Course Title	Numerical Methods, Operations Research & Statistics	Semester	IV
Course Code	MVJ20MCD41	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:

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	8 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	8 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	8 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	8 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	8 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:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	S. D. Sharma, "Operations Research", Kedar Nath and Ram Nath Publishers, Seventh Revised Edition 2014.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.
4.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
5.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
6.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.

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	MVJ20CD42	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3 Hours

Course objective is to:

- 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	10 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	10 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	10 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	10 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	10 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:	
1.	Introduction to the Design and Analysis of Algorithms, Anany Levitin:, 2rd Edition, 2009.Pearson.
2.	Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press
3.	Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein – Introduction to Algorithms, Third edition, PHI, 2010.

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	Advanced JAVA & J2EE	Semester	IV
Course Code	MVJ20CD43	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*

- 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	8 Hours

Syllabus Content:

Enumerations, Autoboxing and Annotations(metadata): Enumerations, Enumeration fundamentals, the values() and valueOf() 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	8 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	8 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 to String( ) Character Extraction, char At( ), 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	8 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	8 Hours

Syllabus Content:

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– Inet Address 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 Hil 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.

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	Data Mining & Data Warehouse	Semester	IV
Course Code	MVJ20CD44	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	8 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	8 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	8 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	8 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	8 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:

1. Apriori Algorithm for market Basket Analysis
2. Bayesian Classification
3. Decision Tree Induction Algorithm

4. 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

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	Information Retrieval & Visualization	Semester	IV
Course Code	MVJ20CD45	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 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	8 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

hfhf

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.

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	Virtual Reality	Semester	IV
Course Code	MVJ20CD46	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	8 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	8 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	8 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	8 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	8 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

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	Design & Analysis of Algorithm Lab	Semester	IV
Course Code	MVJ20CDL47	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	3
2	Implementation of merge and quick sort algorithms and test their correctness and efficiency	L3	3
3	Implementation of Floyd-Warshall Algorithm and test their efficiency	L3	3
4	Implementation of 0/1 Knapsack problem using (a) Dynamic Programming method (b)Greedy method.	L3	3
5	(a) Implementation of all-Pairs Shortest Paths problem (b) Implementation of Travelling Sales Person problem	L3	3
6	Implementation and analysis of running time of eight-queen problem	L3	3
7	Implementation of insertion and topological sorting and test their efficiency.	L3	3
8	Program to find a subset of a given set S = {Sl, S2,.....,Sn} of *n* positive integers	L3	3
9	Program to find all Hamiltonian Cycles in a connected undirected Graph	L3	3
10	Mini Project /Case Presentation	L3	3

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

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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	Advanced Java Programming Lab	Semester	IV
Course Code	MVJ20CDL48	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 error-free, well-documented Java programs.

Sl No	Experiment Name	RBT Level	Hours
1	WAP on Network Programming i.e. Client-Server Programming.	L3	3
2	WAP on Multithreading using runnable interface.	L3	3
3	WAP to Create a New Data Source for Ms. Access	L3	3
4	WAP to show connectivity with database using JDBC/ODBC driver.	L3	3
5	WAP to get Information about database using Database Meta Data	L3	3
6	WAP to get Information about particular table using Result Set Meta Data	L3	3
7	WAP to implement the concept of swings.	L3	3
8	WAP to develop an RMI application.	L3	3
9	WAP in Servlets to get and display value from an HTML page.	L3	3
10	WAP in JSP to get and display value from an HTML page.	L3	3

Course outcomes:

CO1	Develop Java network programs.
CO2	Develop search engine, and web framework programs
CO3	Learn how to write advanced-level Object-Oriented programs using Java.
CO4	Develop appropriate data model and database scheme
CO5	Test and Validate Programs

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	MVJ20BKAN49	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	MVJ20SKAN49	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	MVJ20MDSDIP401	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.pdfhttps://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:
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	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