Semester: VII		
COMPUTER COMMUNICATION NETWORK **(Theory and Practice)**		
Course Code: MVJ21IO42		**CIE Marks: 50+50**
Credits: L:T:P: 3:0:1		**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 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: 2. 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: 3. http://www.redbooks.ibm.com/abstracts/gg243376.html	**8 Hrs**

4. 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, 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/	**8 Hrs**
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	**8 Hrs**

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/	
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 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**: 2. 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	**8 Hrs**
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**:	**8 Hrs**

2. Transport analysis using TCP/UDP using NetSim. **Applications:** MS Teams, Zoom, Cisco webex **Video link / Additional online information:** 2. http://www.digimat.in/nptel/courses/video/106105183/L11.html http://www.digimat.in/nptel/courses/video/106105183/L06.html	

LABORATORY EXPERIMENTS

26. 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.
27. 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.
28. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
29. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.
30. Implementation of Link state routing algorithm.
31. Write a program for a HLDC frame to perform the following.
    i) Bit stuffing ii) Character stuffing.
32. 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
33. Implementation of Sliding Window Protocol.
34. 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

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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: MVJ21IO711		**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 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	8Hrs
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.	8Hrs

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	
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 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	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

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	1	-	-	1
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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		
CRYPTOGRAPHY & CYBER SECURITY **(Theory)**		
Course Code: MVJ21IO712		**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	8Hrs

(DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and modes of operation, Evaluation Criteria for 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

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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: 3 (L : T : P :: 3 : 0 : 0)		**SEE Marks: 100**
Hours: 40L+26T		**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. **Video link / Additional online information :** **https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE**	**8Hrs.**
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.	**8Hrs.**

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**	
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:** 1. https://www.youtube.com/watch?v=hv-aBonZMRQ&list=PLWbMIWDTOauBvP0ZxvoIshg55WPMF37UI https://www.youtube.com/watch?v=p7kYStiASLo&list=PLbRMhDVUMngdcLdH4-YF1uJI4IuhcDZPR	**8Hrs.**

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	
7.	Vermesan, Ovidiu, and Joël Bacquet, eds., "Cognitive Hyperconnected Digital

	Transformation: Internet of Things Intelligence Evolution", 1st edition, River Publishers, 2017.
8.	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

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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	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: 3 (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 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	8 Hrs.

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: https://youtu.be/BXDxYh1EV2w (nptel video)	8 Hrs.

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 Stre Processing 1st edition, CRC Press, 2019.
2.	IoT Product Development with Programming: Stepwise programming approa 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		
DIGITAL IMAGE PROCESSING (THEORY)		
Course Code: MVJ21IO725		**CIE Marks: 50**
Credits: 3 (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 :	8 Hrs.

1. https://nptel.ac.in/courses/117/105/117105079/ https://www.tutorialspoint.com/dip/index.htm	
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**:	8 Hrs.

1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm	
UNIT-IV	
Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. **Representation and Description:** Representation, Boundary descriptors. **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	8 Hrs.
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
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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: VII		
Satellite and Radar Communication **(Theory)**		
Course Code: MVJ21IO731		**CIE Marks: 50**
Credits: 3 (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: https://nptel.ac.in/courses/117/105/117105131/#	8 Hrs.
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	8 Hrs.

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	
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.	8 Hrs.

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/	
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: 3 (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	8Hrs.

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	
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.	8Hrs.

Applications: Speech recognition, character recognition, human face 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:**	8Hrs.

1. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html 2. https://nptel.ac.in/courses/117/105/117105084/	

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
CO2	3	3	3	1	1	1	-	-	1	-	-	1
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 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/	**8 Hrs**
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. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/	**8 Hrs**

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	**8 Hrs**

Applications: Satellite communications, Compact disc players, DVDs, disk 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

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.

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Total marks: 50+50=100

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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: 3 (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 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/	8Hrs.

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 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	8Hrs.

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 **Video link / Additional online information :** 1. https://nevonprojects.com/wireless-patient-health-monitor/ 2. https://www.youtube.com/watch?v=mlTuag3fPA0	8Hrs.

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		
VIRTUAL AND AUGMENTED REALITY (Theory)		
Course Code: MVJ21IIO735		**CIE Marks: 50**
Credits: 3 (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	Establish and cultivate a broad and comprehensive understanding of the virtual reality and Augmented Reality.
2	Exhibit various elements and components used in AR/VR Hardware
3	Provide various factors involved in multisensory action of human being
4	Provide a detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR/AR modelling and programming.
5	Understand virtual reality, augmented reality and using them to build Biomedical, engineering and robotics application.

UNIT-I	
Prerequisites: Intermediate programming ability in object-oriented languages, Basic linear algebra Introduction to Immersive Technologies: A Brief History of Virtual Reality, The five Classic Components of a VR System, Early Commercial VR Technology , VR becomes an Industry, Reality, Virtuality and Immersion , VR, AR, MR, xR: similarities and differences. Laboratory Sessions/ Experimental learning: Choose an existing VR application and write a summary including a personal critical reflection on its look and feel especially in relation to immersion, presence, agency and interactivity. Applications: VR in Sport, Mental Health, Medical Training. Video link / Additional online information: https://nptel.ac.in/courses/121/106/121106013/	**8 Hrs**
UNIT-II	
Motion Tracking and Navigation: Position and Motion Trackers , Inside Out/Outside In , Tracker Performance Parameters , Optical, Active and Passive Trackers , Inertial and Hybrid Trackers, HMD Trackers , Magnetic Trackers , Mechanical Trackers , Ultrasonic Trackers , Navigation and Manipulation Interfaces , Tracker-Based Navigation/Manipulation Interfaces. Laboratory Sessions/ Experimental learning:	**8 Hrs**

Design an immersive environment in Unity-3D or Unreal that will develop and enhance Work in groups. Start by building a simple 3D world that an interactive player can move around in. Connect the controllers and create a simple interaction loop. Measure velocity, acceleration, distances, and other motion and spatial parameters of the user and the controllers. Applications: Industrial Training and Simulation, Flight Training and Simulation, Pilot Head Tracking, Live Aircraft, Sports motion Analysis. Video link / Additional online information: https://nptel.ac.in/courses/106/106/106106138/	
UNIT-III	
The Human behind the lenses: Human Perception and Cognition , The Human Visual System, VR Health and Safety Issues, Effects of VR Simulations on Users , Cyber sickness, before and now Guidelines for Proper VR Usage. Laboratory Sessions/ Experimental learning: Create a well-rounded multisensory action that is meaningful, safe and accommodates all senses, visual, auditory and tactile. Applications: Human–Computer Interaction, e-Sports, Games, Cultural heritage Video link / Additional online information: https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/	**8 Hrs**
UNIT-IV	
Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. Laboratory Sessions/ Experimental learning: Experiment with Photo grammetry and improve the visual look and feel of your environment Applications: Healthcare Video link / Additional online information: https://www.coursera.org/learn/ar-technologies-video-streaming	**8 Hrs**
UNIT-V	
Medical Applications of xR: Behavioural Therapy, Virtual and Augmented Surgery, Triage and Diagnostics, Applications of VR in Robotics: Robot Programming, Robot Tele operation. Laboratory Sessions/ Experimental learning:	**8 Hrs**

Add a training component to your existing prototype. Define the mechanics that will progressively improve user's performance to mastery through an interaction loop using the dual concept of challenge / reinforcing. Video link / Additional online information: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622235/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Acquire various principles and concepts of virtual reality and its application.
CO2	Understand the optical motion tracking and navigation in virtual reality.
CO3	Analyse and solve problems related to their expertise in Augment and Virtual Environments.
CO4	Develop detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR modelling and programming.
CO5	Illustrate the knowledge of integrating hardware, software, tools for AR/VR technology.

Reference Books	
1	C. Burdea and Philippe Coiffet, "Virtual Reality Technology", First Edition, Gregory, John Wiley and Sons, Inc.,2008
2	Steven M. LaValle, "Virtual Reality", 2016. Online version: http://msl.cs.uiuc.edu/vr/
3.	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, First Edition, 2013.
4.	Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice (Usability)" by Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575

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

Semester: VII		
MEMS AND MICROSYSTEMS (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	To understand the fundamental knowledge/ overview in the field of Micro Electromechanical Systems.	
2	To learn about the operation and application of MEMS circuits, design.	
3	To understand techniques used to sniff traffic across a network	
4	To familiarize with the microsystem fabrication process.	
5	To develop the practical applications using MEMS.	

UNIT-I	
OVERVIEW OF MEMS AND MICROSYSTEMS: MEMS & Microsystems, Typical MEMS and Micro system Products, Evolution of Micro fabrication, Microsystems and Microelectronics. The Multidisciplinary nature of Microsystem, Design and Manufacture, Microsystem and Miniaturization, Applications of Microsystems in the Automotive Industry and in other industries. Applications: Pumping devices, gear trains, moveable mirrors Video link / Additional online information (related to module if any): • https://nptel.ac.in/courses/117105082	**8 Hrs**
UNIT-II	
WORKING PRINCIPLES OF MICROSYSTEMS: Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers Micro fluids. Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matter, Ions and Ionization Molecular Theory of Matter and Intermolecular Forces, Plasma Physics, Electrochemistry. Applications: Miniature robots, tweezers, tools, lens, and lasers Video link / Additional online information (related to module if any): • https://nptel.ac.in/courses/117105082	**8 Hrs**

UNIT-III	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics **MATERIALS FOR MEMS AND MICROSYSTEMS**: Introduction, Substrates and wafers, Active Substrate materials, silicon as a substrate material, silicon compounds and silicon piezoresistors. **Applications**: Biomedical, optical **Video link / Additional online information (related to module if any)**: • https://nptel.ac.in/courses/117105082	**8 Hrs**
UNIT-IV	
MICROSYSTEMS FABRICATION PROCESS: Introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour deposition, Deposition by Epitaxy, Etching. **MICROSYSTEMS DESIGN**: Introduction, Design considerations, Process Design, Design of a silicon Die for a Micro pressure sensor, Design of Micro fluidic network systems. **Applications**: Wireless networks, aerospace **Video link / Additional online information (related to module if any)**: • https://nptel.ac.in/courses/117105082	**8 Hrs**
UNIT-V	
MICROSYSTEMS PACKAGING: Introduction, Overview of Mechanical Packaging of Microelectronics, Micro system Packaging, Interfaces in Micro system Packaging, Essential Packaging Technologies, Three-dimensional Packaging, Assembly of Microsystems, Selection of Packaging Materials, Signal Mapping and Transduction, Design Case: Pressure Sensor Packaging. **Applications**: Consumer products **Video link / Additional online information (related to module if any)**: • https://nptel.ac.in/courses/117105082	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the technologies related to Micro Electro Mechanical Systems.
CO2	Understand design and fabrication processes involved with MEMS devices.
CO3	Analyse the MEMS devices and develop suitable mathematical models
CO4	Design and Fabricate using the MEMS Devices.
CO5	Know various application areas for MEMS device.

Reference Books	
1.	MEMS & Microsystems Design and Manufacture – Tai Ran Hsu, TMH 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	1	-	-	-	-	1	-	-	-	3
CO2	3	3	1	-	-	-	-	2	-	1	-	3
CO3	3	3	1	2	-	-	-	-	-	1	-	3
CO4	3	3	3	3	-	3	2	2	2	2	-	3
CO5	3	3	3	3	-	3	2	2	3	2	-	3

Semester: VII		
PROJECT PHASE – I		
Course Code: MVJ21IOPR76		**CIE Marks: 50**
Credits: L:T:P: 0:0:3		**SEE Marks: 50**
Hours: 40L		**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