

**CHOICE BASED CREDIT SYSTEM
EVALUATION SCHEME
AND
COURSE OF STUDY
IN
M.TECH
ELECTRONICS & COMMUNICATION ENGINEERING
(I YEAR& IIYEAR)
SCHEME OF EXAMINATION & SYLLABUS**



**DEPARTMENT OF ELECTRONICS & COMMUNICATION
ENGINEERING**

**FACULTY OF ENGINEERING AND TECHNOLOGY
GURUKULA KANGRI (DEEMED TO BE UNIVERSITY),
HARIDWAR**

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Faculty of Engineering & Technology

In the year 2000 Faculty of Engineering & Technology was established with an aim of imparting technical education in the spiritual surroundings of the Gurukula System. Keeping in mind the importance of technocrats with strong moral character, superior knowledge, and devotion to the nation. FET was established with a motto of Building Technocrats with ethics. FET is known in India and abroad for students with virtuous moral character and Technical abilities. FET is one of the richest faculty of Gurukula Kangri (Deemed to be University), with a huge number of books in the library, well-equipped electronics electrical and mechanical laboratories, latest software, and computers in computer labs. Football field, Tennis court, Volleyball court, Basketball arena, and open gym for the students with athletic interests.

Vision of F.E.T.

To provide affordable & quality education to engineering aspirants and nurture them to be highly skilled & innovative technocrats with ethics and nation building spirit.

Mission of F.E.T.

M1: (ETHICS & VALUES)

To educate and nurture engineering aspirants with values, updated engineering curriculum & latest technology to make them globally trusted and accepted.

M2: (RESEARCH)

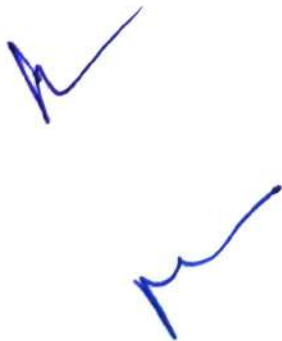
Provide conducive environment for teaching, learning & research that can lead to patents, publications and make country proud.

M3: (AFFORDABILITY)

Provide cost effective education so that every section of society can be benefitted.

M4: (SKILLED)

Design industry oriented curriculum that can make engineering graduates ready to work for Indian Industries as well as MNCs.



Department of Electronics & Communication Engineering

The Department of Electronics & Communication Engineering (ECE) provides in-depth technical knowledge and opportunities for innovation and research with the latest computer and software facilities.

Vision And Mission

Vision of the department

To become an excellence in higher education and learning center, that will provide inter disciplinary knowledge with impartment of human values and professional ethics among the youth, so as to serve as a valuable resource for industry and human society.

Mission of the department

- [M1]: (Contemporary excellence)

To provide students with an academic environment to promote teamwork, ethics, multidisciplinary approach and lifelong learning required for a successful professional carrier.

- [M2]: (Comprehensive Learning)

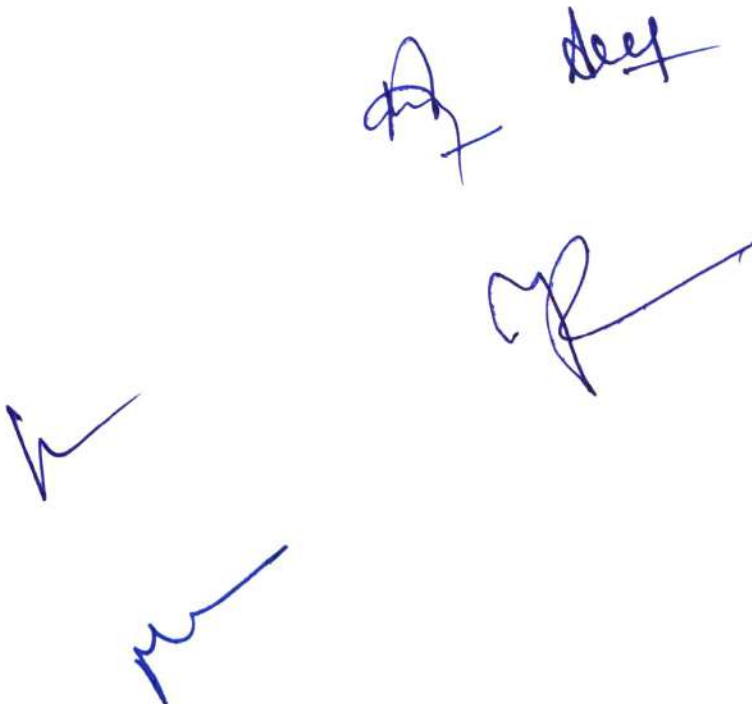
Impart To develop and impart graduated level of state-of-the-art knowledge education in the field of Electronics & Communication Engineering through focused graduate programs.

- [M3]: (Communal Responsibility & Sustainable Development)

Endeavour to apply the acquired knowledge into tangible benefits for to the society.

- [M4]: (Morals & Values)

To provide students with strong foundation in basic sciences, Vedic knowledge, mathematics, computing, engineering principles and human values.



Master of Technology (Electronics & Communication Engineering)

M. Tech (ECE)

M.Tech stands for Master of Technology. It's a postgraduate program in engineering and technology fields pursued after a Bachelor's degree in a related field, typically lasting two years.

1. Introduction

The Department of Electronics & Communication Engineering at FET, Gurukul Kangri, Haridwar starts a new AICTE approved M.Tech program in Electronics & Communication Engineering (ECE) with an intake of 18 students from session 2025-26. This program aims to equip graduates with advanced knowledge and skills in critical areas of ECE and VLSI to address the ever-growing demand for qualified professionals in the industry.

2. Program Structure

The M.Tech Program will be a four-semesters (Two-years) program. Students will complete course work, laboratory sessions, and a final project/thesis.

The M.Tech in ECE program will be a two-years, full-time program consisting of:

- **Core Courses:** These courses provide a strong foundation in advanced computer science concepts.
- **Elective Courses:** Students can choose electives to specialize in specific areas of interest.
- **Audit Course:** A course that a student can take without earning academic credit or a grade.
- **Master's Thesis:** Students will undertake a research project under the supervision of a faculty member.

3. Admission Process/Eligibility Criteria

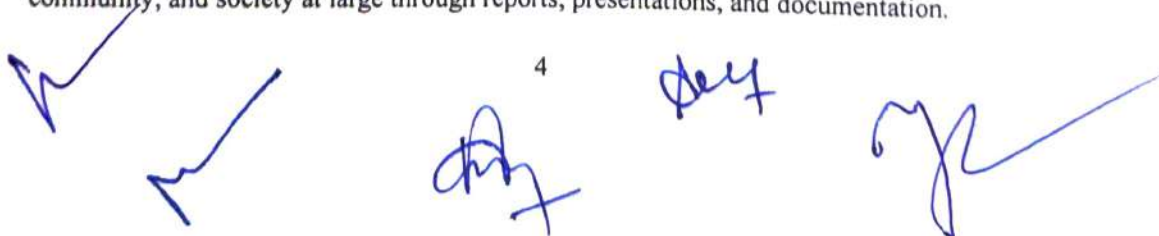
The program will consider applications from both GATE (Graduate Aptitude Test in Engineering) qualified and non-GATE students, though preference will be given to candidates having valid GATE score. Eligible candidates will be shortlisted based on their GATE score/Last Eligible Degree Percentage. The university may consider factors such as overall CGPA or percentage in B.Tech./UG program. Candidates with valid GATE score are eligible for AICTE scholarship as per AICTE norms.

Students must possess a Bachelor's degree in Engineering (BE/B.Tech) in ECE/EEE or allied branches from a recognized university. An M.Sc Physics/M.Sc Electronics are also eligible. The university will set a minimum qualifying GATE score or UG exam percentile based on the program's competitiveness.

4. Program Outcomes of ECE (M.Tech) program:

The main outcomes of the ECE (M.Tech) program are given here. At the end of the program a student is expected to have:

1. Apply advanced knowledge of mathematics, science, and engineering fundamentals to analyze, design, and develop solutions in Electronics and Communication Engineering.
2. Identify, analyze, and solve complex engineering problems using a systematic and research-based approach in ECE applications.
3. Design and develop electronics and communication systems, components, or processes that meet specific needs with consideration for public health, safety, and environmental concerns.
4. Utilize modern engineering tools, techniques, and resources for ECE-related tasks, with an understanding of their limitations.
5. Apply appropriate research methodologies, including literature review, experimentation, and data analysis, to conduct investigations and contribute to technological innovation.
6. Demonstrate ethical behavior, professional responsibility, and a commitment to sustainable development in engineering practice.
7. Communicate effectively on complex engineering activities with peers, the engineering community, and society at large through reports, presentations, and documentation.



8. Apply engineering and management principles to lead and manage projects in multidisciplinary environments efficiently.
9. Recognize the need for and engage in lifelong learning to adapt to emerging technologies and innovations in the field of ECE.
10. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.







(Effective from the academic session 2026-27)
GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
Faculty of Engineering & Technology Electronics
& Communication Engineering

M. Tech. First Year**SEMESTER-I**

SEMESTER-I					SEMESTER-I					Credits
	SUBJECT	PERIODS			EVALUATION SCHEME			Subject Total		
					SESSIONAL EVALUATION		EXAM ESE			
		L	T	P	CT	TA			Total	
THEORY										
CORE-1 MET-C101	Advance Communication System	3	1	0	20	10	30	70	100	3
CORE-2 MET-C102	Advance Microprocessor and Microcontroller	3	1	0	20	10	30	70	100	3
	Program Specific Elective -1	3	1	0	20	10	30	70	100	3
	Program Specific Elective -2	3	1	0	20	10	30	70	100	3
MET-C103	Research Methodology and IPR	2	0	0	20	10	30	70	100	2
PRACTICAL										
LAB-1	Elective -1	0	0	4	20	10	30	70	100	2
LAB-2	Elective -2	0	0	4	20	10	30	70	100	2
Audit Course MET-A101	Physical Fitness and Stress Management	2	0	0	20	10	30	70	100	1
TOTAL										
		16	4	10	160	80	240	560	800	19

List of Elective

- (1) Wireless Sensor Networks (MET-PE 101)
- (2) Embedded System Design (MET-PE 102)
- (3) Advanced Mathematics for engineers (MET-PE 103)
- (4) Analog and Digital CMOS VLSI Design (MET-PE 104)
- (5) Cognitive Radios (MET-PE 105)
- (6) RF and Microwave Circuit Design (MET-PE 106)
- (7) Soft Computing (MET-PE 107)
- (8) Low power VLSI Design (MET-PE 108)

List of Elective (Lab)

- (1) Advanced Communication Lab (MET-C111)
- (2) Advanced Microcontroller Lab (MET-C112)
- (3) Wireless and Mobile Communication Lab (MET-C113)
- (4) Analog and Digital CMOS VLSI Design Lab (MET-C114)

(Effective from the academic session 2026-27)
GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
Faculty of Engineering & Technology Electronics
& Communication Engineering

M. Tech. First Year**SEMESTER-II**

SEMI-TECH. First Year		SEMESTER-II								Credits
	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	Total			
THEORY										
CORE-3 MET-C201	Antennas and Communication Systems	3	1	0	20	10	30	70	100	3
CORE-4 MET-C202	Advanced Digital Signal Processing	3	1	0	20	10	30	70	100	3
	Program specific Elective -3	3	1	0	20	10	30	70	100	3
	Program specific Elective -4	3	0	0	20	10	30	70	100	3
PRACTICAL										
LAB-3	Elective -3	0	0	4	20	10	30	70	100	2
LAB-4	Elective -4	0	0	4	20	10	30	70	100	2
MET-C227	Minor Project	2	0	2	20	10	30	70	100	2
Audit Course MET-A201	English for Research Paper Writing	2	0	2	20	10	30	70	100	1
TOTAL		16	3	12	160	80	240	560	800	19

List of Elective

- (1) Satellite Communication (MET-PE 201)
- (2) Internet of Things (MET-PE 202)
- (3) Machine Learning (MET-PE 203)
- (4) VLSI Design Verification and Testing (MET-PE 204)
- (5) MIMO System (MET-PE 205)
- (6) Artificial Intelligence (MET-PE 206)
- (7) RTL Simulation and Synthesis with PLDs (MET-PE 207)
- (8) Nano Electronics (MET-PE 208)

List of Elective (Lab)

- (1) Microwave Systems lab (MET-C211)
- (2) VLSI Design Verification and Testing Lab (MET-C212)
- (3) Advanced Digital Signal Processing Lab (MET-C213)
- (4) RTL Simulation and Synthesis with PLDs Lab (MET-C214)



(Effective from the academic session 2026-27)
GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
Faculty of Engineering & Technology
Department of Electronics & Communication Engineering

M. Tech. Second Year

(SEMESTER-III)

M. Tech. Second Year										(SEMESTER II)	
	SUBJECT	PERIODS			EVALUATION SCHEME		Subject Total	Credits			
					SESSIONAL EVALUATION	EXAM ESE					
		L	T	P							
THEORY											
Dissertation –Minor MET-P310	Dissertation Phase – I /Internship/Industry project	0	0	6	300		300	8			
MET-P311	Seminar I	0	0	4	100		100	4			
MET-P312	Seminar II Explore Engineering & Technology in Ved, Vedang and other Vedic literature	0	0	4	100		100	1			
TOTAL		0	0	14	500		500	13			







(Effective from the academic session 2026-27)
GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
 Faculty of Engineering & Technology Electronics
 & Communication Engineering

M. Tech. Second Year

(SEMESTER-IV)

	SUBJECT	PERIOD S			EVALUATION SCHEME		Subj ect Total	Cre dits
					SESSIONA L EVALUATI ON	EXAM ESE		
		L	T	P				
THEORY								
Dissertation –Minor MET-P400	Dissertation Phase – II Dissertation With Research Paper/ Internship/Industry project	0	0	16	100	400	500	16
	Total	0	0	16	100	400	500	16

Credit				
Semester	1	2	3	4
Semester wise Total Credit	19	19	13	16
Total Credit	67			

M. Tech. (Electronics & Communication Engineering)**Semester I**

Sr. No.	Course Code	Course Name
1	Core 1(MET-C101)	Advance Communication System
2	Core 2(MET-C102)	Advance Microprocessor and Microcontroller
3	Prog. Specific Elective	
	MET-PE 101	Wireless Sensor Networks
	MET-PE 102	Embedded System Design
	MET-PE 103	Advanced Mathematics for Engineers
	MET-PE 104	Analog and Digital CMOS VLSI Design
	MET-PE 105	Cognitive Radios
	MET-PE 106	RF and Microwave Circuit Design
	MET-PE 107	Soft Computing
	MET-PE 108	Low power VLSI Design
4	Lab Elective	
	MET-C111	Advanced Communication Lab
	MET-C112	Advance Microcontroller Lab
	MET-C113	Wireless and Mobile Communication Lab
	MET-C114	Analog and Digital CMOS VLSI Design Lab
5	MET-C103	Research Methodology and IPR
6	Audit course 1(MET-A101)	Physical Fitness and Stress Management

Semester II

Sr. No.	Course Code	Course Name
1	Core 3(MET-C201)	Antennas and Communication Systems
2	Core 4 (MET-C202)	Advanced Digital Signal Processing
3	Prog. Specific Elective	
	MET-PE 201	Satellite Communication
	MET-PE 202	Internet of Things
	MET-PE 203	Neural networks
	MET-PE 204	VLSI Design Verification and Testing
	MET-PE 205	MIMO System
	MET-PE 206	Artificial Intelligence
	MET-PE 207	RTL Simulation and Synthesis with PLDs
	MET-PE 208	Nano Electronics
4	Lab Elective	
	MET-C211	Microwave Systems Lab
	MET-C212	VLSI Design Verification and Testing Lab
	MET-C213	Advanced Digital Signal Processing Lab
	MET-C214	RTL Simulation and Synthesis with PLDs Lab
5	MET-C227	Mini Project
6	Audit course 2(MET-A201)	English for Research Paper Writing

Semester III

Sr. No.	Course Code	Course Name
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1.	MET-P311	Seminar
2.	MET-P310	Dissertation Phase – I

Semester IV

Sr. No.	Course Code	Course Name
1.	MET-P400	Dissertation Phase – II

NOTE: Specialization certificate will be given by the university with the following conditions

1. If the student opts two electives of VLSI in First and Second semester each. (Total Four Papers of VLSI) he will get specialization certificate in VLSI.
2. If a student opts two electives of communication in First and Second semester each (Total four papers of Communication) he will get specialization certificate in Communication.
3. If the students opt mixed electives, no specialization will be given, only M.Tech in Core ECE will be given.






Course Code: MET-C101

Course Name: Advanced Communication System

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 0 0	

Prerequisites:	Basic Communication Theory
Objectives:	1. Understand advanced concepts of modern communication systems, including modulation and coding techniques. (<i>Understanding</i>) 2. Explain the principles and applications of MIMO, OFDM, and wireless technologies such as 4G, 5G, and beyond. (<i>Understanding</i>) 3. Analyze the performance of various communication system architectures and protocols. (<i>Analyzing</i>) 4. Design efficient and high-performance communication systems for real-world applications. (<i>Creating</i>) 5. Evaluate communication system designs in terms of efficiency, reliability, and adaptability for academic and industrial use. (<i>Evaluating</i>) 6. Apply theoretical knowledge to simulate and develop components of modern wireless systems. (<i>Applying</i>)
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Review of Communication Fundamentals: Overview of analog and digital communication systems, Channel models: AWGN, Rayleigh, Rician, Random processes, and noise characterization, Performance metrics: SNR, BER, capacity, Review of digital modulation: BPSK, QPSK, QAM, FSK, MSK	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Information Theory and Source Coding: Entropy, mutual information, and channel capacity, Shannon's source and channel coding theorems, Discrete memoryless channels, Source coding: Huffman, Arithmetic, Lempel-Ziv coding, Rate-Distortion theory basics	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Channel Coding and Error Control: Linear block codes: Hamming, BCH, Reed-Solomon, Convolutional codes: encoding and Viterbi decoding, Turbo codes, and iterative decoding, Low-Density Parity-Check (LDPC) codes, Performance comparison of coding schemes	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Advanced Modulation and Multicarrier Techniques: M-ary modulation schemes and constellation design, Adaptive modulation	07	PO1/ PO2/ PO3	PSO1/ PSO2/..



		and coding (AMC). Multicarrier modulation: OFDM principles and implementation, Peak-to-Average Power Ratio (PAPR) and mitigation, OFDM in 4G and 5G systems			
UNIT-5	Module-5	MIMO and Wireless Communication Systems: Fading channels and diversity techniques, MIMO systems: spatial diversity, spatial multiplexing, Channel state information and capacity analysis, Massive MIMO and beamforming, Applications in LTE, 5G NR	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Emerging Topics and Applications: Cognitive radio and dynamic spectrum access, Software-Defined Radio (SDR) architecture and applications, Millimeter wave communication and 6G concepts, Internet of Things (IoT) communication protocols, AI/ML applications in communication systems	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	1. Understand and analyze various channel models and evaluate the performance of digital modulation schemes in the presence of noise. 2. Apply principles of information theory to compute channel capacity and design efficient source coding techniques. 3. Design and evaluate error control coding schemes such as block codes, convolutional codes, and LDPC to improve communication reliability. 4. Analyze and implement multicarrier modulation techniques like OFDM, and understand their application in modern wireless systems. 5. Evaluate the performance benefits of MIMO systems and apply diversity and beamforming techniques in wireless communication. 6. Demonstrate an understanding of emerging technologies such as SDR, cognitive radio, and the role of AI/ML in future communication networks.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	John G. Proakis and Masoud Salehi, "Digital Communications", 5th Edition, McGraw-Hill Education, New York, 2007, ISBN-9780072957167.	2007
2.	Simon Haykin, "Communication Systems", 5th Edition, Wiley India Pvt. Ltd., New Delhi, 2013, ISBN-9788126554232.	2013
3.	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, New York, 2005, ISBN-9780521845274.	2005
4.	Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, New Delhi, 2010, ISBN-9788131701805.	2010
5.	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, Cambridge, 2005, ISBN-9780521837163.	2005
6.	Robert G. Gallager, "Information Theory and Reliable Communication", Wiley, New York, 1968, ISBN-9780471290483.	1968

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	N	Y
PO2	Y	Y	Y	Y	Y

PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N

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Course Code: MET-C102**Course Name: Advance Microprocessor & Microcontroller**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	Microprocessor
Objectives:	1. Able to Understand the microprocessor ISA architectures 2. Able to Programme with high level programming 3. Able to communicate processors with I/O devices 4. Able to design a microprocessor-based system design
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Design of Basic Microprocessor Architectural Concepts Microprocessor architecture, word Lengths, addressable memory, Microprocessor's speed architectural characteristics, registers, instruction, memory addressing architecture ,ALU, GPR's Control logic & internal data bus.	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Instruction Set, Mnemonics, Basic Instruction Types, Addressing modes, Microprocessor I/O connecting I/O put to Microprocessor, Polling and Interrupts, Interrupt and OM. Controllers.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Introduction 8051 architecture and programming model. Internal RAM and registers, I/O ports, Interrupt system & Instruction set.	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Intel X86 family of advanced Microprocessor, programming model for 86 family. X86 addressing modes, instruction set, hardware of 186, 286, 386, 486 & Pentium processors. Motorola 68 XXX family of microprocessor, 68 XXX addressing modes, instruction set, hardware.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Data Communication, parallel I/O serial communication, Serial interface and UART, modems, I/O devices, D/A, A/D interface, special I/O devices.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Developing Microprocessor Based Products Introduction to the Design Process, Preparing the specifications, Developing a design, Implementing and Testing and design, Regulatory Compliance Testing, design tool for Microprocessor Development.	06		
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 1. Familiarize 32bit, 64bit and multi core architectures. 2. Compare the features of various microprocessors.
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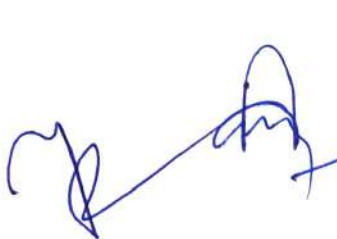
	3. Learn the architecture and programming with 8051 microcontroller. 4. Explain the basic architecture and features of PIC microcontrollers. 5. Develop microcontroller programs. 6. Familiarize basics of interfacing.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	C.M. Gilmore, "Microprocessors Principals and Application" McGraw-Hill 2nd Edition 1995	1995
2.	2. Rajkamal, "Embedded System, Architecture & Programming", Tata McGraw- Hill 2nd Edition 2008	2008
3.	D. V. Hall, "Microprocessor & Interfacing", McGraw-Hill 2nd Edition 2005	2005
5.		

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N






Course Code: MET-C103

Course Name: Research Methodology and IPR

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	Analog and Digital communication,
Objectives:	1. Understand research problem formulation. 2. Analyze research related information. 3. Follow research ethics 4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow's world will be ruled by ideas, concepts, and creativity. 5. Understanding that when IPR would take such an important place in the growth of an individual nation, it is needless to emphasize the need for information about Intellectual Property rights to be promoted among students in general & engineering in particular. 6. Understanding that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about economic growth and social benefits.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Effective literature studies approaches, analysis, Plagiarism, Research ethics,.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	04	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			35		

Learning Outcomes:	After completion of course, students would be able to: 1. You will gain the ability to formulate well-defined research questions, identify relevant research methodologies (quantitative, qualitative, mixed methods), and design effective research plans. 2. You will learn to identify potential biases in research and develop strategies for ensuring the objectivity and validity of your own research findings. 3. You will develop skills in creating presentations to present your research in a clear and engaging manner.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"	
2.	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"	
3.	Ranjit Kumar, 2 ndEdition, "Research Methodology: A Step by Step Guide for beginners"	2005
5.	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.	2007
6.	Mayall, "Industrial Design", McGraw Hill, 1992.	1992

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N

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Course Code: MET-C111

Course Name: Advanced Communication Lab

MM : 100

Time : 2Hr

L T P

0 0 2

Sessional : 30

ESE : 70

Credit : 2

Prerequisites:	Communication Theory basics
Objectives:	1. Simulate and analyze channel models and modulation schemes in digital communication systems. 2. Implement source and channel coding techniques and assess coding gain. 3. Develop and evaluate multicarrier modulation systems including OFDM. 4. Model MIMO systems and assess performance under different fading environments. 5. Explore emerging technologies such as SDR, cognitive radio, and 5G frameworks using simulation tools and hardware kits.
Course Coordinator	Dr. Anuj Kumar Sharma

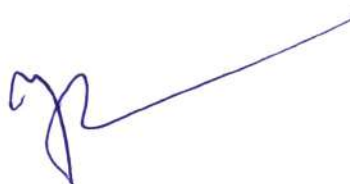
NOTE:	Student can Choose any 8 Experiment.
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EXP	Course Content Using MATLAB/SCILAB & DSK kit	No. of Hours	POs mapped	PSOs mapped
1	Simulation of AWGN, Rayleigh, and Rician channel models.	2		
2	BER vs SNR performance analysis of BPSK, QPSK, and QAM under various channels.	2		
3	Implementation of source coding techniques: Huffman, Lempel-Ziv, and Arithmetic coding.	2		
4	Simulation of channel capacity using mutual information under different noise conditions.	2		
5	Encoding and decoding using Hamming, BCH, and Convolutional codes with Viterbi decoding.	2		
6	BER performance comparison of Turbo and LDPC codes in fading environments.	2		
7	Design and simulation of an OFDM system with PAPR analysis.	2		
8	Implementation of Adaptive Modulation and Coding (AMC) schemes.	2		
9	Simulation of MIMO systems using spatial multiplexing and diversity techniques.	2		
10	Beamforming and Massive MIMO system design using CSI.	2		
11	Implementation of spectrum sensing techniques in cognitive radio.	2		
12	Development of an SDR-based transceiver chain using GNU Radio.	2		
		24		

Learning Outcomes:	On the completion of this laboratory course, the students will be able to have hands on experience on, 1. Model and simulate analog and digital modulation schemes using communication toolboxes. (<i>Applying</i>) 2. Implement and analyze entropy-based source coding and various channel coding schemes. (<i>Analyzing</i>) 3. Design an OFDM system and assess performance in multipath channels. (<i>Creating</i>)
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	4. Simulate MIMO systems with diversity and spatial multiplexing techniques. (<i>Applying</i>) 5. Experiment with SDR tools to explore cognitive radio and 5G signal flow. (<i>Applying / Evaluating</i>)
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Course Code: MET-C112**Course Name: Advanced Microcontroller Lab****MM : 100****Time : 2Hr****L T P****0 0 2****Sessional : 30****ESE : 70****Credit : 2**

Prerequisites:	Microprocessors & Microcontrollers basics, Embedded C programming, Digital interfacing fundamentals.
Objectives:	1. To understand architecture and advanced peripherals of modern microcontrollers (ARM Cortex-M / AVR / PIC). 2. To develop embedded C programs for real-time control and monitoring applications. 3. To interface sensors, actuators, and communication modules with microcontrollers. 4. To explore timing, PWM, ADC, communication protocols, and interrupt mechanisms. 5. To implement embedded IoT applications using microcontroller platforms. 6. To analyze power optimization, debugging, and hardware-software co-design in embedded systems.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	Student can Choose any 8 Experiment.
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EXP	Course Content (Using ARM Cortex-M / STM32 / Arduino / ESP32 / AVR / PIC Platforms)	No. of Hours	POs mapped	PSOs mapped
1	Study of microcontroller architecture and toolchain setup (IDE, compiler, programmer).	2		
2	GPIO programming: LED control, switch interfacing, debouncing using interrupts.	2		
3	Timer and PWM programming: generating waveforms, motor speed control.	2		
4	ADC interfacing: analog sensor data acquisition and real-time plotting.	2		
5	UART communication: serial transmission and reception with PC/terminal.	2		
6	I2C/SPI interfacing: EEPROM, sensor modules, display modules (OLED/LCD).	2		
7	Interrupt-driven programming and event-handling mechanisms.	2		
8	Real-Time Clock (RTC) interfacing and data logging applications.	2		
9	Embedded control application: temperature controller or PID-based control.	2		
10	Wireless communication: Bluetooth/Wi-Fi module interfacing (ESP32/HC-05).	2		
11	Implementation of mini IoT application using microcontroller + cloud (MQTT/HTTP).	2		
12	Low-power modes and power optimization techniques in microcontrollers.	2		
		24		

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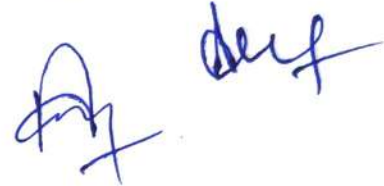
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Learning Outcomes:	On completion of this laboratory course, the students will be able to: 1. Program and configure advanced microcontroller peripherals. (<i>Applying / Understanding</i>) 2. Interface sensors, actuators, and communication modules effectively. (<i>Applying / Analyzing</i>) 3. Design real-time embedded control and monitoring applications. (<i>Creating / Evaluating</i>) 4. Implement interrupt-driven, low-power, and communication-based embedded systems. (<i>Analyzing / Applying</i>) 5. Develop IoT-enabled microcontroller applications with hardware–software integration. (<i>Creating / Applying</i>)
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Course Code: MET-C113**Course Name: Wireless and Mobile Communication Lab**

MM : 100

Time : 2Hr

L T P

0 0 2

Sessional : 30

ESE : 70

Credit : 2

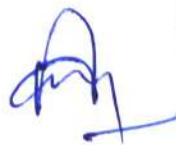
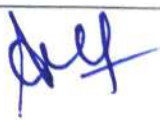
Prerequisites:	Communication Theory basics
Objectives:	1. Understand and model wireless channel impairments like fading and path loss. 2. Analyze the performance of digital modulation schemes under different channel conditions. 3. Simulate and evaluate multiple access techniques and cellular network parameters. 4. Explore handoff mechanisms, call management, and resource allocation in mobile systems. 5. Apply knowledge of wireless protocols and standards through simulation and measurement tools.
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE: Student can Choose any 8 Experiment.

	EXP	Course Content Using MATLAB/SCILAB & DSK kit	No. of Hours	POs mapped	PSOs mapped
	1	Simulation of AWGN and multipath fading channels (Rayleigh, Rician).	2		
	2	BER performance analysis of digital modulation techniques (BPSK, QPSK, 16-QAM) in fading conditions.	2		
	3	Implementation of Direct Sequence Spread Spectrum (DSSS) technique.	2		
	4	Implementation of Frequency Hopping Spread Spectrum (FHSS) system.	2		
	5	Design and simulation of OFDM-based transmission with PAPR analysis.	2		
	6	Simulation and analysis of SNR, BER, and channel capacity under various scenarios.	2		
	7	Simulation of MIMO systems using spatial diversity and multiplexing.	2		
	8	Measurement of received signal strength (RSS) using SDR or mobile-based tools.	2		
	9	Simulation of mobility models and path loss in different propagation environments.	2		
	10	Calculation and simulation of call blocking probabilities using Erlang B and C models.	2		
	11	Channel assignment algorithms: fixed and dynamic channel allocation.	2		
	12	Handoff detection and delay simulation in mobile environments.	2		
			24		

Learning Outcomes:	On the completion of this laboratory course, the students will be able to have hands on experience on,
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	1. Simulate various wireless channels and assess their impact on system performance. <i>(Applying)</i> 2. Analyze the performance of modulation and multiple access schemes in mobile environments. <i>(Analyzing)</i> 3. Design and evaluate spread spectrum and OFDM systems. <i>(Creating / Evaluating)</i> 4. Implement resource allocation and handoff strategies in cellular networks. <i>(Applying)</i> 5. Demonstrate understanding of real-time mobile protocols, signal strength, and QoS metrics. <i>(Understanding / Applying)</i>
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Course Code: MET-C114**Course Name: Analog and Digital CMOS VLSI Design Lab****MM : 100****Time : 2Hr****L T P****0 0 2****Sessional : 30****ESE : 70****Credit : 2**

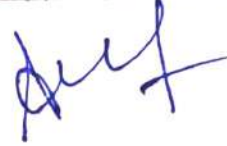
Prerequisites:	Basic knowledge of Digital Electronics, MOSFET operation, CMOS logic circuits.
Objectives:	1. To understand CMOS device characteristics and parasitic effects through simulation. 2. To design and simulate digital CMOS logic gates and combinational circuits. 3. To implement sequential circuits and analyze timing parameters. 4. To design full-custom layouts using industry-standard EDA tools. 5. To perform physical verification, extraction, and estimation of delay and power. 6. To develop hands-on skills in analog CMOS building blocks and mixed-signal circuits.
Course Coordinator	Dr. Prateek Agarwal

NOTE:	Student can Choose any 8 Experiment.
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EXP	Course Content (Using Cadence Workflow/LTspice/Ngspice / eSim/MCP4EDA/Xyce/ Verilog)	No. of Hours	POs mapped	PSOs mapped
1	DC analysis of NMOS and PMOS transistors: I_d-V_g , I_d-V_d , threshold voltage extraction.	2		
2	Transient analysis of CMOS inverter: noise margins, rise/fall time, propagation delay.	2		
3	Design and simulation of CMOS logic gates (NAND, NOR, XOR) and fan-out analysis.	2		
4	Design of combinational blocks: multiplexer, encoder, decoder using CMOS logic.	2		
5	Design of sequential circuits: latch, flip-flop (D, JK) and timing analysis (setup/hold).	2		
6	Static and dynamic power dissipation analysis in CMOS circuits.	2		
7	Layout design of CMOS inverter and extraction of parasitic capacitances.	2		
8	Layout design and DRC/LVS check for NAND/NOR gates.	2		
9	Design and simulation of basic analog CMOS circuits: Common-source amplifier.	2		
10	Design of current mirror, differential pair, and DC operating point analysis.	2		
11	Design of SRAM 6T cell: read/write margin simulations.	2		
12	Study of full-custom VLSI design flow: schematic → layout → extraction → simulation.	2		
		24		

Learning Outcomes:	On completion of this laboratory course, the students will be able to: 1. Characterize MOS transistors and analyze static/dynamic properties of CMOS circuits. (Understanding / Applying)
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	2. Design and simulate combinational and sequential CMOS circuits. (<i>Applying / Analyzing</i>) 3. Create full-custom layouts and perform physical verification (DRC/LVS). (<i>Creating / Evaluating</i>) 4. Extract parasitic components and analyze delay and power in VLSI circuits. (<i>Analyzing / Applying</i>) 5. Implement essential analog CMOS building blocks and mixed-signal interfaces. (<i>Understanding / Applying</i>)
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M.Tech ECE

Subject name: Physical Fitness and Stress Management

Subject code MAT-A101

Objectives

- To enhance physical fitness and mental well-being of M.Tech students
- To understand stress related to academics, research, and professional life
- To improve productivity, focus, and work–life balance

Course Outcomes (COs)

After successful completion, students will be able to:

- **CO1:** Assess fundamental physical fitness and design personalized exercise routines to offset the risks associated with a sedentary lifestyle.]
- **CO2:** Apply fitness testing and training methodologies (aerobic, anaerobic, and resistance) to maintain optimal muscular and cardiovascular health.
- **CO3:** Analyze physiological and psychological stress responses, implementing specific relaxation and stress-management techniques (such as yoga and meditation) to avoid burnout.
- **CO4:** Formulate sustainable lifestyle strategies covering nutrition, sleep hygiene, digital detox, and time management to boost daily professional productivity.
- **CO5:** Examine the physiological mechanisms behind stress-related disorders and apply preventive strategies to maintain holistic well-being.

Unit I: Physical Fitness for Technical Professionals

- Concept and Importance of Physical Fitness
- Occupational Health Issues in Engineers
- Sedentary Lifestyle and Lifestyle Disorders
- Health-Related vs Skill-Related Fitness

Unit II: Exercise Physiology and Fitness Components

- Physical fitness. Stress control exercise Sitting meditation, Walking meditation, Progressive muscular relaxation.
- Muscular Strength and Endurance
- Cardiovascular Endurance
- Flexibility and Mobility
- Body Composition and BMI



Unit III: Training Methods and Fitness Assessment

- Principles of Exercise Training
- Aerobic and Anaerobic Training
- Resistance and Core Training
- Warm-up, Cool-down, and Recovery
- Fitness Testing and Interpretation

Unit IV: Stress and Mental Health

- Meaning and Definition of Stress Types: Eustress, Distress, Anticipatory Anxiety.
- Meaning of Management Stress Management.
- Stress Response: Physiological and Psychological.
- Burnout, Anxiety, and Depression
- Stress–Performance Relationship

Unit V: Stress Management Techniques

- Physical Activity as a Stress Buffer
- Yoga for Stress Reduction, Asanas & Pranayama
- Role of Meditation & Pranayama on stress physiological aspect of Meditation. Constant stress & strain, anxiety, conflicts resulting in fatigue among Executive.
- Mechanism of Stress related diseases: Psychic, Psychosomatic, Somatic and Organic phase.
- Meaning and definition of Health various dimensions of health Yoga and health Yoga as therapy

Unit VI: Lifestyle Management and Productivity

- Nutrition for Brain and Physical Health: Jathara Agni (The Primary Digestive Fire)
- Sleep Hygiene and Circadian Rhythm
- Time Management and Goal Setting
- Digital Detox and Work–Life Balance
- Substance Abuse Prevention

Recommended Reading

1. American College of Sports Medicine – *ACSM's Guidelines for Exercise Testing and Prescription*
2. Weinberg & Gould – *Foundations of Sport and Exercise Psychology*
3. Selye, H. – *The Stress of Life*
4. Andrews, Linda Wasmer., *Stress Control for peace of Mind*. London: Greenwich Editions, 2005.
5. Lalvani, Vimla., *Yoga for stress*. London: Hamlyn, 1998. 3. H.R. Nagendra, and R. Nagarathana, *Yoga perspective in stress management*.
6. H.R. Nagendra and R. Nagarathana, *Yoga practices for anxiety & depression*. Bangalore: Swami Sukhabodhanandha Yoga Prakashana, 2004.
7. Sukhabodhanandha, Swami, *Stress Management*. Bangalore: Prasanna trust, 2002.



8. K.N. Udupa. Stress management by Yoga. NewDelhi: Motilal Banaridass Publishers Private Limited, 1996.

Course Outcomes to Program Outcomes (CO-PO) Mapping Matrix

Course Outcomes	PO1: Engineering Knowledge	PO2: Problem Analysis	PO3: Life-long Learning	PO4: Individual & Teamwork	PO5: Professional Ethics
CO1	1	2	3	1	2
CO2	2	1	3	2	1
CO3	1	3	3	2	3
CO4	2	2	3	1	2
CO5	1	3	3	1	3



Course Code: MET-PE 101**Course Name: Wireless Sensor Network**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	wireless communication, sensors, communication, network
Objectives:	5. Introduce the fundamentals of Wireless Sensor Networks. 6. Understand sensor node hardware and software components. 7. Equip students with practical skills in programming and simulation 8. Explore communication protocols and standards.. 9. Analyze data dissemination, in-network processing.. 10. Investigate advanced research challenges.
Course Coordinator	Dr. Tanuj Garg

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Overview and architecture of wireless sensor networks, Applications of WSNs in various domains (environmental monitoring, healthcare, industrial automation, smart cities), Comparison with Ad Hoc networks and other wireless systems, Sensor node architecture: hardware and software components , Recent developments: Integration of WSNs with IoT and Cyber-Physical Systems (CPS)	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Hardware platforms: mica2, micaZ, telosB, tmote, Imote2, btmote, and modern platforms like Raspberry Pi and ESP32-based nodes, Sensor hardware interfacing basics, Operating systems for WSNs: TinyOS, Contiki-NG, RIOT, Zephyr, Emerging software platforms for WSNs and IoT integration, Energy harvesting and low-power hardware design trends	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Overview of WSN protocol stack, Protocols across layers (Physical, MAC, Routing): MAC: S-MAC, T-MAC, B-MAC, Network/ Routing: LEACH, Directed Diffusion, RPL, Node discovery, synchronization, and data aggregation techniques, Communication standards: IEEE 802.15.4, Zigbee, Bluetooth, BLE, LoRaWAN, NB-IoT, Advances in mesh networking and low-power wide-area networks (LPWAN)	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Programming tools and languages: C, nesC, Python (for data processing and integration), Sensor node programming basics, Simulation and performance analysis tools: NS-2, NS-3, Cooja (Contiki), OMNeT++, TOSSIM, Comparative study of open-source and commercial tools (QualNet, Opnet),	06	PO1/ PO2/ PO3	PSO1/ PSO2/..

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		Introduction to cloud-based WSN testbeds and emulation tool			
UNIT-5	Module-5	Data dissemination, in-network processing, and storage mechanisms, Query processing in sensor networks, Localization techniques and coverage models.	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Security challenges: authentication, encryption, intrusion detection in WSNs, Edge computing and AI at the edge for smart sensor networks, Sensor cloud and fog computing, Open research issues and future directions in WSNs	04		
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to - Design wireless sensor network system for different applications under consideration. - Understand the hardware details of different types of sensors and select right type of sensor for various applications. - Understand radio standards and communication protocols to be used for wireless sensor network based systems and application. - Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms. - Handle special issues related to sensors like energy conservation and security challenges
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.	2012
2.	C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.	2010
3.	F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.	2013
5.	YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.	2008

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N



	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N



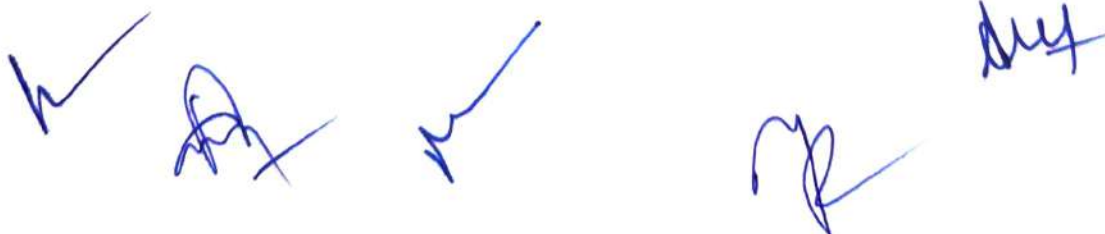
Course Code: MET-PE 102**Course Name: EMBEDDED SYSTEMS DESIGN**

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit :3
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Prerequisites:	Microprocessor & interfacing
Objectives:	11. Understand the Fundamentals of Embedded Systems. 12. Develop Programming Skills for Embedded Systems. 13. Understand Real-Time Operating Systems (RTOS). 14. To explore serial, parallel, and wireless communication protocols. 15. To develop skills for real-world peripheral interfacing.
Course Coordinator	Dr. ANUJ KUMAR SHARMA

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Embedded systems and its applications, Embedded Operating system, Design parameters of an embedded system and its significance, design life cycle, tools introduction, hardware and software partitioning and co-design. Open collector outputs Tristate outputs I/O sinking and Sourcing, PLD's, Watchdog Timers, Hardware design and development.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Microcontroller families and classifications (8-bit, 16-bit, 32-bit), 8051 Microcontroller, AVR Microcontroller, Features of ATmega328 used in Arduino, PIC Microcontrollers, ARM Cortex-M Series (e.g., STM32), ESP32 / ESP8266 (Wi-Fi-enabled microcontrollers), Programming via Arduino IDE and ESP-IDF.	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Introduction to Microcontrollers and Microprocessors, Embedded versus external memory devices, CISC and RISC processors, Harvard and Von Neumann Architectures.	05	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	8051 Microcontrollers-Assembly language, architecture, registers, Addressing modes, Instruction set, I/O ports and memory organization Interrupts Timer/counter and serial communication.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-5	Module-5	RTOS-Tasks, states, Data, Semaphores and shared data, Operating system services, Message queues, Mailboxes. Advanced Processor-(only architectures) 80386, 80486 and ARM (References)	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-6	Module-6	Communication basics, Microprocessor	10	PO2/ PO4/	PSO1/ PSO2/..



	Interfacing I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel protocols and wireless protocols. Real world Interfacing: LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Key board, Latch Interconnection, PPI.		PO5	
Total No. of Hours		40		

Learning Outcomes:	After completing this course, the student will be able to 11. Explain the fundamentals of embedded systems and their applications in real-world scenarios. 12. Develop basic embedded programs using 8051, AVR (ATmega328), PIC, ARM Cortex-M, and ESP32/ESP8266 microcontrollers. 13. Describe the structure and functions of a Real-Time Operating System (RTOS), including tasks, semaphores, shared data, queues, and mailboxes. 14. Compare serial, parallel, and wireless communication protocols for use in embedded applications. 15. Interface real-world devices (LCD, stepper motors, ADC/DAC, LEDs, push buttons, keyboards) with microcontrollers.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Muhammad Ali Mazidi and Janice Gillispie " <i>The 8051 Microcontroller and embedded systems</i> " ISBN: 978-0131194021	1999
2.	Tony Givargis Frank Vahid " <i>Embedded System Design: A Unified Hardware / Software Introduction</i> ", IV, McGraw-Hill, ISBN-9780071371766	2006
3.	Kenneth Hintz, Daniel Tabak " <i>Microcontrollers (Architecture, Implementation & Programming)</i> " Tata McGraw-Hill,	2005
4.	Sampath Kr " <i>Microcontrollers & Embedded Systems 2nd Edition</i> " KatsonBooks	206

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	Y	Y	Y
PO2	Y	Y	N	Y	Y
PO3	Y	N	Y	Y	Y
PO4	N	Y	N	N	Y
PO5	Y	N	Y	Y	Y
PO6	Y	Y	N	Y	Y
PO7	N	N	N	N	Y
PO8	Y	Y	N	Y	Y
PO9	Y	N	Y	N	Y
PO10	Y	Y	N	Y	Y
PO11	Y	N	N	Y	Y
PO12	Y	Y	N	Y	Y

Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
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PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N

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Course Code: MET-PE 103**Course Name: Advanced Mathematics for Engineers**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	Engineering Mathematics
Objectives:	16. Learn distinct methods of solving simultaneous equations. 17. Well-versed with partial differential equations and their solutions and applications. 18. Acquire the knowledge of transformation to ease the complex problems. 19. Acquaintance with basics of random variables and their distribution for dealing with events by chance. 20. Study different mathematical domains to deal with real-time engineering problems.
Course Coordinator	Dr. Vivek Goel

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Probability and Random Processes, Probability spaces and Bayes theorem, Random variables and expectation, Common distributions (Gaussian, Exponential, Poisson, etc.), Random processes: stationarity, autocorrelation, and power spectral density, Noise models in communication systems Markov processes and applications, Parameter Estimation, Testing of Hypothesis, Goodness of Fit	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Linear Algebra and Matrix Theory, Vector spaces, basis, and dimension, Inner product spaces and orthogonality, Eigenvalues and eigenvectors, Diagonalization and Jordan canonical form, Singular value decomposition (SVD), Applications to signal processing and MIMO systems.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Graph Theory : Formal definition; Subgraphs, Walk, Path, Hamiltonian path, Cycle, Euler graph, Planar graph, Tree: Binary tree, Spanning tree, Fundamental circuits: Cutsets, Tie sets, Shortest path, Minimal spanning tree, Algorithms	05	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Complex Analysis and Transforms, Analytic functions, Cauchy-Riemann equations, Contour integration and Cauchy's theorem, Residue theorem and applications, Laplace transform and inverse, Fourier series and Fourier transform, Z-transform for discrete systems	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Numerical Methods : Solution of matrix equation by generalised inverse technique, Numerical evaluation of determinant; Computation of eigenvalues and eigenvectors, Matrix inversion by partitioning; Optimisation technique by conjugate gradient method and method of steepest descent	06		

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UNIT-6	Module-6	Fast-Fourier Transformation (FFT) algorithms; FFT of real functions; Convolution; correlation and auto-correlation using FET, STFT, Wavelet	08	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 16. Comprehend with engineering problems in different mathematical realm. 17. Learn analytical and numerical methods to deal with mathematical problems. 18. Understand how to model the engineering problems and their solutions. 19. Implement the solutions to real-time complex engineering problems. 20. Apprehend with mathematical methodology.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 10th edition, 2011.	2011
2.	R. K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 5th edition, 2016.	2016
3.	Gilbert Strang, Linear Algebra, Cengage learning, 4th edition, 2006.	2006
5.	David Poole, Linear Algebra A Modern Introduction, Thomson, 4th edition, 2019.	2019

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N

Course Code: MET-PE 104

Course Name: ANALOG AND DIGITAL CMOS VLSI DESIGN

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit :3
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Prerequisites:	Semiconductor Devices, Analog Electronics, Digital Circuits
Objectives:	1. To understand MOS transistor operation and modeling. 2. To design and analyze CMOS analog building blocks (amplifiers, current mirrors, etc.). 3. To explore digital CMOS design styles and combinational/sequential circuits. 4. To apply layout, design rules, and parasitic estimation principles. 5. To evaluate performance metrics such as speed, power, and noise in CMOS circuits.
Course Coordinator	Mr. Gorav Malik

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	MOS Transistor Theory: Threshold voltage, I-V characteristics, second-order effects, body effect, short-channel effects, CMOS technology basics.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Analog CMOS Design: Current mirrors, differential amplifiers, gain stages, output stages, biasing techniques, frequency response.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Digital CMOS Design: Static CMOS logic, pass-transistor logic, transmission gates, sizing, dynamic logic, domino logic, noise margins.	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Combinational and Sequential Building Blocks: Latches, flip-flops, SRAM cells, timing analysis, setup/hold time, metastability.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-5	Module-5	Layout and Parasitics: Layout design rules, stick diagrams, Euler paths, estimation of delay and capacitance, interconnect modeling.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-6	Module-6	Performance and Design Considerations: Power-delay trade-offs, sizing for speed, power estimation, low-noise design, mixed-signal layout issues.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 1. Analyze and model MOS transistors for analog and digital operations. 2. Design basic analog circuits such as amplifiers and current mirrors in CMOS. 3. Implement digital CMOS logic with optimized sizing and logic style. 4. Evaluate the performance of combinational and sequential CMOS blocks. 5. Apply layout, parasitic estimation, and performance tuning in practical VLSI designs.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Weste, Neil H.E., and Harris, David, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson Education, ISBN: 978-0321547743	2010

2.	Razavi, Behzad, " <i>Design of Analog CMOS Integrated Circuits</i> ", 1st Edition, McGraw-Hill, ISBN: 978-0072380322	2001
3.	Rabaey, Jan M., " <i>Digital Integrated Circuits: A Design Perspective</i> ", 2nd Edition, Pearson Education, ISBN: 978-0130909961	2003
4.	Baker, R. Jacob, " <i>CMOS: Circuit Design, Layout, and Simulation</i> ", 3rd Edition, Wiley, ISBN: 978-0470881323	2010
5.	Pucknell, D.A., and Eshraghian, Kamran, " <i>Basic VLSI Design</i> ", 3rd Edition, PHI, ISBN: 978-8120309863	1994

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	Y	Y	Y	Y
PO5	N	N	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	Y	Y	Y	Y
PSO4	Y	Y	Y	Y	Y

Course Code: MET-PE 105

Course Name: COGNITIVE RADIOS

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Wireless Communication
Objectives:	1. Understand the principles and implementation of filter banks, discrete multitone modulation, and wavelet transforms for signal processing in cognitive radio systems. 2. Gain knowledge of digital frequency synthesis using DDS and computation techniques like CORDIC for efficient signal processing. 3. Analyze and design software-defined radio (SDR) systems, including digital down converters, demodulators, CIC filters, and under-sampling techniques. 4. Comprehend the fundamentals of cognitive radio technology, its architecture, cognitive engine design, and the role of SDR in enabling cognitive capabilities. 5. Explore the operation of OFDM-based cognitive radio systems, including spectrum sensing, MIMO-OFDM systems, synchronization techniques, and advanced multi-band communication strategies.
Course Coordinator	Mr. Amrish

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Filter banks-uniform filter bank. direct and DFT approaches. Introduction to ADSL Modem. Discrete multitone modulation and its realization using DFT. QMF.STFT.Computation of DWT using filter banks.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	DDFS- ROM LUT approach. Spurious signals, jitter. Computation of special functions using CORDIC. Vector and rotation mode of CORDIC.CORDIC architectures.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Block diagram of a software radio. Digital down converters and demodulators Universal modulator and demodulator using CORDIC. Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS. Down conversion using discrete Hilbert transform. Under sampling receivers, Coherent demodulation schemes.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Concept of Cognitive Radio, Benefits of Using SDR, Problems Faced by SDR, Cognitive Networks,Cognitive	05	PO1/ PO2/ PO3	PSO1/ PSO2/..

		Radio Architecture. Cognitive Radio Design, Cognitive Engine Design.			
UNIT-5	Module-5	A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO channel estimation, Multi-band OFDM, MIMO-OFDM synchronization and frequency offset estimation.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Spectrum Sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	1. Describe the working principles of filter banks, discrete multitone modulation, and wavelet transform techniques for communication systems. 2. Demonstrate the design and implementation of digital frequency synthesizers using DDS and analyze spurious effects and jitter. 3. Implement special mathematical functions using CORDIC algorithms and understand various CORDIC architectures. 4. Explain the architecture of software-defined radios and design digital modulation/demodulation systems using components like CIC filters and RNS-based filters. 5. Analyze and differentiate coherent and incoherent demodulation schemes, including discrete Hilbert transforms and under-sampling techniques. 6. Understand the architecture and components of cognitive radios and cognitive engines, and evaluate the challenges and advantages of SDR-based cognitive systems.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering", Pearson Education, New Jersey, 2002, ISBN-9780130422323.	2002
2.	Ulrich Meyer-Baese, "Digital Signal Processing with Field Programmable Gate Arrays", 2nd Edition, Springer, Berlin, 2004, ISBN-9783540208051.	2004
3.	Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, New York, 2007, ISBN-9781402066285.	2007

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	N	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N

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Course Code: MET-PE 106

Course Name: RF and Microwave Circuit Design

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Antenna Theory
Objectives:	1. Understand the behavior and analysis of RF and microwave transmission lines and components. (<i>Understanding</i>) 2. Analyze and design matching networks, filters, and amplifiers for RF applications. (<i>Analyzing</i>) 3. Apply S-parameter techniques and impedance matching strategies to high-frequency circuit design. (<i>Applying</i>) 4. Evaluate the performance of RF circuits such as oscillators, mixers, and low-noise amplifiers (LNAs). (<i>Evaluating</i>) 5. Develop skills in CAD tools and RF measurement techniques to model, simulate, and test microwave circuits. (<i>Creating / Applying</i>)
Course Coordinator	Dr. Vipul Sharma

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Transmission Line Theory and Components: Review of transmission lines, waveguides, and distributed elements, Smith Chart: reflection coefficient, VSWR, return loss, Impedance transformation and quarter-wave transformers, Microstrip line design and implementation.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	S-Parameters and Network Analysis: Definition and properties of S-parameters, Signal flow graph analysis, Multi-port network theory, Interconnection of networks and stability conditions.	05	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Impedance Matching and Coupling Techniques: L-section, π and T matching networks, Stub matching (single and double), Use of Smith Chart for design, Power dividers, directional couplers, and hybrid junctions.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	RF Filters, Amplifiers and Oscillators: RF/microwave filters:	07	PO1/ PO2/	PSO1/ PSO2/..

		Butterworth, Chebyshev design, Stability analysis and gain-bandwidth considerations, Low-noise amplifier (LNA) design, Oscillator principles: negative resistance and feedback type.		PO3	
UNIT-5	Module-5	Mixers and Nonlinear Circuit Elements: Mixer fundamentals and types (diode and FET-based), Conversion loss, isolation, and intermodulation distortion, Diode and transistor modeling at RF/microwave frequencies, Nonlinearities and linearization techniques.	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	CAD and Measurement Techniques: RF circuit design using simulation tools (ADS, HFSS, CST), RF layout and parasitic effects, Network analyzer, spectrum analyzer, and signal generator usage, Practical design issues and measurement case studies.	09	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	1. Explain the concepts of transmission lines and waveguides used in RF circuits. <i>(Understanding)</i> 2. Analyze the scattering parameters and reflection coefficients in multi-port RF networks. <i>(Analyzing)</i> 3. Design impedance matching networks using Smith Chart and analytical techniques. <i>(Creating)</i> 4. Apply design procedures for filters, amplifiers, and oscillators in microwave frequency ranges. <i>(Applying)</i> 5. Evaluate circuit performance using S-parameters and gain stability techniques. <i>(Evaluating)</i> 6. Demonstrate proficiency in using RF circuit simulation tools and laboratory instrumentation. <i>(Applying)</i>
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Reinhold Ludwig and Pavel Bretchko, "RF Circuit Design: Theory and Applications", 2nd Edition, Pearson Education, New Jersey, 2008, ISBN-9780131471375.	2008
2.	David M. Pozar, "Microwave Engineering", 4th Edition, Wiley, New York, 2012, ISBN-9780470631553.	2012
3.	Guillermo Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", 2nd Edition, Prentice Hall, New Jersey, 1996, ISBN-9780132543354.	1996
4.	Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", 2nd Edition, Cambridge University Press, Cambridge, 2004, ISBN-9780521835398.	2004
5.	Ulrich L. Rohde and David P. Newkirk, "RF/Microwave Circuit Design for Wireless Applications", 2nd Edition, Wiley-Interscience, New Jersey, 2000, ISBN-9780470389621.	2000



	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	N	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N

Course Code: MET-PE 107**Course Name: Soft Computing**

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Mathematics
Objectives:	21. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate techniques for a given scenario. 22. To implement soft computing based solutions for real-world problems. 23. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms. 24. To provide students with hand-on experience on MATLAB to implement various strategies.
Course Coordinator	Mr. Sanjay Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence : Machine Learning Basics.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Matlab/Python Lib: Introduction to Matlab / Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Recent Trends in deep learning, various classifiers, neural networks and genetic algorithms. Implementation of recently proposed soft computing techniques	06		
Total No. of Hours			35		

Learning Outcomes:	After completing this course, the student will be able to 21. Identify and describe soft computing techniques and their roles in building intelligent machines. 22. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. 23. Apply genetic algorithms to combinatorial optimization problems. 24. Evaluate and compare solutions by various soft computing approaches for a given problem.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.	2003
2.	George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.	1995
3.	MATLAB Toolkit Manual	

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N

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Course Code: MET-PE 108

Course Name: LOW POWER VLSI DESIGN

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit :3
3 1 0	

Prerequisites:	Digital Electronics, CMOS VLSI Design
Objectives:	1. To understand the sources of power dissipation in VLSI circuits. 2. To explore transistor, gate, and architecture-level low power techniques. 3. To learn about energy-efficient circuit design, modelling and analysis. 4. To apply power optimization methods during synthesis and physical design. 5. To study recent low power design methodologies and FPGA/ASIC implementations.
Course Coordinator	Mr. Prateek Agarwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to Low Power VLSI: Need for low power design, power dissipation sources (dynamic, short-circuit, leakage), impact of technology scaling, power estimation techniques.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Low Power Circuit Techniques: Transistor sizing, voltage scaling, threshold voltage control, subthreshold design, MTCMOS, power gating, body biasing, clock gating.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Combinational and Sequential Circuit Optimization: Logic level power optimization, glitch reduction, pipelining, latching techniques, latch vs flip-flop design, switching activity reduction.	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Memory and Interconnect Power Management: Low power SRAM and DRAM design, CAMs, sense amplifiers, interconnect modeling, bus encoding techniques, clock distribution networks.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-5	Module-5	Design Methodologies and Tools for Low Power: Power analysis at RTL and gate level, low power synthesis techniques, floor planning, power-aware placement and routing, leakage minimization in physical design.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-6	Module-6	Advanced Topics and Case Studies: Power reduction in FPGA vs ASIC, dynamic voltage/frequency scaling (DVFS), near-threshold computing, real-world low power design case studies in mobile, IoT, and edge devices.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to: 1. Identify sources of power dissipation and apply power estimation techniques. 2. Use circuit and logic-level techniques for low power design. 3. Analyze and design power-optimized sequential and combinational circuits. 4. Implement low power memory and interconnect architectures. 5. Apply EDA tools for low power synthesis and perform real-time power analysis.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Roy, Kaushik, and Prasad, Sharat C., " <i>Low Power CMOS VLSI Circuit Design</i> ", 1st Edition, Wiley, ISBN: 978-0471333654	2000
2.	Yeap, Gary K., " <i>Practical Low Power Digital VLSI Design</i> ", 1st Edition, Springer, ISBN: 978-0792398462	1997
3.	Rabaey, Jan M., " <i>Digital Integrated Circuits: A Design Perspective</i> ", 2nd Edition, Pearson Education, ISBN: 978-0130909961	2003
4.	Rabaey, Jan M., and Pedram, Massoud, " <i>Low Power Design Methodologies</i> ", 1st Edition, Springer, ISBN: 978-1461371261	1996
5.	Kang, Sung-Mo, and Leblebici, Yusuf, " <i>CMOS Digital Integrated Circuits: Analysis and Design</i> ", 4th Edition, McGraw-Hill, ISBN: 978-0073380628	2011

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	Y	Y	Y	Y
PO5	N	N	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	Y	Y	Y	Y
PSO4	Y	Y	Y	Y	Y







Course Code: MET-C201**Course Name: Antennas and Communication Systems**

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Basic Communication Theory
Objectives:	1. Understand the fundamental principles of antennas and electromagnetic radiation. (<i>Understanding</i>) 2. Analyze the design and performance of various antennas used in communication systems. (<i>Analyzing</i>) 3. Apply antenna theory to modern wireless systems including satellite, radar, and 5G. (<i>Applying</i>) 4. Evaluate communication system performance using link budgets and system-level analysis. (<i>Evaluating</i>) 5. Design and simulate antenna structures using modern electromagnetic tools. (<i>Creating</i>)
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Fundamentals of Antennas: Electromagnetic radiation principles, Radiation fields and power density, Antenna parameters: gain, directivity, efficiency, beamwidth, polarization, Impedance and bandwidth concepts.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Wire and Aperture Antennas: Dipole, monopole, loop, and helical antennas, Slot and horn antennas, Reflector antennas: parabolic reflectors and feeds, Radiation resistance and efficiency calculations.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Antenna Arrays: Array factor and pattern multiplication, Uniform linear arrays: broadside and end-fire arrays, Array synthesis: Binomial, Dolph-Chebyshev techniques, Mutual coupling and beam steering.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Microstrip and Broadband Antennas: Microstrip patch antennas: design and analysis, Feeding methods: inset, coaxial, proximity, Bandwidth enhancement techniques, Log-periodic, Yagi-Uda,	05	PO1/ PO2/ PO3	PSO1/ PSO2/..



		spiral and fractal antennas.			
UNIT-5	Module-5	Communication System Fundamentals: System model: transmitter, channel, receiver, Modulation schemes: analog and digital, Noise in communication systems: SNR, BER, Link budget analysis: free-space loss, antenna gains, noise figure.	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Advanced Antenna Applications and Measurements, Antennas for radar, satellite, and mobile communications, MIMO and smart antennas in 4G/5G systems, Antenna testing and measurement techniques: anechoic chambers, pattern plotting, Antenna simulation tools: HFSS, CST, IE3D, FEKO.	09	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	1. Explain the basic concepts of radiation, antenna parameters, and electromagnetic wave propagation. (<i>Understanding</i>) 2. Analyze the radiation characteristics of wire antennas, arrays, and aperture antennas. (<i>Analyzing</i>) 3. Design antennas such as dipoles, microstrip patches, and reflectors for specific applications. (<i>Creating</i>) 4. Evaluate the performance of antennas using gain, efficiency, directivity, and bandwidth metrics. (<i>Evaluating</i>) 5. Apply communication system concepts to link design including noise, modulation, and propagation effects. (<i>Applying</i>) 6. Demonstrate the use of antenna measurement systems and simulation tools. (<i>Applying</i>)
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	John G. Proakis and Masoud Salehi, "Digital Communications", 5th Edition, McGraw-Hill Education, New York, 2007, ISBN-9780072957167.	2007
2.	Simon Haykin, "Communication Systems", 5th Edition, Wiley India Pvt. Ltd., New Delhi, 2013, ISBN-9788126554232.	2013
3.	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, New York, 2005, ISBN-9780521845274.	2005
4.	Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, New Delhi, 2010, ISBN-9788131701805.	2010
5.	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, Cambridge, 2005, ISBN-9780521837163.	2005
6.	Robert G. Gallager, "Information Theory and Reliable Communication", Wiley, New York, 1968, ISBN-9780471290483.	1968

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	N	Y

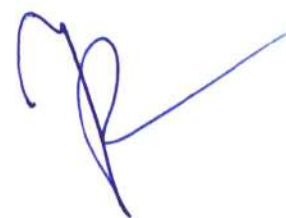


PO2	Y	Y	Y	Y	Y
PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N







Course Code: MET-C202**Course Name: Advance Digital Signal Processing**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	Signal and system
Objectives:	25. Introduce the fundamentals of DSP. 26. Develop proficiency in digital filter design. 27. Explain multirate DSP techniques 28. Students will know linear prediction and optimum filter design, 29. Explore advanced topics and applications
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction..	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm,	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation. Application of	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications	04	PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 25. To understand theory of different filters and algorithms
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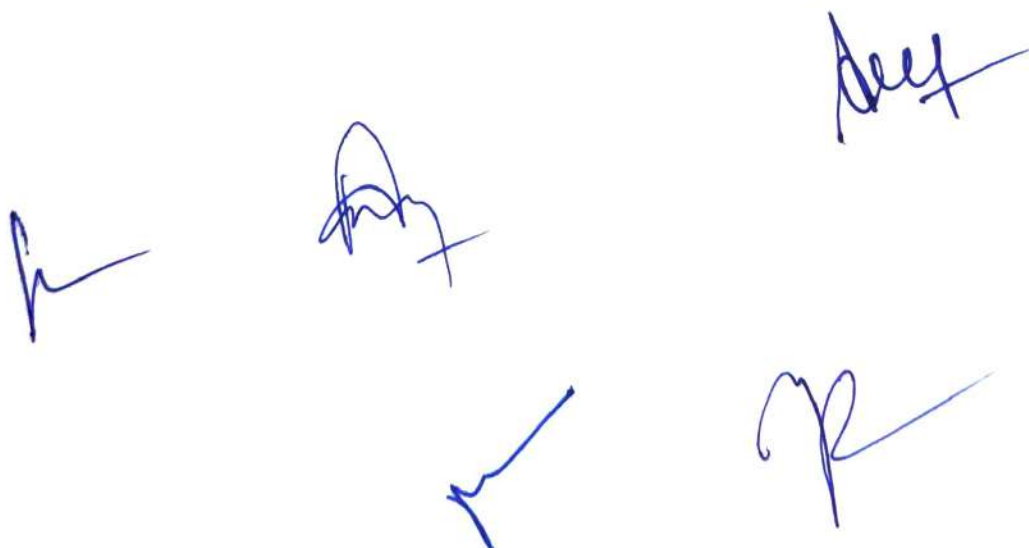
	26. To understand theory of multirate DSP, solve numerical problems and write algorithms
	27. To understand theory of prediction and solution of normal equations
	28. To know applications of DSP at block level.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.	2007.
2.	N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.	1999
3.	M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.	2002
5.	D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.	2000

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N



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Course Code: MET-A201**Course Name: ENGLISH FOR RESEARCH PAPER WRITING**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 1
3 1 0	

Prerequisites:	ENGLISH
Objectives:	30. Understand that how to improve your writing skills and level of readability 31. Learn about what to write in each section 32. Understand the skills needed when writing a Title 33. Ensure the good quality of paper at very first-time submission
Course Coordinator	Dr. Prasant Kaushik

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	04	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	04	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	04	PO1/ PO2/ PO3	PSO1/ PSO2/..
Total No. of Hours			24		

Learning Outcomes:	After completing this course, the student will be able to 29. Plan and structure academic writing clearly and concisely. 30. Clarify authorship, highlight findings, and avoid plagiarism. 31. Write all major sections of a research paper effectively. 32. Develop strong Titles, Abstracts, and Introductions. 33. Apply skills to write Methods, Results, and Conclusions. 34. Use phrases and editing strategies for quality submissions.
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Suggested books:

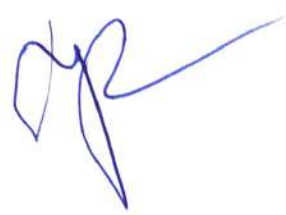
S.	Name of Authors /Books /Publisher	Year of
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No.		Publication
1.	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)	
2.	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press	2006
3.	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .	1998
4.	Adrian Wallwork . English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011	2011

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N




Course Code: MET-C211**Course Name: Microwave Systems lab****MM : 100****Time : 2Hr****L T P****0 0 2****Sessional : 30****ESE : 70****Credit : 2**

Prerequisites:	Basic EM Theory
Objectives:	1. Understand the practical aspects of microwave measurement and circuit design. 2. Perform S-parameter analysis and impedance matching using tools and instruments. 3. Design and simulate microwave components using CAD tools. 4. Gain hands-on experience with microwave test benches, antennas, and high-frequency amplifiers. 5. Integrate theoretical knowledge with hardware implementation and validation.
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE:	Student can Choose any 8 Experiment.
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	EXP	Course Content Using MATLAB/SCILAB & DSK kit	No. of Hours	POs mapped	PSOs mapped
	1	Measurement of VSWR, reflection coefficient, and return loss using microwave bench.	2		
	2	Calibration and use of Vector Network Analyzer (VNA) for S-parameter measurements.	2		
	3	Characterization of directional couplers and isolators.	2		
	4	Determination of attenuation using fixed and variable attenuators.	2		
	5	Design and testing of impedance matching networks using Smith Chart.	2		
	6	Design and simulation of microstrip transmission lines and stubs (quarter-wave, open/short).	2		
	7	Design and realization of low-pass, high-pass, and band-pass microwave filters.	2		
	8	Measurement of insertion loss and isolation of circulators.	2		
	9	Design and simulation of a single-stage low-noise amplifier (LNA) using CAD tools.	2		
	10	Design of power dividers and hybrid couplers (Wilkinson, 90° hybrid).	2		
	11	Measurement of gain and noise figure of an RF amplifier.	2		
	12	Design and simulation of a microwave oscillator.	2		
			24		

Learning Outcomes:	On the completion of this laboratory course, the students will be able to have hands on experience on, 1. Measure key microwave parameters using VNA and test benches. <i>(Applying)</i>
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	2. Design impedance matching circuits using Smith Chart and practical components. <i>(Creating)</i> 3. Simulate microwave circuits (filters, amplifiers) using RF simulation tools. <i>(Applying)</i> 4. Analyze S-parameters of passive and active microwave components. <i>(Analyzing)</i> 5. Implement RF layouts and identify performance-limiting parasitics. <i>(Creating / Evaluating)</i>
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Course Code: MET-C212**Course Name: VLSI Design Verification and Testing Lab****MM : 100****Time : 2Hr****L T P****0 0 2****Sessional : 30****ESE : 70****Credit : 2**

Prerequisites:	Digital VLSI Design basics, HDL (Verilog/VHDL), Fundamentals of testing and verification.
Objectives:	1. To understand the fundamentals of functional verification for digital VLSI systems. 2. To write testbenches and perform simulation using HDL tools. 3. To apply constrained random verification and assertion-based verification techniques. 4. To explore advanced verification methodologies such as UVM. 5. To study fault modeling, ATPG, and fault simulation for testability. 6. To analyze scan chains, BIST structures, and DFT strategies used in chip testing.
Course Coordinator	Mr. Prateek Agarwal

NOTE:	Student can Choose any 8 Experiment.
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EXP	Course Content (Open-Source Tools like LT Spice, NG Spice)	No. of Hours	POs mapped	PSOs mapped
1	Introduction to Verilog/VHDL testbench: waveform debugging and stimulus generation.	2		
2	Functional verification of combinational circuits using self-checking testbenches.	2		
3	Verification of sequential circuits: counters, FSMs using directed and random testing.	2		
4	Assertion-Based Verification (ABV) using SystemVerilog assertions.	2		
5	Constrained Random Verification (CRV) using SystemVerilog: class-based testbench.	2		
6	Introduction to UVM: building basic UVM testbench components (driver, monitor, scoreboard).	2		
7	Code coverage and functional coverage analysis for HDL designs.	2		
8	Fault modeling and fault simulation (stuck-at, bridging faults).	2		
9	ATPG pattern generation using D-algorithm / PODEM / Tool-based ATPG.	2		
10	Scan chain design, insertion, and simulation of scan operations.	2		
11	BIST (LFSR & MISR) design and verification for digital circuits.	2		
12	Study and implementation of Design-for-Testability (DFT) techniques.	2		
		24		

Learning Outcomes:	On completion of this laboratory course, the students will be able to: 1. Develop testbenches and verify HDL designs using simulation tools. (Applying /
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	<i>Analyzing</i>) 2. Apply constrained random and assertion-based verification techniques. (<i>Analyzing / Creating</i>) 3. Use UVM methodology for advanced verification environments. (<i>Creating / Evaluating</i>) 4. Perform fault modeling, ATPG, BIST, and DFT analysis. (<i>Understanding / Applying</i>) 5. Evaluate design quality through coverage metrics and fault simulation. (<i>Evaluating / Applying</i>)
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Course Code: MET-C213



Course Code: MET-C213

Course Name: Advance Digital Signal Processing Lab

MM : 100

Time : 2Hr

L T P

0 0 2

Sessional : 30

ESE : 70

Credit : 2

Prerequisites:	Basic Programming , DSP theory
Objectives:	34. To implement Linear and Circular Convolution 35. To implement FIR and IIR filters 36. To study the architecture of DSP processor. 37. To study the PSD
Course Coordinator	Dr. Gorav Malik

NOTE:	Student can Choose any 8 Experiment.
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EXP	Course Content Using MATLABSCILAB & DSK kit	No. of Hours	POs mapped	PSOs mapped
1	Generate various fundamental discrete time signals.	2		
2	Basic operations on signals (Multiplication, Folding, Scaling).	2		
3	Find out the DFT & IDFT of a given sequence.	2		
4	Interpolation & decimation of a given sequence.	2		
5	Generation of DTMF (Dual Tone Multiple Frequency) signals.	2		
6	Estimate the PSD of a noisy signal using periodogram and modified periodogram.	2		
7	To design FIR filters	2		
8	Design of Chebychev Type I,II Filters.	2		
9	Digital IIR Filter Realization.	2		
10	Parallel Realization of IIR filter.	2		
11	Estimation of power spectrum using parametric methods	2		
12	Time-Frequency Analysis with the Continuous Wavelet Transform.	2		
		24		

Learning Outcomes:	On the completion of this laboratory course, the students will be able to have hands on experience on, • Filter design. • Filter Realization • Signal Manipulations • Wavelet Transforms • Estimating PSD using various techniques
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Course Code: MET-C214**Course Name: RTL Simulation and Synthesis with PLDs Lab**

MM : 100
 Time : 2Hr
 L T P
 0 0 2

Sessional : 30
 ESE : 70
 Credit : 2

Prerequisites:	Digital Logic Design, Basic HDL Programming
Objectives:	1. To design and simulate digital circuits using Verilog/VHDL. 2. To synthesize RTL models using EDA tools. 3. To verify logic and timing of synthesized designs. 4. To implement digital designs on FPGA/CPLD boards.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	Student can Choose any 8 Experiment.
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	EXP	Course Content	Tools Used	No. of Hours	POs mapped	PSOs mapped
	1	Design and simulate basic logic gates and multiplexers in Verilog/VHDL	ModelSim/Vivado	2		
	2	Design and simulate 4-bit adder/subtractor using structural modeling	Vivado/Quartus	2		
	3	Write and simulate a 4-bit synchronous counter	ModelSim	2		
	4	RTL modeling of Mealy and Moore Finite State Machines	Vivado/ModelSim	2		
	5	Synthesize a 4x4 multiplier using behavioral modeling	Vivado	2		
	6	Perform logic synthesis and analyze area, delay and power using synthesis tools	Vivado/Synplify	2		
	7	Map and implement an HDL design on FPGA/CPLD development board	Spartan-6/Artix-7/MAX V	2		
	8	Implement clock divider and PWM generator on FPGA	Vivado/Quartus	2		
	9	Design and simulate simple memory modules: ROM, RAM	Vivado	2		
	10	Realize a UART design with Verilog and test on FPGA	Vivado/ModelSim	2		
	11	Study and apply power optimization techniques at RTL level	Vivado Power Analyzer	2		
	12	Mini project: Design and implement a digital system (e.g., calculator, traffic light controller)	FPGA Board	2		
				24		

Learning Outcomes:	On the completion of this laboratory course, the students will be able to have hands on experience on: • Design and simulate digital systems at RTL level. • Synthesize and optimize HDL code for area, delay, and power. • Realize and verify designs on PLD hardware.
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	• Understand synthesis constraints and timing analysis. • Gain exposure to industry-standard FPGA design tools.
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Course Code: MET-PE 201

Course Name: SATELLITE COMMUNICATION

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 0 0	

Prerequisites:	Basic Communication Theory
Objectives:	1. Understand the fundamentals of satellite communication, including orbital mechanics, launch systems, and geostationary orbits. (<i>Understanding</i>) 2. Analyze satellite subsystems and link design parameters for effective satellite communication. (<i>Analyzing</i>) 3. Apply modulation, multiplexing, and multiple access techniques in satellite communication systems. (<i>Applying</i>) 4. Evaluate error control mechanisms and assess the effects of propagation on satellite links. (<i>Evaluating</i>) 5. Explore modern satellite systems and applications including VSAT, GNSS, DBS, and LEO systems. (<i>Remembering / Understanding / Applying</i>)
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Elements of Satellite Communication, Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.	05	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna, satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.	09	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access: FDMA, TDMA, DAMA and CDMA.	05	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Error control for digital satellite links: error detection and correction, channel capacity, error control coding,	07	PO1/ PO2/ PO3	PSO1/ PSO2/..

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		convolutional codes, linear and cyclic block codes.			
UNIT-5	Module-5	Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems. Pseudo-satellite, brief about satellite pay loads.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

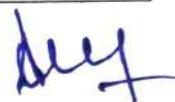
Learning Outcomes:	1. Describe the principles of orbital mechanics, orbit types, look angles, and launch systems for satellite deployment. (<i>Understanding</i>) 2. Explain various satellite subsystems including attitude control, TTC&M, communication systems, and antennas. (<i>Understanding</i>) 3. Design uplink and downlink communication links based on transmission theory, noise temperature, and C/N ratio. (<i>Creating</i>) 4. Apply analog and digital modulation schemes as well as multiple access techniques like TDMA, FDMA, and CDMA. (<i>Applying</i>) 5. Analyze the performance of satellite links under various propagation conditions including rain attenuation and depolarization. (<i>Analyzing</i>) 6. Evaluate error correction coding techniques and their impact on digital satellite communication reliability. (<i>Evaluating</i>)
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Timothy Pratt, Charles Bostian, and Jeremy Allnutt, "Satellite Communications", 2nd Edition, John Wiley & Sons, New York, 2003, ISBN	2003
2.	Dennis Roddy, "Satellite Communications", 4th Edition, McGraw-Hill, New York, 2006, ISBN-9780071462983.	2006
3.	Tri T. Ha, "Digital Satellite Communications", 2nd Edition, McGraw-Hill, New York, 1990, ISBN-9780070252349.	1990

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	N	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N



Course Code: MET-PE 202**Course Name: Internet of Things**

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Basic Electronics communication and networking
Objectives:	38. Able to understand the application areas of IOT. 39. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks. 40. Able to understand building blocks of Internet of Things and characteristics 41. Students conceptualize and develop IoT-based projects
Course Coordinator	Dr. Sanjay Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to the Internet of Things: What is IoT? History, evolution, and key characteristics of IoT. Applications of IoT: Exploring diverse applications across various industries (e.g., smart cities, healthcare, agriculture). Building Blocks of IoT Systems: Sensors, actuators, microcontrollers, communication modules. IoT Architectures: Layered architectures (perception, network, application, management)	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Hardware Platforms and Communication Technologies: Popular IoT Development Boards: Introduction to platforms like Arduino, Raspberry Pi, and ESP8266. Sensors and Actuators: Types of sensors (temperature, humidity, motion) and actuators (relays, motors, LEDs). Interfacing Sensors and Actuators: Connecting sensors and actuators to microcontroller boards. Wireless Communication Protocols: Wi-Fi, Bluetooth, Zigbee, LoRaWAN for IoT communication	08	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Data Acquisition, Processing, and Analytics : Data Acquisition Strategies: Techniques for collecting data from sensors in IoT devices. Data Storage and Management: Cloud platforms and databases for storing and managing IoT data. Data Processing Techniques: Stream processing, time-series analysis, data visualization for IoT data. Machine Learning for IoT: Introduction to using machine learning for anomaly detection and predictive maintenance in IoT applications.	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Security and Privacy in IoT: Security Challenges in IoT: Vulnerability to cyberattacks, data breaches, and privacy concerns. Authentication and Authorization: Implementing secure access control mechanisms for IoT devices. Data Security and Encryption: Techniques for securing data at rest, in transit, and in	06	PO1/ PO2/ PO3	PSO1/ PSO2/..

		use. Security Best Practices: Guidelines for secure development, deployment, and management of IoT devices			
UNIT-5	Module-5	Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor.	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Advanced Topics and Future of IoT: IoT Cloud Platforms: Exploring popular cloud platforms for developing and managing IoT applications. Edge Computing for IoT: Decentralized processing and decision-making at the edge of the network. Artificial Intelligence for IoT: Exploring the integration of AI techniques for advanced IoT functionalities. Emerging Trends in IoT: Discussing recent advancements and the future direction of IoT technology	04	PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			35		

Learning Outcomes:	After completing this course, the student will be able to 35. Understand the vision of IoT from a global context. 36. Determine the Market perspective of IoT. 37. Use of Devices, Gateways and Data Management in IoT. 38. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints. 39. Building state of the art architecture in IoT
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing	
2.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing	
3.	Cuno Pfister, Getting Started with the Internet of Things, Oreilly	2022
4.	Donald Norris, THE INTERNET OF THINGS	2020

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N



Course Code: MET-PE 203

Course Name: Machine Learning

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 1 0	

Prerequisites:	Mathematics ,AI..
Objectives:	42. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes. 43. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances. 44. Explore supervised and unsupervised learning paradigms of machine learning. 45. To explore Deep learning technique and various feature extraction strategies.
Course Coordinator	Dr. Atul Varshney

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naïve, Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)	05	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.	06	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.	05		
Total No. of Hours			35		

Learning Outcomes:	After completing this course, the student will be able to 40. Extract features that can be used for a particular machine learning approach in
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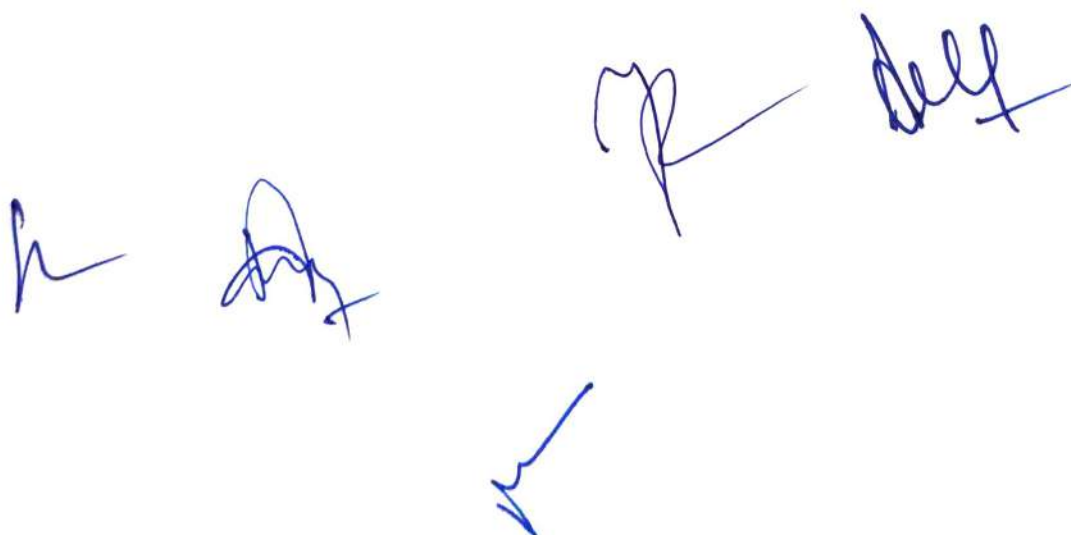
	various IOT applications. 41. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach. To study the design of Earth station and tracking of the satellites. 42. To mathematically analyse various machine learning approaches and paradigms. Students will be able to explain the key elements of robot cell design and identify potential applications of robots in various industries
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012	2012
2.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)	2009
3.	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.	2007

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N



Course Code: MET-PE 204**Course Name: VLSI Design Verification and Testing**

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit :3
3 1 0	

Prerequisites:	Digital Design, CMOS VLSI Design, HDL Programming
Objectives:	1. Understand the challenges and techniques for verifying complex VLSI systems. 2. Explore functional and formal verification methodologies. 3. Learn various fault models and test generation algorithms. 4. Apply Design for Testability (DFT), scan design, and BIST techniques. 5. Evaluate testing strategies and implement using modern CAD tools.
Course Coordinator	Dr. Prateek Agarwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to VLSI Testing and Verification: Importance of verification and testing, yield and defects, fault types (stuck-at, bridging, open, delay), fault modeling, observability and controllability, fault simulation basics.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Functional Verification and Simulation: Testbench architecture, directed vs constrained-random simulation, assertions (SystemVerilog), code and functional coverage, introduction to UVM methodology.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Design for Testability (DFT): Scan chain design, ATPG basics, boundary scan (JTAG IEEE 1149.1), test compression, insertion of test points, scan cell architecture, stuck-at and transition delay ATPG.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	BIST and Memory Testing: Built-In Self-Test for combinational and sequential logic, LFSR/MISR, signature analysis, aliasing, memory fault models (stuck-at, coupling), MARCH test algorithms, BIST for memory.	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-5	Module-5	Formal Verification and Equivalence Checking: Model checking, symbolic simulation, SAT/BDD-based equivalence checking, assertion-based verification, comparison with simulation-based techniques.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-6	Module-6	Post-Silicon Debug and Industry Practices: Scan diagnosis, layout-aware debugging, validation strategies, functional ECO flow, ATE, overview of industrial verification tools (VCS, JasperGold, Tessent, etc.).	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to:
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	1. Understand fault models and test generation principles. 2. Develop testbenches and simulation-based verification strategies. 3. Apply DFT techniques such as scan chains and boundary scan. 4. Design BIST architecture and perform memory testing. 5. Use formal verification tools and identify silicon-level faults. 6. Apply industry-grade EDA tools for VLSI testing and debug.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Abramovici, M., Breuer, M. A., and Friedman, A. D., " <i>Digital Systems Testing and Testable Design</i> ", 1st Edition, Springer, ISBN: 978-8181280911	1999
2.	Bushnell, M. L., and Agrawal, V. D., " <i>Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits</i> ", 1st Edition, Springer, ISBN: 978-0387950340	2006
3.	Spear, Chris, " <i>SystemVerilog for Verification: A Guide to Learning the Testbench Language Features</i> ", 1st Edition, Springer, ISBN: 978-0387275061	2005
4.	Hachtel, G. D., and Somenzi, F., " <i>Functional Verification of Digital Hardware: From Simulation to Formal Methods</i> ", 1st Edition, Springer, ISBN: 978-0387310045	2006

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	N	Y	N
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	Y	Y	N	Y
PO5	N	N	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	Y	Y	N	Y
PSO4	N	Y	Y	Y	Y

Course Code: MET-PE 205

Course Name: MIMO System

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit : 3
3 0 0	

Prerequisites:	Basic Antenna Theory
Objectives:	1. Understand the fundamental principles of MIMO systems and their role in modern wireless communications. (<i>Understanding</i>) 2. Analyze capacity, channel modeling, and spatial techniques used in MIMO environments. (<i>Analyzing</i>) 3. Apply beamforming, diversity, and precoding techniques for performance optimization in practical systems. (<i>Applying</i>) 4. Evaluate the performance of MIMO systems under real-world constraints such as fading and imperfect channel knowledge. (<i>Evaluating</i>) 5. Explore MIMO applications in standards such as LTE and 5G including massive MIMO and mmWave technologies. (<i>Understanding / Analyzing</i>)
Course Coordinator	Dr. Vipul Sharma

NOTE:	The question paper shall consist of two sections (Section A and Section B). Section A shall contain ten (10) short answer type questions of six (06) marks each and the student shall be required to attempt any five (05) questions. Section B shall contain eight (08) long answer-type questions of ten (10) marks each and the student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to MIMO Systems: Evolution of wireless communication and MIMO motivation, MIMO system model and types (SIMO, MISO, MIMO), Benefits: capacity, reliability, and spectral efficiency, Diversity techniques: time, frequency, and space diversity.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	MIMO Channel Modeling and Capacity: Fading channel models: Rayleigh, Rician, Channel correlation and keyhole effects, MIMO channel capacity: with and without channel state information (CSI), Capacity analysis under practical constraints, Water-filling algorithm.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Spatial Multiplexing and Space-Time Coding: Spatial multiplexing and trade-offs, V-BLAST architecture and detection methods (ZF, MMSE, SIC), Alamouti code and orthogonal space-time block codes (OSTBC), Channel estimation and detection strategies.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Beamforming and Precoding: Beamforming at the transmitter and receiver, Linear precoding: ZF, MMSE, SVD-based techniques, Codebook-based	07	PO1/ PO2/ PO3	PSO1/ PSO2/..

		feedback techniques, Hybrid beamforming for mmWave MIMO.			
UNIT-5	Module-5	Applications and Standard Implementations: MIMO in LTE and 5G NR, Massive MIMO: concept, challenges, and performance gains, MIMO in mmWave communication, Practical issues: channel estimation errors, pilot contamination, hardware constraints	05	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Emerging Topics and Research Trends in MIMO: Cell-free massive MIMO and coordinated multipoint (CoMP), Intelligent Reflecting Surfaces (IRS) and reconfigurable metasurfaces, Machine learning and AI techniques in MIMO systems, MIMO in 6G and terahertz communications, Open research challenges and testbeds	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	1. Explain the basic architecture and advantages of MIMO communication systems. <i>(Understanding)</i> 2. Analyze MIMO channel models such as Rayleigh and Rician fading channels. <i>(Analyzing)</i> 3. Compute MIMO channel capacity under various channel conditions and CSI assumptions. <i>(Applying)</i> 4. Apply spatial multiplexing, diversity, and OFDM techniques in MIMO frameworks. <i>(Applying)</i> 5. Design and evaluate beamforming and linear precoding methods like ZF and MMSE. <i>(Creating / Evaluating)</i> 6. Assess the performance of MIMO technologies in LTE, 5G, and Massive MIMO environments. <i>(Evaluating)</i>
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ezio Biglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, Arogyaswami Paulraj, and H. Vincent Poor, "MIMO Wireless Communications", Cambridge University Press, Cambridge, 2007, ISBN-9780521877688.	2007
2.	Arogyaswami Paulraj, Rohit Nabar, and Dhananjay Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, Cambridge, 2003, ISBN-9780521826150.	2003
3.	Claude Oestges and Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, London, 2010, ISBN-9780123850559.	2010
4.	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, New York, 2005, ISBN-9780521845274.	2005
5.	Robert G. Gallager, "Information Theory and Reliable Communication", Wiley, New York, 1968, ISBN-9780471290483.	1968

Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
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PO1	Y	Y	Y	N	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	N	N	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	N	Y
PO6	Y	N	Y	N	Y
PO7	Y	Y	N	Y	Y
PO8	N	Y	Y	N	Y
PO9	Y	Y	Y	Y	Y
PO10	Y	N	Y	N	Y
PO11	N	Y	Y	Y	Y
PO12	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	Y	Y	Y	Y	N







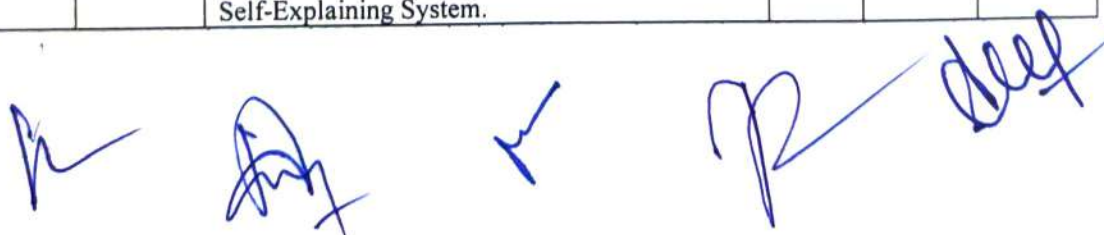

Course Code: MET-PE 206**Course Name: Artificial Intelligence**

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Mathematics, Machine Learning
Objectives:	1. To introduce the fundamental concepts, history, and scope of Artificial Intelligence (AI). 2. To develop an understanding of intelligent agents and their architecture. 3. To explore various problem-solving strategies including uninformed, informed, and adversarial search techniques. 4. To familiarize students with knowledge representation, logical reasoning, and uncertainty handling through probabilistic models. 5. To introduce machine learning approaches including supervised and unsupervised methods, and expert systems. 6. To provide insight into pattern recognition, perception, and the use of AI programming languages like LISP and PROLOG.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Processing.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Introduction to Search: Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Machine Learning: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models. Expert System: Existing Systems (DENDRAL, MYCIN) domain exploration Meta Knowledge, Self-Explaining System.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..



UNIT-5	Module-5	Pattern Recognition: Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine perception, Line Finding, Interception Semantic & Model, Object Identification, Speech Recognition. Programming Language Introduction to programming Language, LISP, PROLOG.	06	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	Classical planning, planning graphs, partial-order planning, hierarchical planning, Concepts, reward signals, Markov Decision Processes (MDPs), Q-learning, exploration vs. exploitation.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 1. Understand the fundamentals of Artificial Intelligence, its history, applications, and the structure of intelligent agents. 2. Apply various search algorithms including uninformed, informed, and adversarial strategies to solve AI problems. 3. Represent and reason with knowledge using propositional and first-order logic, and handle uncertainty with probabilistic models. 4. Analyze and implement basic machine learning techniques including decision trees, Naive Bayes, and clustering methods. 5. Demonstrate understanding of pattern recognition, machine perception, and the use of AI programming languages like LISP and PROLOG. 6. Evaluate advanced AI topics such as planning, reinforcement learning, multi-agent systems, and ethical implications of AI technologies.
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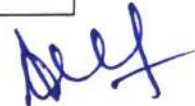
Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i>, Pearson Education, 3rd Edition, 2010	2010
2.	Elaine Rich, Kevin Knight, and Shivashankar B. Nair, <i>Artificial Intelligence</i>, McGraw Hill Education, 3rd Edition, 2008.	2008
3.	Nils J. Nilsson, <i>The Quest for Artificial Intelligence: A History of Ideas and Achievements</i>, Cambridge University Press, 2010.	2010
4.	Ethem Alpaydin, <i>Introduction to Machine Learning</i>, MIT Press, 3rd Edition, 2014.	2014
5	Christopher M. Bishop, <i>Pattern Recognition and Machine Learning</i>, Springer, 2006.	2006

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	N	N	Y	Y	Y
PO4	Y	Y	Y	N	Y
PO5	Y	Y	Y	Y	Y
PO6	Y	N	Y	Y	Y
PO7	N	Y	Y	N	Y
PO8	Y	Y	Y	Y	N

PO9	Y	Y	Y	Y	N
PO10	N	Y	Y	Y	N
PO11	Y	Y	N	Y	N
PO12	N	Y	Y	Y	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	N	N	Y	Y
PSO2	Y	Y	Y	N	Y
PSO3	Y	Y	N	N	N
PSO4	Y	N	N	N	Y



Course Code: MET-PE 207

Course Name: RTL Simulation and Synthesis with PLDs

MM: 100	Sessional: 30
Time: 3 Hr.	ESE: 70
L T P	Credit :3
3 1 0	

Prerequisites:	Digital Logic Design, VLSI Design, HDL (VHDL/Verilog) Basics
Objectives:	1. Understand the principles of Register Transfer Level (RTL) design. 2. Learn behavioral and structural modeling using VHDL/Verilog. 3. Gain proficiency in RTL simulation, testbenches, and debugging. 4. Explore synthesis process and constraints with PLDs (CPLDs, FPGAs). 5. Implement digital systems from HDL to hardware using simulation and synthesis tools.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	RTL Design Fundamentals: Introduction to RTL abstraction, hierarchy, dataflow, control path, clocking strategies, metastability, register balancing, timing issues	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	HDL Coding for RTL Design: Behavioral, dataflow, structural modeling, combinational and sequential circuits, FSM modeling, synthesizable vs. non-synthesizable constructs (Verilog/VHDL)	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Simulation & Testbenches: Writing testbenches, simulation models, event-driven simulation, functional verification, waveform analysis, code coverage	06	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Synthesis with PLDs: Synthesis flow, constraints, timing analysis, logic optimization, netlists, technology mapping, FPGA-specific optimizations	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-5	Module-5	Programmable Logic Devices: Architecture and features of PLDs (PAL, GAL, CPLD, FPGA), internal structure, logic blocks, interconnects, configuration memory	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-6	Module-6	Case Studies and Tools: RTL-to-GDSII flow overview, synthesis using tools (Vivado/Quartus), implementing counters, ALUs, UARTs, GPIO controllers, debouncing logic, project-based hardware design	07	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			40		

Learning Outcomes:	After completing this course, the student will be able to 1. Understand and describe RTL-level digital system design and abstraction. 2. Model and simulate combinational/sequential logic using HDLs. 3. Write and debug synthesizable code for digital circuits. 4. Perform synthesis for PLD targets and apply constraints effectively. 5. Develop complete RTL-to-PLD hardware implementation projects using industry tools.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Palnitkar, Samir, " <i>Verilog HDL</i> ", 2nd Edition, Pearson Education, ISBN: 978-0130449115	2003
2.	Bhasker, J., " <i>VHDL Primer</i> ", 2nd Edition, Pearson Education, ISBN: 978-0130335647	2001
3.	Perry, Douglas L., " <i>VHDL Programming by Example</i> ", 4th Edition, McGrawHill, ISBN: 978-0071400701	2002
4.	Brown, Stephen, and Vranesic, Zvonko, " <i>Fundamentals of Digital Logic with VHDL Design</i> ", 3rd Edition, McGraw Hill, ISBN: 978-0073380544	2008
5.	Roth, Charles H., and John, Lizy Kurian, " <i>Digital Systems Design using VHDL</i> ", 3rd Edition, Cengage Learning, ISBN: 978-1305635142	2017

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	Y	Y
PO6	N	N	Y	N	Y
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	N	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	Y	Y	Y	Y
PSO4	Y	Y	Y	Y	Y



Course Code: MET-PE 208

Course Name: NANO ELECTRONICS

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional: 30 ESE: 70 Credit : 3
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Prerequisites:	Basic Electronics
Objectives:	1. To understand the fundamentals of nanoscience and nanoelectronics, including the concepts of nanomaterials, quantum effects, and nanoscale devices. 2. To explain the Silicon MOSFET's, QTD and carbon nano tubes. 3. To understand the fundamentals of molecular electronics 4. To analyze the operation and applications of nanoelectronic devices, such as carbon nanotubes (CNTs), graphene-based devices, quantum dots, and single-electron transistors. 5. To know the types of nanotechnology, atomic structure, molecular technology and preparation of nano materials
Course Coordinator	Dr. Anuj Kumar Sharma

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	Module-2	Particle in a box Concepts, Degeneracy. Band Theory of Solids. KronigPenny Model. Brillouin Zones.	07	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	Module-3	Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)	07	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	Module-4	Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors.	06	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	Module-5	Carbon nanotube electronics, Bandstructure and transport, devices, applications.	06	PO2/ PO4/ PO5	PSO1/ PSO2/..
UNIT-6	Module-6	2D semiconductors and electronic devices, Graphene, atomistic simulation.	07	PO2/ PO4/ PO5	PSO1/ PSO2/..

Total No. of Hours	40		
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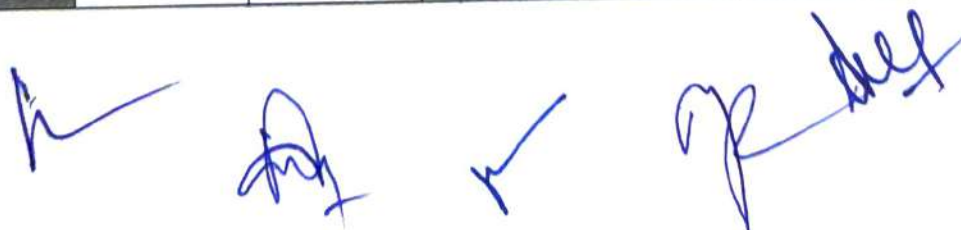
Learning Outcomes:	After completing this course, the student will be able to 1. Understand various aspects of nano-technology and the processes involved in making nano components and material. 2. Leverage advantages of the nano-materials and appropriate use in solving practical problems. 3. Understand various aspects of nano-technology and the processes involved in making nano components and material. 4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
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Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	G.W. Hanson, Fundamentals of Nanoelectronics, Pearson.	2009
2.	W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH.	2003
3.	K.E. Drexler, Nanosystems, Wiley.	1992
4.	J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press.	1998
5.	C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley.	2003

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	N	N	Y	Y	Y
PO4	Y	Y	Y	N	Y
PO5	Y	Y	Y	Y	Y
PO6	Y	N	Y	Y	Y
PO7	N	Y	Y	N	Y
PO8	Y	Y	Y	Y	N
PO9	Y	Y	Y	Y	N
PO10	N	Y	Y	Y	N
PO11	Y	Y	N	Y	N
PO12	N	Y	Y	Y	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	N	N	Y	Y
PSO2	Y	Y	Y	N	Y



PSO3	Y	Y	N	N	N
PSO4	Y	N	N	N	Y



Course Code: MET-C227

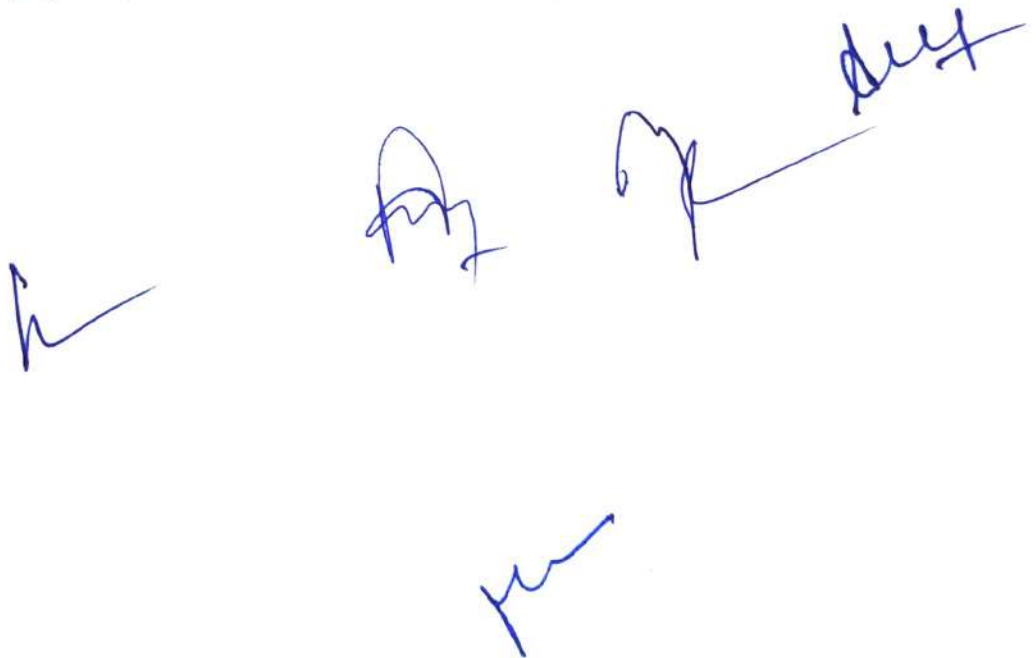
Course Name: MINOR PROJECT

MM: 100 Time: 3 Hr. L T P 2 0 2	Sessional: 30 ESE: 70 Credit : 2
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OBJECTIVE: The object of Minor Project Work is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

INSTRUCTIONS FOR STUDENTS: Each student shall be assigned a Minor Project by departmental committee. The student shall be required to perform his project work under the supervision of the supervisor(s). There shall be a seminar on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student shall be required to submit his project report in the form of dissertation 15 days before the end of 2nd semester.



Course Code: MET-P310**Course Name: Dissertation Phase – I**

MM: 300 Time: 3 Hr. L T P 0 0 6	Sessional: 300 Credit : 8
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Course Description:

Dissertation Phase-I introduces students to independent research in their chosen area of specialization. The course focuses on identifying a research problem, conducting an extensive literature review, defining research objectives, and formulating an appropriate methodology. Students are expected to carry out preliminary theoretical, simulation, or experimental work, prepare a detailed research proposal, and present their progress through seminars and reviews. The course aims to develop research aptitude, analytical thinking, technical writing, and problem-solving skills, providing a strong foundation for successful completion of the dissertation in Phase-II.

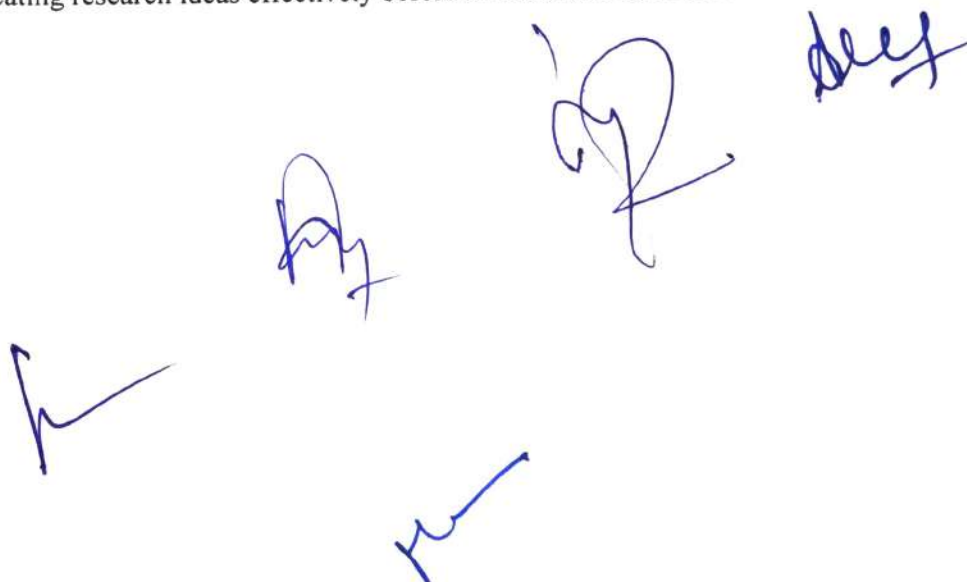


Course Code: MET-P311
Course Name: Seminar I

MM: 100 Time: 3 Hr. L T P 0 0 4	Sessional: 100 Credit : 4
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Course Description:

Seminar-I is designed to enhance the research, communication, and presentation skills of M.Tech students. Students are required to select a recent topic related to their specialization, conduct an in-depth literature review, and critically analyze current research trends. They will prepare and deliver a technical seminar, followed by discussion and evaluation. The course aims to develop technical writing, analytical thinking, presentation abilities, and confidence in communicating research ideas effectively before an academic audience.

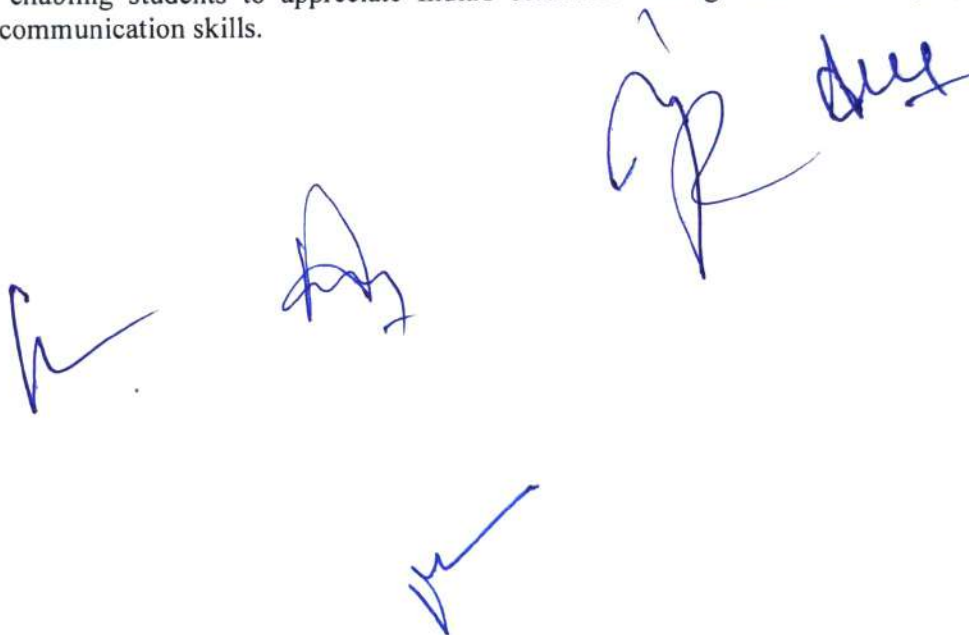
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Course Code: MET-P312
Course Name: Seminar II

MM: 100 Time: 3 Hr. L T P 0 0 4	Sessional: 100 Credit : 1
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Course Description:

Seminar-II provides M.Tech students with an opportunity to explore and critically examine the concepts of Engineering and Technology described in the **Vedas, Vedangas, and other Vedic literature**. Students are expected to study ancient Indian scientific knowledge related to fields such as mathematics, astronomy, architecture, metallurgy, materials, communication, environmental science, and engineering practices, and analyze their relevance in the context of modern technological advancements. The seminar emphasizes interdisciplinary learning, critical analysis, research methodology, and effective technical presentation, enabling students to appreciate India's scientific heritage while developing research and communication skills.



Course Code: MET-P400**Course Name: Dissertation Phase – II**

MM: 500 Time: 3 Hr. L T P 0 0 16	Sessional: 100 ESE: 400 Credit : 16
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Course Description:

Dissertation Phase–II is the continuation and completion phase of the M.Tech research work initiated in Dissertation Phase–I. In this course, students are expected to carry out detailed experimentation, analysis, design implementation, validation of results, and interpretation of findings related to their chosen research problem. The course emphasizes independent research, technical writing, and presentation skills. Students are required to submit a comprehensive dissertation report and successfully defend their work through a viva-voce examination, demonstrating their ability to conduct quality research and contribute to advancements in their field of specialization.

