Semester: IV		
Numerical Methods Operations Research & Statistics **(Theory)**		
Course Code:MVJ21MCS41/MVJ21IS41		**CIE Marks:50**
Credits: L:T:P:S:3:1:0:0		**SEE Marks: 50**
Hours: 40L+26T		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able 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.		

UNIT-I	
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/	**12 Hrs**
UNIT-II	
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/	**12 Hrs**
UNIT-III	
Operations Research-1	**12 Hrs**

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/	
UNIT-IV	
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/	**12 Hrs**
UNIT-V	
Statistical Methods Correlation and Regression: Correlation, Regression coefficients, line of regressionproblems. 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/	**12 Hrs**

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

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 NathPublishers, Seventh Revised Edition 2014.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition, 2014.
4.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	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

Semester: IV		
Microcontroller & Embedded Systems (Theory)		
Course Code:MVJ21IS42		**CIE Marks:50**
Credits: L:T:P:S:3:1:0:0		**SEE Marks: 50**
Hours: 40L+26T		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Explain the fundamentals of ARM based system, basic hardware components, selection methods and attributes of an ARM Controller.	
2	Program ARM controller using the various instructions.	
3	Explain the fundamentals of Exception, Interrupt Handling and Memory Management Unit of ARM Controller.	
4	Identify the Embedded System Design applications.	
5	Explain the real time operating system for the embedded system design.	

UNIT-I	
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/	**12 Hrs**
UNIT-II	

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	**12 Hrs**
UNIT-III	
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	**12 Hrs**
UNIT-IV	
Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems,	**12 Hrs**

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	
UNIT-V	
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/	**12 Hrs**

Course Outcomes: After completing the course, the students will be able to	
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	
3.	Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developer's guide, Elsevier, Morgan Kaufman publishers, 2008.
4.	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.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	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

Semester: IV		
Computer Organization & Architecture (Theory)		
Course Code:MVJ21IS43		**CIE Marks:50**
Credits: L:T:P:S:3:1:0:0		**SEE Marks: 50**
Hours: 40L+26T		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	distinguish between the various ISA style	
2	trace the execution sequence of an instruction through the processor	
3	compare different approaches used for implementing a functional unit	
4	understand the fundamentals of memory and I/O systems and their interaction with the processor	

UNIT-I	
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/	**12 Hrs**
UNIT-II	
Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input –Output Processor (IOP) Serial	**12 Hrs**

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	
UNIT-III	
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	**12 Hrs**
UNIT-IV	
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/	**12 Hrs**
UNIT-V	

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	**12 Hrs**

Course Outcomes: After completing the course, the students will be able to	
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	
5.	M. Morris Mano, Computer System Architecture, 3rd edition, Prentice- Hall of IndiaPvt. Ltd., 1999.
6.	CarlHamacher : “Computer Organization ”, Fifth Edition, Mc Graw Hill
3.	William Stallings: “Computer Organisation and Architecture”, Pearson Education

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	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

Semester: IV		
Python Programming and Lab (Theory and Practice)		
Course Code: MVJ21IS44		**CIE Marks:50+50**
Credits: L:T:P: 3:0:1		**SEE Marks: 50 +50**
Hours:40 L+26P		**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Learn fundamental features of object-oriented language	
2	Design, write, debug, run Python Programs	
3	Develop console -based applications using Python	
4	Develop console & windows applications using Python.	
5	Introduce event driven Graphical User Interface (GUI) programming using Python built in functions	

UNIT-I

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: 1. https://www.py4e.com/ http://greenteapress.com/wp/think-python/	**12 Hrs**
UNIT-II	
Syllabus Content:Iteration, Strings, Files. Application: • Pattern recognition and Reading resultant column in supervised learning data set Video Link: 1. https://www.codecademy.com/learn/learn-python http://www.tutorialspoint.com/python/	**12 Hrs**
UNIT-III	
Syllabus Content: Lists, Dictionaries, Tuples, Regular Expressions. Application: • Handling query languages and Managing Large set of data with respect to database Video Link: 1. https://www.programiz.com/python-programming/class https://www.udemy.com/course/web-scraping-with-python-beautifulsoup/	**12 Hrs**
UNIT-IV	
Syllabus Content: Classes and objects, Classes and functions, Classes and methods. Application: • Designing games and puzzles Video Link: 1. https://datatofish.com/json-string-to-csv-python/	**12Hrs**

https://automatetheboringstuff.com/	

UNIT-V

Syllabus Content: Networked programs, Using Web Services, Using databases and SQL. Application: • Music composition and movie development Video Link: 1. http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf 2. https://www.datacamp.com/community/tutorials/reading-and-editing-pdfs-and-word-documents-from-python	**12 Hrs**

LABORATORY EXPERIMENTS

1.Python Program to Reverse a linked list

2. Python Program for Find largest prime factor of a number

3.Python Program for Efficient program to print all prime factors of a given number

4.Python Program for Product of unique prime factors of a number

5.Python Program for Find sum of odd factors of a number

6 Python Program for Coin Change

7 Python Program for Tower of Hanoi

8 Python Program to Check if binary representation is palindrome

9 Python Program for Basic Euclidean algorithms

10 Python Program for Maximum height when coins are arranged in a triangle

Course Outcomes: After completing the course, the students will be able to	
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 useRegular Expressions.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Implement exemplary applications related to Network Programming, Web Servicesand Databases in Python.

Reference Books

7.	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)
8.	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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare executed by means of an examination.

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	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

Semester: IV		
Design Analysis of Algorithms and Lab (Theory and Practice)		
Course Code: MVJ21IS45		**CIE Marks:50+50**
Credits: L:T:P: 3:0:1		**SEE Marks: 50 +50**
Hours:40 L+26P		**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Explain various computational problem-solving techniques.	
2	Apply appropriate method to solve a given problem.	
3	Describe various methods of algorithm analysis	

UNIT-I	
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	**12 Hrs**
UNIT-II	
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	**12 Hrs**

divide_conquer_htm	
UNIT-III	
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	**12 Hrs**
UNIT-IV	
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	**12Hrs**
UNIT-V	
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	**12 Hrs**

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

LABORATORY EXPERIMENTS

1. Implementation of Binary Search Trees

2. Implementation of merge and quick sort algorithms and test their correctness and efficiency

3. Implementation of Floyd-Warshall Algorithm and test their efficiency

4. Implementation of 0/1 Knapsack problem using

(a) Dynamic Programming method

(b)Greedy method.

5. (a) Implementation of all-Pairs Shortest Paths problem

(b) Implementation of Travelling Sales Person problem

6 Implementation and analysis of running time of eight-queen problem

7 Implementation of insertion and topological sorting and test their efficiency.

8 Program to find a subset of a given set S = {Sl, S2,.....,Sn} of *n* positive integers

9 Program to find all Hamiltonian Cycles in a connected undirected Graph

10 Mini Project /Case Presentation

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksare executed by means of an examination.

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	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

Semester: IV		
BALIKE KANNADA (Theory)		
Course Code:MVJ21IS46		**CIE Marks:50**
Credits: L:T:P:S:1:0:0:0		**SEE Marks: 50**
Hours: 40L+26T		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
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		

UNIT-I	
Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)	**12 Hrs**
UNIT-II	
Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronounciation	**12 Hrs**
UNIT-III	
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).	**12 Hrs**
UNIT-IV	
Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)	**12 Hrs**
UNIT-V	
Activities in Kannada	**12 Hrs**

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksis executed by means of an examination. The Question paper consists of objective type questions for 50 marks covering the entire syllabus. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	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

Course Title	**SAMSKRUTHIKA KANNADA**	Semester	IV
Course Code	**MVJ21IS46**	**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 ªÉßUÀ¼ÀÄ 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.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marksis executed by means of an examination. The Question paper consists of objective type questions for 50 marks covering the entire syllabus. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	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

Semester: IV
Additional Mathematics-2

(Theory)		
Course Code:MVJ21MATDIP-II		**CIE Marks:50**
Credits: L:T:P:S:3:1:0:0		**SEE Marks: 50**
Hours: 40L+26T		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able 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.		

UNIT-I	
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**	**12 Hrs**
UNIT-II	
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	**12 Hrs**
UNIT-III	
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/	**12 Hrs**
UNIT-IV	
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,	**12 Hrs**

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	
UNIT-V	
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	**12 Hrs**

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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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