definitions, Software Quality, Requirements, Behaviour and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, Insights from a Venn diagram, Identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies, Levels of testing, Testing and Verification, Static Testing. Problem Statements: Generalized pseudocode, the triangle problem, the NextDate function, the commission problem, the SATM (Simple Automatic Teller Machine) problem, the currency converter, Saturn windshield wiper Application: software systems

Video Link: https://www.youtube.com/watch?v=cv6GvRCIuTs

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Black Box Testing Types of Black Box Testing Techniques: Boundary Value Testing, Normal Boundary Value Testing Robust Boundary Value Testing, Worst-Case Boundary Value Testing, Special Value Testing, Examples, Random Testing Guidelines for Boundary Value Testing

Equivalence Class Testing Equivalence Classes, Traditional Equivalence Class Testing Improved Equivalence Class Testing, Equivalence Class Test Cases for the Triangle Problem, Equivalence Class Test Cases for the NextDate Function, Equivalence Class Test Cases for the Commission Problem, Edge Testing Decision Table–Based Testing Decision Tables, Decision Table Techniques Test Cases for the Triangle Problem, Test Cases for the Next Date Function, Test Cases for the Commission Problem

Application: Multilanguage support and compatibility Testing

Video Link: https://www.youtube.com/watch?v=2MRU2oRUlDo

Module-3	L1,L2,L3	12 Hours

Syllabus Content:

Evaluating Test Cases Mutation Testing, Fuzzing, Fishing Creel Counts and Fault Insertion Software Technical Reviews Economics of Software Reviews, Roles in a Review Types of Reviews, Contents of an Inspection Packet, An Industrial Strength Inspection Process, Effective Review Culture,Inspection Case Study

Application: Pit mutation testing

Video Link: https://www.youtube.com/watch?v=mZjPzlX9YJY

Module-4	L1,L2,L3	12 Hours

Syllabus Content:

Integration and Component-Based Software Testing: Overview, Integration testing strategies, Testing components and assemblies. System, Acceptance and Regression Testing: Overview, System testing, Acceptance testing, Usability, Regression testing, Regression test selection techniques, Test case prioritization and selective execution.

Levels of Testing, Integration Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing, A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integration Application: Online delivery system Video Link: https://www.coursera.org/lecture/engineeringandroidapps/integration-testing-FbJOF		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Software test automation – skill needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics. Application: TestSigma Video Link: https://www.edureka.co/blog/test-automation-strategy/		
Practical Experiments: 1. Study of any testing tool. 2. Study of any web testing tool 3. Study of any bug tracking tool 4. Study of any test management tool. 5. Case study on Selenium.		

Course outcomes:	
CO1	Apply the concepts of Quality Engineering.
CO2	Design Test cases for various black box testing techniques
CO3	Plan, employ and measure proper Quality approaches applied.
CO4	Apply the appropriate technique for the design of flow graph.
CO5	Create automation test scripts

Text/Reference Books:	
1.	Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 4th Edition, Auerbach Publications, 2013.

2.	Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, Wiley India, 2009.
3.	Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008
4.	Software testing Principles and Practices – Gopalaswamy Ramesh, Srinivasan Desikan, 2nd Edition, Pearson, 2007
5.	Software Testing – Ron Patton, 2nd edition, Pearson Education, 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 Mapping

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

High-3, Medium-2, Low-1

Course Title	Cyber Security, Law & Ethics	Semester	VII
Course Code	MVJ20IS744	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

Explain the fundamental definitions of different security issues.

Familiarize cybercrimes happening with mobile and wireless devices.

Use cybercrime tools to analyze the security gaps.

Familiarize with different OSI layers and security aspects.

Explain legal aspects and Indian IT Act.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes, How criminal plan the attacks, Social Eng., Cyber fraud vs. Cybercrime Cyber stalking, Cybercafe and Cybercrimes, Botnets, Attack vector, Cloud computing.

Application:

security services that are invoked at the interface between an application

Video Link:

https://www.youtube.com/watch?v=gfFKuiZ9Y7s

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on

Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Application:

the usage of small wireless mobile devices such as PDAs, Blackberrys and smartphones

Video Link:

https://www.youtube.com/watch?v=frM_7UMD_-A

Module-3	L1,L2,L3	12 Hours

Syllabus Content:

Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft), Case Study.

Application:

Application-level gateway

Video Link:

https://www.youtube.com/watch?v=6MvRi2Gqh_Y

Module-4	L1,L2,L3	12 Hours

Syllabus Content:

Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidance, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting of a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to the Computer Forensics and Social Networking Sites: The Security/Privacy Threats, Forensics Auditing, Anti Forensics.

Application:

Application of Digital Forensics With increasing digital crime in each branch

Video Link: https://www.youtube.com/watch?v=2ESqwX3qb94		
Module-5	L1,L2,L3	12 Hours
Syllabus Content: Cyber law: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario. Application: Case IV: Ownership of Program Video Link: https://www.youtube.com/watch?v=ZFHCZt5VnMs		
Hands on Experiments: Cyber fraud vs Cybercrime stalking, Cybercafé and Cybercrimes. Mobile Devices: Security Implementation for organizations. Phishing, Password cracking, Dos Attacks. Cyber forensics and digital Evidence.		

Course outcomes:	
CO1	Understand Cybercrime and Cyber offenses
CO2	Explain cybercrime happening with Mobile and Wireless Devices.
CO3	Analyze cybercrimes using different tools and methods.
CO4	Cyber forensics and Digital forensics
CO5	Legal aspects of cybercrimes.

Text/Reference Books:	
1.	"Cyber Security", Nina Godbole, Sunit Belapure, Wiley India, New Delhi, 2011.
2.	"Information Systems Security", Nina Godbole, Wiley India, New Delhi, 2017.
3.	"Cyber Security & Global Information Assurance", Kennetch J. Knapp, Information Science Publishing, 2009.
4.	"Cryptography and Network Security", William Stallings, Pearson Publication, 2005.
5.	"Cyber Security", Avantika Yadav, Narosa Publishing, 2017.

CIE Assessment:
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SEE Assessment:
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CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1		2										
CO2			2								2	
CO3					2							
CO4			2									2
CO5					2							

High-3, Medium-2, Low-1

Course Title	Cloud Computing	Semester	VII
Course Code	MVJ20IS751	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

understands cloud computing models and infrastructure for larger networks

Identify policies, mechanisms and scheduling for resource management, virtualization, and optimization of networks.

Compare multiple approaches to cloud system design and solve real world problems.

Illustrate storage concept and self-organizing capability for different cloud systems.

Understands cloud security and risk..

Module-1	L1,L2,L3	12 Hours

Defining a Cloud, Cloud Computing Reference Model , Characteristics and Benefits, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Eras of Computing, Parallel vs. Distributed Computing, Elements of Parallel Computing.

Application:

Art Applications

Business Applications

Data Storage and Backup Applications

Video Link:

https://www.youtube.com/watch?v=eaf_l9SBmyQ

Module-2	L1,L2,L3	12 Hours

Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology

Examples, Xen, VMware, Microsoft Hyper-V, Cloud Reference Model and Architecture, Infrastructure as a Service, Platform as a Service, Software as a Service, Types of Clouds, Economics of the Cloud, Open Challenges in Clouds.

Application:

Big data analysis

Storage

Recovery

Backup

Video Link:

https://www.youtube.com/watch?v=_pPlanX5wQY

Module-3	L1,L2,L3	12 Hours

Data-intensive computing Characterizing data-intensive computations, Challenges ahead, Historical perspective, Technologies for data-intensive computing – Storage systems, Programming platforms – Map Reduce. Public Cloud Infrastructures: Amazon Web Services - Compute, Storage, and Communication Services; Google App Engine – Architecture, Application Life-Cycle, Cost Model; and Microsoft Azure.

Application:

Disaster recovery

Online File storage

Photo editing software

Digital video software

Twitter-related applications

Video Link:

https://www.youtube.com/watch?v=9C9VJh19YFs

https://www.youtube.com/watch?v=dB1R9XHAng0

Module-4	L1,L2,L3	12 Hours
ECG Data Analysis on Cloud, Protein Structure Prediction, Satellite Image Processing; Business and Consumer Applications – CRM, Social Networks, Media Applications, and Multiplayer Online Gaming. Advanced Topics in Cloud Computing, Energy efficiency in clouds, Energy-efficient and green cloud computing architecture, Market-based management of clouds, Market-oriented cloud computing, A reference model for MOCC,3 Technologies and initiatives supporting MOCC, Observations Application: Creating image-album Web application for antivirus Word processing application Spreadsheets Presentation software Video Link: https://www.youtube.com/watch?v=s9G2NQhvaKQ		
Module-5	**L1,L2,L3**	**12 Hours**
Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor. Application: Finding a way on the map E-commerce software Miscellaneous applications Video Link: https://www.youtube.com/watch?v=0lw4KU5wHsk		

Practical Experiments/ Case Study:
Creating a Warehouse Application in SalesForce.com. Implementation of SOAP Web services in C#/JAVA Applications. Installation and Configuration of Hadoop. Case Study: Amazon Web Services Case Study: PAAS(Facebook, Google App Engine) Create an application (Ex: Word Count) using Hadoop Map/Reduce

Course outcomes:	
CO1	Explore the basic concepts of cloud computing, cloud infrastructure, cloud models, cloud services, distributed computing, and other related concepts.
CO2	Understand Virtualization, and working of some of industrially popular Virtualization technologies.
CO3	Apply Map Reduce programming model to solve some data-intensive computing applications over public or private cloud platforms.
CO4	Analyzing the security risks in cloud from different perspectives and study some of the available solutions.
CO5	Explain Operating system security, Virtual machine Security and Security of virtualization.

Text/Reference Books:	
1.	Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi, 2013, McGraw Hill, New Delhi, India, ISBN-13: 978-1-25-902995-0.
2.	2.Cloud Computing Theory and Practice, Dan C Marinescu, 1st Edition, 2013, Elsevier (MK), ISBN: 9780124046276. (Unit – 5)
3.	3.Distributed Computing and Cloud Computing, from parallel processing to internet of things, Kai Hwang, GeofferyC.Fox, Jack J Dongarra, 1st Edition, 2012, Elsevier(MK), ISBN: 978-0-12-385880-1.
4.	4.Cloud Computing Implementation, Management and Security,John W Rittinghouse, James F Ransome, 1st Edition, 2013, CRC Press, ISBN: 978-1-4398-0680-7.

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

High-3, Medium-2, Low-1

Course Title	Mobile Computing	Semester	VII
Course Code	MVJ20IS752	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

To provide an overview of Wireless Communication networks area and its applications in communication engineering

To appreciate the contribution of Wireless Communication networks to overall technological growth.

Define concepts of wireless communication.

Compare and contrast propagation methods, Channel models, capacity calculations multiple

antennas and multiple user techniques used in the mobile communication.

Explain CDMA, GSM. Mobile IP, WImax and Different Mobile OS

Module-1	L1,L2	8 Hours

Cellular Phone Standards, Cellular Evaluation, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANs), Overview of WLAN standards (802.1g/n/ ac/ad) and channel management. Handover in WLAN network.

Application:

Demonstrating applications of wireless network standards

Video Link:

https://nptel.ac.in/courses/106/106/106106147/

Module-2	L2,L3	8 Hours

Syllabus Content: Wifi, Wimax (IEEE 806.16a), IoT Wireless -Topologies, Zigbee Wireless Networks and Transceivers, NFC, 6LoWPAN, Tradeoff between Battery, Bandwidth and

Distance. Wireless Channel Models: Path Loss and Shadowing Models, Millimeter Wave Propagation, Statistical Fading Models, Narrowband Fading, Wideband Fading Models.

Application:

Identifying IoT wireless topologies.

Video Link:

https://nptel.ac.in/courses/106/106/106106147/

Module-3	L2,L3	8 Hours

Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Emerging Technologies: Wireless broadband (WiMAX), Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6. Wireless Networks : Global Systems for Mobile Communication (GSM): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Service Messages (SMS): Introduction to SMS, SMS Architecture, SMMT, SMMO, SMS as Information bearer.

Application:

Differentiate various levels of Mobile computing architecture.

Video Link:

https://nptel.ac.in/courses/106/106/106106147/

Module-4	L2,L3	8 Hours

GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS. Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices.

Application:

Making devices mobile using GPRS.

Video Link: https://nptel.ac.in/courses/106/106/106106147/		
Module-5	**L2,L3**	**8 Hours**
Mobile OS and Computing Environment: Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators Application: Emulating a mobile OS. Video Link: https://nptel.ac.in/courses/106/106/106106147/		
Hands on Experiments:	**L3**	**20**
Program in NS 3 to connect WIFI TO BUS Program in NS 3 to create WIFI SIMPLE INFRASTUCTURE MODE Program in NS 3 to create WIFI SIMPLE ADHOC MODE Program in NS 3 to connect WIFI TO WIRED BRIDGING Program in NS 3 to create WIFI TO LTE(4G) CONNECTION Program in NS3 for CREATING A SIMPLE WIFI ADHOC GRID		

Course outcomes:	
CO1	Understand the cellular system design and technical challenges
CO2	Analyze the Mobile radio propagation, fading, diversity concepts and the channel modeling.

CO3	Explain state of art techniques in wireless communication
CO4	GPRS,CDMA its architecture and application.
CO5	Discover CDMA, GSM. Mobile IP, WImax.

Text/Reference Books:	
1.	"Wireless Communication", Andrea Goldsmith, First Edition, Cambridge University Press.
2.	Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
3.	Fundamentals of Wireless Communication", David Tse, Pramod Viswanath, First Edition, Cambridge University Press.
4.	"Advanced Wireless Communication and Internet: Future Evolving Technologies", Savo G Glisic, Third Edition, Wiley.
5.	Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003
6.	Raj kamal: Mobile Computing, Oxford University Press, 2007

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

High-3, Medium-2, Low-1

Course Title	Pattern Recognition	Semester	VII
Course Code	MVJ20IS753	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

The main objective of this course is to introduce the fundamentals of pattern recognition and classification.

Understand Non-parametric Techniques.

Learn Bayesian decision theory, Maximum likelihood estimation, Hidden Markov Models, some of the non-parametric techniques.

Learn linear discriminant functions.

Understand Unsupervised Learning and Clustering

Module-1	L1,L2,L3	12 Hours

Machine perception- example; pattern recognition systems the design cycle - learning and adaptation

Application: Students can learn basics of pattern recognition

Video Link: https://nptel.ac.in/courses/117/105/117105101/

Module-2	L1,L2,L3	12 Hours

Introduction: Bayesian decision theory – continuous features; minimum-error-rate classification - classifiers, discriminant functions, normal density; discriminant functions for the normal density - Bayesian decision theory – discrete features - missing and noisy features - Maximum-likelihood and Bayesian Parameters Estimation - Maximum-likelihood estimation - Bayesian estimation;

Bayesian parameter estimation: Gaussian case and general theory - problems of dimensionality - component analysis and discriminants - Hidden Markov models.

Application: Students can learn various algorithm related to pattern recognition.

Video Link: https://www.youtube.com/watch?v=Lveq5dIaiXY

Module-3	L1,L2,L3	12 Hours
Density estimation - Parzen windows - kn-nearest-neighbour estimation - nearest-neighbor rule - metrics and nearest-neighbour classification - approximation by series expansions. Application: Students can learn how to derive pattern using clustering and classfications. Video Link: https://nptel.ac.in/courses/106/106/106106046		
Module-4	L1,L2,L3	12 Hours
Linear discriminant functions and decision surfaces - generalized linear discriminant functions - two-category linearly separable case - minimizing the perceptron criterion function; relaxation procedures – Non-separable behavior - minimum squared-error procedures - Ho-Kashyap procedures - linear programming algorithms - support vector machines - multicategory generalizations; Application: Students can learn mathematical model for pattern recognition. Video Link: https://www.youtube.com/watch?v=5QWX8vSD9_c		
Module-5		
Mixture densities and identifiability - maximum-likelihood estimates - application to normal mixtures - unsupervised Bayesian learning - data description and clustering - criterion functions for clustering - hierarchical clustering - on-line clustering - component analysis - low-dimensional representation and multidimensional scaling. Application: Students can learn machine learning methods. Video Link: https://www.youtube.com/watch?v=NhimXdFenrg	L1,L2,L3	12 Hours
Practical Experiments/Research paper Study: A Pattern-Recognition-Based Algorithm and Case Study for Clustering and Selecting Business Services Case study in agriculture and aquaculture Case study in Optical Music Recognition Case study in Financial database Case study in fault detection in a gas turbine	20	

Course outcomes:		
CO1	Understand the major concepts and techniques in pattern recognition	
CO2	Acquire abilities to solve problems in specialized application areas such as speech recognition, signal classification	
CO3	Capable of designing pattern recognition systems and QAM	
CO4	Explain Linear Discriminant functions	
CO5	Explore Unsupervised Learning and Clustering:	

Text/Reference Books:	
1.	Pattern Classification, Richard O. Duda, Peter E. Hart and David G. Stork, 2nd Edition, John Wiley, 2001.
2.	Pattern Recognition and Image Analysis, Eart Gose, Richard Johnsonburg and Steve Joust, Prentice-Hall of India, 2003.
3.	Pattern Recognition and Machine Learning, Christopher M. Bishop, 3rd Edition, Springer, 2007.
4.	Statistical Pattern Recognition, Andrew R. Webb, 2nd Edition, John Wiley, 2002.

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		2									2	
CO2				2								
CO3		2										
CO4				2								2
CO5			2									

High-3, Medium-2, Low-1

Course Title	Ethical Hacking	Semester	VII
Course Code	MVJ20IS754	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 4 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

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

Understand Cyber Crime and Forensics.

Analyze the nature and effect of cyber-crime in society.

Understand Sarbanes-Oxley Financial and Accounting Disclosure Information

Understand Computer Crime and Criminals.

Understand Liturgical Procedures.

Module-1	L1,L2,L3	12 Hours

Syllabus Content:

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime.

Application:

Cybercrime is carried out by individuals or organizations.

Video Link:

https://www.youtube.com/watch?v=ONcQ26UA07M

Module-2	L1,L2,L3	12 Hours

Syllabus Content:

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. Application: IDS makes a better post-mortem forensics tool for the CSIRT to use as part of their security incident investigations Video Link: https://www.youtube.com/watch?v=VPLSIsRegFI		
Module-3	L1,L2,L3	12 Hours
Syllabus Content: Introduction to Cyber Crime 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. Application: Investigation Tools Video Link: https://www.youtube.com/watch?v=QQ9ZLlj36qs		
Module-4	L1,L2,L3	12 Hours
Syllabus Content: 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. Application: Encrypted Disk Detector. Encrypted Disk Detector can be helpful to check encrypted physical drives Video Link: https://www.youtube.com/watch?v=7eT8KSHMGFw		
Module-5	L1,L2,L3	12 Hours

Syllabus Content:

Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

Application:

Digital forensic applications in order to gather evidence information.

Video Link:

https://www.youtube.com/watch?v=rZ63OH2TAOo

Hands on Experiments:

Types of Cyber Crimes: Social Engineering, Categories of Cyber Crime.

Virus Attacks, Software Piracy.

Encryption and Decryption methods.

Analysis using advanced tools.

Course outcomes:

CO1	Describe the importance of Computer Security and the vulnerability issues
CO2	Analyse and explain various types of computer crimes, and the legal aspects of the same along with the Indian IT act
CO3	Identify and Use appropriate tools and techniques to control and prevent the digital criminal activities
CO4	Apply forensic analysis tools to recover important evidence for identifying computer crime.
CO5	Understand laws and ethics.

Text/Reference Books:

1.	Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009, ISBN 13: 9781435498839
2.	Kevin Mandia, Chris Prosise, Matt Pepe, "Incident R esponse and Computer Forensics ",
3.	Tata McGraw -Hill , New Delhi, 2006.
4.	Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 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. iv. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	Machine Learning Laboratory	Semester	VII
Course Code	MVJ20ISL76	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	3	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

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

Sl No	Experiment Name	RBT Level	Hours
1	Implementation of FIND-Algorithm	L3	4
2	Implementation of Candidate-Elimination algorithm	L3	4
3	Implementation of ID3 algorithm	L3	4
4	Implementation of Backpropagation algorithm	L3	4
5	Implementation of naïve Bayesian Classifier	L3	4
6	Implementation of Bayesian network	L3	4
7	Implementation of EM algorithm	L3	4
8	Implementation of *k*-Means algorithm	L3	4
9	Implementation of *k*-Nearest Neighbour algorithm	L3	4
10	Implementation of Locally Weighted Regression algorithm	L3	4

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.

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

High-3, Medium-2, Low-1

Course Title	Bigdata and Hadoop Lab	Semester	VII
Course Code	MVJ20ISL77	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 1 : 2)	Total	100
Credits	2	Exam. Duration	3 Hours

Course objective is to:

- Understand Hadoop Distributed File system and examine MapReduce Programming
- Explore Hadoop tools and manage Hadoop with Ambari
- Appraise the role of Business intelligence and its applications across industries
- Assess core data mining techniques for data analytics
- Identify various Text Mining techniques

Sl No	Experiment Name	RBT Level	Hours
1	Implement the following Data structures in Java Linked Lists b) Stacks	L3	4
2	Implement the following Data structures in java a) Queues b) Set c) Map	L3	4
3	Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed	L3	4
4	Use web-based tools to monitor your Hadoop setup.	L3	4
5	Implement the following file management tasks in Hadoop: • Adding files and directories • Retrieving files • Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.	L3	4
6	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	L3	4

7	Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.	L3	4
8	Implement Matrix Multiplication with Hadoop Map Reduce	L3	4
9	Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.	L3	4
10	Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes	L3	4

Course outcomes:	
CO1	Master the concepts of HDFS and MapReduce framework
CO2	Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop Administration
CO3	Recognize the role of Business Intelligence, Data warehousing and Visualization in decision making
CO4	Infer the importance of core data mining techniques for data analytics
CO5	Compare and contrast different Text Mining Techniques

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

High-3, Medium-2, Low-1

Course Title	PROJECT PHASE – 1	Semester	VII
Course Code	MVJ20ISP78	CIE	50
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	L : T : P :: 0 : 0 : 4	Total	50
Credits	2	Exam. Duration	-

Course Objective:

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

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

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

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

Scheme of Evaluation :

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

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

High-3, Medium-2, Low-1

Course Title	PROJECT PHASE – 2	Semester	VIII
Course Code	MVJ20ISP81	CIE	50
Total No. of Contact Hours	-	SEE	50
No. of Contact Hours/week	L : T : P :: 0 : 0 : 16	Total	100
Credits	8	Exam. Duration	3 Hours

Course Objective:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

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

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

CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.

CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation :

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

Semester End Examination: SEE marks for the project (50 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the norms by the examiners appointed

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	INTERNSHIP	Semester	VIII
Course Code	MVJ20ISI82	CIE	50
Total No. of Contact Hours	Industrial Oriented	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	3 Hours

Course Objective:

- To get the field exposure and experience
- To apply the theoretical concept in field application
- To prepare the comparison statement of difference activities

Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the civil engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.

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

CO1	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation of the activities undertaken during the internship, to a panel comprising internship guide, a senior faculty from the department and head of the department. Each

student should submit the internship report at the end of semester with internship certificate.

Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of internship supervisor, a senior faculty from the department and head of the department.

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

High-3, Medium-2, Low-1

Course Title	SEMINAR	Semester	VIII
Course Code	MVJ20ISS83	CIE	50
Total No. of Contact Hours	-	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	1	Exam. Duration	3 Hours

Course Objective:

- To inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Seminar: Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey; organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

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

CO1	Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study.
CO2	Identify and discuss the current, real-time issues and challenges in engineering & technology. Develop written and oral communication skills.
CO3	Explore concepts in larger diverse social and academic contexts.
CO4	Apply principles of ethics and respect in interaction with others.

CO5	Develop the skills to enable life-long learning.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation, to a panel comprising seminar guide, a senior faculty from the department and head of the department. Each student should submit the Seminar report at the end of semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of seminar supervisor, a senior faculty from the department and head of the department.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	CERTIFICATION	Semester	VIII
Course Code	MVJ20ISC84	CIE	-
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	-	Total	-
Credits	2	Exam. Duration	3 Hours

Course Objective:

- To inculcate self-learning, enhance the skill in different field of Engineering

Certification: Each student, under the guidance of a Faculty, is required to undergo online certification course minimum of 30 hours (number of courses is not limited) preferably, a recent topic of his/her interest. Each student should submit the Course details and Qualification Certificates at the end of semester.

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

CO1	Develop knowledge in different fields of Engineering
CO2	Develop the skills to enable life-long learning.