Semester: III		
Transform, Fourier Series and Numerical Methods		
Course Code:	**MVJ21MA31D**	**CIE Marks: 50**
Credits:	**L: T:P:S: 3:2:0:0**	**SEE Marks: 50**
Hours:	**30L+20T**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Solve the linear differential equations using Laplace transforms	
2	Apprehend and apply Fourier transform	
3	Realize and use of Z-Transforms	
4	Use of numerical methods to solve ordinary differential equation	
5	Use of statistical methods in curve fitting applications.	

UNIT-I	
Laplace Transforms: Definition, Transforms of elementary functions, Properties, Periodic function, Unit step function. **Inverse Laplace Transforms:** Inverse Laplace Transforms, Convolution theorem to find inverse Laplace transform. Solution of linear differential equations using Laplace transforms **Self-study:** Solution of simultaneous first order differential equations. **Applications:** Analysis of electrical and electronic circuits, used in Signal processing and in control systems. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**
UNIT-II	
Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse. Fourier sine and cosine transforms, Convolution theorem **Self-study:** Complex form of Fourier series. **Applications:** Fourier transforms used in image **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**
UNIT-III	
Z-Transforms: Definition, standard Z-transforms, properties of Z- transforms- Shifting property, Reversal property, Multiplication by n, initial value and final value theorems. Inverse Z- transform, convolution theorem (proof and problems) Application of Z-transforms to solve difference equations. **Self-study:** Damping rule and problems on them. **Applications:** Fourier transforms used in image processing and Z-transforms in Digital signal processing. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**
UNIT-IV	

Numerical solution of ordinary differential equations: Numerical solution of first order and first degree; Taylor's series method, modified Euler's method, Runge-Kutta method of fourth-order. Milne's and Quadratic Spline Method. **Self-study:** Adams Bash-Method . **Applications:** To solve initial value problems **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**
UNIT-V	
Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares, fitting of linear, quadratic and geometric curve. **Self-study:** A study of rank correlation. **Applications:** Applications of Correlation in Signal Processing and application of regression analysis in business **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Learn to solve linear differential equations using Laplace transforms
CO2	Demonstrate Fourier Transform as a tool for solving Integral equations
CO3	Learn to evaluate Z-transform to solve difference equations.
CO4	Learn to solve algebraic, transcendental and ordinary differential equations numerically.
CO5	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.
3.	Prof G.B.Gururajachar "Engineering Mathematics-III , Academic Excellent series Publications, 2016-17
4.	Ramana B. V., "Higher Engineering Mathematics", Tata McGraw-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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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**	**1**	**0**
CO2	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO3	**2**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
CO4	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CO5	**3**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Semester: III		
COMPUTER ORGANIZATION (Theory)		
Course Code:	**MVJ21IO32**	**CIE Marks: 50**
Credits:	**L:T:P: 4:0:0**	**SEE Marks: 50**
Hours:	**50L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To learn the basic structure and operations of a computer.	
2	To learn the arithmetic and logic unit.	
3	To learn the different ways of communication with I/O devices & memo memory hierarchies, cache memories and virtual memories.	
4	To understand & implement arithmetic process.	
5	To understand the processor and pipelining concepts.	
UNIT-I		
Basic Structure of Computers: Basic Operational Concepts, Bus Structures,		

Performance –Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions. **Arithmetic:** Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division. **Laboratory Sessions/ Experimental learning:** Study of peripherals, components of a Computer System **Applications:** Basic Computer Devices **Video link:** https://nptel.ac.in/courses/106105163/	**10 Hrs**
UNIT-II	
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits. Standard I/O Interfaces – PCI Bus, SCSI Bus, USB **Laboratory Sessions/ Experimental learning:** Design of ALU **Applications:** input /output operations **Video link:** https://www.youtube.com/watch?v=RkAE4zE4uSE&list=PL13FD5F00C21BBC0B&index=11	**10 Hrs**
UNIT-III	
Memory: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Types of cache, Cache miss management Mapping Functions, Replacement Algorithms, Performance Considerations, (ARM Cache and Pentium cache). **Laboratory Sessions/ Experimental learning:** Design of Memory **Applications:** Different Types of Memory **Video link:** https://nptel.ac.in/courses/106105163/	**10 Hrs**
UNIT-IV	
Processor: A Basic MIPS implementation – Building a Data path – Control	**10 Hrs**

Implementation Scheme –Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards –Exceptions. **Laboratory Sessions:** Instruction scheduling **Applications:** Types of processors **Video link:** https://nptel.ac.in/courses/106106166/	
UNIT-V	
Parallelism: Parallel processing challenges –Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors. **Laboratory Sessions:** Process Scheduling **Applications:** Grid and Cloud Computing **Video link:** https://nptel.ac.in/courses/106102114/	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the basic organization of a computer system.
CO2	Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
CO3	Design and analyses simple arithmetic and logical units.
CO4	Illustrate hardwired control and micro programmed control, pipelining, embedded and other Computing systems.
CO5	Design and analyses of simple Parallelism and Multithread.

Reference Books	
3.	Carl Hamacher, Zvonko Vranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, and 6).
4.	David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.(Listed topics only from Chapters 4and 6).
3.	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
4.	John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	1	2	1	1	1	-	-	-	-	-	-	-
CO2	2	2	1	1	1	-	-	-	-	-	--	-
CO3	1	2	2	1	1	-	-	-	-	-	-	-
CO4	2	2	2	1	2	-	-	-	-	-	-	-
CO5	1	2	2	1	2	-	-	-	-	-	-	-

Semester: III		
OBJECT ORIENTED CONCEPTS WITH JAVA (Theory)		
Course Code:	**MVJ21IO33**	**CIE Marks: 50**
Credits:	**L:T:P: 2:2:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Identify the need for Java - an object-oriented language. Set up Java JDK environment to create, debug and run simple Java programs.	
2	Illustrate the use of classes and distinguish the usage of different types of Inheritance and constructors in real world.	
3	Demonstrate the use of exceptions and to create multi-threaded program	
4	Illustrate the use of Collections with elements in Java program	
5	Develop Java Application using JDBC connectivity.	

UNIT-I	
Prerequisites: Basic Knowledge about C or C++ **Introduction to Object Oriented Concepts and Java:** Java's Magic: The Byte code; Java Development Kit (JDK); The Java Buzz words, Object Oriented Programming - Two Paradigms, Abstraction, The Three OOP Principles and its advantages, Simple Java programs. Data types, variables and arrays, Operators, Control Statements. **Laboratory Sessions/ Experimental learning:** A professor in college will allow a student to be excused from the final exam if either of the following is true: • They have a 90% average or higher in the class and have missed 3 or less class lectures. • They have a 80% average or higher in the class and have not missed any class lectures. The program below will determine whether a student can get out of the exam or not. Rewrite the program so only one if statement is used. **Applications:** Arrays in mathematical vectors, matrices. **Video link / Additional online information (related to module if any):** • Differences between JVM vs JRE vs JDK in Java: https://www.youtube.com/watch?v=5Bp6GLU6HKE	**8 Hrs**
UNIT-II	
Classes, Inheritance, Packages, and Interfaces: Classes fundamentals; Declaring objects; Assigning object reference variables; Introducing	**8 Hrs**

Methods, Constructors, this keyword, Finalize Method. Inheritance: Inheritance basics, using super, creating multi-level hierarchy, when constructors are called, method overriding, using abstract classes. Packages, Access Protection, Importing Packages, Interfaces. **Laboratory Sessions/ Experimental learning:** Write a program that calculates the number of buckets of paint to use for a room and the optimal number of cans to purchase. You need to ask the height of the room and the length and width of the room. The room is rectangular. You must paint the walls and the ceiling but not the floor. There are no windows or skylights. You can purchase the following size buckets of paint. • 5-liter bucket costs $15 each and covers 1500 square feet. • 1-liter bucket costs $4 and covers 300 square feet. **Applications:** Inheritance in Banking Sectors **Video link / Additional online information (related to module if any):** Types of Inheritance: https://www.youtube.com/watch?v=ZP27c7i5zpg	
UNIT-III	
Exception Handling and Multi-Threaded Programming: Exception Handling fundamentals, Exception Types, Uncaught Exceptions, Using try catch, Multiple catch clauses, Nested try statements, throw, throws, finally, Java's built-in exceptions, Programming Examples. **Multi-Threaded Programming**: The java thread model, Main thread, Creating Thread, creating multiple threads, Using is Alive () and join (), Thread priorities, Synchronization; Inter Thread Communication - Bounded buffer problem. **Laboratory Sessions/ Experimental learning:** The Producer-Consumer problem describes two processes, the producer, and the consumer, which share a common, fixed-size buffer used as a queue. The producer's job is to generate data, put it into the buffer, and start again. At the same time, the consumer is consuming the data (i.e., removing it from the buffer), one piece at a time. Make sure that the producer won't try to add data into the buffer if it's full and that the consumer won't try to remove data from an empty buffer. Write a java code to get the solution for this multi-process synchronization	**8 Hrs**

problem. **Applications:** Multithreads in Browsers, Servers **Video link / Additional online information (related to module if any):** Multithreading: https:/youtu.be/QFbxzynUij4	
UNIT-IV	
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. **Java Lambda expressions:** Java Lambda expressions, Using Java Lambda expressions, Lambda expression vs method in java, Lambda expression in the array list. **Laboratory Sessions/ Experimental learning:** Write a Java program to iterate through all elements in a array list**.** Write a Java program to create a new array list, add some colours (string) and print out the collection **Applications:** Elements in group **Video link / Additional online information (related to module if any):** https://www.youtube.com/watch?v=Q_9vV3H-dt4	**8 Hrs**
UNIT-V	
JDBC: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data types; Exceptions. **Laboratory Sessions/ Experimental learning:** Develop Student Management System application with swings as the front end and database as the back end using JDBC connectivity. **Applications:** Scientific Applications, Financial Applications **Video link / Additional online information (related to module if any):** **Java JDBC:** https://www.youtube.com/watch?v=hEWBIJxrLBQ	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the Object-Oriented Programming concepts and basic characteristics of Java.
CO2	Demonstrate the principles of classes, inheritance, packages and interfaces.
CO3	Experiment with exception handling Mechanisms and Create multi-threaded programs.
CO4	Interpret the need for advanced Java concepts like collections in developing

	modular and efficient programs.
CO5	Develop an application with Database using JDBC connectivity.

Reference Books	
1.	Herbert Schildt, "Java The Complete Reference", 7 /9th Edition, Tata McGraw Hill, 2007.
2.	Jim Keogh: "J2EE-The Complete Reference", McGraw Hill, 2007.
3.	"Effective Java", Third Edition, Joshua Bloch, Addison-Wesley Professional,2017
4.	Richard Warburton**,** Java 8 Lambdas: "Pragmatic Functional Programming" Kindle Edition.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	**1**											
CO2	**1**		**2**	**2**			**1**			**2**	**2**	
CO3	**1**							**2**	**2**	**2**	**1**	
CO4	**1**	**2**				**2**						**2**
CO5	**1**	**2**				**2**						**2**

Semester: III		
INTRODUCTION TO EMBEDDED SYSTEM DESIGN (Theory and Practice)		
Course Code:	**MVJ21IO34**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
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	
ARM EMBEDDED SYSTEMS: ***Prerequisites:*** **ARM DESIGN PHILOSOPHY, ARM DATAFLOW MODEL** **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:** **1.Comparision of Microprocessor and Microcontroller hardware Model** **2.Comparing the Microprocessor and Microcontroller Software Model** **Applications:** Smartphones, Tablets, Wearables **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=DMsL6TVS0IQ https://www.youtube.com/watch?v=JPfG0UQd3x4	**10 Hrs**
UNIT-II	
ARM Instruction Set and Programming ***Prerequisites:*** **ARM INSTRUCTION SET,ARM ASSEMBLY PROGRAMMING** **Introduction to the ARM Instruction Set :** Data Processing Instructions ,	**10 Hrs**

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:** **1.Writing ARM Assembly program for Embedded System Applications** **Applications:** Coding Device Drivers, Real-Time Systems, Low-Level Embedded Systems, Boot Codes, Reverse Engineering **Video link / Additional online information:** https://www.youtube.com/watch?v=gfmRrPjnEw4	
UNIT-III	
Interrupt and Memory Management Unit: ***Prerequisites:*** **Interrupt, Exception, Memory Management unit** **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:** **1) Use of External interrupt0 to turn ON/OFF led connected to Pin P1.25 of ARM Processor.** **2) Use of Software Interrupt SWI instruction in programming.** **3) Calculating physical memory address from logical address**. **Applications: Internal Errors and Special Conditions Management, Hardware Concurrency, and Service Requests Management.** **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=-Dt9EDsMHiI https://www.youtube.com/watch?v=Kju5UMLC7hg	**10 Hrs**
UNIT-IV	
Prerequisites: Embedded systems, Embedded Applications **Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems,	**10 Hrs**

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:** Digital Clock, Battery operated Smartcard Reader **Applications:** Home Appliances, Office Automation, Security, Telecommunication **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=SD65b5cYfdI https://www.youtube.com/watch?v=obknO3gA92E	
UNIT-V	
Prerequisites: Real time operating system **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 **Laboratory Sessions/ Experimental learning:** Automated Meter Reading System (AMR) and Digital Camera, Real time concepts **Applications: Industrial Control, Telephone Switching Equipment, Flight Control, and Real-Time Simulations** **Video link / Additional online information:** https://www.youtube.com/watch?v=T54qJMqpim8	**10 Hrs**
LABORATORY EXPERIMENTS **1.** Write a program to find the sum of first 10 integer numbers. **2.** Write a program to find factorial of a number. **3.** Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM	

4. Write a program to find the square of a number (1 to 10) using look-up table.
5. Write a program to find the largest/smallest number in an array of 32 numbers
6. Write a program to arrange a series of 32 bit numbers in ascending/descending order
7. Write a program to count the number of ones and zeros in two consecutive memory locations
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.
9. Display "Hello World" message using Internal UART
10. Interface and Control a DC Motor
11. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction
12. Interface a DAC and generate Triangular and Square waveforms.
13. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in Between

STUDY EXPERIMENT

1. Interface a 4x4 keyboard and display the key code on an LCD

Any 12 experiments to be conducted

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	
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.

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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/PSO Mapping

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

Semester: III		
ANALOG AND DIGITAL ELECTRONICS (Theory and Practice)		
Course Code:	**MVJ21IO35**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Explain the use of photo electronics devices, 555 timer IC, Regulator ICs and uA741.	
2	Make use of simplifying techniques in the design of combinational circuits.	
3	Illustrate combinational and sequential digital circuits.	
4	Demonstrate the use of flipflops and apply for registers.	
5	Design and test counters, Analog-to-Digital and Digital-to-Analog conversion techniques.	

UNIT-I	
Prerequisites: *BJT Transistor* **BJT Biasing:** Fixed bias, Collector to base Bias, voltage divider bias **Operational Amplifier Application Circuits:** Peak Detector, Schmitt trigger, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage and Voltage-to-Current Converter, Regulated Power Supply Parameters, adjustable voltage regulator, D to A and A to D converter. **Laboratory Sessions/ Experimental learning**: 1. Simulate BJT CE voltage divider biased voltage amplifier using any suitable circuit simulator. 2. Design an astable multivibrator circuit for three cases of duty cycle (50%, <50% and >50%) using NE 555 timer IC. 3. Using ua 741 opamap, design a window comparator for any given UTP and LTP. **Applications:** Design a integrated power supply and function generator operating at audio frequency. Sine, square and triangular functions are to be generated. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=l6M6FvjUdTI https://www.youtube.com/watch?v=kiiA6WTCQn0&list=PLwjK_iyK4LLDBB	**10 Hrs**

1E9MFbxGCEnmMMOAXOH	
UNIT-II	
Karnaugh maps: minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants **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:** 1. Given a 4-variable logic expression, simplify it using appropriate technique and inplement the same using basic gates. **Applications:** Logic gates simplification **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=BPBiyzc0OBw https://www.youtube.com/watch?v=QIs7YbV6htg	**10 Hrs**
UNIT-III	
Combinational circuit design and simulation using gates: Review of Combinational circuit design, Full Adder & Subtractors, Parallel Adder and Subtractor, Look ahead carry Adder, Binary comparators, Hazards in combinational Logic, simulation and testing of logic circuits **Multiplexers, Decoders and Programmable Logic Devices:** Multiplexers, Multiplexers & Demultiplexer, Decoders & Multiplexers as minterm /maxterm Generator, Decoder, Encoders, Programmable Logic devices. **Laboratory Sessions/ Experimental learning:** 1. Design a full adder using two half adders in Pspice tool. 2. Design an Adder cum Subtractor circuit which adds when input bit operation=1 or subtract if 0, using Pspice. 3. Realize a Boolean expression using decoder IC74139. 4. Design and implement code converter I) Binary to Gray (II) Gray to Binary Code **Applications:** Audio and Video transmission. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RZQTTfU9TNA, 2. https://www.youtube.com/watch?v=36hCizOk4PA, 3. https://www.youtube.com/watch?v=397DDnkBm8A&t=42s	**10 Hrs**

UNIT-IV	
Sequential Circuit Design: Characteristic equations, Asynchronous Counter, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops, Mealy& Moore Models, Synchronous Sequential circuit Analysis. **HDL Concepts**: Sequential circuit design on Synchronous and Asynchronous Counters in Verilog. **Laboratory Sessions/ Experimental learning:** 1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 using Verilog. 2. Design a 4-bit Asynchronous up/down counter using Pspice tool (D, T, JK, SR flipflops) 3. Design a 4-bit binary Synchronous up/down counter using Pspice tool. (D, T, JK, SR flipflops) 4. Design Pseudo Random Sequence generator using 7495 **Applications:** Data synchronizer, Counter. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=O3If0Nr9to0	**10 Hrs**
UNIT-V	
Registers and Counters: Registers and Register Transfers, Parallel Adder with accumulator, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops. **Synthesis Basics**: Introduction, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain. **Laboratory Sessions/ Experimental learning:** 1. Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working. 2. 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) **Applications:** Timing verification, test documentation. Video link / Additional online information: **https://nptel.ac.in/courses/117108040/**	**10 Hrs**
LABORATORY EXPERIMENTS	

1. Design Adder, Integrator and Differentiator using Op-Amp.
2. Design instrumentation amplifier of a differential mode gain of "A" using three Amplifiers.
3. Verify
   (a) Demorgan's Theorem for 2 variables.
   (b) The sum-of product and product-of-sum expressions using universal gates.
4. Design and implement
   (a) Full Adder using basic logic gates.
   (b) Full subtractor using basic logic gates.
5. (a)Design and implement (i) 4-bitParallelAdder/ Subtractor using IC 7483. (ii) BCD to Excess-3 code conversion and vice-versa.

   (b)Realize (i) Adder & Subtractors using IC 74153(ii) 4-variable function using IC 74151(8:1MUX)
6. Realize the following flip-flops using NAND Gates.(a) Clocked SR Flip-Flop (b) JK Flip-Flop (c) D-Flip-Flop
7. Realize the following shift registers using IC7474
   a.SISO (b) SIPO (c) PISO (d) PIPO (e) Ring Counter (f) Johnson Counter.
8. Realize (i) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop (ii) Mod-N Counter using IC7490 / 7476.
9. Write a Verilog program for the following combinational designs a) 2 to 4 decoder b) 8 to 3 (encoder without priority & with priority) c). 8 to 1 multiplexer d) 4 bit binary to gray converter e) Multiplexer, De-multiplexer, Comparator.
10. Design 4 bit binary, BCD counters with Synchronous reset and asynchronous reset and "any sequence"counters using Verilog code.
11. Write HDL code to display messages on alpha numeric LCD display.
12. Write a HDL code to accept Analog signal, Temperature sensor and display the data on LCD or Seven Segment Display.

Any 12 experiments to be conducted

Course Outcomes: After completing the course, the students will be able to	
CO1	Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp.
CO2	Illustrate simplification of Algebraic equations using K-map & Quine-McCluskey Technique.
CO3	Analyze & design different applications of Combinational & Sequential Circuits to meet desired need within realistic constraints.
CO4	Write code & verify the functionality of digital circuit/system using test benches to solve engineering problems in digital circuits.
CO5	Know the importance of Synthesis & counters used for designing digital circuits.

Reference Books	
1.	Charles H Roth and Larry L Kinney and Raghunandan G H Analog and Di

	Electronics, Cengage Learning,2019
2.	John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001.
3.	Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
4.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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	2	1	1	1	-	-	-	-	-	-	-
CO2	1	-	-	-	3	-	-	-	-	-	-	-
CO3	1	2	3	-	3	-	-	-	-	-	-	-
CO4	1	2	2	2	3	-	-	-	-	-	-	-
CO5	1	1	1	-	2	-	-	-	-	-	-	-

Course Title	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW**	Semester	III/IV
Course Code	MVJ21IO36	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	1 Hour

Course objective is to:

- To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.
- To provide overall legal literacy to the young technocrats to manage complex societal issues in the present scenario.
- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.

Module-1	**RBT Level L1,L2,L3**	**3Hrs.**

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**	**3Hrs.**

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**	**3Hrs.**
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 its 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**	**3Hrs.**
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**	**3Hrs.**
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 cybercrimes 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.

Semester: III		
Additional Mathematics-I (Common to all branches)		
Course Code:	**MVJ21MATDIP1**	**CIE Marks:50**
Credits:	**L:T:P:S: 4:0:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	To familiarize the important and introductory concepts of Differential calculus
2	Aims to provide essential concepts integral calculus
3	To gain knowledge of vector differentiation
4	To learn basic study of probability
5	Ordinary differential equations of first order and analyze the engineering problems.

UNIT-I	
Differential calculus: Recapitulation of successive differentiation -nth derivative -Leibnitz theorem (without proof) and Problems, Polar curves - angle between the radius vector and tangent, angle between two curves, pedal equation, Taylor's and Maclaurin's series expansions- Illustrative examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-II	
Integral Calculus: Statement of reduction formulae for the integrals of $\sin^n(x)$, $\cos^n(x)$, $\sin^n(x)\cos^n(n)$ and evaluation of these integrals with standard limits-problems. Double and triple integrals-Simple examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-III	
Vector Differentiation: Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. **Vector identities** - $div(\phi \vec{A})$, $curl(\phi \vec{A})$, $curl(grad(\phi))$, $div(curl \vec{A})$. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-IV	
Probability: Basic terminology, Sample space and events. Axioms of probability. Conditional probability – illustrative examples. Bayes theorem-examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
UNIT-V	
Ordinary Differential Equations of First Order: Introduction – Formation of differential equation, solutions of first order and first degree differential equations: variable separable form, homogeneous, exact, linear differential equations. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**

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

CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications
CO2	Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
CO4	Understand the basic Concepts of Probability
CO5	Recognize and solve first-order ordinary differential equations occurring in different branches of engineering.

Reference Books	
1.	B.S. Grewal, Higher Engineering Mathematics**,** Khanna Publishers, 43rd Edition**,** 2013**,** .
2.	G. B. Gururajachar, Calculus and Linear Algebra, Academic Excellent Series Publicatio 2018-19
3.	Chandrashekar K. S, Engineering Mathematics-I, Sudha Publications, 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.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	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	1	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

Semester: IV		
Probability distribution, optimization and complex variables		
Course Code:	**MVJ21MA41D**	**CIE Marks: 50**
Credits:	**L: T:P:S: 2:2:0:0**	**SEE Marks: 50**
Hours:	**20L+20T**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	
2	Learn the mathematical formulation of linear programming problem	
3	Learn the mathematical formulation of transportation problem.	
4	Understand the concepts of Complex variables and transformation for solving Engineering Problems.	
5	Learn the solutions of partial differential equations numerically	

UNIT-I	
Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function. **Probability Distributions:** Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution. Joint probability distributions. **Self-study:** Discrete and continuous probability problems **Applications:** Discrete and continuous probability distributions help in analysing the probability models arising in engineering field. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-II	
Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method. **Self-study:** Two phase simplex method **Applications:** Applications of transportation Problems **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-III	
The transportation problem: Initial Basic Feasible Solution (IBFS) by Least Cost Method, North West Corner Rule method, Vogel's Approximation Method, MODI method (Optimal Solution), Salesman problem, Assignment problem. **Self-Study Topic**: Matrix Minima Method **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-IV	
Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates,	**8 Hrs**

Construction of analytic function (Using Milne-Thomson method) Consequences of Cauchy-Riemann equations, Properties of analytic functions. Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines. **Self-study:** Unique Expression Method **Applications:** Application to flow problems **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	
UNIT-V	
Numerical solutions of PDE – Classification of second order equations, finite difference approximation to derivatives, solution of heat equations, solution of wave equations and solution of Laplace equation. **Self-study:** Crank Nicolson method – problems. **Applications:** To solve boundary value problems **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply discrete and continuous probability distributions in analysing the probability models arising in engineering field.
CO2	Learn the mathematical formulation of linear programming problem
CO3	Solve the applications of transport problems
CO4	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory
CO5	Learn the numerical solutions of partial differential equations

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 44th Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition, 2014.
3.	Prof G.B.Gururajachar "Engineering Mathematics-III , Academic Excellent series Publications, 2016-17
4.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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**	**1**	**1**
CO2	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
CO3	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CO4	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
CO5	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Semester: IV		
Operating System		
Course Code:	**MVJ21IO42**	**CIE Marks: 50**
Credits:	**L: T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the services provided by an operating system.	
2	Learn how processes are synchronized and scheduled.	
3	Identify different approaches of memory management and virtual memory management.	
4	Study the structure and organization of the file system	
5	Understand inter process communication and deadlock situations.	

Module-1	RBT Level L1, L2, L3	8Hrs.
Prerequisites: Computer Organization and Architecture **Introduction to Operating Systems:** OS, Goals of an OS, Operation of an OS, Program's, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes of operating System,		

Batch processing, Multi programming, Time Sharing Systems, Real Time , distributed and modern Operating Systems.

Laboratory Sessions/ Experimental learning:

Case study: Basics of LINUX OS.

Applications:

Controls the backing store and peripherals such as scanners and printers.

Maintains security and access rights of users.

Spooling (Simultaneous Peripheral Operation on Line)

Video link / Additional online information :

https://nptel.ac.in/courses/106/105/106105214/

https://www.youtube.com/watch?v=qJ_bXhrUOkc&t=12s

https://www.youtube.com/watch?v=29JPq5JuKj8

Module-2	RBT Level L1, L2, L3	8Hrs.

Process Management: OS View of Processes, PCB, Process States and Transitions, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Long term, medium term and short-term scheduling in a time sharing system.

Laboratory Sessions/ Experimental learning:

Case study on Processes and threads in Linux/ Windows/ UNIX Scheduling Algorithms

Applications:

Organizes the use of memory between programs.

Organizes processing time between programs and users.

Install Operating Systems - Ubuntu Linux.

Video link / Additional online information:

https://www.youtube.com/watch?v=Lf3xYcIzgeQ

https://www.youtube.com/watch?v=s1KsWNqezbY

https://www.youtube.com/watch?v=Q6rniXYg1UM

Module-3	RBT Level L1, L2, L3, L6	8Hrs.

Memory Management: Static and Dynamic memory allocation, Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Paging Hardware, VM handler, Page replacement policies - FIFO, LRU.

Laboratory Sessions/ Experimental learning:

Case Study on Linux/ UNIX Memory Management.

Applications:

Memory Management deals with the transfer of programs in and out of memory.

Dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed.

Video link / Additional online information:

https://www.youtube.com/watch?v=MLbdsuxYAF4

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

https://www.youtube.com/watch?v=EbnaTJIf0ZE

Module-4	RBT Level L1, L2, L3	8Hrs.

File Systems: File systems and IOCS, Files and File Operations, Fundamental File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of diskspace, Implementing file access, and File sharing schematics.

Laboratory Sessions/ Experimental learning:

Case Study on UNIX/ Windows/ Linux File System.

Applications:

Understand file handling operations (read, write, and append).

Basic understanding of how pointers are used

Video link / Additional online information :

https://www.youtube.com/watch?v=Fjz3PKJGe5s

https://www.youtube.com/watch?v=E3PshX16WEY

Module-5	RBT Level L1, L2, L3, L6	8Hrs.

Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling Deadlocks, Deadlock detection algorithm, Deadlock Prevention, Deadlock avoidance-Bankers algorithm.

Laboratory Sessions/ Experimental learning:

Simulate Bankers Algorithm for Dead Lock Avoidance.

Applications: Email management

Video link / Additional online information:

https://www.youtube.com/watch?v=rCHnS-ZX7PE

https://www.youtube.com/watch?v=vOfKOg0rFg4

https://www.youtube.com/watch?v=eJBoT0LbK2k

Course outcomes:	
CO1	Summarize the goals, structure, operation and types of operating systems.
CO2	Apply scheduling techniques to find performance factors.
CO3	Apply suitable techniques for contiguous and non-contiguous memory allocation.
CO4	Interpret the organization of file systems and IOCS.
CO5	Describe message passing, deadlock detection and prevention methods.

Text Books:	
1.	Dhamdare, “Operating Systems – A concept-based approach”, by TMH, 2nd edition, 2009.
2.	Silberschatz and Galvin, “Operating systems concepts”, John Wiley India Pvt. Ltd,5th edition, 2001.
Reference Books:	
1.	William Stalling, “Operating system–internals and design system”, Pearson Education, 4th ed, 2006.
2	Tannanbhaum, “Design of operating systems”, TMH, 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 of two parts i.e., Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students must answer five full questions. One question must be set from each unit. The duration of examination is 3 hours.

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

High-3, Medium-2, Low-1

Semester: IV		
MACHINE LEARNING (Theory)		
Course Code:	**MVJ21IO43**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Define machine learning and understand the basic theory underlying machine learning.	
2	Differentiate supervised, unsupervised and reinforcement learning.	
3	Understand the basic concepts of learning and decision trees.	
4	Understand neural networks and Bayesian techniques for problems appear	

	in machine learning
5	Gain the knowledge on instant based learning and reinforced learning.

UNIT-I	
Prerequisites: *Basics of binary tree, Decision Tree* **Introduction, Concept learning and Decision trees:** Machine Learning Design, Applications of Machine learning, Learning Problems, Well posed learning problems, Designing a Learning system, Concept Learning, Perspective and Issues in Machine Learning. **Laboratory Sessions/ Experimental learning:** 1. Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. **Applications:** Data training samples, Speech Recognition algorithm. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106/106/106106139/ https://www.digimat.in/nptel/courses/video/106105152/L01.html	**8 Hrs**
UNIT-II	
Prerequisites: *Data structures, Decision Tree and binary tree* **Decision Tree Learning and Artificial Neural Networks:** Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms. **Laboratory Sessions/ Experimental learning:** 1. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. **Applications:** Email Spam and Malware Filtering,ID3 algorithm, Self-driving cars **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106198/ https://www.youtube.com/watch?v=fPLxFXiS9fU	**8 Hrs**
UNIT-III	
Bayesian and Computational Learning: Introduction, Analyze Bayes theorem, Bayes theorem demonstration and concept learning, ML and LS	**8 Hrs**

error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm **Laboratory Sessions/ Experimental learning:** 1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets. **Applications:** Artificial Neural Network, Virtual Personal Assistant, Online Fraud Detection. **Video link / Additional online information:** https://nptel.ac.in/courses/106/105/106105215/	
UNIT-IV	
Instant Based Learning and Learning set of rules: Demonstrate K-Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning and Develop Sequential Covering Algorithms. **Reinforcement Learning:** Introduction, Evaluate Learning Task, Q Learning **Laboratory Sessions/ Experimental learning:** Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. **Applications:** Market segmentation, Document clustering **Video link / Additional online information :** 1. http://1.https//nptel.ac.in/courses/11706087/ https://nptel.ac.in/courses/106/106/106106198/	**8 Hrs**
UNIT-V	
Analytical Learning: Perfect Domain Theories, Explanation Based Learning, Inductive, Analytical Approaches, FOCL Algorithm. **Real life applications of Machine learning:** Develop an algorithm and flowchart for Traffic prediction, Image recognition and Self-driving cars. **Laboratory Sessions/ Experimental learning:** 1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. **Applications:** Regression algorithm, Tower of Hanoi. **Video link / Additional online information:** https://nptel.ac.in/courses/117102059/	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Choose the learning techniques and investigate concept learning.
CO2	Identify the characteristics of decision tree and solve problems associated with
CO3	Apply effectively neural networks for appropriate applications.
CO4	Apply Bayesian techniques and derive effectively learning rules
CO5	Evaluate hypothesis and investigate instant based learning and reinforced learning.

Reference Books	
1.	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.
2.	Ethem Alpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
3.	T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	2	-	-	-	2	-	-	1
CO2	3	3	3	2	2	1	-	-	2	-	-	1
CO3	3	3	3	3	3	1	-	-	2	-	-	1

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

Semester: IV		
SENSOR AND VIRTUAL INSTRUMENTATION (Theory and Practice)		
Course Code:	**MVJ21IO44**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	To identify the characteristics of transducer and its response for various inputs.	
2	To explain the concepts of Virtual Instrumentation and LabVIEW.	
3	To acquaint about the concepts of programming in Virtual Instrumentation using LabVIEW.	
4	To brief about the data acquisition and state machine architecture in LabVIEW.	
5	To impart knowledge on various instrument control interface and Machine Vision.	

UNIT-I	
Prerequisites: *knowledge of basic of sensors* Static characteristics – Accuracy, precision, resolution, sensitivity, linearity – Dynamic characteristics – Mathematical model of transducer – Zero, first and second order transducers Resistance thermometer – Thermistor – Hot-wire anemometer – Humidity sensor - Piezoelectric transducer – Hall effect transducer – Magnetostrictive - Vibration sensor – Ultrasonic based sensors – Introduction to MEMS and Nanotechnology – Applications **Laboratory Sessions/ Experimental learning:** Characteristic of LDR and thermistor. Characteristics of Hall effect transducer. **Applications:** Selection of appropriate sensors for different industrial applications. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=YKM2Dw8QS9w 2. https://www.youtube.com/watch?v=SN5SSwlzNzU	**10 Hrs**
UNIT-II	
Introduction: Tradition instrument – Virtual instrument – Components of	**10 Hrs**

a VI – Difference between TI and VI – Advantages of VI – VI Programming Environment: Front panel – Block diagram – VI and sub-VI. **Laboratory Sessions/ Experimental learning:** Virtual instrumentation **Applications:** Develop a simulation platform for various circuits. **Video link / Additional online information:** https://www.youtube.com/watch?v=EmmpdzBzY74	
UNIT-III	
Case structure – Sequence structures - Loops – For loop – While loop – Shift registers – Formula nodes – Local and global variables – Control timings – Waveform chart – XY Graph – Waveform graph – Arrays and array operations – Clusters and cluster functions – String and file I/O **Laboratory Sessions/ Experimental learning:** Programming with structures, Arrays, Clusters. **Applications:** Tank level automation, Home automation, Traffic Light control **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=cJfIOhFg8Ew 2. https://www.youtube.com/watch?v=wbKCS--8IDo	**10 Hrs**
UNIT-IV	
State Machine architecture – Concepts of data acquisition and signals types– Signal conditioning and grounding – Hardware and software configuration – Analog and digital I/O – Timers and counters – DAQ assistant and DAQmx **Laboratory Sessions/ Experimental learning:** ATM Machine program, Car Wash Program **Applications:** Coffee Vending Machine **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=V7Bmty7K2nw 2. https://www.youtube.com/watch?v=sWPgItbhWOU	**10 Hrs**
UNIT-V	
GPIB – Hardware and software – Instrument I/O assistant – VISA – Instrument drivers – Driver VI – Serial port communication – IMAQ Vision – Image processing and analysis – Particle analysis – Machine vision – Hardware and software – Building a complete machine vision system – Acquiring and displaying images with NO – IMAQ driver	**10 Hrs**

software – Image processing tools and functions in IMAQ Vision **Laboratory Sessions/ Experimental learning:** Image processing functions and operations using LabVIEW. **Applications:** Real time data acquisition using NI Hardware **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=U0bQBOEiBQY 2. https://www.youtube.com/watch?v=6DBihtsVCcY	

LABORATORY EXPERIMENTS

2. Programming using different data types: numeric, Boolean and strings.
    a. Develop a VI to check whether a given input string is a palindrome or not.
    b. Build a VI to create a two digit seven segment display LED display.
3. Programming using for loop and while loop.
    a. Build a VI to find the Fibonacci series according to the given input of the user.
    b. Create a VI to find the sum of first n natural numbers using a while loop with a feedback node and Shift Register.
4. Programming with shift register and formula node.
    a. Create a VI to find the factorial of a given number using While loop and Shift Register.
    b. Build a VI to find the roots of a quadratic equation. Input the coefficients of X2, X and Constant as A,B and C respectively. Display the roots and the message if the roots are Real or imaginary or equal.
5. Programming with case structure, flat sequence structure
    a. Build a VI to find whether the given input year is a leap year or not.
    b. Build a VI to simulate traffic light control using Flat Sequence Structure and Local Variables.
6. Programming on Arrays
    a. Build a VI that generates a 1D array of any integer values and replace the negative numbers with 0. Then build from the same VI to remove the negative numbers and sort the arrays. (Example: Input array : 1,-3, 4, 9, 21, -89; Output array1: 1, 0, 4, 9, 21, 0 , Output array 2: 1, 4, 9, 21(Sorted))
    b. Build a VI to generate 1D Boolean array Running LED.
7. Programming on Clusters

   This task focus on updating the student database with grace mark.

   Database:

   Take a cluster constant. Put string control for Name. Numeric control for Roll no. Numeric control for Marks. Boolean LED for Pass/Fail. Right click on the cluster to auto size it. Put it in an array constant and create the database.

   Task:

   The task is to update the student database with grace marks.

   1. The grace marks can be + value or - value and the functionality should be the same.
   2. It should add or subtract the grace marks according to the input.
   3. Marks should be updated accordingly
   4. The pass/fail status should be updated according to the marks

5. Make sure that grace marks should not cross 100 or should not be less than 0.

8. Programming with sub VI
    a. Create a VI to find the nCr and nPr values using subVI.
    b. Create a VI to compute full adder logic using half adder logic as subVI.
9. Roll of a Dice. Write a VI to count the number of occurrence's in the multiple roll of the dice.
10. Write a VI to find the berth spot (Side lower/middle/ upper, etc) of the given seat number.
    (Ex: 1-LB , 2-MB, 3-UB, 4-LB,5-MB, 6-UB, 7-SL, 8-SU)

11. Develop a VI to find whether a given number is a disarium number. (A disarium number is a number in which the sum of the digits to the power of their respective position is equal to the number itself (position is counted from left to right starting from 1). Hence,175 is a disarium number.)
    Example: 175=(1^1)+(7^2)+(5^3) = 175 = Disarium Number
12. Build a VI for SGPA calculation.

Any 12 experiments to be conducted

Course Outcomes: After completing the course, the students will be able to	
CO1	Choose appropriate sensors for the measurement of various physical parameters.
CO2	Describe the concepts of Virtual Instrumentation and LabVIEW
CO3	Program in LabVIEW with various tools.
CO4	Deal with various data acquisition methods in LabVIEW.
CO5	Interface the system with external device using communication methods and instrument drivers and able to work on IMAQ applications.

Reference Books	
1.	"A Course in Electrical and Electronics Measurements and Instrumentation", Sawhney A K,Dhanpat Rai and Sons, New Delhi, 2013
2.	Virtual Instrumentation Using LabVIEW", Jovitha Jerome, Prentice Hall of India, Fifth Edition, 2018.
3.	"Data Acquisition using LabVIEW", Behzad Ehsani, PACKT Publishing Ltd, 2016.

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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.

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

Semester: IV		
DATA STRUCTURES AND APPLICATIONS (Theory and Practice)		
Course Code:	**MVJ21IO45**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Identify the importance of data structures & memory allocation.	
2	Perform operations on stacks and queues and its applications.	
3	Apply the operations of linked list, Trees & Graphs in various applications.	
4	Apply searching and sorting operations in real time applications.	
5		

UNIT-I	
Introduction: Data Structures, Classifications (Primitive & Non Primitive),	**10 Hrs**

Data structure Operations, Review of Arrays, Structures, Self-Referential Structures. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays.

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

Array ADT :Multidimensional Arrays, Polynomials and Sparse Matrices.

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

Laboratory Sessions/ Experimental learning:

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

```
int minval(int *A, int n) {
int currmin;
for (int i=0; i<n; i++)
  if (A[i] < currmin)
    currmin = A[i];
 return currmin;
}
```

3. Compile the following code and debug it.

```
#include <stdio.h>
#include <string.h>
struct student
{
 int id;
 char name[30];
```

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

Real Time Applications: System memory allocation

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

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

UNIT-II

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

Recursion - GCD, Tower of Hanoi.

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

Laboratory Sessions/ Experimental learning:

Design, Develop and Implement a menu driven Program in C for the

10 Hrs

following operations on DEQUEUE of Integers (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to DEQUEUE b. Delete an Element from DEQUEUE c. Demonstrate Overflow and Underflow situations on DEQUEUE d. Display the status of DEQUEUE e. Exit Support the program with appropriate functions for each of the above operations **Real Time Applications: Game applications, Ticket booking applications (Eg: Train, restaurant etc)** **Video link / Additional online information (related to module if any):** 1.https://nptel.ac.in/courses/106106130/ 2. https://nptel.ac.in/courses/106102064/ 3. https://nptel.ac.in/courses/106105085/ 4. https://nptel.ac.in/courses/106/106/106106127/	
UNIT-III	
Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials. Programming Examples **Hashing:** Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. **Laboratory Sessions/ Experimental learning:** 1.Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2 y 2 z-4yz5 +3x3 yz+2xy5 z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations 2. Debug the following code and explain the process	**10 Hrs**

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

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

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

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

UNIT-IV

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

10 Hrs

Laboratory Sessions/ Experimental learning:

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

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

63, 9, 19, 27, 18, 108, 99, 81. ii)searching for a node iii)Deleting a node **Real Time Applications:** Indexing in databases, Programming Languages, Computer chess games, Computer file system, Undo function in text editor, representing city region telehone network etc. **Video link:** • https://nptel.ac.in/courses/106102064/ • http://www.digimat.in/nptel/courses/video/106106127/L50.html https://www.youtube.com/watch?v=ffgg_zmbaxw	
UNIT-V	
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search, Topological Sort. **Sorting and Searching:** Quick sort, Insertion Sort, Radix sort, Merge Sort, Address Calculation Sort. **Laboratory Sessions/ Experimental learning:** Sort a given set of elements using the sorting Method which divides input array in two halves, calls itself for the two halves and then merges the two sorted halves" and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. **Real Time Applications:** Graph Theory, E-Commerce websites, Google Maps, Facebook **Video link:** • https://www.youtube.com/watch?v=hk5rQs7TQ7E&feature=youtu.be https://nptel.ac.in/courses/106/102/106102064/	**10 Hrs**
LABORATORY EXPERIMENTS	
1. A courier company has number of items to be delivered to its intended customers through its salesman. The salesman visits the following cities to deliver the respective	

items. Write a C program,

S.No	Cities	Number of items
1	Agra	25
2	Chennai	50
3	Kolkata	59
4	Mumbai	72
5	Delhi	12

a. To display name of cities where salesman has delivered maximum and minimum number of items

b. To search the number of items to be delivered of a user supplied city.

2. Implement Knuth-Morris- Pratt pattern matching algorithm using C program.

3. Design, Develop and Implement a menu driven Program in C with the listed operations for the data structure which follows Last In First Out (LIFO) order. (Use Array Implementation of specified DS with maximum size MAX).

a. Push an Element

b. Pop an Element

c. Demonstrate how it can be used to check Palindrome

d. Demonstrate Overflow and Underflow situations

e. Display the status

f. Exit

Support the program with appropriate functions for each of the above operations

4. Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.

5. Design, Develop and Implement a menu driven Program in C for the following operations on Ring Buffer of Integers (Use Array Implementation)

a. Insert an Element on to Ring Buffer

b. Delete an Element from Ring Buffer

c. Demonstrate Overflow and Underflow situations on Ring Buffer

d. Display the status of Ring Buffer

e. Exit

Support the program with appropriate functions for each of the above operations

6. Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name,

Programme, Sem, PhNo

a. Create a SLL of N Students Data by using front insertion

b. Display the status of SLL and count the number of nodes in it

c. Perform Insertion / Deletion at End of SLL

d. Perform Insertion / Deletion at Front of SLL

e. Exit

7. Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo.

a. Create a DLL of N Employees Data by using end insertion.

b. Display the status of DLL and count the number of nodes in it.

c. Perform Insertion and Deletion at End of DLL .

d. Perform Insertion and Deletion at Front of DLL .

e. Demonstrate how this DLL can be used as Double Ended Queue.

f. Exit

8. Design, Develop and Implement a menu driven C Program for the following operations on Binary Search Tree (BST) of Integers.

a) Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2.

b) Traverse the BST recursively in inorder, preorder & postorder

c) Search the BST for a given element (KEY) and report the appropriate message

9. Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities

a. Create a Graph of N cities using Adjacency Matrix.

b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

10. Develop a C program to sort a given set of n integer elements using Quick Sort method. Run the program for varied values of n and show the results of each iteration.

11. Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2- digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the necessity of data structure and its storage process.
CO2	Analyse the various operations performed on stack and queues for different applications.

CO3	Perform various operations on linked list for different applications**.**
CO4	Learn Trees and its applications.
CO5	Analyse the concepts of Graphs, searching, sorting & hashing in real time.

Reference Books	
1.	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2.	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
3.	Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4.	Mark Allen Weiss, –Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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	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

Course Title	**SAMSKRUTHIKA KANNADA**	**Semester**	III/IV
Course Code	MVJ21IO46	**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**	1 Hour

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

- Samskruthika Kannada –Parichaya (Introduction to Adalithakannada)
- Kannada Kavyagalaparichaya (Kannada D Ra Bendre, Siddalingaiha)
- Adalithdalli Kannada Padagalu (Kannada KagunithaBalake, Patra Lekhana, Prabhandha)
- Kannada Computer Gnyana (Kannada ShabdhaSangraha, Computer Paribashikapadagalu)
- Activities in Kannada.

Module - 1	**L1**	**3 Hrs**
1. PÀ£ÀßqÀ ¨sÁµÉ-¸ÀAQë¥ÀÛ «ªÀgÀuÉ. 2. ¨sÁµÁ ¥ÀæAiÉÆÃUÀ¯ÁèUÀÄªÀ ¯ÉÆÃ¥ÀzÉÆÃµÀUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À ¤ªÁgÀuÉ		
Module - 2	**L1**	**3 Hrs**
1. ¯ÉÃR£À aºÉßUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À G¥ÀAiÉÆÃUÀ 2. ¥ÀvÀæ ªÀåªÀºÁgÀ.		

Module - 3	**L1**	**3 Hrs**
1. DqÀ½vÀ ¥ÀvÀæUÀ¼ÀÄ. 2. ¸ÀPÁðgÀzÀDzÉÃ±À ¥ÀvÀæUÀ¼ÀÄ		
Module - 4	**L1**	**3 Hrs**
1. ÀAQÃ¥ÀÛ ¥Àæ§AzsÀgÀZÀ£É, ¥Àæ§AzsÀ ªÀÄvÀÄÛ ¨sÁµÁAvÀgÀ 2. PÀ£ÀßqÀ ±À§Ý¸ÀAUÀæºÀ		
Module - 5	**L1**	**3 Hrs**
1. PÀA¥ÀÆålgï ºÁUÀÆ ªÀiÁ»wvÀAvÀæeÁÕ£À 2. ¥Áj¨sÁ¶PÀ DqÀ½vÀ PÀ£ÀßqÀ ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛvÁAwæPÀ/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 / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

Course Title	BALAKE KANNADA	Semester	III/IV
Course Code	MVJ21IO46	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	1 Hour

Course objective :

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

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

Module - 1
Vyavharika Kannada –Parichaya (Introduction to Vyavharikakannada)
Module - 2
Kannada Aksharamaalehaaguuchcharane(Kannada Alphabets and Pronounciation
Module - 3
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
Module - 4
Kannada Grammar in Conversations (Sambhasaneyalli Kannada Vyakarana)
Module - 5
Activities in Kannada

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 / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Course Title	**SUMMER INTERNSHIP-I**	**Semester**	IV
Course Code	**MVJ21INT48**	**CIE**	50
Total No. of Contact Hours	Industrial Oriented	**SEE**	50
No. of Contact Hours/week	-	**Total**	100
Credits	2	**Exam. Duration**	-

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 Electronics and Communication 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

High-3, Medium-2, Low-1

Semester: IV		
Additional Mathematics-II (Common to all branches)		
Course Code:	**MVJ21MATDIP2**	**CIE Marks:50**
Credits:	**L:T:P:S: 4:0:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	To familiarize the important concepts of linear algebra.	
2	Aims to provide essential concepts differential calculus, beta and gamma functions.	
3	Introductory concepts of three-dimensional geometry along with methods to solve them.	
4	Linear differential equations	
5	Formation of partial differential equations.	

UNIT-I	
Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Diagonalization of a square matrix of order two. **Self study**: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-II	
Differential calculus: Indeterminate forms: L-Hospital rule (without proof), Total derivatives, and Composite functions. Maxima and minima for a function of two variables. **Beta and Gamma functions:** Beta and Gamma functions, Relation between Beta and Gamma function-simple problems. **Self study**: Curve tracing. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8Hrs**
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,	**8Hrs**

shortest distance between two line, plane and equation of plane in different forms and problems. **Self study**: Volume tetrahedron. **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	
UNIT-IV	
Differential Equations of higher order: Linear differential equations of second and higher order equations with constant coefficients. Inverse Differential operator, Operators methods for finding particular integrals , and Euler –Cauchy equation. **Self study**: Method of variation of parameters **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**
UNIT-V	
Partial differential equation: Introduction- Classification of partial differential equations, formation of partial differential equations. Method of elimination of arbitrary constants and functions. Solutions of non-homogeneous partial differential equations by direct integration. Solution of Lagrange's linear PDE. **Self study:** One dimensional heat and wave equations and solutions by the method of separable of variable **Video Link**: 1. http://nptel.ac.in/courses.php?disciplineID=111	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Make use of matrix theory for solving system of linear equations and compute eigenvalues and eigen vectors required for matrix diagonalization process.
CO2	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.
CO3	Understand the Three-Dimensional geometry basic, Equation of line in space-different forms, Angle between two line and studying the shortest distance .
CO4	Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.
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.	G. B. Gururajachar, Calculus and Linear Algebra, Academic Excellent Series Publicatio 2018-19
3.	Chandrashekar K. S, Engineering Mathematics-I, Sudha Publications, 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.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	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

Semester: V		
TECHNICAL MANAGEMENT & ENTREPRENEURSHIP (Theory)		
Course Code:	**MVJ21IO51**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Study the concepts of management, planning, organizing, and staffing.
2	Acquire the knowledge required to become an entrepreneur.
3	Understand and choose the appropriate institutional support to succeed as an entrepreneur.
4	Study the requirements towards the small-scale industries and project preparation.
5	Understand the general principles of IPR, Concept and Theories, Criticisms of Intellectual Property Rights.

UNIT-I	
Prerequisites: *Basics of management system, roles and responsibilities.* **Management:** Introduction, Meaning, nature and characteristics of Management, Scope and Functional areas of management, Management as a science, art of profession, Management &Administration, Roles of Management, Levels of Management, Managerial Skills, Management & Administration, Development of Management Thought early management approaches, Modern management approaches. **Planning:** Nature, Importance, Types, Steps and Limitations of Planning, Decision Making: Meaning, Types and Steps in Decision Making **Laboratory session/Experiment:** 1. Choose, Conduct & document a survey on the Management structure of an organization. **Applications:** IT sectors and Institutional Research sectors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/110/107/110107150/ https://nptel.ac.in/courses/110/105/110105146/	**8 Hrs**
UNIT-II	
Organizing and Staffing: Nature and purpose of organization, Principles of organization, Span of Management, Types of organization, Departmentation Committees, Centralization Vs Decentralization of authority and responsibility, Span of control, MBO and MBE (Meaning Only) Nature and importance of staffing: Need and Importance,	**8 Hrs**

Recruitment and Selection Process. **Directing and Controlling:** Meaning and nature of directing Leadership styles, Motivation Theories, Communication: Meaning and importance, Leadership: Meaning, Characteristics, Behavioral Approach of Leadership; Coordination: Meaning, importance and Techniques of Coordination. Meaning and steps in Controlling, Essentials of a sound control system and Methods of establishing control system. **Laboratory session/Experiment:** 1. Document the job responsibilities of a manager level employee of an organization. **Applications:** IT sectors, Banking sectors and Institutional Research sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/107/110107151/	
UNIT-III	
Entrepreneur: Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneurs, Entrepreneur - an emerging. Classification of Entrepreneurs, 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. **Laboratory session/Experiment:** 1. Find, Fill and Document the application forms which are all need to start an enterprise. **Applications:** Core Industrial sectors, New Enterprises sectors. **Video link / Additional online information:** https://nptel.ac.in/courses/110/106/110106141/	**8 Hrs**
UNIT-IV	
Small Scale Industries: Definition, Characteristics, Need and rationale, Objectives, Scope, role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI-Government policy, Different Policies of SSI, Government Support for SSI during 5year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT, Sickness in SSI sector, Problems for Small Scale Industries, Supporting Agencies of	**8 Hrs**

Government for SSI, Meaning, Nature of support, Objectives, Functions, Types of Help, Ancillary Industry and Tiny Industry. **Laboratory session/Experiment:** 1. Find, Fill and Document the application forms which are all need to start a small-scale industry. **Applications:** Industrial sectors, and Institutional Research sectors. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=2I0XdF_uOuA https://www.youtube.com/watch?v=jmx7SiCzay8	
UNIT-V	
Intellectual Property Rights: Introduction to Intellectual Property Rights, Copyrights, Trademarks, Designs and Design Patents, Semiconductor Integrated Circuits and Layout Designs. Ideas and Intellectual Property Rights, Contents of a Patent, Patent Draft, Filing Patent Applications, IPR Strategy and IPR Policy **Laboratory session/Experiment:** 1. Conduct a survey on Forms and Fees related to IPR. Document the application forms for the Grant of Patent. https://www.ipindia.gov.in/form-and-fees.htm **Applications:** Research works copyrights, Paper Publication and Patent filing. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RLQivEQUgUc https://www.youtube.com/watch?v=NFTBbfYGM6A	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain about the management and planning.
CO2	Apply the knowledge on organizing, staffing, directing, and controlling.
CO3	Analyse the concept of Entrepreneurship.
CO4	Choose the requirements towards the small-scale industries and project preparation.
CO5	Understand the Concepts of Intellectual Property Rights

Text Books:	
1.	P.C.Tripathi, P.N.Reddy , “Principles of Management”, Tata Mc Graw Hill, 5th edition, 2008.

2.	Poornima M Charantimath, "Entrepreneurship Development Small Business Enterprises", Pearson Education, 2008, ISBN 978-81-7758-260-4.
3.	Rachna Singh Puri & Arvind Viswanathan, "Practical Approach to Intellectual Property Rights", 1/e, I K International Publishing House Pvt. Ltd, 2009.
Reference Books:	
1.	Vasant Desai, "Dynamics of Entrepreneurial Development & Management", Himalaya Publishing House, 6th Edition, 2018.
2.	Stephen P Robbins, "Management", Pearson Education/PHI1, 7thEdition, 2003.
3.	Roberts Lusier Thomson, "Management Fundamentals - Concepts, Application, Skill Development", Fifth Edition, Thomson Publications, 2011.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	-	-	1	-	3	3	2	2	1
CO2	-	3	3	-	-	1	-	3	3	2	2	1
CO3	-	3	3	-	-	1	-	3	3	2	2	1
CO4	-	3	3	-	-	1	-	3	3	2	2	1
CO5	-	3	3	-	-	1	-	3	3	2	2	1

High-3, Medium-2, Low-1

Semester: V		
Data Base Management System (Theory)		
Course Code:	**MVJ21IO52**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Provide a strong foundation in database concepts, technology, and practice.	
2	Practice SQL programming through a variety of database problems.	
3	Demonstrate the use of concurrency and transactions in database.	
4	Design and build database applications for real world problems.	

UNIT-I	
Introduction to Databases: Introduction; An example; characteristics of the database approach; actors on the scene; workers behind the scene; advantages of using the DBMS approach; A brief history of database Applications; when Not to use a DBMS. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples. **Laboratory Sessions/ Experimental learning:** Draw ER diagram for database applications (logical database design). **Applications:** Library Management system, Banking, Universities and colleges, credit card transactions, social media sites, Telecommunications, Finance, Military, online shopping, Human Resource Management, Manufacturing, Airline Reservation systems. **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=WSNqcYqByFk	**10 Hrs**
UNIT-II	
Relational Model: Relational Model Concepts, Relational Model	**10 Hrs**

Constraints and relational database schemas, Update operations, dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping. **SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. **Laboratory Sessions/ Experimental learning:** programs to perform set operations, arithmetic operations, joins, selection, projection, create tables for real world db applications and insert values to it. **Applications:** RDBMS, enterprise level software solution (except light weight web applications) **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ • https://www.youtube.com/watch?v=gGGHjYbQMvw • https://www.youtube.com/watch?v=nc1yivH1Yac https://www.youtube.com/watch?v=64szTfLNu3o	
UNIT-III	
SQL: Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL. **Database Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Embedded SQL. **Laboratory Sessions/ Experimental learning:** Mini-projects to develop connections between front end and backend(database) using JDBC. Write SQL queries for the given schema. **Applications:** Java Programming, In Server to reduce network traffic and to provide security (Stored procedure) **Video link / Additional online information (related to module if any):**	**10 Hrs**

• https://www.youtube.com/watch?v=64szTfLNu3o • https://www.digimat.in/nptel/courses/video/106105175/L11.html • https://www.youtube.com/watch?v=sjzlr0EsZL4 • https://nptel.ac.in/courses/106106093/ https://nptel.ac.in/courses/106105175/	
UNIT-IV	
Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers. **Laboratory Sessions/ Experimental learning:** Draw schema diagram which satisfy all forms of normalization for all db real world application **Applications:** to optimize database design **Video link / Additional online information (related to module if any):** • https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ https://www.youtube.com/watch?v=YD8dhOmuVnY	**10 Hrs**
UNIT-V	
Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. **File Organizations and Indexes:** Introduction, Hashing techniques, Indexing, Structures for Files. **Laboratory Sessions/ Experimental learning:** Develop banking and other financial applications. **Applications:** systems that manage sales order entry, airline reservations, payroll, employee records, manufacturing, and shipping. Operating system(deadlock)	**10 Hrs**

Video link / Additional online information (related to module if any):	
• https://nptel.ac.in/courses/106106093/ • https://nptel.ac.in/courses/106105175/ https://www.youtube.com/watch?v=5ammL5KU4mo	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify, analyse and define database objects, enforce integrity constraints on a database using RDBMS.
CO2	Use Structured Query Language (SQL) for database manipulation.
CO3	Design and build simple database systems.
CO4	Apply the concepts of Normalization and design database which possess no anomalies.
CO5	Develop application to interact with databases.

Text/Reference Books:	
1	Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson
2	Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill
3	Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, McGrawH 2013.
4	Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	**1**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**2**
CO4	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**2**
CO5	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

SEMESTER:V		
PYTHON FOR IOT (THEORY AND PRACTICAL)		
Course Code:	**MVJ21IO53**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	To know the basics of Python Programming and to read and write simple Python programs with expression and statements.	
2	To develop Python programs with conditionals and loops.	
3	To define Python functions and call the function.	
4	To implement Python Programming in Arduino.	
5	To Understand the Python programming for Data Science.	

UNIT-I	
Prerequisite: *Basic mathematical calculation skills and logical skills* **The Context of Software Development:** Software, Development Tools, Learning Programming with Python, The Python Interactive Shell. Values and Variables, Integer and String Values, Variables and Assignment, Identifiers, Floating-point Numbers, Control Codes within Strings, User Input, Controlling the print, String , Multi-line Strings Writing a Python Program and a Longer Python program. **Laboratory Sessions/ Experimental learning:** Print "Python foundation for IIOT Engineering" by executing python programming. **Applications:** Printing of Results from the modules. **Video link / Additional online information:** https://pythonprogramming.net › introduction-learn-python-3-tutorials	**8 Hrs**
UNIT-II	
Expressions and Arithmetic: Expressions; Mixed Type Expressions; Operator Precedence and Associativity; Formatting Expressions; Errors; Syntax Errors; Run-time Exceptions; Logic Errors ; Arithmetic Operators; **Conditional Execution:** Boolean Expressions, Statements, Compound	**8 Hrs**

Boolean Expressions, Floating-point Equality, Nested Conditionals, Multi-way Versus Sequential Conditionals, Conditional Expressions, Errors, Logic Complexity **Laboratory Sessions/ Experimental learning:** Find the Greatest Number among "12345, 32145 and 23154" by executing python programming. **Applications:** Arithmetic / Conditional Operations **Video link / Additional online information:** 1. https://www.coursera.org/lecture/interactive-python-1/arithmetic-expressions-rMvoA	
UNIT-III	
Iterations And Functions; Iteration: While Statement; Definite Loops vs Indefinite Loops; for Statement; Nested Loops; Abnormal Loop Termination; while/else and for/else; Infinite. **Functions:** Introduction to Using Functions; Functions and Modules ; Function Basics ; Types of Functions; Parameter Passing ; Documenting Functions and Custom Functions vs. Standard Functions Turtle Graphics ; Techniques for Importing Functions and Modules; Writing Functions. **Laboratory Sessions/ Experimental learning:** Compute Square Root, drawing a Tree, Printing Prime Numbers and Insisting on Proper Input by using Iterations. **Applications:** Iterative operations can be implemented Video link / Additional online information: 1. https://www.codementor.io/@kaushikpal/user-defined-functions-in-python-8s7wyc8k2	**8 Hrs**
UNIT-IV	
Lists, Tuples, Dictionaries; Lists: list operations, slices, methods and parameters; **Tuples:** tuple assignment, tuple as return value; **Dictionaries:** operations and methods. **Arduino with Python:** Introduction to Arduino programming History; Why Arduino; Arduino variants; Comments; Variables; Constants; Data types; Conversions; Functions and statements; setup function; loop function; pin Mode function; Working with pins; Statements **Laboratory Sessions/ Experimental learning:** How to apply the Firmata Protocol and to connect the Arduino board for python programming	**8 Hrs**

execution. **Applications:** Implementation of modules in Aurdino board **Video link / Additional online information :** 1. https://www.electronicshub.org/arduino-rf-transmitter-receiver-module/	
UNIT-V	
Data Science and Python: Considering the emergence of data science; Outlining the core competencies of a data scientist; Linking data science and big data ;Understanding the role of programming ; Creating the Data Science Pipeline ; Understanding Python's Role in Data Science; Considering the shifting profile of data scientists; Working with a multipurpose, simple, and efficient language; Learning to Use Python Fast. **Laboratory Sessions/ Experimental learning:** How to Load, Train and View a simple model using python programming. **Applications:** Machine Learning Project in Python Video link / Additional online information: 1. https://data-flair.training/blogs/train-test-set-in-python-ml/	**8 Hrs**

LABORATORY EXPERIMENTS

1. Print all the Disarium numbers between 1 and 100.
2. Encrypt the text using Caesar Cipher technique. Display the encrypted text. Prompt the user for input and the shift pattern.
3. Perform Jump Search for a given key and report success or failure. Prompt the user to enter the key and a list of numbers.
4. The celebrity problem is the problem of finding the celebrity among n people. A celebrity is someone who does not know anyone (including themselves) but is known by everyone. Write a Python program to solve the celebrity problem.
5. Construct a linked list. Prompt the user for input. Remove any duplicate numbers from the linked list.
6. Traverse a path and display all the files and subdirectories in each level till the deepest level for a given path. Also, display the total number of files and subdirectories
7. How to create a menu drive with a dictionary for words and their meanings. How to add the Write functions to add a new entry (word: meaning), search for a particular word and retrieve meaning, given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.
8. Identify a word with a sequence of one upper case letter followed by lower case letters.
9. Plot the Line chart in MS Excel Sheet using Xlsx Writer module to display the annual net income of the companies.Design of Thickener

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the Basics of Python Programming

CO2	Implement the expression, conditional executions in Python flow.
CO3	Understand the iterations and functions in Python Programming.
CO4	Implement the Python Programming in Arduino.
CO5	Demonstrate python proficiency in handling Data Science.

Text Books:	
1.	Fundamentals of Python Programming, Richard L. Halterman, Southern Adventist University, Year: 2019
2.	Python Programming for Arduino, Pratik Desai ,Packt Publishing Ltd, 2015.
3.	Python for Data Science by Luca Massaron and John Paul MuellerPublished by: John Wiley & Sons, Inc., 2015.
Reference Books:	
1.	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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	3	3	2	2	-	-	1	-	-	1
CO2	3	3	3	3	2	2	-	-	1	-	-	1
CO3	3	3	3	3	2	2	-	-	1	-	-	1
CO4	3	3	3	3	2	2	-	-	1	-	-	1
CO5	3	3	3	3	2	2	-	-	1	-	-	1

High-3, Medium-2, Low-1

SEMESTER: V		
Internet Of Things (THEORY AND PRACTICAL)		
Course Code:	**MVJ21IO54**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	To understand the various modes of communications with Internet.	
2	To learn the basic issues, policy, and challenges on the Internet	
3	To get an idea of some of the application areas where Internet of Things can be applied.	
4	To understand the cloud and internet environment	

UNIT-I	
Prerequisites : Basic Knowledge about C or C++ **Introduction to IoT:** Definition – Foundations – Challenges and Issues - Identification - Security. Components in internet of things: Control Units – Sensors – Communication modules –Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks –Mobile Internet – Wired Communication-IoT Platform Overview-Raspberry pi-Arduino boards. * **Laboratory Sessions/ Experimental learning:** Comparative study of Oracle, IBM and Cisco Architectures of IoT **Applications:** Sensors in IoT. **Video link / Additional online information (related to module if any):**	**10 Hrs**

1. http://www.theinternetofthings.eu/what-is-the-internet-of-things. 2. https://www.engineersgarage.com/article_page/sensors-different-types-of-sensors 3. https://www.educba.com/applications-of-sensors/ * Programming Assignments are Mandatory.	
UNIT-II	
IoT Protocols: Protocol Standardization for IoT-M2M and WSN Protocols-SCADA and RFID Protocols-Issues with IoT Standardization-Protocols-IEEE 802.15.4-BACNet Protocol-Zigbee Architecture - Network layer – APS Layer – Security. * **Laboratory Sessions/ Experimental learning:** Implement an IoT architecture to design an application of your own. **Applications:** IoT Protocol Applications **Video link / Additional online information (related to module if any):** https://inductiveautomation.com/resources/article/what-is-scada https://iotbytes.wordpress.com/application-protocols-for-iot/ https://data-flair.training/blogs/iot-protocols/ https://www.avsystem.com/blog/iot-protocols-and-standards/ * Programming Assignments are Mandatory.	**10 Hrs**
UNIT-III	
Resource Management in the Internet of Things: Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects.*	**10 Hrs**

Laboratory Sessions/ Experimental learning: 1. Weather monitoring using Blynk/ThingSpeak 2. Design a people counter using Node MCU 3. Christmas light show with Arduino **Applications:** RFID Applications **Video link / Additional online information (related to module if any):** RFID Applications: 1. https://www.digiteum.com/rfid-technology-internet-of-things 2. https://www.uio.no/studier/emner/matnat/ifi/INF5910CPS/h10/undervisningsmateriale/RFID-IoT.pdf * Programming Assignments are Mandatory.	
UNIT-IV	
Case Study and IoT Application Development: IoT applications in home-infrastructures security-Industries- IoT electronic equipment's. Use of Big Data and Visualization in IoT Industry 4.0 concepts - Sensors and sensor Node – Interfacing using Raspberry Pi/Arduino- Web Enabled Constrained Devices. * **Laboratory Sessions/ Experimental learning:** Interfacing using Raspberry Pi/Arduino **Applications:** Elements in group **Video link / Additional online information (related to module if any):** 1. https://www.simform.com/home-automation-using-internet-of-things/ 2. https://iot5.net/iot-applications/smart-home-iot-applications/ 3. https://maker.pro/raspberry-pi/tutorial/how-to-connect-and-interface-raspberry-pi-with-arduino# 4. https://create.arduino.cc/projecthub/ruchir1674/how-to-interface-arduino-with-raspberrypi-504b06 * Programming Assignments are Mandatory.	**10 Hrs**
UNIT-V	

Web of Things: Web of Things versus Internet of Things-Architecture Standardization for WoT-Platform Middleware for WoT- WoT Portals and Business Intelligence-Cloud of Things: Grid/SOA and Cloud Computing-Cloud Standards –Cloud of Things Architecture-Open Source e-Health sensor platform. **Laboratory Sessions/ Experimental learning:** Web Application Development **Applications:** Multiple IoT domains, Including Smart Home, Industrial, Smart City, Retail, and Health applications **Video link / Additional online information (related to module if any):** 1. https://www.water-io.com/iot-vs-wot 2. https://www.talend.com/resources/iot-cloud-architecture/ * Programming Assignments are Mandatory.	**10 Hrs**

LABORATORY EXPERIMENTS

1. Write a program for interface Arduino Uno with DHT Sensor to print Humidity and Temperature.
2. Write a program for interface Arduino Uno with Smoke Sensor to print digital and analog output.
3. Write a program for interface Arduino Uno with LM-35 Sensor for analog output result.
4. Write a program for interface Arduino Uno with LDR (Light Dependent Resistor) Sensor.
5. Write a program for interface Arduino Uno with Magnetic Sensor.
6. Write a program for sending the data of Serial communication between Gateway and Arduino.
7. Write a program for establishing Wifi IOT module with Arduino uno.
8. Write a program for Communication between gateways to an end node.
9. Write a program for Send data on Thing speak with end node and display those data on LCD.

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the components of IoT.
CO2	Analyse various protocols of IoT.
CO3	Design portable IoT using appropriate boards
CO4	Develop schemes for the applications of IOT in real time scenarios.

CO5	Design business Intelligence and Information Security for WoT

Reference Books	
1	Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective" -CRC Press-2012.
2	Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer2011.
3.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
5	Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October 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 self -study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: V		
INDUSTRY 4.0 AND IIOT (PEC)		
Course Code:	**MVJ21IO551**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To impart basic concepts of IIoT and its implementation	
2	To Understand potential gains of IIoT business incentives and models	
3	To understand the working of IIoT through case studies	
4	To understand the technical issues required to build an IIoT network	
5	To provide business and technology participants with the information required in deploying and delivering an IIoT network.	

UNIT-I	
Introduction to the Industrial Internet: Basic introduction, What Is the Industrial Internet?, The Power of 1%, Key IIoT Technologies, Why Industrial Internet and Why Now?, Catalysts and Precursors of the IIoT, Innovation and the IIoT, Intelligent Devices, Key Opportunities and Benefits, The Digital and Human Workforce Industrial Internet Use-Cases: Healthcare, Oil and Gas Industry, Smart Office, Logistics and the Industrial Internet, IOT Innovations in Retail. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf • https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 • https://nptel.ac.in/courses/106105195	**8 Hrs**
UNIT-II	
IIoT Reference Architecture: Introduction, The IIC Industrial Internet Reference, Architecture, Industrial Internet Architecture Framework (IIAF), Industrial Internet Viewpoints, The Business Viewpoint, The Usage Viewpoint,	**8 Hrs**

The Functional Viewpoint, Implementation Viewpoint, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management, Advanced Data Analytics. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf • https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 • https://nptel.ac.in/courses/106105195	
UNIT-III	
Designing Industrial Internet Systems: Introduction, The Concept of the IIoT, The Proximity Network, WSN Edge Node, WSN Network Protocols, Legacy Industrial Protocols, Modern Communication Protocols, Wireless Communication Technologies, Gateways. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf • https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 • https://nptel.ac.in/courses/106105195	**8 Hrs**
UNIT-IV	
Introducing Industry 4.0: Introduction, Defining Industry 4.0, Why Industry 4.0 and Why Now?, Four Main Characteristics of Industry 4.0, The Value Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Industry 4.0 Reference Architecture. **Video link:** http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf • https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 • https://nptel.ac.in/courses/106105195	**8 Hrs**
UNIT-V	
Smart Factories: Introducing the Smart Factory, Smart Factories in Action, Why Smart Manufacturing Is Important, Winners and Losers?, Real-World Smart Factories, Industry 4.0: The Way Forward. Video link: http://www.nitttrc.edu.in/nptel/courses/video/106105195/lec6.pdf • https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_Industry_4_0 • https://nptel.ac.in/courses/106105195	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Define IIoT and Industry 4.0, and list the uses of IIoT

CO2	Describe the IIoT architecture
CO3	Discuss the concepts used to design and implement IIoT.
CO4	Explain the need of Industry 4.0 and design principles.
CO5	Discuss the development of smart factories based in IIoT and Industry 4.0 protocols

Reference Books	
1.	"Industry 4.0: The Industrial Internet Of Things" by Alasdair Gilchrist, Apress Publications, 2016
2.	"Introduction to Industrial Internet of Things and Industry 4.0" by Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press, 2020

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	1	1	-	-	-	-	-	1
CO2	3	3	3	2	1	1	-	-	-	-	-	1
CO3	3	3	3	2	1	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	-	-	-	-	1
CO5	3	3	3	2	1	1	-	-	-	-	-	1

Semester: V		
LINEAR IC'S AND APPLICATIONS (PEC)		
Course Code:	**MVJ21IO552**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Define the basic concepts of OP-Amp, various parameters of Op-Amp, its characteristics and specifications.	
2	Analyse Op-Amp circuits to determine Input Impedances, output Impedances and other performance parameters.	
3	Sketch and Explain typical Frequency Response graphs for each of the Filter circuits.	
4	Describe and Sketch the various switching circuits of Op-Amps and analyse its operations.	
5	Differentiate between various types of DACs and ADCs and evaluate the performance of each with neat circuit diagrams.	

UNIT-I	
Operational Amplifier Fundamentals: Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedance, Slew rate and Frequency limitations. OP-Amps as DC Amplifiers – Biasing OP-amps, Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers. **Laboratory Sessions/ Experimental learning:** 1. To obtain the Gain of inverting & non inverting amplifier by varying the resistor values. **Applications:** Sensors, Mixers. **Video link / Additional online information**: https://www.youtube.com/watch?v=clTA0pONnMs	**Hrs**
UNIT-II	
Op-Amps as AC Amplifiers: Capacitor coupled voltage follower, High input impedance – Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, High input impedance – Capacitor coupled Non-inverting amplifiers, Capacitor coupled inverting amplifiers, setting the upper cut-off frequency, Capacitor coupled difference amplifier. OP-Amp Applications: Current amplifiers, instrumentation amplifier, Precision Half wave rectifiers, Precision Full wave rectifiers - Half wave rectifier &	**Hrs**

Summing Amplifier. **Laboratory Sessions/ Experimental learning:** 1. Design and find the gain of a Differential Amplifier. **Applications:** Industrial areas (Temperature Indicator, Light Intensity Meter, Temperature Controller) **Video link / Additional online information:** https://www.youtube.com/watch?v=GjG8oshYNLQ	
UNIT-III	
Op-amp Applications: Limiting circuits - Peak Clipper, Clamping circuits, Precision Rectifier Peak Detectors, Sample and hold circuits, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wein bridge oscillator, Zero Crossing detectors, inverting Schmitt trigger, Log and antilog amplifiers, Multiplier, and divider. **Laboratory Sessions/ Experimental learning:** 1. Design and verify a sample and hold circuit using IC 741 opamp. **Applications:** Quartz watches, various radio, TV, and other communication devices, alarms and buzzes. **Video link / Additional online information:** https://www.youtube.com/watch?v=xki9taCqsWY	**Hrs**
UNIT-IV	
Active Filters: First order and second order active Low-pass and high pass filters, Bandpass Filter, Band stop Filter.Voltage Regulators: Introduction, Series Op-amp regulator, IC voltage regulators, Voltage follower regulator, 723 general purpose regulators - Introduction, Low Voltage Regulator, High Voltage Regulator. **Laboratory Sessions/ Experimental learning:** 1. Design & setup a low voltage regulator for an output voltage of 6V using 723 IC. **Applications:** Communication systems, Audio systems and Biomedical instruments **Video link / Additional online information:** https://www.youtube.com/watch?v=y5s4bQnmV-g	**Hrs**
UNIT-V	
Phase locked loop: Basic Principles, Phase detector/comparator, VCO. **DAC and ADC convertor:** DAC using R-2R, ADC using Successive	**Hrs**

approximation. **Other IC Application:** 555 timer, Basic timer circuit, 555 timer used as astable and monostable multivibratos. **Specialized IC Applications:** Introduction on Universal active filters, Power amplifiers- LM380 Power Audio amplifier. **Laboratory Sessions/ Experimental learning:** 1. Demonstrate a simple light circuit that uses a decade counter to drive two traffic lights and uses 555 timer chip as clock. **Applications:** PWM (Pulse Width Modulation) & PPM (Pulse Position Modulation), Analog frequency meters, Digital logic probes. **Video link / Additional online information**: https://www.youtube.com/watch?v=-KMAQxc3J3g	

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire knowledge about fundamental concepts of Op-Amp circuit and parameters.
CO2	Describe AC Amplifiers and application.
CO3	Develop circuits for Op-Amp based linear and non-linear circuits.
CO4	Acquire knowledge about Active Filters and Voltage Regulators.
CO5	Explain applications of linear ICs in phase detector, VCO, DAC, ADC and Timer.

Reference Books	
1.	"Operational Amplifiers and Linear IC"s", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
2.	"Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978-81-224-3098-1.
3.	Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015. ISBN 81-7808-501-1.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	3	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-

Semester: V		
SOFTWARE ENGINEERING (PEC)		
Course Code:	**MVJ21IO553**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand principles, concepts, methods, and techniques of the software engineering approach to producing quality software (particularly for large, complex systems).	
2	Impart skills in the design and implementation of efficient software systems across disciplines.	
3	Familiarize engineering practices and standards used in developing software products and components.	
4	Gather knowledge on various software testing, maintenance methods.	

UNIT-I	
INTRODUCTION TO SOFTWARE ENGINEERING: The Evolving nature of software engineering, Changing nature of software engineering, Software engineering Layers, The Software Processes, Software Myths. **PROCESS MODELS:** A Generic Process Model, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Spiral Model, the Unified Process, Personal and Team Process Models, the Capability	**8 Hrs**

Maturity Model Integration (CMMI). **Laboratory Sessions/ Experimental learning:** To write the SRS for the given real time application using report writing tools. **Applications:** In Software development process. **Video link / Additional online information:** https://nptel.ac.in/courses/106105182/	
UNIT-II	
REQUIREMENTS ENGINEERING: Functional and Non-Functional Requirements, The Software requirements Document, Requirements Specification, requirements Engineering, Requirements Elicitation and Analysis, Requirement Validation, Requirement Management, System Modelling: Context Models, Interaction Models, Structural Models, Behavioural Model, Model-Driven Engineering. **DESIGN CONCEPTS:** The Design Process, Design Concepts, The Design Models, Architectural Design: Software Architecture, Architectural Genres, Architectural Styles. **Applications:** In Software development process. **Video link / Additional online information:** https://www.coursera.org/lecture/client-needs-and-software-requirements/3-2-4-use-cases-bZNCr	**8 Hrs**
UNIT-III	
DESIGN AND IMPLEMENTATION: The Object-Oriented Design with UML, Design Patterns, Implementation Issues, Open-Source Development. User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation. **SOFTWARE TESTING STRATEGIES:** A Strategic approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing, The Art of Debugging, White-Box Testing, Black Box Testing. **Laboratory Sessions/ Experimental learning:** Using Selenium IDE write a test suite containing minimum 4 test cases. **Applications:** In Software development process. **Video link / Additional online information:** https://www.youtube.com/watch?v=T3q6QcCQZQg	**8 Hrs**

UNIT-IV	
PRODUCT METRICS: A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for Design Model, Metrics for Source Code, Metrics for Testing. **PROCESS AND PROJECT METRICES:** Metrics in the Process and Project Domains, Software Measurements, Metrics for Software Quality, Risk Management: Risk verses Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinements, Risk Mitigation Monitoring and Management (RMMM), The RMMM Plan. **Laboratory Sessions/ Experimental learning:** Create a project using MS projects for any real time scenario. **Applications:** In Software development process. **Video link / Additional online information:** https://youtu.be/tIZ1dg4pxCE	**8 Hrs**
UNIT-V	
QUALITY MANAGEMENT: Quality Concepts, Software Quality, Software Quality Dilemma, Achieving Software Quality, Review Techniques, Reviews: A Formal spectrum, Informal Reviews, Formal Technical Reviews, **SOFTWARE QUALITY ASSURANCE:** Background Issues, Elements of Software Quality Assurance, Tasks, Goals and Metrics, Software Reliability, the ISO 9000 Quality Standards. **Laboratory Sessions/ Experimental learning:** Estimation of test coverage metrics using manual test metrics. **Applications:** In Software development process. **Video link / Additional online information:** https://nptel.ac.in/courses/110105039/	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand various Process Models.
CO2	Investigate various requirements engineering and apply design concepts.
CO3	Identify numerous Software Testing Strategies.
CO4	Evaluate Process and Project Metrices.
CO5	Illustrate Quality Management and Software Quality Assurance Concepts

Reference Books	
1.	Roger S. Pressman (2011), Software Engineering, A Practitioner's approach, 7

	th edition, McGraw Hill International Edition, New Delhi
2.	Sommerville (2001), Software Engineering, 9 th edition, Pearson education, India
3.	K. K. Agarval, Yogesh Singh (2007), Software Engineering, 3rd edition, New Age International Publishers, India.
4.	Lames F. Peters, Witold Pedrycz(2000), Software Engineering an Engineering approach, John Wiely & Sons, New Delhi, India

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	2	2	2	2	2	-	-	1	2	2	2	-
CO2	2	2	2	2	2	1	-	1	2	2	2	1
CO3	2	2	2	2	2	1	-	1	2	2	2	-
CO4	1	2	2	2	2	1	-	1	2	2	2	1
CO5	1	2	2	1	2	1	2	1	2	2	2	2

Semester: V		
WIRELESS AND CELLULAR COMMUNICATION (PEC)		
Course Code:	**MVJ21IO554**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.	
2	Familiarize students to radio signal propagation mechanisms and to the characteristics of mobile radio channels, which both are needed in the designing of modern wireless communication systems and networks.	
3	Study the concepts of cellular communication system, architecture, functioning, various standards	
4	Learn the concepts of signal propagation in cellular environment	
5	Study the different multiple access techniques for Wireless Communication	

UNIT-I	
Introduction to Cellular Mobile Systems: The Cellular concept, System design, Capacity improvement in cellular systems, Co-channel interference reduction. Intelligent cell concept and applications, technical Challenges. **Laboratory Sessions/ Experimental learning:** 1. Understand how pulse shaping is realized using MATLAB® functions **Applications:** 1. Transmission of music, news, road conditions, weather reports, and other broadcast information are received via digital audio broadcasting (DAB) with 1.5Mbit/s. 2. A universal mobile telecommunications system (UMTS) phone might be available offering voice and data connectivity with 384kbit/s. **Video link / Additional online information:** 1. https://www.coursera.org/lecture/wireless-communications/1-1-cellular-communication-KpitQ https://nptel.ac.in/courses/117/102/117102062/	**8 Hrs**
UNIT-II	
Mobile radio propagation: Reflection, Diffraction, Fading, Multipath	**8 Hrs**

Propagation, Channel modelling, Diversity Schemes and Combining Techniques. The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Interference and cellular system capacity: co-channel interference and adjacent channel interference, power control. **Laboratory Sessions/ Experimental learning:** 1. Compute the power of the noise and the original signal. Find signal to noise ratio (SNR), compare it with the desired value and see if they are the same using MATLAB **Applications:** **1.** International broadcasting, long distance aircraft and ship communication, citizen band (CB) radios. **2.** Diffraction and reflection give rise to propagation beyond the horizon. Propagation at large distance propagates well within buildings. **Video link / Additional online information:** 1. https://freevideolectures.com/course/2329/wireless-communication/14 https://nptel.ac.in/courses/108/108/108108148/	
UNIT-III	
Signal propagation in mobile communication: Design parameters at the base station, Practical link budget design using path loss models. propagation path loss, outdoor propagation models (Okumura model & Hata model), indoor propagation models, power delay profile, channel parameters (delay spread, doppler spread, coherence bandwidth, coherence time, Smart antenna systems, Beam forming. MIMO Systems. RAKE receiver. **Laboratory Sessions/ Experimental learning:** 1. Performance of Baseband QAM/QPSK Under AWGN Channel **Applications:** 1. Antennas mounted on these structures pump out wireless communications signals to devices in the field via electromagnetic waves. **2.** Wireless signal propagation is the movement of these radio waves	**8 Hrs**

(which move at the speed of light) to and from these sites and devices. **Video link / Additional online information:** 1. https://freevideolectures.com/course/2329/wireless-communication 2. https://web.stanford.edu/class/ee359/lectures.html https://nptel.ac.in/courses/117/105/117105084/	
UNIT-IV	
Multiuser Systems: CDMA- Principle, Network design, Link capacity, Power control, WCDMA-Network planning, MC-CDMA, OFDM, Cellular mobile communication beyond 3G. Wireless Personal Area Networks (Bluetooth, UWB and ZigBee), Wireless Local Area Networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Networks (WiMAX), Ad-hoc Wireless Networks. **Laboratory Sessions/ Experimental learning:** 1. Develop a detector and calculate BER with MATLAB Simulation **Applications:** Radio and TV Broad casting **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/104/108104157/ 2. https://nptel.ac.in/courses/106/105/106105173/ https://nptel.ac.in/courses/111/102/111102130/	**8 Hrs**
UNIT-V	
5G Radio Access Technologies: Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Non orthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication – Radio Access for Massive Machine-type Communication. **Laboratory Sessions/ Experimental learning:** 1. Implementation of channel estimation for multipath environment **Applications:** Television remote control, Wi-Fi, Cell phones, wireless power transfer, computer interface devices **Video link / Additional online information:** 1. https://www.technologyreview.com/collection/wireless-technology-innovations-lead-the-way-to-a-smartly-connected-future/	**8 Hrs**

2. https://in.mathworks.com/videos/5g-new-radio-fundamentals-understanding-the-next-generation-of-wireless-technology-1561301737915.html https://nptel.ac.in/courses/117/104/117104099/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Discuss the cellular system design and technical challenges.
CO2	Analyse the Mobile radio propagation, fading, diversity concepts and the channel modelling.
CO3	Evaluate design parameters involved in the base station.
CO4	Discriminate Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
CO5	Describe the concepts of 5G Radio Access Technologies

Reference Books	
1.	T.S Rapaport, "Wireless Communications" 2 nd edition, Pearson Education, Noida, India.
2.	A. F. Molisch, Wireless Communications, Wiley, 2005.
3.	A. Goldsmith, Wireless Communications, Cambridge University Press, 2005.
4.	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	2	1	-	-	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

Semester: V		
ENVIRONMENTAL STUDIES (Theory)		
Course Code:	**MVJ21ENV56**	**CIE Marks: 50**
Credits:	**L:T:P: 1:0:0**	**SEE Marks: 50**
Hours:	**15 L**	**SEE Duration: 02 Hrs.**
Course Learning Objectives: The students will be able to		
1	Relate interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes	
2	Study drinking water quality standards and to illustrate qualitative analysis of water.	
3	Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.	

UNIT-I	
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/	**3 Hrs**
UNIT-II	
Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, Tidal and Wind. **Natural Resource Management (Concept and case-study):** Disaster Management, Sustainable Mining and Carbon Trading. Video link: https://nptel.ac.in/courses/121/106/121106014/	**3 Hrs**

UNIT-III	
Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects:** Bio-medical Waste, Solid waste, Hazardous waste and E-waste. 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/	**3 Hrs**
UNIT-IV	
Global Environmental Concerns (Concept, policies, and case-studies): Global Warming, Climate Change, Acid Rain, Ozone Depletion and 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	**3 Hrs**
UNIT-V	
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems. Video link: • https://nptel.ac.in/courses/105/102/105102015/ • https://nptel.ac.in/courses/120/108/120108004/	**3 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem
CO5	Describe the realities that managers face when dealing with complex issues.

Reference Books	
1.	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.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE for 50 marks, executed by way of tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 40 marks and assignment is evaluated for 10 marks. The three tests are conducted for 40 marks each and the average of all the tests are calculated for 40. The marks for the assignments are 10 (2 assignments for 5 marks each). The marks obtained in test and assignment are added and report CIE for 50 marks.

Semester End Examination (SEE):

SEE for 50 marks, executed by means of an examination. The Question paper contains objective type questions for 50 marks covering the entire syllabus having same complexity in terms of COs and Bloom's taxonomy level.

Total marks: 50+50=100

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

Semester: V		
RESEARCH METHODOLOGY &IPR		
Course Code:	**MVJ21RMI57**	**CIE Marks: 50**
Credits:	**L:T:P: 1:2:0**	**SEE Marks: 50**
Hours:	**30L**	**SEE Duration: 2 Hrs.**
Course Learning Objectives: The students will be able to		
1	To give an overview of the research methodology and explain the technique of defining a research problem and explain the basic ethics in research.	
2	To develop a suitable outline for research studies through various sources of information from literature review and data collection.	
3	To develop an understanding of the results and on analysis of the work carried.	
4	To Demonstrate enhanced Scientific writing skills.	
5	To Develop an Understanding on Various Intellectual Property Rights and importance of filing patents.	

UNIT-I	
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem. ***Ethics in Engineering Research:*** Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.	**6 Hrs**
UNIT-II	
Research Writing and Journal Publication Skills: Understanding the importance of quality research papers, Differences between conference papers, journal articles, and other academic publications, criteria for selecting a journal, understanding impact factors and journal rankings. place of the literature review in research, how to review the literature, structure of a research paper, effective use of figures and tables, preparing a cover letter and author contributions, Responding to reviewers' comments. **Attributions and Citations:** Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Tools for citation management, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	**6 Hrs**
UNIT-III	
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. ***Results and Analysis:*** Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.	**6 Hrs**
UNIT-IV	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Oral Presentation, Mechanics of Writing a Research Report,	**6 Hrs**

Precautions for Writing Research Reports.	
UNIT-V	
Introduction to Intellectual Property Rights: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights. Kinds of Intellectual property rights—Copy Right, Patent, Trademark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge. Patents: Trips Definition, Patentable and Non-Patentable inventions, Legal requirements for patents. Patent application process: Prior art search, Drafting of a patent, Filing of a patent, Patent document: specification and claims, Granting of patent, Management of IP, Commercialization of IP – Assignment, licensing and infringement.	**6 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Formulate the research problem and follow research ethics.
CO2	Carry to carrying out a Literature survey for the topic identified
CO3	Analyse the research and interpret the outcomes of the research.
CO4	Enhance their technical writing skills
CO5	Understand the importance of Patenting, Licensing and technology transfer.

Text Books:	
1.	C.R. Kothari, Research Methodology, Methods and Techniques, 2nd Revised edition, New Age International Publishers, 2015
2.	Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI Learning Pvt Ltd, 2014
Reference Books:	
1.	Geoffrey Marczyk, David De Matteo, David Festinger (2005) Essentials of Research Design and Methodology, John Wiley & Sons, Inc.
2.	Carol Ellison (2010) McGraw-Hill's Concise Guide to Writing Research Papers, McGraw-Hill
3.	Sinha, S.C. and Dhiman, A.K., (2002). Research Methodology, Ess Publications. 2nd volume.
4.	Wadehra, B.L. (2000). Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing

Assessment Details (both CIE and SEE)

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

· The student has to obtain a minimum of 40% of maximum marks in CIE and a minimum of 40% of maximum marks in SEE.

· Semester End Exam (SEE) is conducted for 50 marks (2 hours duration).

· Based on this grading will be awarded.

· The student has to score a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

· Three Unit Tests each of 30 Marks (30 MCQ's) (duration 01 hour)

1. First test at the end of 5th week of the semester.

2. Second test at the end of the 10th week of the semester.

3. Third test at the end of the 15th week of the semester.

· Report Writing /Presentation/ Assignment to attain the COs and POs for 20 Marks, (Students can decide the topic for Mini Project and start doing literature survey, report of literature survey can be considered for assignments) At the end of the 13th week of the semester

· The average of three tests and report writing/presentation/Assignment summing to 50 marks

Semester End Examination:

· Theory SEE will be conducted by College as per the scheduled timetable, with common question paper for the subject

· SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 02 hours

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

High-3, Medium-2, Low-1

Semester: V		
UNIVERSAL HUMAN VALUES (Theory)		
Course Code:	**MVJ21UHV58**	**CIE Marks: 50**
Credits:	**L:T:P: 2:0:0**	**SEE Marks: 50**
Hours:	**30 L**	**SEE Duration: 02 Hrs.**
Course Learning Objectives: The students will be able to		
1	Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.	
2	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.	
3	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.	

UNIT-I	
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations. **Practical Sessions**: (1) Sharing about Oneself (2) Exploring Human Consciousness (3) Exploring Natural Acceptance. Video link: • https://www.youtube.com/watch?v=85XCw8SU084 • https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6j qzA3p Z3yA7g_OAQz • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-II	
Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health. **Practical Sessions**: (4) Exploring the difference of Needs of Self and Body (5) Exploring Sources of Imagination in the Self (6) Exploring Harmony of Self with the Body Video link: • https://www.youtube.com/watch?v=GpuZo495F24 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-III	
Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.	**6 Hrs**

Practical Sessions: (7) Exploring the Feeling of Trust (8) Exploring the Feeling of Respect (9) Exploring Systems to fulfill Human Goal Video link: • https://www.youtube.com/watch?v=F2KVW4WNnS • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	
UNIT-IV	
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**: (10) Exploring the Four Orders of Nature (11) Exploring Co-existence in Existence Video link: • https://www.youtube.com/watch?v=1HR-QB2mCF0 • https://www.youtube.com/watch?v=lfN8q0xUSpw • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**
UNIT-V	
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession **Practical Sessions**: (12) Exploring Ethical Human Conduct (13) Exploring Humanistic Models in Education (14) Exploring Steps of Transition towards Universal Human Order Video link: • https://www.youtube.com/watch?v=BikdYub6RY0 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	**6 Hrs**

Course Outcomes: After completing the course, the students will 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

Reference Books	
3.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
4.	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
4.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Continuous Internal Evaluation (CIE):

CIE for 50 marks 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):

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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.

Total marks: 50+50=100

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

Semester: VI		
Wireless Network Management (Theory)		
Course Code:	**MVJ21IO61**	**CIE Marks:50**
Credits:	**L:T:P:S: 3:0:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Learn the basic issues, policy and challenges on the Internet.
2	Bring the IoT perspective in thinking and building solutions
3	Acquire an idea of some of the application areas where Internet of Things can be applied.
4	Understand the cloud and internet environment.
5	Analyse the various modes of communications with Internet.

UNIT-I	
Prerequisites : *Basic Knowledge about C or C++* **Introduction to IoT**: IoT Vs. IIoT, History of IIoT, Components of IIoT: Sensors, Interface, Networks, People &Process, Hype cycle, IoT Market, Trends& future Real life examples, Key terms: IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT **Video link / Additional online information (related to module if any):** 1. http://www.theinternetofthings.eu/what-is-the-internet-of-things. 2. https://www.engineersgarage.com/article_page/sensors-different-types-of-sensors/ **3.** https://www.educba.com/applications-of-sensors/	**8 Hrs**
UNIT-II	
Architectures: Overview of IoT components ,Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet, Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT. **Applications:** IoT Protocol Applications **Video link / Additional online information (related to module if any):** 1. https://inductiveautomation.com/resources/article/what-is-scada 2. https://iotbytes.wordpress.com/application-protocols-for-iot/ **3.** https://data-flair.training/blogs/iot-protocols/ **4.** https://www.avsystem.com/blog/iot-protocols-and-standards/	**8 Hrs**
UNIT-III	
Sensor and Interfacing: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel,	**8 Hrs**

Ethernet, BACNet , Current, M2M etc **Video link / Additional online information (related to module if any):** **1.** https://www.digiteum.com/rfid-technology-internet-of-things **2.** https://www.uio.no/studier/emner/matnat/ifi/INF5910CPS/h10/undervisningsmateriale/RFID-IoT.pdf	
UNIT-IV	
Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture, Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. Applications: Health care monitoring, Area monitoring, Industrial monitoring, Threat detection. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105166/ **2.** https://nptel.ac.in/courses/106/105/106105160/	**8 Hrs**
UNIT-V	
Communication Protocols: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA, PAMAS), Schedule based protocols (LEACH) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. Applications: Environmental/Earth sensing, Air pollution monitoring, Forest fire detection, Landslide detection, Water quality monitoring **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105160/ 2. https://nptel.ac.in/courses/106/105/106105195/ **3. Video link / Additional online information (related to module if any):** 1. https://www.water-io.com/iot-vs-wot https://www.talend.com/resources/iot-cloud-architecture/	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe IoT and IIoT
CO2	Analyse various IoT Layers and their relative importance
CO3	Design and develop the real life IoT applications using off the shelf hardware and software
CO4	Develop an energy efficient system for WSN.
CO5	Create a real-life application involving Wireless Sensor Networks using IoT concepts

Text Books	
1.	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2.Bernd Scholz-Reiter, Florian.
2.	Cisco, IOT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT, Pearson Education; First edition (16 August 2017). ISBN-10: 9386873745, ISBN-13: 978-9386873743
3.	Raj Kamal,"Internet of Things-Architecture and design principles", McGraw Hill Education.
4.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols, And Applications", John Wiley, 2007.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**1**

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

High-3, Medium-2, Low-1

Semester: VI		
Artificial Intelligence (Theory and Practice)		
Course Code:	**MVJ21IO62**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Describe the basic principles, techniques, and applications of Artificial Intelligence	
2	Analyze and explain different AI learning methods.	
3	Compare and contrast different AI techniques available.	
4	Understanding the minimax algorithm.	
5	Apply the concept of NLP algorithms	

UNIT-I	
INTRODUCTION: What Is AI? The Foundations of Artificial Intelligence ,The History of Artificial Intelligence, The State of the Art . Intelligent Agents : Agents and Environments ,Good Behaviour: The Concept of Rationality ,The Nature of Environments, The Structure of Agents. Knowledge Representation Issues, Using Predicate Logic, Representing knowledge using Rules. **Experimental Learning:** Implementation of Relational and Inheritable Knowledge **Video Links** • https://www.youtube.com/watch?v=3MW3ICnkQ9k	**8 Hrs**
UNIT-II	
The natural Language of Artificial Intelligence: Introduction, Converting English to Prolog Facts and Rules, Goals, Prolog Terminology, Variables, Control Structures, Arithmetic operators, Matching in Prolog, Backtracking, Cuts, Recursion, Lists, Dynamic databases, Input/Output and Streams **Using Predicate Logic:** Representing simple facts in logic, representing instance and ISA relationships, Computable Functions and Predicates, Resolution, Natural Deduction.	**8 Hrs**

Experimental Learning: Implementing programs in PROLOG to solve problems of Predicate Logic **Video Links:** • https://www.youtube.com/watch?v=pzUBrJLIESU • https://www.youtube.com/watch?v=2juspgYR7as • https://www.youtube.com/watch?v=h9jLWM2lFr0 • https://www.youtube.com/watch?v=-v1K9AnkAeM	
UNIT-III	
Heuristic search techniques: Generate and test, Hill Climbing, Best First Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis. **Weak Slot- and- Filler Structures:** Semantic Nets,Frames. **Strong slot-and Filler Structures-** Conceptual Dependency, Scripts. **Experimental Learning**: Program to implement Best first Search, A*, AO* algorithm **Video Links:** • https://www.youtube.com/watch?v=ieZr_TpRwnQ • https://www.youtube.com/watch?v=lCrHYT_EhDs	**8 Hrs**
UNIT-IV	
Game Playing : Overview, Minimax Search Procedure, Adding alpha beta cut off, Additional Refinements, Iterative Deepening, References on Specific games. **Learning:** What is learning?, Forms of learning, Rote learning, learning by taking advice, Learning in problem solving, Induction leaning, Explanation based learning, Discovery, Analogy, Formal learning Theory, Neural Network Learning. **Experimental Learning** : Real time problem solving using Game Playing **Video Links**: • https://www.youtube.com/watch?v=_i-lZcbWkps • https://www.youtube.com/watch?v=l-hh51ncgDI	**8 Hrs**
UNIT-V	
Natural Language Processing: Syntactic Processing, Semantic Analysis, Discourse and Pragmatic processing, Statistical Natural language processing and Spell checking. **Genetic Algorithms**: A peek into the biological world, Genetic Algorithms (GAs), Significance of genetic operators, termination parameters, niching and speciation, evolving neural network, theoretical grounding. **Experimental Learning**: Program to implement spell checking problem	**8 Hrs**

Video Links:

- https://www.youtube.com/watch?v=zG8AJhVy5NY
- https://www.youtube.com/watch?v=Z_8MpZeMdD4

LABORATORY EXPERIMENTS

1. Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem
2. Implement and Demonstrate Best First Search Algorithm on any AI problem
3. Implement AO* Search algorithm.
4. Solve 8-Queens Problem with suitable assumptions
5. Implementation of TSP using heuristic approach
6. Implementation of the problem-solving strategies: either using Forward Chaining or Backward Chaining
7. Implement resolution principle on FOPL related problems
8. Implement any Game and demonstrate the Game playing strategies
9. Aim: Illustrate and Demonstrate the working model and principle of Find-S algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
10. Aim: Demonstrate the working model and principle of candidate elimination algorithm. Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
11. Aim: To construct the Decision tree using the training data sets under supervised learning concept. Program: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
12. Aim: To understand the working principle of Artificial Neural network with feed forward and feed backward principle. Program: Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
13. Aim: Demonstrate the text classifier using Naïve bayes classifier algorithm. Program: Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

Any 12 experiments to be conducted

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify AI based problems and understand Intelligent agents
CO2	Apply predicate logic and heuristic techniques to solve AI problems.
CO3	Understand the different representation of knowledge.
CO4	Understand the concepts of learning and Natural Language Processing.
CO5	Understand Genetic Algorithms and solve AI problems using PROLOG.

Text Books	
1.	Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
2.	E. Rich , K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.

3.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
Reference Books	
1	G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
2	N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford University Press-2015

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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/PSO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	3	1	-	-	-	-	-	-	2	2	2
CO3	3	3	2	3	1	-	-	-	-	-	-	2	3	-
CO4	3	3	2	3	2	-	-	-	-	-	-	2	3	-
CO5	3	3	2	3	2	-	-	-	-	-	-	2	3	1

Semester: VI		
Cloud Computing		
Course Code:	**MVJ21IO63**	**CIE Marks:50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50 +50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	To understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges.	
2	To introduce the basic ideas and principles in data center design, cloud management techniques and cloud software deployment considerations.	
3	To discuss the different CPU, memory and I/O virtualization techniques that serve in offering software, computation, and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS)	
4	To introduce cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage.	
5	To discuss the variety of programming models and develop working experience in several of them.	

UNIT-I	
Introduction to Cloud Computing: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud. Introduction to big data analytics, using MapReduce/Hadoop for analyzing unstructured data, Hadoop ecosystem of tools. **Applications:** Microsoft Azure, Amazon Web Services **Video link / Additional online information:** https://www.youtube.com/watch?v=PW-V-72MJNY	**10 Hrs**
UNIT-II	
'Integration as a Service' Paradigm for the Cloud Era: An Introduction, The Onset of Knowledge Era, The Evolution of SaaS , The Challenges of SaaS Paradigm, Approaching the SaaS Integration Enigma, New Integration Scenarios, The Integration Methodologies, SaaS Integration Products and Platforms , SaaS Integration Services, Businesses-to-Business Integration (B2Bi) Services, A Framework of Sensor- Cloud Integration, SaaS Integration Appliances, Issues for Enterprise Applications on the Cloud, Transition Challenges, Enterprise Cloud Technology and Market Evolution, Business Drivers	**10 Hrs**

Toward a Marketplace for Enterprise Cloud Computing, The Cloud Supply Chain **Laboratory Sessions/ Experimental learning:** 1. Installation and Configuration of Hadoop. **Applications:** PAAS (Facebook, Google App Engine) **Video link / Additional online information:** https://www.youtube.com/watch?v=ifZh5SJAujA	
UNIT-III	
Virtual Machines Provisioning and Migration Services: Introduction and Inspiration- Background and Related Work-Virtual Machines Provisioning and Manageability- Virtual Machine Migration Services- VM Provisioning and Migration in Action–Provisioning in the Cloud Context- The Anatomy of Cloud Infrastructures-Distributed Management of Virtual Infrastructures - Scheduling Techniques for Advance Reservation of Capacity-Capacity Management to meet SLA Commitments- RVWS Design and Cluster as a Service: The Logical Design **Laboratory Sessions/ Experimental learning:** Implementation of Para-Virtualization using VM Ware‘s Workstation/ Oracle‘s Virtual Box and Guest O.S **Applications:** Hardware Virtualization, Operating system Virtualization, Server Virtualization, Storage Virtualization **Video link / Additional online information:** https://www.youtube.com/watch?v=7m3f-P-WWbg	**10 Hrs**
UNIT-IV	
Platform and Software as a Service**:**Technologies and Tools for Cloud Computing- Aneka Cloud Platform- Aneka Resource Provisioning Service-Hybrid Cloud Implementation - Comet Cloud Architecture- Autonomic Behavior of Comet Cloud- Overview of Comet Cloud-based Applications- Implementation and Evaluation- Workflow Management Systems and Clouds- Architecture of Workflow Management Systems - Utilizing Clouds for Workflow Execution-Case Study: Evolutionary Multi objective Optimizations- Visionary thoughts for	**10 Hrs**

Practitioners **Laboratory Sessions/ Experimental learning:** Create an application (Ex: Word Count) using Hadoop Map/Reduce. **Applications:** Schedule book **Video link / Additional online information:** https://www.youtube.com/watch?v=3KJjKY8k9Lk	
UNIT-V	
MapReduce Programming Model and Implementations**:** MapReduce Programming Model- Major MapReduce Implementations for the Cloud- The Basic Principles of Cloud Computing-A Model for Federated Cloud Computing-Traditional Approaches to SLO Management- Types of SLA- Life Cycle of SLA-SLA Management in Cloud- Automated Policy-based Management- The Current State of Data Security in the Cloud-Data Privacy and Security Issues-Producer Consumer Relationship-Cloud Service Life Cycle **Laboratory Sessions/ Experimental learning:** Create your resume in a neat format using google and zoho cloud Programs on PaaS **Applications:** Network Storage, Google Apps and Microsoft office online **Video link / Additional online information:** **https://www.youtube.com/watch?v=uj2Sb7b_Do0**	**10 Hrs**
LABORATORY EXPERIMENTS	
1. Installation of various hypervisors and instantiation of VMs with image file using open-source hypervisors such as Virtual Box, VMWare Player, Xen and KVM. 2. Create and Launch Virtual Machines in Amazon Web Services and Google App Engine. Access Windows Server using RDP and Linux Instances using Putty/ssh. 3. Develop the Storage Services Using Buckets and EBS in Amazon Web Services 4. Write a Google app engine program to generate n even numbers and deploy it to Google cloud. 5. Develop a Virtual Private Cloud using AWS/GCP Platform. 6. Demonstrate Cloud Database Services in AWS/GCP 7. Working in Codenvy to demonstrate Provisioning and Scaling of a website 8. Install Hadoop single node cluster and run simple applications like wordcount **Any 6 experiments to be conducted**	

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

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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. 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 self -study are 20 (2 presentations are be held for 10 marks each). The marks obtained in test, quiz and self -studies 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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete 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.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: VI		
SUMMER INTERNSHIP-II		
Course Code:	MVJ21INT68	**CIE Marks:50**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: 50**
Hours:	Industrial Oriented	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	To get the field exposure and experience	
2	To apply the theoretical concept in field application	
3	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 Electronics and Communication 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

High-3, Medium-2, Low-1

Semester: VII		
COMPUTER COMMUNICATION NETWORK (Theory and Practice)		
Course Code:	**MVJ21IO71**	**CIE Marks: 50+50**
Credits:	**L:T:P: 3:0:2**	**SEE Marks: 50+50**
Hours:	**40 L+ 26 P**	**SEE Duration: 03+03 Hours**
Course Learning Objectives: The students will be able to		
1	Understand the layering architecture of OSI reference model and TCP/IP protocol suite.	
2	Know about the protocols associated with each layer.	
3	Learn the different networking architectures and their representations.	
4	Acquire a knowledge of various routing techniques and the transport layer services	
5	Learn the security features and functionality of application layer protocols.	

UNIT-I	
Prerequisites: Basic knowledge on computers & programming	**8 Hrs**
Introduction: Data Communications: Components, Representations, Data Flow, Networks: Network criteria, Physical Structures, Network Types: LAN, WAN, Switching, Internet. **Network Models:** Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP. **Laboratory Sessions/ Experimental learning**: 1. Study and draw the layout of LAN connection in Computer Networks Lab in NetSim. List out the type of cabling involved. **Applications:** Ethernet, Fibernet, Satellite Communication. **Video link / Additional online information:** 1. http://www.redbooks.ibm.com/abstracts/gg243376.html 2. https://nptel.ac.in/courses/106/106/106106091/ https://nptel.ac.in/courses/106/105/106105080/	
UNIT-II	
Data-Link Layer: Introduction: Nodes and Links, Services, Categories of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. **Media Access Control:** Random Access: ALOHA, CSMA, CSMA/CD,	**8 Hrs**

CSMA/CA. **Wired LANs: Ethernet:** Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, and Implementation. **Wireless LANs:** Introduction: Architectural Comparison, Characteristics, Access control **Laboratory Sessions/ Experimental learning**: 1. Study and analyze packet transfer using CSMA/CD and CSMA/CA using NetSim. **Applications:** Collision detection and avoidance in wired and wireless network. **Video link / Additional online information:** https://nptel.ac.in/courses/106/105/106105183/	
UNIT-III	
Wireless LANs: Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Layers. **Connecting Devices:** Hubs, Switches. **Virtual LANs:** Membership, Configuration, Communication between Switches and Routers, Advantages. **Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses, Address Space, Classful Addressing, Classless Addressing, DHCP. **Laboratory Sessions/ Experimental learning**: 1. Study of different types of connecting devices. **Applications:** Bluetooth, WiFi, WiMax **Video link / Additional online information:** https://nptel.ac.in/courses/117/102/117102062/	**8 Hrs**
UNIT-IV	
Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol. **Transport-Layer Protocols on the Internet:** User Datagram Protocol: User	**8 Hrs**

Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. **Laboratory Sessions/ Experimental learning**: 1. Study of IP addressing, subnet mask and subnetting. **Applications:** Routing and forwarding packets. **Video link / Additional online information:** https://nptel.ac.in/content/storage2/courses/106105080/pdf/M6L2.pdf	
UNIT-V	
Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client -Server Protocols: World wide web, Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Wed Based Mail, Telnet: Local versus remote logging. Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. **Laboratory Sessions/ Experimental learning**: 1. Transport analysis using TCP/UDP using NetSim. **Applications:** MS Teams, Zoom, Cisco webex **Video link / Additional online information:** 1. http://www.digimat.in/nptel/courses/video/106105183/L11.html http://www.digimat.in/nptel/courses/video/106105183/L06.html	**8 Hrs**
LABORATORY EXPERIMENTS	
1. Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth. 2. Implement a four node point to point network with links n0-n1, n1-n2 and n2-n3. Apply TCP agent between n1-n2 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP. 3. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate. 4. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters. 5. Implementation of Link state routing algorithm. 6. Write a program for a HLDC frame to perform the following. i) Bit stuffing ii) Character stuffing. 7. Write a program for distance vector algorithm to find suitable path for transmission.For the given data, use CRC-CCITT polynomial to obtain CRC code.	

Verify the program for the cases. a. Without error, b. With error 8. Implementation of Sliding Window Protocol. **9.** Write a program for congestion control using leaky bucket algorithm.

Course Outcomes: After completing the course, the students will be able to	
CO1	Implement Netsim tool for learning and practicing of network algorithms.
CO2	Apply the knowledge of C programming for network operation.
CO3	Evaluate the network with different configurations to measure the performance parameters.
CO4	Analyse the data link layer and routing protocols using C programming
CO5	Implement congestion control and avoidance protocol in wired and wireless networks.

Text Books:	
1.	Behrouz A Forouzan,“ Data Communication and Networks”, 3rd Ed. TMH.
2.	Andrew S Tanebaum, “Computer Networks”, 4th Ed. PHI/ Pearson education.
Reference Books:	
1.	S. Keshav, “An Engineering approach to Computer Networks”, 5th Ed. Pearson.
2.	W.A. Shay, “Understanding communication and Networks”, Thomson.
3.	Irvine Olifer, “Computer Networks: Principles, Technology and Protocols”, Wiley India.
4.	William Stalling, “Data and Computer communications”, 7th Ed. PHI

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 for 10 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 marks are executed by means of an examination.

The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students 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	3	2	2	1	-	-	1	-	-	1
CO2	3	3	3	2	2	1	-	-	1	-	-	1
CO3	3	3	3	3	2	1	-	2	1	-	-	1
CO4	3	3	3	3	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	2	1	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
DESIGN OF SMART CITIES (Theory)		
Course Code:	MVJ21IO721	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To acquire specific scripting knowledge to develop interactive applications.	
2	To understand the basics of android application development.	
3	To apply the programming skills in developing application pertaining to Industrial, medical,	

UNIT-I	
Smart City Introduction: Introduction, Smart City, Complexities of Smart Cities, Urban Network, Sensor Network, Role of Urban Networks, Trends	**8Hrs**

in Urban Development, Community Resource Sensing. **Applications:** Philosophy and project management, Phases and Stages of Project, Work Breakdown Structure **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=tKJZxsEeVzk **2.** https://www.youtube.com/watch?v=lmRkYi6WAhE	
UNIT-II	
Urban Planning Urban Planning, Databases, Principles of Urban Planning, Data Organization, Role of Planning in Smart Cities, Case Studies. **Applications:** Project Organization Structure, Planning, Scheduling. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=q_XmlG3CwNk **2.** https://www.youtube.com/watch?v=2F0Bdfb1GqY	**8Hrs**
UNIT-III	
Energy Sustainability in Smart Cities: Energy, Decision Making, Energy as a catalyst for Sustainable Transformation, Cohesion and efficiency of smart cities. **Applications:** Internet of Vehicle (IoV) Importance **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=j_5GldeUpRg 2. https://www.youtube.com/watch?v=BJSiN9FH5UU **3.** https://www.youtube.com/watch?v=g8JgdzbOYUA	**8Hrs**
UNIT-IV	
Security, Privacy and Ethics in Smart Cities Security challenges in Internet of Things, Security threats in IoT, IoT related safety measures for a safer smart city. **Applications:** Structural concept, Specific applications, Structural health monitoring-Process control and stabilization **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=ye0RGdlxGX0 **2.** https://www.youtube.com/watch?v=92c4xj5N2mk	**8Hrs**
UNIT-V	
Smart Cities Planning and Development : City Planning, Understanding Smart Cities, Dimensions of Smart Cities, Global standards and	**8Hrs**

performance benchmark of smart cities, Financing smart cities development, Governance of smart cities. **Applications:** Perspectives on Intelligent Transport Systems (ITS), ITS Highway safety perspective, Environmental aspects of ITS. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=i8LhbDJf2WU **2.** https://www.youtube.com/watch?v=IYZA06kRktw	

Course Outcomes: After completing the course, the students will be able to	
CO1	Design dynamic systems to process user & sensor data
CO2	On a profound level to implement hardware & software for wireless sensor networks in day to day life
CO3	Implement secured application using android Software Development Kit
CO4	Solve the need for smart systems in a distributed environment.
CO5	Understand the Internet of Things (IoT) architecture and building blocks for various domains

Text Books:	
1.	Fadi Al-Turjman, Intelligence in IoT-enabled Smart Cities,1st edition, CRC Press ,2019.
2.	Giacomo Veneri, and Antonio Capasso , Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0 , 1 st edition, Packt Publishing,2018
Reference Books:	
1.	John Dean, Web Programming with HTML5, CSS and JavaScript, 1 st edition, Jones and Bartlett Publishers Inc.,. 2018
2.	Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 1 st edition, Springer, 2012
3.	Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	1	1	-	-	1	-	-	1
CO2	3	3	3	2	1	1	-	-	1	-	-	1
CO3	3	3	3	2	1	1	-	-	1	-	-	1
CO4	3	3	3	2	1	1	-	-	1	-	-	1
CO5	3	3	3	2	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
CRYPTOGRAPHY & CYBER SECURITY (Theory)		
Course Code:	MVJ21IO722	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Outline the basic principles of Cyber security and its applications
2	Familiarize with Cryptography and very essential algorithms
3	Use the theorems needed for cryptographic operations and compare & contrast different types of cryptography
4	State the concepts & uses of Digital signature and web security
5	Demonstrate the need and summarize the concept of Secure Electronic Transactions & Intrusion detection system.

UNIT-I	
Introduction: Services, Mechanisms, Mechanism Attacks, The OSI Security Architecture, A Model for Network Security, Cyber Attacks, Defence Strategies and Techniques, Guiding Principles **Mathematical Background of Cryptography:** Integer Arithmetic, Modular Arithmetic, Matrices, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem **Applications:** Time Stamping, Electronic Money, Secure Network Communication **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117103063/ 3. https://nptel.ac.in/courses/117107095/ 4. http://nptelvideos.com/video.php?id=2441 5. http://www.nptelvideos.com/video.php?id=429	**8Hrs**
UNIT-II	
Basics of Cryptography: Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties. **Symmetric Ciphers:** Symmetric Ciphers model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption Standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and modes of operation, Evaluation Criteria for	**8Hrs**

Advanced Encryption standard, The AES Cipher. **Applications:** wireless security, processor security, file encryption. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117106087/ 2. https://www.youtube.com/watch?v=ANHTfY9feZg **3.** https://nptel.ac.in/courses/108102095/	
UNIT-III	
Principles of public key Cryptosystem, The RSA algorithms, Key management, Diffie – Hellman key exchange, Elliptic Curve Arithmetic, Authentication functions, Hash functions. Digital Signatures, Authentication protocols, Digital signature standard. Web security consideration, Secure Socket Layer, Transport layer security, secure electronic transaction. **Applications:** Random number generator, permutation generator **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=m4sjTt7rhow 2. https://nptel.ac.in/courses/117101106/ 3. https://nptel.ac.in/courses/108108114/	**8Hrs**
UNIT-IV	
Intruders, Intrusion Detection, Password Management, Malicious software programs – Viruses and related Threats, Virus Countermeasures Firewall Design Principles, Trusted Systems **Applications:** Cyber-attacks, Cybercrime, Cyber security. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/108105113/ **2.** https://nptel.ac.in/courses/117106086/	**8Hrs**
UNIT-V	
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **Applications: Encryption, message authentication and integrity, and replay attack protection** **Video link / Additional online information:** **1. https://nptel.ac.in/courses/117102052/**	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Design dynamic systems to process user & sensor data
CO2	On a profound level to implement hardware & software for wireless sensor networks in day to day life
CO3	Implement secured application using android Software Development Kit
CO4	Solve the need for smart systems in a distributed environment.
CO5	Understand the Internet of Things (IoT) architecture and building blocks for various domains

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Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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
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CO3	3	3	3	2	1	1	-	-	1	-	-	1
CO4	3	3	3	2	1	1	-	-	1	-	-	1
CO5	3	3	3	2	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
APPLICATIONS OF IOT IN ROBOTICS (Theory)		
Course Code:	**MVJ21IO723**	**CIE Marks:100**
Credits:	L : T : P :: 3 : 0 : 0	**SEE Marks: 100**
Hours:	**40L**	**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
1	To learn basics of Internet of Things (IoT), and its execution using multiple robotic sensors	
2	To understand Internet of Robotic Things (IoRT) and its various implementations in industry and automation	
3	To implement IoT and Robotics application in autonomous driving and health care	
4		
5		

UNIT-I	
Introduction to IoT and Vision systems: Machine Vision, optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms, and vision systems.	**8Hrs.**

Video link / Additional online information : https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE	
UNIT-II	
Robotic Sensors: Optical sensors and actuators; Mechanical sensors and actuators; Acoustic sensors and actuators; Performance characteristics of sensors and actuators. **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=nE1C4ghfvac&list=PLgMDNELGJ1CbufZjqWa8uoSlQWKqVwPN7	**8Hrs.**
UNIT-III	
Internet of Robotic Things : Communication architecture for IoRT; Decentralized and automated IoT infrastructure using Blockchain; IoRT Platforms Architecture, IoRT applications. **Applications:** **Video link / Additional online information:** **1.** https://www.youtube.com/watch?v=lRm9GiGoZKg&list=PLLy_2iUCG87AjAXKbNMiKJZ2T9vvGpMB0 https://www.youtube.com/watch?v=rYWJdZ5qg6M&list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_	**8Hrs.**
UNIT-IV	
Autonomous Vehicle Systems: Introduction to Autonomous Driving; Perception in Autonomous Driving; Robot Operating System (ROS) Overview - Client Systems for Autonomous Driving - Decision planning and control in autonomous vehicle systems - Cloud Platform for Autonomous Driving. **Video link / Additional online information :** **1.** https://www.youtube.com/watch?v=iTnbD180VMg	**8Hrs.**
UNIT-V	
Industrial Internet of Things : IIoT Architecture; IIoT Applications and Challenges; IIoT Standards and Frameworks; IIoT security concerns **Video link / Additional online information:**	**8Hrs.**

1. https://www.youtube.com/watch?v=hv-aBonZMRQ&list=PLWbMIWDTOauBvP0ZxvoIshg55WPMF37UI https://www.youtube.com/watch?v=p7kYStiASLo&list=PLbRMhDVUMngdcLdH4-YF1uJI4IuhcDZPR	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand IoT ecosystem in robotic paradigm
CO2	Analyze IoT infrastructure and develop IoRT applications
CO3	Apply IoT in robotics over different platforms
CO4	Implement Cloud robotics in automations
CO5	Implement automated applications using multiple robotic sensors

Reference Books	
1.	Vermesan, Ovidiu, and Joël Bacquet, eds., "Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution", 1st edition, River Publishers, 2017.
2.	A.K.Gupta, S.K.Arora, and J.Riescher, "Industrial Automation and Robotics", 1 st edition, Mercury Learning and Information LLC,2017
3.	A.K Dubey, A.Kumar, and S.R Kumar., AI and IoT-based Intelligent Automation in Robotics, 1st edition. Wiley, 2020

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a

maximum of three 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.

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

High-3, Medium-2, Low-1

Semester: VII		
Mobile Application Development for IOT **(Theory)**		
Course Code:	MVJ21IO724	**CIE Marks: 50**
Credits:	L : T : P :: 3 : 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Learn the mobile application development for Internet of Things (IoT) devices.	

UNIT-I	
IoT Product Conceptualization: IoT Product Development Lifecycle, IoT Product Conceptualizations IoT Programming Fundamentals: Getting Started, IoT Programming setup for LED flashing, Program to display message on screen, Program to read LDR level and display on screen, Android APK to perform read write operation, Particle android APK to control LED intensity, LED switching with HTML interface, Cloud based motion detection, Displaying temperature sensor data on terminal, Publishing sensor values on the cloud, Performing computation on sensor values. **Applications: Wearables, Smart Grids, Industrial IoT** **Video link / Additional online information (related to module if any):** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-II	
IoT Programming Applications: Gas level detection using MQ2 sensor, Blink Android Application for controlling LED from mobile, Integration of	**8 Hrs.**

Temperature and Gas Sensor with Blynk Mobile Application, Printing real-time Date and Time values on serial terminal, Display temperature value on serial terminal, Display temperature values on 16*2 LCD display Interfacing: Interfacing of Nokia 5110 display, display image on Nokia 5110, Particle Electron displaying battery charging level status, GPS tracking device interface to get coordinates. Applications: Sensor integration, Self-driven cars, smart home. **Video link / Additional online information (related to module if any):** https://youtu.be/BXDxYh1EV2w (nptel video)	
UNIT-III	
IoT Product Hardware Development: Product realization, Connection diagram of IoT product, Engineering board development, Product board customization and optimization, Flowchart of IoT warehouse monitoring system, Wireless communication between the multiple kits, Particle cloud IDE. **Applications: Data acquisition, Communication systems, Data processing** **Video link / Additional online information (related to module if any):** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-IV	
IoT Advance Wireless Interfaces: Bluetooth communication between master and slave module, Data visualization on ThingSpeak cloud using webhook services, Storing data into google excel sheet and sending the sheets to emails. Applications: Smart city, self-driven cars, Farming , Wearables **Video link / Additional online information:** https://youtu.be/BXDxYh1EV2w (nptel video)	**8 Hrs.**
UNIT-V	
IoT Production System: IoT Warehouse Monitoring System, IoT Product Packaging, Future of IoT Product Development. Applications: Asset tracking, Asset Management, Inventory Optimization Video link / Additional online information:	**8 Hrs.**

https://youtu.be/BXDxYh1EV2w (nptel video)	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand fundamentals of IOT programming.
CO2	Analyse the various IoT programming applications.
CO3	Develops IoT applications using standardized hardware
CO4	Discuss concepts of IoT Advance Wireless Interfaces and IoT Produc System.

Text Books:	
1.	IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil.
Reference Books:	
1.	Kale, Vivek. Parallel Computing Architectures and APIs: IoT Big Data Str Processing 1st edition, CRC Press, 2019.
2.	IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a

maximum of three 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	3	2	1	1	-	-	1	-	1	1
CO2	3	3	3	2	1	1	-	-	1	-	1	1
CO3	3	3	3	2	1	1	-	-	1	-	1	1
CO4	3	3	3	2	1	1	-	-	1	-	1	1
CO5	3	3	3	2	1	1	-	-	1	-	1	1

Semester: VII		
Satellite and Radar Communication **(Theory)**		
Course Code:	MVJ21IO731	**CIE Marks: 50**
Credits:	L : T : P :: 3 : 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Provide a conceptual knowledge of communication through satellites.	
2	Study the concept of navigation - both inertial and by navigation satellites.	
3	Understand typical challenges of satellite-based systems	
4	Learn the basic principle of radar equation	
5	Motivate to learn modern radar and navigational techniques.	

UNIT-I	
Prerequisites: Digital Communication Systems Introduction to Satellite Communication: Orbital aspects of Satellite Communication: Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, Locating the satellite with respect to the earth, Sub-satellite point, Look angles, Mechanics of launching a synchronous satellite. Applications: DTH, or satellite television, services (such as the DirecTV and DISH Network services Video link / Additional online information:	**8 Hrs.**

https://nptel.ac.in/courses/117/105/117105131/#	
UNIT-II	
Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Space craft antennas, Multiple access techniques, comparison of FDMA, TDMA, and CDMA. Earth station equipment, tracking systems. Satellite Link Design: Basic transmission theory, System noise temperature and G/T Ratio, Noise figure and noise temperature, Calculation of system noise temperature, G/T ratio for earth stations, Link budgets - Uplink and downlink budget calculations, Error control for digital satellite links, Prediction of rain attenuation and propagation impairment counter measures. Applications: Mobile Communication, Error detection and correction Video link / Additional online information: https://nptel.ac.in/courses/117/105/117105131/# https://www.youtube.com/watch?v=FTHt-c8hWKw	**8 Hrs.**
UNIT-III	
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems. Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals: Images, Orbits, Payloads, And Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications. Applications: Communication, Weather forecasting, Remote sensing, Navigation Video link / Additional online information: https://nptel.ac.in/courses/117/105/117105131/# https://nptel.ac.in/courses/121/107/121107009/ https://onlinecourses.nptel.ac.in/noc19_ce45/preview	**8 Hrs.**
UNIT-IV	

Introduction to Radar: Radar block diagram and operation, Radar frequencies, Applications of radar, Prediction of range performance, Minimum detectable signal, Receiver noise, Probability density function, SNR, Integration of radar pulses, Radar cross-section of targets, PRF and range ambiguities, Transmitter power, System losses. Electronically steered Phased Array Antenna in Radar: Phase shifters, Frequency scan arrays, Array elements, Feeds for arrays, Computer Control of Phased-Array Radar. Applications: Ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI). Video link / Additional online information: https://onlinecourses.nptel.ac.in/noc19_ee58/preview https://nptel.ac.in/courses/108/105/108105154/	**8 Hrs.**
UNIT-V	
Radar Technology and Applications: Doppler Effect, CW radar, FM CW radar, Multiple frequency CW radar, MTI radar, Delay line canceller, Range gated MTI radar, Blind speeds, Staggered PRF, Limitations to the performance of MTI radar, Non-coherent MTI radar. Tracking radar: sequential lobing, conical scan, Monopulse: amplitude comparison and phase comparison methods, Radar antennas. Radar displays. Applications: Ground surveillance, weapons location, and vehicle search Video link / Additional online information: https://nptel.ac.in/courses/108/105/108105154/ https://youtu.be/XFapyIIzX_8 https://freevideolectures.com/course/5299/introduction-radar-systems/42	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the basics of digital transmission related to satellite communication
CO2	Comprehend the design of satellite subsystems
CO3	Evaluate spacecraft subsystem performance and trades
CO4	Model the characteristics of radar echoes from different types oftargets and clutter.
CO5	Calculate and simulate receiver noise and losses.

Text Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, “Satellite Communication”, 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 1981.
Reference Books:	
1.	Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2.	Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	-	-	-	2	-	-	-	-	-	-	-
CO2	3	3	2	-	2	-	-	-	-	-	-	-

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

High-3, Medium-2, Low-1

Semester: VII		
FUZZY LOGIC AND NEURAL NETWORKS (Theory)		
Course Code:	MVJ21IO732	**CIE Marks: 50**
Credits:	L : T : P :: 3 : 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Make the students to understand about the concept of fuzzy set theory and fuzzy systems.	
2	Analyse the fuzzy system-based rules and fuzzy logic decision making.	
3	Understand the basics of Neural Networks and its architecture.	
4	Know about the single and multilayer feed forward networks.	
5	Provide the adequate knowledge about the Associative memory.	

UNIT-I	
Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations. **Fuzzy Systems:** Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Interference, Fuzzy rule-based system, Defuzzification methods, Applications. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Fuzzy operations. 2. Implementation of Fuzzy relations. **Applications:** Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/104/108104157/	**8Hrs.**

UNIT-II	
Fuzzy Rule- Based Systems: Natural Language, Linguistic Hedges, Rule-Based Systems, Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules, Graphical Techniques of Inference. **Fuzzy Decision Making :** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Preference and consensus, Multi-objective Decision Making, Fuzzy Bayesian Decision Method, Decision Making under Fuzzy States and Fuzzy Actions. **Laboratory Sessions/ Experimental learning:** 1. Development of fuzzy membership functions and Fuzzy set properties 2. Implementation of Air Conditioning system using Fuzzy Logic Algorithm. 3. Implementation of Facial Pattern Recognition using Fuzzy Logic Algorithm. **Applications:** Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems. **Video link / Additional online information:** 1. https://www.digimat.in/nptel/courses/video/117105084/L01.html 2. https://www.digimat.in/nptel/courses/video/127105006/L01.html	**8Hrs.**
UNIT-III	
Prerequisites: *Fundamentals of computing, Analysation, Mathematical calculations.* **Introduction to Neural Networks:** Basic concepts of Neural networks, Human Brain, Model of an Artificial Neuron, Artificial Neural network architectures, Characteristics of Artificial Neural Networks, Learning methods, Taxonomy of Neural Network Architectures, Early Neural Network Architectures, Rosenblatt's perceptron, ADALINE and MADALINE networks. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Simple Neural Network in pattern recognition/matching. **Applications:** Speech recognition, character recognition, human face	**8Hrs.**

recognition **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105084/	
UNIT-IV	
Back Propagation Networks: Architecture**:** The perceptron model, the solution, Single Layer Artificial Neural Network, Model of multilayer Perceptron. **Back propagation Learning:** Input layer, Hidden layer, Output layer Computations, Error calculation, Training of neural network, Steepest Descent, Effect of learning rate, Adding of Momentum term, Back propagation algorithm. **Laboratory Sessions/ Experimental learning:** 1. Implementation of Perceptron Learning Algorithm for AND gate 2. Application of Back Propagation technique in financial data. **Applications:** Voice Recognition, Financial forecasting **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106184/ 2. https://nptel.ac.in/courses/108/108/108108148/	**8Hrs.**
UNIT-V	
Associative Memory: Auto correlators, Hetero correlators, Wang et al's Multiple Encoding Strategy, Exponential BAM (Bidirectional Associative Memory), Associative memory for Real coded pattern pairs, Applications. **Laboratory Sessions/ Experimental learning:** 1. Development of auto associative network using outer product rule **Applications:** Used for parallel searches, speedup databases, page tables used by virtual memory in neural networks **Video link / Additional online information:** 1. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html 2. https://nptel.ac.in/courses/117/105/117105084/	**8Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire the comprehensive knowledge of fuzzy set theory and fuzzy logic

	systems.
CO2	Apply the concepts of Fuzzy rule-based system and fuzzy decision making in real time applications.
CO3	Analyze the organization of the Brain, Biological and Artificial Neuron Models.
CO4	Design Perceptron Model, Single layer Artificial Neural Network, Back propagation network architecture, Model for Multilayer Perceptron.
CO5	Illustrate the concepts of associative memory in neural networks.

Text Books:	
1.	Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications" by – PHI Publication.
2.	Timothy. J. Ross, "Fuzzy logic with engineering applications", McGraw Hill International Edition, 1997.
3.	James A Freeman and Davis Skapura, "Neural Networks", Pearson Education, 2002.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	1	1	1	-	-	1	-	-	1
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CO3	3	3	3	1	1	1	-	-	1	-	-	1
CO4	3	3	3	1	1	1	-	-	1	-	-	1
CO5	3	3	3	1	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
INFORMATION THEORY AND CODING (Theory)		
Course Code:	**MVJ21IO733**	**CIE Marks: 50**
Credits:	**L:T:P: 3:0:0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the concept of Entropy, Rate of information and order of the source with reference to dependent and independent source.	
2	Study various source encoding algorithms.	
3	Model discrete & continuous communication channels.	
4	Study various error control coding algorithms.	
5	Emphasize encoding and error correction circuits for different coding algorithms	

UNIT-I	
Prerequisites: *Probability theory, Encoder, and decoder concept* **Information Theory:** Introduction, Measure of information, Information content of message, average information content of symbols in long independent sequences, average Information content of symbols in long dependent sequences, Markov Statistical Model of Information Sources, Entropy, and Information rate of Markoff Sources. **Laboratory session/Experiment:** 1. Design a markoff model for calculating the steady state probabilities	**8 Hrs**

Applications: Board games played with dice, Predicting the weather, Stock market. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/ https://nptel.ac.in/courses/117/101/117101053/	
UNIT-II	
Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fanon Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm. **Laboratory session/Experiment:** 1. Design a digital image compression and encoding using LZW algorithm **Application:** Lossless compression **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=aTHVz5pECog 2. https://www.youtube.com/watch?v=yHw1ka-4g0s&t=358s https://nptel.ac.in/courses/117/104/117104129/	**8 Hrs**
UNIT-III	
Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem, Continuous Channels, Fano's Inequality and the Converse to the Coding Theorem. **Laboratory session/Experiment:** 1. Compare the channel capacities of different channels **Applications:** To model data networks, where packets either arrive correctly or are lost due to buffer overflows or excessive delays.	**8 Hrs**

Video link / Additional online information: 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/ 3. https://nptel.ac.in/courses/117/101/117101053/	
UNIT-IV	
Error Control Coding: Introduction, examples of Error control coding, methods of controlling Errors, Types of Errors, types of Codes, **Linear Block Codes:** matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes **Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction. **Laboratory session/Experiment:** 1. Design encoding circuit for(6,3)linear code **Applications**: Binary cyclic codes in stegnography **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/ https://nptel.ac.in/courses/117/101/117101053/	**8 Hrs**
UNIT-V	
Some Important Cyclic Codes: Golay Codes, BCH Codes, Reed-Solomon Codes. **Convolution Codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm. **Introduction to Cryptography:** Symmetric key and Asymmetric key cryptography. **Laboratory session/Experiment:** 1. Write a MATLAB code for Reed-Solomon code **Applications:** Satellite communications, Compact disc players, DVDs, disk	**8 Hrs**

drives, solid-state drives, quantum-resistant cryptography and two-dimensional bar codes. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/ https://nptel.ac.in/courses/117/101/117101053/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire the knowledge of dependent & independent Source, measure of information, Entropy, Rate of Information and Order of a source
CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
CO3	Model the continuous and discrete communication channels using input, output and joint probabilities
CO4	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes
CO5	Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

Reference Books	
1.	K. Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
2.	K Giridhar, "Information Theory And Coding", 4th Edition, Pooja Publication, Bangalore, 2001.
3.	Simon Haykin, "Digital communication", John Wiley India Pvt. Ltd, Third Edition, 2010.
4.	Muralidhar Kulkarni, K.S. Shivaprakasha, "Information Theory and Coding", Wiley India Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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.

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

High-3, Medium-2, Low-1

Semester: VII		
INDUSTRIAL AND MEDICAL IOT (Theory)		
Course Code:	MVJ21IO734	**CIE Marks: 50**
Credits:	L: T : P :: 3 : 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To develop knowledge in Industrial Internet of Things (IIoT) fundamentals.	
2	To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments	
3	To Understand the various Internet of Things (IoT) Protocols like COAP, MQTT.	
4	To enables healthcare professionals to be more watchful and connect with the patients proactively.	
5	To gain knowledge in Low power and wireless connectivity to other devices and the cloud	

UNIT-I	
***Prerequisites**: IOT, Medical Electronics* **Industrial IOT Introduction:** Introduction to IOT, what is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business	8Hrs.

excellence tools Challenges & Benefits in implementing IIOT **Laboratory Sessions/ Experimental learning:** **1.** Long-Distance Serial Link Between Two Arduino Devices **2.** IoT on the MATLAB Platform **Applications:** Automated and remote equipment management and monitoring, Pinpoint inventories **Video link / Additional online information :** **1.** http://www.nitttrc.edu.in/nptel/courses/video/106105195/L32.html **2.** https://www.henryharvin.com/blog/iot-courses-online/ **3.** http://vlabs.iitb.ac.in/vlab/	
UNIT-II	
IIoT Architecture: IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers, and its integration, WSN, WSN network design for IOT **Laboratory Sessions/ Experimental learning:** 1. Experiment on Gate way as a service deployment in IoT Toolkit 2. Design of mixer **Applications:** Internet gateways: , Edge or fog computing, Cloud or data center **Video link / Additional online information:** **1.** https://onlinecourses.nptel.ac.in/noc20_cs66/preview **2.** https://www.youtube.com/watch?v=-RHYCpsn8TA **3.** https://www.youtube.com/watch?v=xsZ9YhVy-7g https://www.digimat.in/nptel/courses/video/106105166/L02.html	8Hrs.
UNIT-III	
IoMT Introduction; What are IoMT and its working? Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare **Laboratory Sessions/ Experimental learning:** **1.** Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT	8Hrs.

Toolkit. **Applications:** Activity Trackers During Cancer Treatment, Heart Monitors with Reporting, Medical Alert Systems **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=uDzRyrA1Z5Q 2. https://www.youtube.com/watch?v=9lNB7DK1-oo 3. https://nptel.ac.in/courses https://nptel.ac.in/courses/108105154	
UNIT-IV	
Healthcare Technologies: Home Monitoring System for Aged Care, Smart Medicinal Packages for Medication Adherence, Smart Drug Delivery System for Automated Drug Dispensation, Connected Rural Healthcare Consultation, Population and Environment Monitoring of Infectious Diseases **Laboratory Sessions/ Experimental learning:** 1. Experiment on Gate way as a health care service deployment in IoT Toolkit. **Applications:** Remote patient monitoring, Glucose monitoring, Ingestible Sensors, Trackable Inhaler, Wearables to Fight Depression, Connected Contact Lenses **Video link / Additional online information:** 1. http://nitttrc.edu.in/nptel/courses/video/106105166/L58.html 2. https://www.youtube.com/watch?v=UvQFH5RGOnU 3. https://www.youtube.com/watch?v=_qO9nETG7QU https://onlinecourses.nptel.ac.in/noc22_cs53/preview	8Hrs.
UNIT-V	
Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor Application Design: Design of IOT based pulse oximeter, Reliability of IoT-Aware BPNM Healthcare process **Laboratory Sessions/ Experimental learning:** 1. Speed Control of motors using PWM with python programming. 2. Create Wireless network of sensors using Zigbee. **Applications:** leap fitness step counter, Strava, Pacer Pedometer	8Hrs.

Video link / Additional online information : 1. https://nevonprojects.com/wireless-patient-health-monitor/ 2. https://www.youtube.com/watch?v=mlTuag3fPA0 https://nptel.ac.in/courses/106105160	

Course Outcomes: After completing the course, the students will be able to	
CO1	Develop conceptual design of Medical and Industrial IoT architecture.
CO2	Develop conceptual design of Medical and Industrial IoT architecture.
CO3	Develop conceptual design of Medical and Industrial IoT architecture.
CO4	Study about Internet of Medical Things (IoMT) and its applications in Healthcare industry
CO5	Design various applications using IoT in Healthcare Technologies.

Text Books:	
1.	Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.
2.	Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, 1st edition, IGI Global, 2016.
Reference Books:	
1.	Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	-	-	-	-	-	-	-	-	1
CO2	3	3	3	-	-	-	-	-	-	-	-	1
CO3	3	3	3	-	-	-	-	-	-	-	-	1
CO4	3	3	3	-	-	-	-	-	-	-	-	1
CO5	3	3	3	-	-	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
PROJECT PHASE – I		
Course Code:	**MVJ21IOP75**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:4**	**SEE Marks: 50**
Hours:	**26P**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To support independent learning.	
2	To develop interactive, communication, organization, time management, and presentation skills.	
3	To impart flexibility and adaptability.	
4	To expand intellectual capacity, credibility, judgment, intuition.	
5	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: After completing the course, the students 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

Semester: VIII		
PROJECT PHASE – II		
Course Code:	**MVJ21IOP81**	**CIE Marks: 50**
Credits:	**L:T:P: 0:0:20**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	To inspire independent and team working.
2	To expand intellectual capacity, credibility, judgment, intuition.
3	To adhere to punctuality, setting and meeting deadlines.
4	To instill responsibilities to oneself and others.
5	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: After completing the course, the students 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

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Semester: VI		
PRINCIPLES OF COMMUNICATION (THEORY)		
Course Code:	**MVJ21IO641**	**CIE Marks: 50**
Credits:	**L: T : P :: 3: 0 : 0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand and analyze the concepts of Analog Modulation schemes viz; AM, FM.	
2	Learn the concepts of digitization of signals viz; sampling, quantizing and encoding.	
3	Realize the basic concepts of various digital modulation techniques.	
4	Study the principles behind information theory and coding.	
5	Understand the basics of spread spectrum modulation.	

UNIT-I	
Prerequisites: *Modulation, Need for Modulation and types of Modulation.* Analog Modulation: Amplitude Modulation - AM, DSBSC, SSBSC, VSB - PSD, modulators and demodulators, Angle modulation - PM and FM - PSD, modulators, and demodulators - Super heterodyne receivers. **Laboratory Sessions/ Experimental learning:** 1. Introduction to Matlab 2. Generation of AM signal using Matlab **Applications:** Broadcast transmissions, Air band radio, Quadrature amplitude modulation **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/ 2. https://youtu.be/00ZbuhPruJw https://youtu.be/rt08yTGv_z4	**8 Hrs.**
UNIT-II	
Pulse Modulation: Low pass sampling theorem, Quantization, PAM, Line coding, PCM, DPCM, DM, and ADPCM and ADM, Channel Vocoder, Time Division Multiplexing, Frequency Division Multiplexing. **Laboratory Sessions/ Experimental learning:** 1. Delta modulation using MATLAB	**8 Hrs.**

Applications: Speech recognition systems, pattern recognition systems, digital audio in computers, CDs, digital telephony, telephone and radio communications, television systems. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/ 3. https://youtu.be/s6vlXP3mYXk https://youtu.be/HlGJ6xxbz8s	
UNIT-III	
Digital Modulation and Transmission: Phase shift keying, BPSK, DPSK, QPSK, Principles of M-ary signaling M-ary PSK & QAM, Comparison, ISI Pulse shaping, Duo binary encoding, Cosine filters, Eye pattern, equalizers. **Laboratory Sessions/ Experimental learning:** 1. Eye diagram using MATLAB 2. Generation of BPSK Using LabVIEW **Applications:** LAN, CDMA, WiMAX**,** wireless communication, mobile communication, Satellite Communication, Bluetooth, RFID. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/	**8 Hrs.**
UNIT-IV	
Information Theory and Coding: Measure of information, Entropy, Source coding theorem – Shannon Fanon coding, Huffman Coding, LZ Coding, Channel capacity, Shannon-Hartley law – Shannon's limit, Error control codes, Cyclic codes, Syndrome calculation, Convolution Coding, Sequential and Viterbi decoding. **Laboratory Sessions/ Experimental learning:** 1. Huffman coding using MATLAB **Applications:** Data Compression, audio/video transmission, data transmission and file transfer **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/102/108102117/ https://nptel.ac.in/courses/117/104/117104129/	**8 Hrs.**
UNIT-V	

Spread Spectrum Multiple Access Techniques: PN sequences, properties, m-sequence, DSSS – Processing gain, Jamming, FHSS, Synchronization and tracking, Multiple Access FDMA, TDMA, CDMA. **Laboratory Sessions/ Experimental learning:** 1. Direct Sequence Spread Spectrum Signal Generation & Detection using MATLAB **Applications:** CDMA, Wi-Fi, WPAN, etc., **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/ 3. https://nptel.ac.in/courses/117/105/117105136/ https://youtu.be/Ojmv3I4kDn4	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Examine the concepts of AM and FM modulation and demodulation.
CO2	Apply the concepts of sampling, quantization and encoding for digitization of signals.
CO3	Evaluate the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO4	Analyse source and error control coding.
CO5	Illustrate the digital communication system with spread spectrum modulation.

Textbooks:	
1.	H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007
2.	Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 2003.
Reference Books:	
1.	Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2.	B.P.Lathi, "Modern Digital and Analog Communication systems", 3rd edition, Oxford University Press, 2007
3.	H P Hsu, Schaum Outline Series – "Analog and Digital Communications"

	TMH 2006
4.	B.Sklar, "Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	1	1	-	-	-	-	-	3
CO2	3	3	3	2	1	1	-	-	-	-	-	3
CO3	3	3	3	2	1	1	-	-	-	-	-	3
CO4	3	3	3	2	1	1	-	-	-	-	-	3
CO5	3	3	3	2	1	1	-	-	-	-	-	3

High-3, Medium-2, Low-1

Semester: VI		
DIGITAL IMAGE PROCESSING (THEORY)		
Course Code:	**MVJ21IO642**	**CIE Marks: 50**
Credits:	**L: T : P :: 3: 0 : 0**	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Learn the fundamentals of digital image processing
2	Understand the image transforms and other image enhancement techniques used in digital image processing
3	Study the image restoration techniques and methods used in digital image processing
4	Understand region-based segmentation and segmentation using morphological watersheds
5	Know the color fundamentals and various morphological image processing techniques.

UNIT-I	
Prerequisites: *Discrete Fourier Transform, MATLAB Basics* **Introduction to Digital Image Processing:** What is Digital Image Processing? Origin of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. **Applications of Image Processing:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB **Applications:** Medical imaging, Robot vision, Character recognition, Remote Sensing. **Video link / Additional online information :** **1.** https://nptel.ac.in/courses/117/105/117105079/ https://www.tutorialspoint.com/dip/index.htm	**8 Hrs.**
UNIT-II	

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image, Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications:** Image Enhancement, Image Analysis **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8 Hrs.**
UNIT-III	
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. **Laboratory Sessions/ Experimental learning:** **1.** Test the restoration with the Inverse Filter for deblurring and denoising. Identify the problem with the Inverse Filter and discuss the solution for the same. **Applications:** Image Enhancement, Image Analysis, Error detection and correction **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8 Hrs.**
UNIT-IV	
Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. **Representation and Description:** Representation, Boundary descriptors.	**8 Hrs.**

Laboratory Sessions/ Experimental learning: **1.** Develop and implement a MATLAB code for Image segmentation using thresholding technique. **Applications:** Object tracking, Pattern recognition **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2 .https://www.tutorialspoint.com/dip/index.htm	
UNIT-V	
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. Four morphological principles, Skeletons and object marking. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of multimodal image fusion using MATLAB. **Applications:** Color conversion, Object marking **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze image processing algorithms used for sampling and quantization.
CO2	Apply and analyze image processing techniques in both the spatial and frequency (Fourier) domains.
CO3	Implement and analyse various image restoration algorithms
CO4	Design image analysis techniques for image segmentation and evaluate the methodologies for segmentation.
CO5	Conduct independent study and analyze various Morphological Image Processing techniques.

Textbooks:	
1.	Rafel C Gonzalez and Richard E. Woods, “Digital Image Processing”-, PHI

	3rd Edition, 2010.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, ―" Image Processing, Analysis, and Machine Vision‖", Cengage Learning, Fourth Edition, 2013, ISBN: 978-81-315-1883-0
Reference Books:	
1.	S.Jayaraman, S.Esakkirajan, T.Veerakumar, "Digital Image Processing"-Tata McGraw Hill 2014.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	2	1	-	-	1	-	-	1
CO2	3	3	3	2	2	1	-	-	1	-	-	1
CO3	3	3	3	2	2	1	-	-	1	-	-	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Semester: VI		
SENSOR TECHNOLOGY (THEORY)		
Course Code:	MVJ21IO643	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand various technologies associated in manufacturing of sensors.	
2	Provide better familiarity with different sensors and their applications in real life.	
3	Acquire knowledge about types of sensors used in modern digital systems.	
4	Evaluate the technological and physical limitations of a specific sensor.	
5	Propose a suitable sensor for a given measurement situation.	

UNIT-I	
Prerequisite: *Basic Electronics, Knowledge on physical quantities* **Sensors Fundamentals and Characteristics:** General Concepts and Terminology, Sensor Classification, Static Characteristics, Dynamic Characteristics, Materials for Sensors. **Laboratory Sessions/ Experimental learning:** 1. Study on applications of sensors **Applications:** Biological, Chemical, Electric, magnetic, or electromagnetic wave, Heat, temperature, Mechanical displacement or wave, Radioactivity, radiation and other. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ https://nptel.ac.in/courses/108/108/108108147/	**8 Hrs.**
UNIT-II	
Primary sensors: Temperature sensors, Pressure sensors, Flow-velocity and flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors and Velocity sensors. **Resistive Sensors:** Resistive Temperature Detectors (RTDs), Thermistors, Magneto resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas sensors. **Laboratory Sessions/ Experimental learning:**	**8 Hrs.**

1. Strain measurement with Bridge circuit **Applications:** Patient monitoring in medical applications, Manufacturing and industrial equipment and motorsport applications. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ 3. https://nptel.ac.in/courses/108/106/108106165/	
UNIT-III	
Reactance Variation and Electromagnetic Sensors: Capacitive sensors: Variable capacitor and Differential capacitor**,** Inductive sensors: Variable reluctance sensors, Eddy current sensors, Linear Variable Differential Transformers (LVDTs), Electromagnetic sensors: Sensors based on Faraday's Law and Hall effect sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a displacement measurement system with inductive sensors (LVDT) **Applications:** Smart phones, Industrial automation, Communication, automobile and aerospace. **Video link / Additional online information:** https://nptel.ac.in/courses/108/105/108105064/	**8 Hrs.**
UNIT-IV	
Self-Generating sensors: Thermoelectric sensors, Piezoelectric sensors, Pyroelectric sensors, Photovoltaic sensors, Electrochemical sensors, Proximity sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a sensor system for force measurement using piezoelectric sensors **Applications:** Temperature controlled devices: refrigeration and air conditioning, Alarm clocks, medical devices, PIN pads, photonics and pharmaceutical compositions, Robotics. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/	**8 Hrs.**
UNIT-V	
Digital sensors: Position encoders, Resonant sensors: SAW sensors, Vibratin Vibrating cylinder sensors, Digital flow meters	**8 Hrs.**

Other sensing methods: Charge-Coupled sensors – Fundamentals & types o sensors, Ultrasonic-based sensors, Gyroscope sensors, optical sensors, IR sensor

Laboratory Sessions/ Experimental learning:

1. Measure strain, temperature and pressure using LabVIEW.

Applications: Industries, digital cameras, photocopiers.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/112/103/112103174/

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of sensors and its characteristics.
CO2	Explain the working principles of primary and resistive sensors.
CO3	Understand the inductive, capacitive and Electromagnetic sensors and its applications
CO4	Identify alternative methods to measure common quantities such as temperature, pressure, force and acceleration.
CO5	Select appropriate sensors used for various applications

Textbooks:	
1.	Ramon Pallas & John G.Webster, "Sensors and signal conditioning", John Wiley & Sons., 2nd Ed.,2001.
2.	J. Fraden, "Handbook of Modern Sensors: Physical, Designs, and Applications", AIP Press, Springer, 3rd Ed.,2004.
Reference Books:	
1.	D. Patranabis, "Sensors and Transducers", PHI Publication, 2nd Ed.,2004 New Delhi.
2.	Webster John G, "Instrumentation and sensors Handbook", CRC Press, 1st Ed., 1999.
3.	Shawhney A.K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 1994.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	2	2	1	-	2	-	-	-	-	2	3
CO2	3	2	2	1	1	2	-	-	-	-	2	3
CO3	3	2	2	1	1	2	-	-	-	-	2	3
CO4	3	2	2	1	1	2	-	-	-	-	2	3
CO5	3	2	2	1	2	2	-	-	-	-	2	3

High-3, Medium-2, Low-1

Semester: VI		
INTRODUCTION TO MATLAB & SIMULINK (THEORY)		
Course Code:	MVJ21IO644	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To provide a foundation in programming for engineering problem solving using the MATLAB software package.	
2	To acquaint the student with some of the terminology in this very new field and relate it to the basic engineering process of design.	
3	To provide an introduction to the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.	
4	To develop the skills to analyse and break down an engineering program and solve it algorithmically using MATLAB	

UNIT-I	
Introduction to MATLAB, Creating Variables, Some Useful MATLAB Functions Data Types creating simple and multiple data set in single plot, Matrix generation, Array operations and Linear equations Introduction to programming in MATLAB, Visualization and Programming, Control flow and operators **Laboratory Sessions/ Experimental learning:** 1. Write MATLAB commands to analyze arithmetic, logical and Boolean operations. 2. Write MATLAB commands to analyze vector operations and magic matrixes. 3. Write a MATLAB program to demonstrate if and else if statement for comparing Two numbers. **Video link / Additional online information :** 1. https://in.mathworks.com/videos/writing-a-matlab-program-69023.html 2. https://youtu.be/ygGF3RR1NyM https://www.halvorsen.blog/documents/programming/matlab/matlab_basics.php	**8 Hrs.**

UNIT-II	
Solving Equations, Curve Fitting, and Numerical Techniques: Linear Algebra, Polynomials, Optimization, Differentiation/Integration, Differential Equations **Advanced Methods**: Probability and Statistics, Data Structures, Images, File I/O **Video link / Additional online information:** 3. https://www.youtube.com/watch?v=14H4UFoxZjs 4. https://www.youtube.com/watch?v=fqS873TnMDs	**8 Hrs .**
UNIT-III	
Various functions and toolboxes: Documentation, Misc. Useful Functions, Graphical User Interfaces, Simulink, Symbolic Toolbox **Applications:** App Designing using GUI, Image processing **Video link / Additional online information:** 1. https://in.mathworks.com/matlabcentral/fileexchange/44634-design-of-graphical-user-interface-application-with-matlab https://in.mathworks.com/videos/app-designer-overview-1510748719083.html	**8 Hrs .**
UNIT-IV	
Prerequisites: *Types of filters* **Introduction to SIMULINK:** Multiple plots creating models, blocks, Systems and sub-systems, Simulating Dynamic System, Solving a model, solvers, MATLAB SIMULINK integration, S-function); MATLAB Toolboxes training (Signal Processing, Neural Network, FUZZY logic, Control System, Communication, Power System toolboxes); **Laboratory Sessions/ Experimental learning:** **1.** Create a spreadsheet file with some data (or use an existing spreadsheet with data if you have) and import the data into MATLAB. 2. Matlab 2D and 3D Plot **Video link / Additional online information :** 2. https://www.youtube.com/watch?v=iOmqgewj5XI 3. https://in.mathworks.com/learn/tutorials/simulink-onramp.html 4. https://www.halvorsen.blog/documents/teaching/courses/matlab/matlab3.php 5. https://www.youtube.com/watch?v=EW544PfgBrs	**8 Hrs .**

UNIT-V	
Applications of MATLAB: Diode Characteristics, Fourier Analysis, Signal Processing, Deep learning, Image processing **Laboratory Sessions/ Experimental learning:** 1. Image Enhancement Using Intensity Transformations, 2. Morphological and Other Set Operations **3.** Two-Dimensional Fast Fourier Transform **Video link / Additional online information:** 1. https://in.mathworks.com/videos/image-processing-and-computer-vision-in-matlab-and-simulink-96760.html https://in.mathworks.com/videos/introduction-to-deep-learning-and-applications-in-image-processing-1606855547622.html	**8 Hrs .**

Course Outcomes: After completing the course, the students will be able to	
CO1	Students should be able to apply computer methods for solving a wide range of engineering problems.
CO2	Students should be able to use computer engineering software to solve and present problem solutions in a technical format.
CO3	Students should be able to utilize computer skills to enhance learning and performance in other engineering and science courses.
CO4	Understand how signals, images, and data are represented and manipulated in MATLAB
CO5	Students should be able understand the various programming constructs and how they can be used to solve a computational problem.

Textbooks:	
1.	MATLAB and SIMULINK for Engineers by Kumar Tyagi Agam, OUP India, 9780198072447, 2011
2.	Jan Valdman, “Applications from Engineering with MATLAB concepts:, Published by Intech Janeza Trdline, 51000 Rijeka, Croatia
Reference Books:	
1.	A Guide to MATLAB for Begineers and Experienced Users, Brian R Hunt Ronald L, Lipsman Jonathan M Rosenberg, Cambridge Press, Cambridge

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	-	-	-	-	2	1	1	2
CO2	3	3	3	2	-	-	-	-	2	1	1	2
CO3	3	3	3	3	-	-	-	-	2	1	1	2
CO4	3	3	3	3	-	-	-	-	2	1	1	2
CO5	3	3	2	-	3	-	-	-	3	1	3	3

High-3, Medium-2, Low-1

Semester: VII		
LabVIEW (THEORY)		
Course Code:	MVJ21IO741	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Explore the basics of Virtual Instrumentation.	
2	Differentiate and handle the analog and digital I/Os.	
3	Use LabVIEW for real time experiments.	
4	Analyze tools and applications in Virtual Instrumentation.	

UNIT-I

Prerequisites: *Fundamentals of C-Programing, Basic Electrical and Electronics.* **GRAPHICAL SYSTEM DESIGN:** Graphical System Design (GSD) model, Design flow with GSD, VI and traditional instrument, Hardware and Software in VI, Test, control and design in the engineering process, VI beyond personal computer, GSD using LabView, Graphical Programming and Textual Programming. **INTRODUCTION TO LABVIEW:** Introduction, Advantages of LabView, Software environment, Creating and Saving a VI, Front Panel Toolbar, Block Diagram Toolbar, Palettes, Panel Controls and Indicators, Data types, Keyboard Shortcuts. **Laboratory Sessions/Experimental Learning:** 1. Perform basic arithmetic & Boolean Operations using LabView **Applications:** Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI. **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=VQ7kL6knMdo	**8 Hrs.**
UNIT-II	
MODULAR PROGRAMMING: Modular Programming in LabVIEW, Build A VI Front Panel and Block Diagram, Creating an Icon, Building a Connector Pane, Creating, Opening And Editing SUBVIs, **REPETITION AND LOOPS:** For Loops, While Loops, Structure Tunnels, Terminals Inside Or Outside Loops, Shift Registers, Feedback Nodes, Control Timing, Communicating Among Multiple Loops, Local & Global Variables. **ARRAYS:** Creating 1-D, 2-D And Multidimensional Arrays, Deleting, Inserting, Replacing, Elements, Array Functions, Matrix Operations with Arrays, Polymorphism. **Laboratory Sessions/ Experimental learning:** **1.** Find the sum of 'n' numbers using FOR loop using LabView **2.** To perform the factorial of a given number using WHILE loop **3.** To sort even numbers using WHILE loop in an array	**8 Hrs.**

4. To find the maximum and minimum variable from an array. **Applications:** Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI. **Video link/ Additional online information:** 5. https://www.youtube.com/watch?v=WKvRDIuUNNs	
UNIT-III	
PLOTTING DATA: Types of Waveforms, Graphs, Charts, Data Type, XY Graphs, Intensity Graphs And Charts, Digital Waveform Graphs, 3D Graphs, Customizing Graphs And Charts, Customizing Graphs, Customizing 3D Graphs, and Displaying Special Planes on the XY Graph. **STRUCTURES, STRINGS AND FILE I/O:** Case, Sequence, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, String Functions, Formatting Strings, Basics of File Input/Output, File I/O VIs, and Creating a Relative Path. **Laboratory Sessions/ Experimental learning:** 1. To bundle and unbundle a cluster. 2. To perform functions using flat and stacked sequence. 3. To create a sine wave using formula node. **Applications:** Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI. **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=kdPyGcJNQbM https://www.youtube.com/watch?v=c6hLkFsQ-VU	**8 Hrs.**
UNIT-IV	
DATA ACQUISITION: Transducers, Signals and Signal Conditioning, DAQ Hardware Configuration, Analog Inputs & Outputs, Counters, DAG Software Architecture, Assistant, Selecting and Configuring a Data Acquisition Device, Components of Computer Based Measurement System. **Laboratory Sessions/ Experimental learning:** 1. Temperature sensor using LabView and NI myDAQ. 2. To apply filtering technique for a given input signal 3. To perform discrete cosine transform on the given signal	**8 Hrs.**

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI. **Video link/ Additional online information:** https://www.youtube.com/watch?v=fIy6XT3CdPQ	
UNIT-V	
IMAQ VISION: Vision Basics, Image Processing and Analysis, Particle Analysis, Machine Vision, Machine Vision Hardware and Software. **Laboratory Sessions/ Experimental learning:** 1. Build a complete machine vision system. 2. Acquire and Display images with NI-IMAQ driver software. **Applications:** Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI. **Video link/ Additional online information:** https://www.youtube.com/watch?v=4vDS4CRGhL0&list=PL3qqtKc HarV1yCaDZBQHXunX6MAwhXny1	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Familiarize with basic concepts, tools and functions of LabView Programming.
CO2	Develop Virtual Instrumentation using LabVIEW.
CO3	Appreciate the technologies related to VI for Industrial Applications.
CO4	Use DAQ for Real Time Applications.
CO5	Illustrate the basic design approaches for various Tools and Functions in IMAQ Vision.

Textbooks:	
1.	Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI publications, 2010
2.	BehzadEhsani, "Data Acquisition using LabVIEW", Packt Publishing, 2016.
Reference Books:	
1.	John Essick, "Hands-On-Introduction to LabVIEW for Scientists and Engineers" – Fourth Edition, OXFORD Publications, 2016
2.	Richard Jennings & Fabiola De La Cueva, "LabVIEW Graphical

	Programming" - Fifth Edition, McGraw-Hill, 2018.
3.	Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	2	2	-	3	-	-	-	-	-	-	-
CO2	3	2	2	-	3	-	-	-	-	-	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-	-
CO4	3	2	2	-	3	-	-	-	-	-	-	-
CO5	3	2	2	-	3	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Semester: VII		
MEMS & SENSOR DESIGN (THEORY)		
Course Code:	MVJ21IO742	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the overview of Microsystems and their applications.	
2	Study the working principles of Micro sensors and Micro Actuators.	
3	Acquire the knowledge of various Microsystems Fabrication Processes.	
4	Illustrate the Microsystems Design consideration.	
5	Know the basics of MEMS and its applications.	

UNIT-I	
Prerequisites: *Fundamentals of Physics (Mechanics, Optics, Electricity and magnetism),Fundamentals of Inorganic Chemistry* **MEMS Overview:** MEMS and Microsystems, Typical MEMS and Microsystems products: Micro gears, Micromotors, Microturbines & Micro-optical components, History of MEMS development, Intrinsic characteristics of MEMS, Application of Microsystems in various Industries. **Laboratory Sessions/ Experimental learning:** 1. An introduction to Comsol Multiphysics which is ideally suited for MEMS applications. **Applications:** Airbag Systems, Controlling automotive movement changes. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105082/ 2. https://nptel.ac.in/courses/108/108/108108147/ 3. http://www.nptelvideos.in/2012/12/mems-microsystems.html https://youtu.be/j9y0gfN9WMg	**8 Hrs.**
UNIT-II	
MEMS Sensors: Acoustic wave sensors, Biomedical & Biosensors, Chemical sensors, Optical sensors, Pressure sensor and thermal sensors, Piezo-resistive and Piezo-electric sensors. **Laboratory Sessions/ Experimental learning:**	**8 Hrs.**

1. Case study of Blood Pressure Sensors **Applications:** Satellite launch vehicle, industries, automobile, medical, consumer applications **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105082/ 2. https://nptel.ac.in/courses/108/108/108108113/ 3. https://nptel.ac.in/courses/108/108/108108147/ 6. http://www.nptelvideos.in/2012/12/mems-microsystems.html	
UNIT-III	
Micro actuation: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric effect, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), **MEMS with Micro actuators:** Microgrippers, Miniature Microphones, Micromotors, Micro actuators with mechanical inertia, Microfluidics. **Laboratory Sessions/ Experimental learning:** 1. Case studies on MEMS Microphone. **Applications:** Optical, RF and industrial applications. **Video link / Additional online information:** https://nptel.ac.in/courses/117/105/117105082/	**8 Hrs.**
UNIT-IV	
Microsystems Fabrication Processes: Photolithography, Ion implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition, Deposition by Epitaxy, Etching. **Bulk Micro manufacturing:** Overview of Etching, Isotropic & Anisotropic Etching, Wet Etchants, Etch Stop, Dry Etching. **Surface Micromachining:** Description, Process, Mechanical Problems Associated with Surface Micromachining **Laboratory Sessions/ Experimental learning:** **1.** Study the process involved in LIGA micromanufacturing **Applications:** Hybrid integrated circuits, integrated passive devices & sensors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105082/ 2. https://nptel.ac.in/courses/108/108/108108113/	**8 Hrs.**

3. https://nptel.ac.in/courses/108/108/108108147/ http://www.nptelvideos.in/2012/12/mems-microsystems.html	
UNIT-V	
Microsystems Design: Introduction, Design Considerations, Process Design, Mechanical Design, Computer Aided Design. **Introduction to NEMS:** Micro and Nanoscale Technologies, General Principle of Nanofabrication, Nanoproducts, Applications of Nanoproducts. **Laboratory Sessions/ Experimental learning:** 1. Design Capacitive Pressure Sensor using Comsol Multiphysics. **Applications:** To measure blood pressure within the body, detect ions, to perform biological tests, displays, tunable Lasers, smart phones, mobile infrastructure, IoT and defense. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105082/ http://www.nptelvideos.in/2012/12/mems-microsystems.html	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Appreciate the technologies related to MEMS.
CO2	Gain knowledge of various Microsensors.
CO3	Understand actuators for MEMS applications.
CO4	Analyze the fabrication process involved with MEMS devices
CO5	Illustrate the basic design approaches for various sensors. Understand overview of NEMS.

Textbooks:	
1.	Tai-Ran Hsu, "MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering", 2nd Ed, John Wiley & Sons, Inc. 2008.
2.	Chang Liu, "Foundation of MEMS", 2011, 2nd ed., Pearson Education India.
Reference Books:	
1.	Rai Choudhury, "MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, India, 2013.
2.	Marc Madou, "Fundamentals of Micro fabrication", CRC press, 1997.

3.	Stephen D. Senturia, “Micro system Design”, Kluwer Academic Publishers, 2001.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	2	1	-	2	2	1	-	1	-	-	1
CO2	3	2	1	1	-	2	1	-	1	-	-	1
CO3	3	2	1	1	-	2	1	-	1	-	-	1
CO4	3	3	2	2	-	2	1	-	1	-	-	1
CO5	3	3	3	2	2	2	1	-	1	-	-	1

High-3, Medium-2, Low-1

Semester: VII		
MEDICAL ELECTRONICS (THEORY)		
Course Code:	MVJ21IO743	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain physiological parameters such as electrical, non-electrical and the recording methods.	
2	Learn the methods used for recording and measuring the biological signals	
3	Illustrate the various Medical Imaging devices used in the hospitals.	
4	Explain the telemetry systems and know the safety aspects required in medical equipment.	
5	Understand the various Therapeutic Devices and know about recent trends in medical system.	

UNIT-I	
Prerequisites: *Basics of Transducer*	**8 Hrs.**
Fundamentals of Physiology and Transducer: **Types of Bioelectric Potentials:** Introduction to different types of bioelectric potentials, Action and resting potentials, Propagation of action potentials. **Biological Systems:** Nervous system and its fundamentals, Basic components of a biomedical system, Cardiovascular systems, Respiratory systems **Electrodes and Transducers in Medical systems:** Different type of electrodes, sensors used in biomedicine. Physiological signals and transducers, Piezoelectric Transducers, ultrasonic transducers, Temperature measurement, Fibre optic temperature sensors. Selection criteria for transducer and electrodes. **Laboratory Sessions/ Experimental learning:** 1. Practical applications of electrodes in medical field. **Applications:** Ultrasonic scanning devices, Measures skin and body temperature, Measures Respiratory rate**Video link / Additional online information :**	

1. https://nptel.ac.in/courses/102/104/102104043/ 2. https://www.youtube.com/watch?v=QiwxdcckPGc 3. https://www.youtube.com/watch?v=LOjK2wB_qcg&feature=youtu.be https://youtu.be/7TabKYSbdH4	
UNIT-II	
Electrical and Non-Electrical Parameter Measurement: **Electro Physiological Measurement:** Biological amplifiers, ECG,EEG, EMG, PCG, typical waveforms and signal characteristics **Non Electrical Parameter Measurement:** Measurement of blood pressure, Ultra sound blood flow meter, Blood flow cardiac output, Heart rate, heart sound, measurement of gas volume, flow rate of CO2 and O2 in exhaust air, pH of blood **Laboratory Sessions/ Experimental learning:** 1. Measure the "PQRST ECG" signal in both normal and abnormal conditions. **Applications:** Psychology and Neuroscience, Brain Computer Interfaces (BCI) **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/108/108108167/ 2. https://www.youtube.com/watch?v=7cvgDIdtw8M 7. https://www.youtube.com/watch?v=mK6sPBbChqc	**8 Hrs.**
UNIT-III	
Amplifiers used in Medical Electronics: Amplifiers, preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier **Medical Imaging:** X-ray machine, Computer tomography, Magnetic resonance imaging system, Positron emission tomography and endoscopy. **Laboratory Sessions/ Experimental learning:** 1. Graphical results of all Medical Images. **Applications:**Diagnose disease, blood clots, tumours, bone fractures ,inflammation or infection in an organ ,degenerative diseases ,strokes **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=N0Dwh3avx9A	**8 Hrs.**

2. https://www.youtube.com/watch?v=5_k6GVMwQ8w https://www.youtube.com/watch?v=1ftsuzhJ-vk	
UNIT-IV	
Telemetry: Introduction to telemetry systems, Different types of biotelemetry systems, Retinal Imaging, Imaging application in Biometric systems. **Safety in Medical Environment:** Electrical safety in medical environment, shock hazards, leakage current, Instruments for checking safety parameters of biomedical equipment **Laboratory Sessions/ Experimental learning:** 1. Practical applications of telemetry in medical systems. **Applications:**In the branch of Ophthalmology **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=0UPoSdBFD48 https://www.youtube.com/watch?v=8SPHA_1tTw4	**8 Hrs.**
UNIT-V	
Assisting and Therapeutic Devices: Cardiac pacemakers, Defibrillators, Ventilators, Surgical diathermy, Heart lung machine, Laser in surgery and medicine. **Recent Trends in medical System:** Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, Lab on a chip, ICCU patient monitoring system, Wearable Antennas. **Robotic Devices:** Nano Robots, Robotic surgery, Orthopedic prostheses fixation. **Laboratory Sessions/ Experimental learning:** 1. Functions of ICCU patient Monitoring Systems. **Applications:** Diagnosis of the gastrointestinal tract. Applications of BCI are neuroergonomics, medical, smart environment, education and self-regulation, games and entertainment, neuro marketing and advertisement **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=SMXBR_YFocs 2. https://www.youtube.com/watch?v=qUD865w2Drw https://www.youtube.com/watch?v=KAvQsRL-jeo	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse the operation and characteristics of Electronic devices and use of them in applications.
CO2	Evaluate the performance of electronic circuits.
CO3	Demonstrate the electronic systems and analyse their applicability
CO4	Analyse requirement of electronic devices and systems.
CO5	Design a simple prototype for a certain application.

Textbooks:	
1.	R.S. Khandpur, "Hand book of Bio Medical Instrumentation" (2nd edition)-ISBN-13: 9789339205430.
2.	Mandeep Singh, "Introduction to Biomedical Instrumentation", ISBN-13: 9788120350236
Reference Books:	
1.	S.K. Guha, "Principles of Medical Electronics and biomedical Instrumentation" - ISBN-13: 978-8173712579.
2.	J.G.Webster(Wiley India), "Medical instrumentation Application and Design", ISBN-13: 978-0471676003.
3.	Joseph D. Bronzino, "The Biomedical Engineering Handbook", Third Edition, CRC Press-2006.
4.	John D. Enderle and Joseph D. Bronzino, "Introduction to Biomedical Engineering", Third Edition, Elsevier Inc.-2012.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions

for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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.

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

High-3, Medium-2, Low-1

Semester: VII		
INDUSTRIAL IOT (THEORY)		
Course Code:	MVJ21IO744	**CIE Marks: 50**
Credits:	L: T : P :: 3: 0 : 0	**SEE Marks: 50**
Hours:	**40L**	**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Learn the basic issues, policy and challenges on the Internet.	
2	Bring the IoT perspective in thinking and building solutions	
3	Acquire an idea of some of the application areas where Internet of Things can be applied.	
4	Understand the cloud and internet environment.	
5	Analyse the various modes of communications with Internet.	

UNIT-I	
Prerequisites : *Basic Knowledge about C or C++* **Introduction to IoT**: IoT Vs. IIoT, History of IIoT, Components of IIoT: Sensors, Interface, Networks, People &Process, Hype cycle, IoT Market, Trends& future Real life examples, Key terms: IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT **Video link / Additional online information (related to module if any):** 1. http://www.theinternetofthings.eu/what-is-the-internet-of-things.	**8 Hrs.**

2. https://www.engineersgarage.com/article_page/sensors-different-types-of-sensors/ 3. https://www.educba.com/applications-of-sensors/	
UNIT-II	
Architectures: Overview of IoT components ,Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet, Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT. **Applications:** IoT Protocol Applications **Video link / Additional online information (related to module if any):** 1. https://inductiveautomation.com/resources/article/what-is-scada 2. https://iotbytes.wordpress.com/application-protocols-for-iot/ 3. https://data-flair.training/blogs/iot-protocols/ 4. https://www.avsystem.com/blog/iot-protocols-and-standards/	**8 Hrs.**
UNIT-III	
Sensor and Interfacing: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc **Video link / Additional online information (related to module if any):** 1. https://www.digiteum.com/rfid-technology-internet-of-things 2. https://www.uio.no/studier/emner/matnat/ifi/INF5910CPS/h10/undervisningsmateriale/RFID-IoT.pdf	**8 Hrs.**
UNIT-IV	
Protocols and Cloud: Need of protocols, Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIoT protocols – COAP, MQTT,6lowpan, lwm2m, AMPQ IIoT cloud platforms : Overview of cloud platforms, predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas. **Video link / Additional online information (related to module if any):** 1. https://www.simform.com/home-automation-using-internet-of-things/ 2. https://iot5.net/iot-applications/smart-home-iot-applications/ 3. https://maker.pro/raspberry-pi/tutorial/how-to-connect-and-interface-	**8 Hrs.**

raspberry-pi-with-arduino# 4. https://create.arduino.cc/projecthub/ruchir1674/how-to-interface-arduino-with-raspberrypi-504b06	
UNIT-V	
IoT Analytics and Applications: IoT Analytics, Role of Analytics in IoT, Data visualization Techniques, Introduction to R Programming, Statistical Methods. Internet of Things Applications: Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIoT in Manufacturing Sector **Video link / Additional online information (related to module if any):** 1. https://www.water-io.com/iot-vs-wot 2. https://www.talend.com/resources/iot-cloud-architecture/	**8 Hrs.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe IoT and IIoT
CO2	Analyse various IoT Layers and their relative importance
CO3	Design and develop the real life IoT applications using off the shelf hardware software
CO4	Realize the importance of Data Analytics in IoT
CO5	Apply the concepts of Design Thinking

Textbooks:	
1.	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2.Bernd Scholz-Reiter, Florian
2.	Cisco, IOT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT, Pearson Education; First edition (16 August 2017). ISBN-10: 9386873745, ISBN-13: 978-9386873743
3.	Raj Kamal,"Internet of Things-Architecture and design principles", McGraw Hill Education.
Reference Books:	
1.	Honbo Zhou, "The Internet of Things in the Cloud:A Middleware Perspectiv

	CRC Press-2012
2.	Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Thin Springer2011.
3,	Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approac VPT, 2014.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Thin Key applications and Protocols", Wiley, 2012.

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 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the entire syllabus. Part – B Students have to answer five questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have a maximum of three 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	3	2	1	1	-	-	1	-	1	1
CO2	3	3	3	2	1	1	-	-	1	-	1	1
CO3	3	3	3	2	1	1	-	-	1	-	1	1
CO4	3	3	3	2	1	1	-	-	1	-	1	1
CO5	3	3	3	2	1	1	-	-	1	-	1	1

High-3, Medium-2, Low-1