RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, Mysuru Road
Bengaluru – 560059

Scheme and Syllabus of III & IV Semester

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)
in
RADIO FREQUENCY AND MICROWAVE ENGINEERING

DEPARTMENT OF

TELECOMMUNICATION ENGINEERING

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work and Innovation

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Master of Technology (M. Tech)

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RADIO FREQUENCY AND MICROWAVE ENGINEERING

DEPARTMENT OF

TELECOMMUNICATION ENGINEERING

DEPARTMENT OF
TELECOMMUNICATION ENGINEERING

VISION

Imparting quality education in electronics and telecommunication engineering through focus on fundamentals, research and innovation for sustainable development.

MISSION

1. Provide comprehensive education that prepares students to contribute effectively to the profession and society in the field of Telecommunication.
2. Create state-of-the–art infrastructure to integrate a culture of research with a focus on Telecommunication Engineering Education.
3. Encourage students to be innovators to meet local and global needs with ethical practice.
4. Create an environment for faculty to carry out research and contribute in their field of specialization, leading to Center of Excellence with focus on affordable innovation.
5. Establish a strong and wide base linkage with industries, R&D organization and academic Institutions.

PROGRAMME OUTCOMES (PO)

M. Tech in Radio Frequency and Microwave Engineering graduates will be able to:

PO1: Acquire in-depth knowledge of RF and Microwave Engineering with an ability to analyze, synthesize, evaluate existing and new technologies.

PO2: Learn and apply modern engineering tools to solve complex engineering problems.

PO3: Engage in life-long learning independently, to contribute for multidisciplinary research work.

PO4: Independently carry out research /investigation and development work to solve practical problems.

PO5: Write and present a substantial technical report/document.

Po6: Demonstrate a degree of mastery over the area Radio Frequency and Microwave Engineering. The mastery would be at a higher than the requirements in the appropriate bachelor program.

ABBREVIATIONS

Sl. No.	Abbreviation	Acronym
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics
23.	MCA	Master of Computer Applications
24.	MST	Structural Engineering
25.	MHT	Highway Technology
26.	MPD	Product Design & Manufacturing
27.	MCM	Computer Integrated & Manufacturing
28.	MMD	Machine Design
29.	MPE	Power Electronics
30.	MVE	VLSI Design & Embedded Systems
31.	MCS	Communication Systems
32.	MBS	Bio Medical Processing Signal & Instrumentation
33.	MCH	Chemical Engineering
34.	MCE	Computer Science & Engineering
35.	MCN	Computer Network Engineering
36.	MDC	Digital Communication
37.	MRM	Radio Frequency and Microwave Engineering
38.	MSE	Software Engineering
39.	MIT	Information Technology
40.	MBT	Biotechnology
41.	MBI	Bioinformatics

CONTENTS

RV COLLEGE OF ENGINEERING®, BENGALURU - 560059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF TELECOMMUNICATION ENGINEERING

M.Tech in RADIO FREQUENCY AND MICROWAVE ENGINEERING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MDC31	Wireless Communication	TE	4	1	0	**5**
2	18MRM32	Internship	TE	0	0	5	**5**
3	18MRM33	Major Project : Phase-I	TE	0	0	5	**5**
4	18MDC3EX	Elective-E	TE	4	0	0	**4**
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours/Week				**8**	**2**	**20**	

SEMESTER : III		
GROUP E: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18MDC3E1	Short Range Wireless Communication
2.	18MDC3E2	Software Defined Networks.
3.	18MDC3E3	Network Security

FOURTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1	18MRM41	Major Project : Phase-II	TE	0	0	20	**20**
2	18MRM42	Technical Seminar	TE	0	0	2	**2**
Total number of Credits				**0**	**0**	**22**	**22**
Total Number of Hours / Week				**0**	**0**	**44**	

SEMESTER : III						
WIRELESS COMMUNICATION (Theory)						
Course Code	**:**	**18MDC31**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L+26T**		**SEE Duration**	**:**	**3 Hrs**
Unit – I						**10Hrs**
Wireless channel: Physical modeling for wireless channels, input/output model of wireless channel, time and frequency response.						
Unit – II						**10Hrs**
Point to point communication: Detection in Rayleigh fading channel, time diversity, antenna diversity, frequency diversity.						
Unit – III						**10Hrs**
Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear time invariant Gaussian channels, capacity of fading channels.						
Unit – IV						**12Hrs**
MIMO Systems: Introduction, Space Diversity and Systems Based on Space Diversity, Smart antenna system and MIMO, MIMO based System architecture, MIMO exploits multipath, Space time Processing, Antenna considerations for MIMO, MIMO channel Modeling, MIMO Channel measurement, MIMO Channel capacity, Space Time Coding, Advantages and Applications of MIMO, MIMO applications in 3G.						
Unit – V						**10Hrs**
Spatial multiplexing and channel modeling: multiplexing capability of MIMO channels, physical modeling of MIMO channels, modeling MIMO fading channels.						
Course Outcomes **After successful completion of this course the student will be able to:** CO1: Describe physical modeling for wireless channel and diversity techniques. CO2: Analyze the Modeling of MIMO fading channels. CO3: Evaluate diversity techniques and multiplexing capability of MIMO channels. CO4: Design a MIMO system with smart antennas in wireless communication applications.						
Reference Books						
1.	Fundamentals of wireless communication, David Tse, P. Viswanath, 2006,Cambridge,.ISBN 0-521-68749-7.					
2.	Wireless communication, Upen Dalal, Oxford university Press, 2009, ISBN-13:978-0-19-806066-6.					
3.	Wireless communications, Andreas Molisch, 2nd Edition, 2009,Wiley, *ISBN*: 978-0-470-74187-0.					
4.	Mobile Communication Engineering Theory and applications, William C Y Lee,2008, McGraw Hill Education, ISBN 10: 0070252203.					

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.

Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
INTERNSHIP						
Course Code	**:**	**18MRM32**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1) The duration of the internship shall be for a period of 8 weeks on full time basis after II semester final exams and before the commencement of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization : Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed : summaries the tasks performed during 8 week period
    - Chapter 4 – Reflections : Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments,	45%
Review-II	Importance of resource management, environment and sustainability presentation skills and report writing	55%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER : III						
MAJOR PROJECT : PHASE-I						
Course Code	**:**	**18MRM33**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:5**		**SEE Marks**	**:**	**100**
Hours/week	**:**	**10**		**SEE Duration**	**:**	**3 Hours**

GUIDELINES

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. The total duration of the Major project Phase-I shall be for 16 weeks.
3. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
4. The allocation of the guides shall be preferably in accordance with the expertise of the faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from Internal Guide, Associate Dean and Head of the Department.
6. Students have to complete Major Project Phase-I before starting Major Project Phase-II.
7. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of the topic, Literature Survey, Problem Formulation and Objectives	45%
Review-II	Methodology and Report writing	55%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-I evaluation shall be done by an external examiner (domain expert) and respective guide as per the schedule. Maximum of four candidates per batch shall be allowed to take examination. The batches are to be formed based on specific domain of work.

SEMESTER : III						
SHORT RANGE WIRELESS COMMUNICATION (Elective-E1)						
Course Code	**:**	**18MDC3E1**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10Hrs**
Introduction to Short Range Wireless Communication (SWC): Growth of standards, Market, Wireless architecture, wireless parameters, Enabling factors, Design rules for SRC, Short-range vs medium/long range communications., High rate vs Low rate communications, Review of frequency regulations and available frequency bands, State of the Art SWC systems: WLAN, Bluetooth, ZigBee, NFC, UWB, BAN, 60GHz, LiFi, and VLC.	
Unit – II	**10Hrs**
Channel Estimation for high-rate systems: High rate UWB and 60GHz communications - Overview and Application Scenario's, ECMA-368 High rate UWB standard, ECMA-387 Millimeter wave radio standard, IEEE 802.15.3C, Channel models for high rate systems, Review of channel estimation techniques, Impact on channel estimation error on performance.	
Unit – III	**10Hrs**
Adaptive Modulation and coding for high rate systems: Adaptive modulation and coding, AMC in MB-OFDM systems, WPAN link architecture in ECMS-368, Packet level model for UWB channels with shadowing, WPAN link performance analysis, AMC in 60GHz millimeter wave radio systems, modulation techniques and system architectures for multi-Gb/s, RF Packaging and Antenna design issues.	
Unit – IV	**12Hrs**
PHY Layer Design Issues for High Data Rate (Gbps) communication: Principles of MIMO systems, MIMO for UWB systems, Adaptive Antenna Array Systems Design, active phased array based on analog beam-forming, PAPR Reduction for Discrete-time OFDM Signals, Soft Iterative Equalization for Clipped and Filtered COFDM Signals, power-amplifier utilization - significantly improved by clipping and filtering; matching receive algorithm for equalization of in-band distortion noise.	
Unit – V	**10Hrs**
Low rate systems & Emerging concepts in Short Range communications: ZigBee networks and low rate UWB communications - Overview and application examples, ZigBee, Impulse radio based UWB (IEEE 802.15.4a), Low latency MAC for WPANs (IEEE 802.15.4e), Active RFID (IEEE 802.15.4f), Smart utility Networks (IEEE 802.15.4g), Energy efficiency in Low rate systems- Background, Energy saving MACs. UROOF' (UWB radio-over-optical-fibre), UROOF - user applications and basic system configuration, Fundamentals of UROOF Technologies, Link Analysis of UROOF Systems, Analysis of UWB Technologies for UROOF, Visible Light Communications, Discrete Multitone Modulation, Potential applications of VLC, Technical challenges of implementing VLC.	

Course Outcomes

After successful completion of this course the student will be able to:

CO1: Explain the architectures and operations of state-of-the-art short range wireless networking standards.

CO2: Analyze the error performance of short range communication systems in presenceof noise and other interferences.

CO3: Gain in-depth knowledge about multicarrier and multiantenna techniques and their applications in current and emerging communication systems.

CO4: Identify various technical challenges on low rate systems and short range communication systems.

Reference Books

1.	Reliable Communications for Short-Range Wireless Systems, Ismail Guvenc, Sinan Gezici, Zafer Sahinoglu and Ulas C. Kozat, 1st Edition, 2011, Cambridge University Press, ISBN: 978-0-521-

	76317-2.
2.	Essentials of short-range wireless, Nick Hunn, 1st Edition, 2010, Cambridge University Press, ISBN: 978-0521760690.
3.	Short-range Wireless Communication, Alan Bensky, 3rd Edition, 2019, Newnes, , ISBN: 9780128154069, 9780128154052.
4.	Short Range Wireless Communications: Emerging Technologies and Applications, Rolf Kraemer, Marcos D. Katz, 1st Edition, 2009, John Wiley & Sons Ltd, ISBN: 9780470699959, 9780470740125.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
SOFTWARE DEFINED NETWORKS (Elective-E2)						
Course Code	**:**	**18MDC3E2**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10Hrs**
Software Defined Networking: Introduction, Modern Data Center, Traditional Switch Architecture, Layer 2 & 3 Control, Evolution of switches and control planes, Data Center Innovation & Needs, The Evolution of Networking Technology, Forerunners of SDN, Open Source Contributions and Network Virtualization.	
Unit – II	**10Hrs**
How SDN Works: Fundamental Characteristics of SDN, SDN Operation SDN Devices, SDN Controller, SDN Applications. **The Open Flow Specification**: Open Flow Overview, Open Flow 1.0 and Open Flow Basics, Open Flow 1.1, 1.2, and 1.3 Additions and Open Flow Limitations.	
Unit – III	**10Hrs**
Alternative Definitions of SDN: Potential Drawbacks of Open SDN, Alternate SDN Methods, Network Functions Virtualization, Alternatives Overlap and Ranking, SDN in the Data Center: Definition, Data Center Demands, Tunneling Technologies, Path Technologies, Ethernet Fabrics, SDN Use Cases in the Data Center and Real-World Data Center Implementations.	
Unit – IV	**12Hrs**
SDN in Other Environments: Consistent Policy Configuration**,** Global Network View**,** WANs**,** Service Provider and Carrier Networks**,** Campus Networks**,** Hospitality Networks**,** Mobile Networks**,** In-Line Network Functions, and Optical Networks. **Players in the SDN Ecosystem:** Academic Research Institutions**,** Industry Research Labs and Network Equipment Manufacturers**.**	
Unit – V	**10Hrs**
SDN Applications: Reactive versus Proactive Applications**,** A Simple Reactive Java Application**,** Background on various Controllers like Floodlight Controller**,** Open Daylight Controller**,** Cisco XNC Controller**,** and Hewlett-Packard Controller**.** Switch Considerations**,** Creating NV Tunnels**,** Offloading Flows in the Data Center**,** Access Control for the Campus**,** Traffic Engineering for Service Providers**.**	

Course Outcomes

After successful completion of this course the student will be able to:

CO1: Explain and discuss the basic concepts and architectural differences of conventional networking approaches and SDN.

CO2: Analyze and apply implementation of SDN through Open Flow Switches.

CO3: Apply the principles of SDN for the design of data centre using SDN elements of reputed vendors.

CO4: Design and implement software defined network application on SDN-based networking devices

Reference Books:

1.	Software Defined Networks: A Comprehensive approach, Paul Goransson, Chuck Black, Timothy Culver, 2nd Edition, Elsevier, ISBN-13: 978-0128045558, ISBN-10: 0128045558, 2014.
2.	Software Defined Networking design and deployment, Patricia A. Morreale, James M. Anderson, 1st Edition, CRC Press, ISBN-10: 1482238632, ISBN-13: 978-1482238631, 2015.
3.	SDN: Software Defined Networks: An Authoritative Review of Network, Programmability Technologies, Thomas D. Nadeau, Ken Gray, 1st Edition, ISBN-13: 978-1449342302, ISBN-10: 9781449342302, 2013.
4.	OpenFlow Cookbook, S., Kingston Smiler, 1st Edition, Packt Publishing, ISBN - 1783987944, 9781783987948, 2015.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : III						
NETWORK SECURITY (Elective-E3)						
Course Code	**:**	**18MDC3E3**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**10Hrs**

Introduction: OSI Security Architecture, Classical Encryption techniques: Symmetric Cipher Model, Substitution Techniques, Transportation Techniques.
Block Ciphers and Data Encryption Standards: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES. **Advanced Encryption Standard:** AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation.

Unit – II	**10Hrs**

Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm. **Other Public-Key Cryptosystems:** Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography, Pseudorandom Number Generation Based on an Asymmetric Cipher.

Unit – III	**10Hrs**

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3.
Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM, Pseudorandom Number Generation Using Hash Functions and MACs.
Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

Unit – IV	**12Hrs**

Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control.
Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security.

Unit – V	**10Hrs**

Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy, DNSSEC, DNS-Based Authentication of Named Entities, Sender Policy Framework, Domain Keys Identified Mail.
IP Security: Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

Course Outcomes
After successful completion of this course the student will be able to:
CO1: Describe the issues addressed by Network Security and understand the concepts of cryptography and Network security.
CO2: Apply cryptographic techniques and algorithms to provide security to the transmitted information.
CO3: Analyze the concepts of Authentication and Hash functions.
CO4: Understand and analyze System level security issues.

Reference Books

1.	Cryptography And Network Security - Principles and Practices, William Stallings Pearson Education Limited, 7th Edition, 2017. ISBN-13: 978-0134444284 ISBN-10: 0134444280.
2.	Cryptography and Network Security, Behrouz A. Forouzan, Tata McGraw-Hill, 2008, *ISBN*-13:

	978-0-13-187319-3.
3.	Computer Security: Principles and Practice, William Stallings, Lawrie Brown , Pearson Education Limited, 4th Edition. *ISBN*-10: 9780134794105.
4.	Cryptography and Network Security, Atul Kahate, Tata McGraw-Hill, 2003,ISBN-81:203-2186-3.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignments (A). A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) Solving innovative problems 2) Seminar/new developments in the related course 3) Laboratory/field work 4) Minor project.
Total CIE (Q+T+A) is 20+50+30=100 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

SEMESTER : IV						
MAJOR PROJECT : PHASE-II						
Course Code	**:**	**18MRM41**		**CIE Marks**	**:**	**100**
Credits L:T:P	**:**	**0:0:20**		**SEE Marks**	**:**	**100**
Hours/Week	**:**	**40**		**SEE Duration**	**:**	**3 Hrs**

GUIDELINES

1. Major Project Phase-II is continuation of Phase-I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of methodology, algorithm development, experimentation, testing and analysis of results.
4. It is mandatory for the student to present/publish the work in National/International conferences or Journals
5. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the students will be able to:

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics, societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Review and refinement of Objectives, Methodology and Implementation	20%
Review-II	Design, Implementation and Testing	40%
Review-III	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

Stage-1 Report Evaluation

Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2 Project Viva-voce

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats.

SEE procedure is as follows:

	Internal Guide	External Examiner	TOTAL	
SEE Report Evaluation	100 marks	100 marks		200 marks
			(A)	(200/2) = 100 marks
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator		(B)	100 marks
			Total Marks	**[(A)+(B)]/2 = 100**

SEMESTER : IV						
TECHNICAL SEMINAR						
Course Code	**:**	**18MRM42**		**CIE Marks**	**:**	**50**
Credits L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/Week	**:**	**4**		**SEE Duration**	**:**	**30 min**

GUIDELINES

1) The presentation shall be done by individual students.
2) The seminar topic shall be in the thrust areas of respective PG programme.
3) The seminar topic could be complementary to the major project work
4) The student shall bring out the technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation along with the report.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes

After going through this course the student will be able to:

CO1: Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Selection of Topic, Review of literature, Technical Relevance, Sustainability and Societal Concerns, Presentation Skills	45%
Review-II	Technological Developments, Key Competitors, Report writing	55%

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner and an internal examiner. Evaluation will be done in batches, not exceeding 6 students per batch.