MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act, 1956)

FACULTY OF ENGINEERING AND TECHNOLOGY

CURRICULUM

AND

SCHEME OF EXAMINATION

M.TECH- ELECTRONICS AND COMMUNICATION ENGINEERING

BATCH : 2022-2024

FOREWARD

This is to certify that this booklet contains the entire Curriculum and Scheme of Examination of M. Tech in Electronics and Communication Engineering being offered at Faculty of Engineering & Technology of this University. This has been duly vetted and finally approved by the Academic Council of the University **vide its 30th Academic Council** held on **11th Oct, 2019** and changes, if any deemed appropriate, shall be duly incorporated after the necessary approval by the Academic Council.

This Curriculum and Scheme of Examination of M. Tech in Electronics and Communication Engineering shall be implemented w.e.f. AY 2022-23.

Prof. (Dr.) Naresh Grover
Dean-Academics, MRIIRS

Date:

PREAMBLE

The Department of Electronics and Communication Engineering has been offering M.Tech in Electronics and Communication Engineering since 2008. The duration of M.Tech Programme is of two years, covered in four semesters with the specialization in VLSI & Embedded Systems and Communication Systems. The position and sequence of study of core courses and elective courses are made to ensure an integral learning that enables the department to offer extensive knowledge in the broad field of VLSI and Communication.

The program is designed giving importance to theory as well as exposure to industry needs. It is structured to give solid theoretical foundation and practical, hands-on experience which would enable the student to tackle problems in the area of Signal processing, Communications, VLSI and Embedded Systems in a holistic manner.
The selection of unique courses in the basket of electives is a special feature of curriculum ensuring flexibility and diversity in learning.

The introduction of two Audit courses covering various subjects like Yoga, Value Education and Disaster management aims to develop desired attitude amongst the learners. The introduction of mini projects ensures preparedness of students to undertake project / dissertation. The dissertation/major project work of PG programme of one-year duration is given strong weight age in the curriculum. It is expected to undertake industrially relevant problem to develop an optimal solution through extensive research work. So, the curricula is structured in such a manner that will make the learner to undertake industrially relevant problem and a prepare him to be a responsible member of society with inherent ethical and moral values, who can contribute in prevalence of science and technology at global level.

Contents

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

To impart latest knowledge and skills so as to kindle innovation & creativity among students, to develop and sustain a culture of research while promoting values, ethics and responsible professionalism, leading to a progressive career in industry & academia globally.

MISSION

- To engage modern education aids, laboratories and competent faculty ensuring effective teaching learning process to meet the ever growing and changing industrial and business environment.
- To continuously challenge the young minds with ideas so as to carry out innovative research through interaction with the research organizations & industry and to provide them avenues for recognition by participation in challenging platforms.
- To develop responsible citizens and professional leaders with high ethical and moral values, who contribute in dissemination of universal science and technology.

ABOUT THE DEPARTMENT

The Electronics and Communication Engineering Department was set up in 1997 and its B.Tech in ECE programme was accredited by NBA thrice, in 2004, 2007 and 2021. The Department has a rich tradition in research and teaching. The research interests of the faculty members of the department encompass the wide area of applied and fundamental aspects of Electronics and Communication Engineering including but not limited to Communication Systems, Microelectronics & VLSI, Digital Signal Processing, Wireless and Mobile communication, Antenna Design and RF & Microwave Engineering. A large number of Ph.D. scholars are currently engaged in cutting edge research in the Department.

The Department has modern, well equipped laboratories with adequate facilities catering to the requirements of undergraduates, postgraduates and research scholars particularly in the area of High End Electronic Design, Microcontrollers, Microprocessors, Embedded System Design, VLSI Design, Antenna Design, Microwave, Advanced Communication Systems, Simulation and Digital Signal Processing. In addition to the well-equipped curriculum related laboratories, the Department has strong association with the Research Clusters and various Centres of Excellence in the University.

The Department continuously upgrades the curriculum and teaching inputs taking cognizance of its prime stake holders viz. research organizations, industry, peer community, alumni, parents and students. To give greater emphasis on education methodology, guest lectures, seminars, workshops, personality development programs, educational tours, industrial visits and quizzes are organized. The department has linkages with industry, leading academic institutes and scientific research organizations like the DST, MoSPI, DRDO, IIT, ISI, SAP, RIL etc. The department has offered consultancy to various industries.The student chapter of Institution of Engineers India (IEI) and ISTE is fully functional in the department.

The Department also has the following Knowledge Partners:

- INTEL Internet of Things (IOT) is a centre for higher education program for conducting FDPs,

Events, Workshops on GALILEO and EDISON platform.

- ATMEL India University program for sponsoring labs and organizing FDPs, events, workshops on ATMEGA 168PB and SAM D21 Microcontrollers.
- Texas Instruments (TI) India University Program (Edgate Technologies) forrunning Teaching Lab Facility
- National Kaohsiung University of Applied Science (KUAS) Taiwan- A student exchange program where-in the selected students shall be provided fully paid two years academic and industrial exposure.

Taking a leaf out of Government's initiative towards Digital transformation, Smart and future ready cities, the department has ventured into a specialization program in Internet of Things (IOT). It is an interdisciplinary program that combines the study of electronic engineering, with an emphasis on computer science, internet technologies, wireless communications, sensor devices, and cloud computing.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The Department of Electronics and Communication Engineering keeping in view interests of all their stakeholders have formulated the Program Educational Objectives (PEO's) that are comprehensive statements describing the career and professional accomplishments that the program is preparing the learner for.

PEO's of M. Tech Program in Electronics and Communication Engineering are:

PEO 1: To impart in-depth knowledge and skills to students so as to enable them solve issues in real world Communication, VLSI and Embedded sectors and provide feasible and viable solutions.

PEO 2: To help them learn to effectively communicate their ideas and research in oral and written form and to enable them to adapt to the evolving technical challenges and changing career opportunities in their specialized domains.

PEO 3: To inculcate professional and ethical attitude, team spirit and leadership qualities in Students and to make them aware of their social responsibilities.

"Mission of the Department – PEOs matrix"

PEO Statements		**Mission 1**	**Mission 2**	**Mission 3**
PEO1:	To impart in-depth knowledge and skills to students so as to enable them solve issues in real world Communication, VLSI and Embedded sectors and provide feasible and viable solutions.	**3**	**3**	**2**
PEO2:	To help them learn to effectively communicate their ideas and research in oral and written form and to enable them to adapt to the evolving technical challenges and changing career opportunities in their specialized domains	**3**	**3**	**2**
PEO3:	To inculcate professional and ethical attitude, team spirit and leadership qualities in Students and to make them aware of their social responsibilities.	**3**	**3**	**3**

PROGRAM OUTCOMES (POs) / PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Outcomes / Program Specific Outcomes describe graduate attributes i.e. what students are expected to know or will be able to do when they graduate from a program. The POs / PSOs of M. Tech. in Electronics & Communication Engineering are:

PO1. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PSO1: Embed hardware and Software expertise in different domains of Electronics and Communication Engineering through specialized Courses and projects based on latest technological tools to cater to the emerging industrial requirements.

PSO2: Develop research oriented approach amalgamated with professional ethics for solving real life problems and serving the societal needs in terms of health, safety and environment.

Mapping of PEO's with PO's and PSO's

PEO/PO's & PSO's	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**
PEO1	3	3	3	2	2	2	3	3	3
PEO2	3	3	3	2	2	3	2	3	3
PEO3	3	2	2	3	2	3	3	3	3

SEMESTER AND CHOICE BASED CREDIT SYSTEM:

Credit based system of study and student's performance/progress is measured by the number of credits that he/she has earned i.e. completed satisfactorily. Based on the course credits and grade obtained by the student, grade point average is calculated.

(a) Course credits assignment

Each course has a certain number of credits assigned to it depending upon its duration in periods for lecture, tutorial and laboratory/clinical practice in a week. A few courses/activities are without credit (s) and are referred to as Audit Pass Courses (APC) but are mandatory to pass as a partial fulfilment of award of degree.

(b) Earning of credits

At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however shall be mandatory to pass as a partial fulfilment of award of degree.

For Award of Degree of a programme M.Tech Electronics and Communication Engineering, he/she has to earn minimum 68 credits during the 2 year duration of the programme in 4 semesters.

The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket", and "Elective Courses Basket". The total 50 credits required to be earned under "Compulsory Courses Basket" and 18 credits under "Elective Courses Basket".

All courses under "Compulsory Courses Basket", are required to be qualified and cleared/pass by each and every students enrolled under the programme and are semester-wise listed in the study scheme along with credits assigned to each course.

Under Elective Courses Basket, there will be three types of courses:

- Semester-wise courses offered by the department itself
- Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.
- Massive Open Online Courses (MOOCs) available on SWAYAM Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. Student shall be required to register courses every semester for as many courses/credits specified under "Elective Courses Basket" depending upon his/her interest, capability/pace of learning and availability of time slot (without any clash in time table) so as to earn all required total credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses [including courses under "Compulsory Courses Basket", "Elective Courses Basket" and Previous Semester Courses (wherein he/she was declared in-eligible on the basis of attendance or he/she could not clear the course within permissible given chances)], if any, the maximum limit in a semester shall be 28 credits.

SEMESTER WISE STUDY SCHEME WITH CONTACT HOURS, ASSIGN CREDITS AND DISTRIBUTION OF MARKS

Programme: M. Tech in Electronics and Communication Engineering with Specialization in Communication Systems/ VLSI Design & Embedded Systems

Compulsory Courses						Elective Courses
Type of Courses						
Fundamental	**Core**	**Ability Enhancement Courses (AEC)**	**Skill Enhancement Courses (SEC)**		**Domain Specific Electives under Compulsory basket***	**Domain Specific Electives under Elective basket****
Sem1	**Sem1**	**Sem1**	**Sem1**	**Sem1**		**Sem1**
	Advance Communication Networks	Research Methodology and IPR	Advance Communication Networks Laboratory	Audit 1 Stress Management by Yoga		Wireless Sensor Networks
	Wireless and Mobile Communication		RTL Simulation and Synthesis with PLDs Laboratory			Optical Networks
			Wireless and Mobile Communication Laboratory			RTL Simulation and Synthesis with PLDs
			Microcontrollers and Programmable Digital Signal Processors Laboratory			Programming Languages for Embedded Softwares
						Cognitive Radio
						DSP Architecture
						CAD of Digital System
						Microcontrollers and Programmable Digital Signal Processors
Sem 2	Sem 2	Sem 2	Sem 2	Sem 2		Sem2

	Antennas and Radiating Systems	Audit 2 English for Research Paper Writing	Mini Project	Antennas and Radiating Systems Lab		Satellite Communication
	Advanced Digital Signal Processing			Analog and Digital CMOS VLSI Design Lab		Internet of Things
				Advanced Digital Signal Processing Lab		Analog and Digital CMOS VLSI Design
				VLSI Design Verification and Testing Lab		Nano materials and Nanotechnology
						Markov Chain and Queuing System
						MIMO System
						VLSI Design Verification and Testing
						Network Security and cryptography
Sem3	Sem3	Sem3	Sem3	Sem3		Sem3
			Dissertation (Phase-I)	Business Analytics		Pattern Recognition and Machine learning
				Industrial Safety		Remote Sensing
				Operations Research		Low power VLSI Design
				Cost Management of Engineering Projects		Selected Topics in Mathematics
				Composite Materials		
				Waste of Energy		
Sem4	Sem4	Sem4	Sem4	Sem4		Sem4
			Dissertation (Phase-II)			

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M. Tech. (Electronics & Communication Engineering) Specialization: Communications/VLSI & Embedded Systems

SEMESTER I												
S. No	Course Code	Subject	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous Evaluation	End Semester Examination	Total		
1	MEC-101	Advanced Communication Networks	3	0	0	3	100	100	200	3	3
2	MEC-102	Wireless and Mobile Communication	3	0	0	3	100	100	200	3	3
3		Programme Elective-I	3	0	0	3	100	100	200	3	3
4		Programme Elective-II	3	0	0	3	100	100	200	3	3
5	M- MC-100	Research Methodology and IPR	2	0	0	2	50	50	100	3	2
6	MEC-111	*Advanced Communication Networks Lab	0	0	4	4	50	50	100	3	2
	MEC-112	**RTL Simulation and Synthesis with PLDs Lab									
7	MEC-113	*Wireless and Mobile Communication Lab	0	0	4	4	50	50	100	3	2
	MEC-114	**Microcontrollers and Programmable Digital Signal Processors Lab									
8	M-MC-001	Audit 1 Stress Management by Yoga	2	0	0	2	25+25	50	100		AP
		TOTAL	**16**	**0**	**8**	**24**	**350**	**600**	**1200**		**18**

S. No	Course Code	Programme Elective-I	L	T	P	Credits
1	MEC-151	*Wireless Sensor Networks	3	0	0	3
2	MEC-152	*Optical Networks	3	0	0	3
3	MEC-153	**RTL Simulation and Synthesis with PLDs	3	0	0	3
4	MEC-154	**Programming Languages for Embedded Softwares	3	0	0	3

S. No	Course Code	Programme Elective-II	L	T	P	Credits
1	MEC-155	*Cognitive Radio	3	0	0	3
2	MEC-156	*DSP Architecture	3	0	0	3
3	MEC-157	**CAD of Digital System	3	0	0	3
4	MEC-158	**Microcontrollers and Programmable Digital Signal Processors	3	0	0	3

Note:
***Communications Domain**
**** VLSI & Embedded Systems Domain**

SEMESTER II											
1	MEC-201	Antennas and Radiating Systems	3	0	0	3	100	100	200	3	3
2	MEC-202	Advanced Digital Signal Processing	3	0	0	3	100	100	200	3	3
3		Programme Elective-III	3	0	0	3	100	100	200	3	3
4		Programme Elective-IV	3	0	0	3	100	100	200	3	3
5	EC-M-200	Mini Project with Seminar	0	0	4	4	100	50	150	3	2
6	MEC-211	*Antennas and Radiating Systems lab	0	0	4	4	50	50	100	3	2
	MEC-212	**Analog and Digital CMOS VLSI Design Lab									
7	MEC-213	*Advanced Digital Signal Processing Lab	0	0	4	4	50	50	100	3	2
	MEC-214	**VLSI Design Verification and Testing Lab									
8	M-MC-002	English for Research Paper Writing	2	0	0	2	50	50	100	2	AP
		TOTAL	**14**	**0**	**12**	**26**	**650**	**600**	**1250**		**18**

S. No	Course Code	Programme Elective-III	L	T	P	Credits
1	MEC-251	*Satellite Communication	3	0	0	3
2	MEC-252	*Internet of Things	3	0	0	3
3	MEC-253	**Analog and Digital CMOS VLSI Design	3	0	0	3
4	MEC-254	**Nano materials and Nanotechnology	3	0	0	3

S. No	Course Code	Programme Elective-IV	L	T	P	Credits
1	MEC-255	*Markov Chain and Queuing System	3	0	0	3
2	MEC-256	*MIMO System	3	0	0	3
3	MEC-257	**VLSI Design Verification and Testing	3	0	0	3
4	MEC-258	**Network Security and Cryptography	3	0	0	3

SEMESTER III											
S. No		Subject	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous Evaluation	End Semester Examination	Total		
1		Programme Elective-V	3	0	0	3	100	100	200	3	3
2		Open Elective	3	0	0	3	100	100	200	3	3
3	MEC-300	Dissertation (Phase-I)	0	0	20	20	200	100	300	4	10
		TOTAL	**6**	**0**	**20**	**26**	**400**	**300**	**700**	**10**	**16**

S. No	Course Code	Programme Elective-V	L	T	P	Credits
1	MEC-351	*Pattern Recognition and Machine learning	3	0	0	3
2	MEC-352	*Remote Sensing	3	0	0	3
3	MEC-353	**Low power VLSI Design	3	0	0	3
4	MEC-354	**Selected Topics in Mathematics	3	0	0	3

S. No	Course Code	Open Elective	L	T	P	Credits
1	M-ID-001	Business Analytics	3	0	0	3
2	M-ID-002	Industrial Safety	3	0	0	3
3	M-ID-003	Operations Research	3	0	0	3
4	M-ID-004	Cost Management of Engineering Projects	3	0	0	3
5	M-ID-005	Composite Materials	3	0	0	3
6	M-ID-006	Waste to Energy	3	0	0	3

S. No	Course Code	Audit Course 1 & 2	L	T	P	Credits
1	M-MC-001	Stress Management by Yoga	2	0	0	AP
2	M-MC-002	English for Research Paper Writing	2	0	0	AP
3	M-MC-003	Disaster Management	2	0	0	AP
4	M-MC-004	Sanskrit for Technical Knowledge	2	0	0	AP
5	M-MC-005	Value Education	2	0	0	AP
6	M-MC-006	Constitution of India	2	0	0	AP
7	M-MC-007	Pedagogy Studies	2	0	0	AP
8	M-MC-008	Personality Development through Life Enlightenment Skills.	2	0	0	0

SEMESTER IV											
			Periods/Week				Marks				
S. no		Subject	L	T	P	Total	Continuous Evaluation	End Semester Examination	Total	Duration of Exam	Credits
1	MEC-400*	Dissertation(Phase-II)*	0	0	32	32	400	200	600	**3**	16
		TOTAL	**0**	**0**	**32**	**32**	**400**	**200**	**600**	**3**	**16**

Summary of Semester-wise credits	
Semester	**Credits**
I	18
II	18
III	16
IV	16
TOTAL	**68**

* The student should publish at least one research paper in reputed indexed journal based on their dissertation work

SEMESTER-I

MEC-101: ADVANCED COMMUNICATION NETWORKS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-101.1 Apply advanced concepts used in Communication Networking.
MEC-101.2 Design different protocols for Communication Networks.
MEC-101.3 Illustrate the mechanisms of Quality of Service in networking.
MEC-101.4 Optimise the Network Design.

Unit 1: Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IPCongestion and Flow Control in Internet-Throughput analysis of TCP congestion control, TCP for high bandwidth delay networks. Fairness issues in TCP.

Unit 2: Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

Unit 3: Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.;Active Queue Management - RED, WRED and Virtual clock, Control theoretic analysis of active queue management.

Unit 4: IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Unit 5: Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

Unit 6: IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

References:

1. Jean Wairand and Pravin Varaiya, 2000, "High Performance Communications Networks", 2nd edition.
2. Jean Le Boudec and Patrick Thiran, 2001, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag.
3. Zhang Wang, 2001, "Internet QoS", Morgan Kaufman Publishers.
4. Anurag Kumar, D. Manjunath and Joy Kuri,2004 "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers.
5. George Kesidis, 2005, "ATM Network Performance", Kluwer Academic, Research Papers.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-101)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
MEC-101.1	3	3	2	-	-	-	-	3	2
MEC-101.2	3	3	1	-	-	-	-	3	3
MEC-101.3	3	3	1	-	-	1	-	2	2
MEC-101.4	3	3	1	-	-	-	-	3	2

MEC-102: WIRELESS AND MOBILE COMMUNICATION

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-102.1 Explain the Classification of mobile communication systems.

MEC-102.2 Apply frequency-reuse concept in mobile communications, and analyze its effects on interference, system capacity, handoff techniques

MEC-102.3 Classify various multiple access techniques in mobile communication.

MEC-102.4 Identify various propagation effects.

MEC-102.5 Outline cellular mobile communication standards

Unit 1: Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Unit 2: Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit 3: Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading

Unit 4: Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving

Unit 5: Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels

Unit 6: Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

References:

1. V.K.Garg, J.E.Wilkes, 2008, "Principle and Application of GSM", 5th edition, Pearson Education.
2. V.K.Garg,2009, "IS-95 CDMA & CDMA 2000",4th edition, Pearson Education.
3. T.S.Rappaport, 2002, "Wireless Communications Principles and Practice", 2nd edition, PHI.
4. William C.Y.Lee, 1995, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH.
5. Asha Mehrotra, 1997, "A GSM system Engineering" Artech House Publishers Bosten, London.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-102)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-102.1	3	3	2	-	-	-	1	3	2
MEC-102.2	3	3	2	-	-	-	1	3	3
MEC-102.3	3	3	2	-	-	-	2	2	2
MEC-102.4	3	3	1	-	-	1	2	2	2

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MEC-151: WIRELESS SENSOR NETWORKS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-151.1 Design wireless sensor network system for different applications under consideration.

MEC-151.2 Understand the hardware details of different types of sensors and select right type of sensor for various applications.

MEC-151.3 Analyze radio standards and communication protocols to be used for wireless sensor network based systems and application.

MEC-151.4 Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.

MEC-151.5 Handle special issues related to sensors like energy conservation and security challenges.

Unit 1: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Unit 2: Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 3: Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 4: Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy),UWB.

Unit 5: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 6: Specialized features: Energy preservation and efficiency; security challenges; faulttolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

References:

1. H. Karl and A. Willig, 2012, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, 2010, Editors, "Wireless Sensor Networks", 1st Indian reprint, Springer Verlag.
3. F. Zhao and L. Guibas, 2013, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint.

4. YingshuLi, MyT. Thai, Weili Wu, 2008, "Wireless sensor Network and Applications", Springer series on signals and communication technology.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-151)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-151.1	2	2	2	-	-	1	-	3	2
MEC-151.2	1	1	2	-	-	-	1	3	3
MEC-151.3	3	1	2	-	-	-	2	2	2
MEC-151.4	1	2	1	-	-	1	2	2	2
MEC-151.5	1	-	-	-	2	2	2	2	2

MEC-152: OPTICAL NETWORKS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-152.1 Contribute in the areas of optical network and WDM network design.

MEC-152.2 Implement simple optical network and understand further technology developments for future enhanced network.

Unit 1: SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching

Unit 2: WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects

Unit 3: Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety

Unit 4: Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 5: WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models

Unit 6: Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON

References:

1. Rajiv Ramaswami, Sivarajan, Sasaki, 2010, "Optical Networks: A Practical Perspective", 3rd edition MK, Elsevier.
2. C. Siva Ram Murthy and Mohan Gurusamy, 2001, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-152)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-152.1	2	2	2	-	-	1	-	3	2
MEC-152.2	1	1	2	-	-	-	1	3	3

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MEC-153: RTL SIMULATION AND SYNTHESIS WITH PLDS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of the course, students will be able to:

MEC-153.1 Students will be able to understand the Finite State Machines, RTL design using reconfigurable logic.

MEC-153.2 Students will be able to understand the methodology to design and develop IP cores and Prototypes with performance guarantees.

MEC-153.3 Students will be able to understand the designing of digital circuits using Verilog or VHDL.

MEC-153.4 Students will be able to understand the use of EDA tools like Cadence, Mentor Graphics and Xilinx.

Unit1: Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static Timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs

Unit 2: Design entry by Verilog/VHDL/FSM, Verilog AMS

Unit 3: Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection

Unit 4: Design for performance, Low power VLSI design techniques. Design for testability.

Unit 5: IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping.

Unit 6: Case studies and Speed issues

References:

1. Richard S. Sandige, "Modern Digital Design", MGH, International Editions.
2. Donald D Givone, "Digital principles and Design", TMH.
3. Charles Roth, Jr. and Lizy K John, "Digital System Design using VHDL", Cengage [351] Learning.
4. Samir Palnitkar, "Verilog HDL, a guide to digital design and synthesis", Prentice Hall.
5. Doug Amos, Austin Lesea, Rene Richter, "FPGA based prototyping methodology manual", Xilinx.
6. Bob Zeidman, "Designing with FPGAs & CPLDs", CMP Books.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.

3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-153)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-153.1	3	3	2	-	-	-	1	3	2
MEC-153.2	3	3	2	-	-	-	1	3	3
MEC-153.3	3	3	1	-	-	-	2	2	2
MEC-153.4	3	3	2	-	-	1	3	2	2

MEC-154: PROGRAMMING LANGUAGES FOR EMBEDDED SOFTWARES

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-154.1 Acquire knowledge of an embedded C and can work in embedded network environment.

MEC-154.2 Describe interpreted languages and compiledlanguages.

MEC-154.3 Design and analyze application on embedded systems.

Unit 1: Embedded 'C' Programming: Bitwise operations, Dynamic memory allocation, OS services, Linked stack and queue, Sparse matrices, Binarytree, Interrupt handling in C, Code optimizationissues, Writing LCD drives, LED drivers, Drivers for serial portcommunication, Embedded Software Development Cycle and Methods (Waterfall, Agile)

Unit 2: Object Oriented Programming, Introduction toprocedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism,

Unit 3: CPP Pogramming: 'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation

Unit 4: Overloading and Inheritance: Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions

Unit 5: Templates: Function template and class template, member function templates and template arguments, Exception Handling: syntax for exception handling code: try-catch-throw, Multiple Exceptions

Unit 6: Scripting Languages, Overview of Scripting Languages – PERL, CGI, VB Script, Java Script, PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing

References:

1. Michael J. Pont, 2008, "Embedded C", Pearson Education, 2nd Edition.
2. Randal L. Schwartz, 2011, "Learning Perl", 6th Edition, O'Reilly Publications.
3. A. Michael Berman, 2002, "Data structures via C++", Oxford University Press.
4. Robert Sedgewick, 1999, "Algorithms in C++", Addison Wesley Publishing Company.
5. Abraham Silberschatz, Peter B, Greg Gagne, 2005, "Operating System Concepts", John Willey & Sons.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-154)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**
MEC-154.1	2	2	1	1	-	1	1	3	3
MEC-154.2	1	-	-	-	-	1	1	2	1
MEC-154.3	2	1	1	1	-	2	2	3	3

MEC-155: COGNITIVE RADIO

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

PE-EC-M-155.1 Describe the architecture of Cognitive Radio for end-to-end communication.

PE-EC-M-155.2 Analyze the various methods of implementing the Cognitive Radio functions.

PE-EC-M-155.3 Exemplify the research challenges in designing a Cognitive Radio Network and the applications.

Unit 1: Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Unit 2: Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Unit 3: Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Unit 4: Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Unit 5: Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Unit 6: Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer design for cognitive radio networks.

References:

1. Ekram Hossain, Dusit Niyato, Zhu Han, 2009, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press.
2. Kwang-Cheng Chen, Ramjee Prasad, 2009, "Cognitive radio networks", John Wiley & Son Ltd.
3. Bruce Fette, 2009, "Cognitive radio technology", 2nd edition, Elsevier.
4. Huseyin Arslan, 2007, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springe.
5. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, 2009, "Optimizing Wireles Communication Systems" Springer.

6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-155)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**
MEC-155.1	1	-	-	-	-	1	1	1	1
MEC-155.2	1	2	1	1	-	2	3	3	2
MEC-155.3	1	2	1	1	-	2	3	3	3

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MEC-156: DSP ARCHITECTURE

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-156.1 Identify and formalize architectural level characterization of P-DSP hardware.

MEC-156.2 Develop programme (assembly and C) using Code Composer Studio environment.

MEC-156.3 Illustrate the deployment of DSP hardware for Control, Audio and Video Signal processing applications

MEC-156.4 Analyze the major areas and challenges in DSP based embedded systems

Unit 1: Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking

Unit 2: Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding

Unit 3: VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications development as an embedded environment

Unit 4: Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem)

Unit 5: FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor

Unit 6: High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

1. M. Sasikumar, D. Shikhare, Ravi Prakash,2006, "Introduction to Parallel Processing", 1st Edition, PHI.
2. Fayez Gebali, 2011, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons.
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald, 2000, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman.
4. Ann Melnichuk,Long Talk, 2010, "Multicore Embedded systems", 1st Edition, CRC Press.
5. Wayne Wolf, 2006, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman.
6. E.S.Gopi, 2007, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-156)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
MEC-156.1	2	-	-	-	-	1	1	2	1
MEC-156.2	2	-	-	-	1	-	1	3	1
MEC-156.3	1	-	-	-	-	-	2	3	-
MEC-156.4	3	-	-	-	-	-	-	2	2

MEC-157: CAD OF DIGITAL SYSTEM

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-157.1 Understand the fundamentals of CAD tools for modelling, design, test and verification of VLSI systems.

MEC-157.2 Study of various phases of CAD, including simulation, physical design, test and verification.

MEC-157.3 Demonstrate knowledge of computational algorithms and tools for CAD.

Unit 1: Introduction to VLSI Methodologies – Design and Fabrication of VLSI Devices, Fabrication Process and its impact on Design.

Unit 2: VLSI design automation tools – Data structures and basic algorithms, graph theory and computational complexity, tractable and intractable problems.

Unit 3: General purpose methods for combinational optimization – partitioning, floor planning and pin assignment, placement, routing.

Unit 4: Simulation – logic synthesis, verification, high level Synthesis.

Unit 5 and 6: MCMS-VHDL-Verilog-implementation of simple circuits using VHDL

References:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation".
2. S.H. Gerez, "Algorithms for VLSI Design Automation.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-157)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
MEC-157.1	2	-	-	-	-	1	1	2	1
MEC-157.2	2	-	-	-	1	-	1	3	1
MEC-157.3	1	-	-	-	-	-	2	3	-

MEC-158: MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-158.1 Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.

MEC-158.2 Identify and characterize architecture of Programmable DSP Processors.

MEC-158.3 Develop small applications by utilizing the ARM processor core and DSP processor based platform.

Unit 1: ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces

Unit 2: Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and dependable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

Unit 3: LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT

Unit 4: Programmable DSP (P-DSP) Processors: Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family

Unit 5: VLIW architecture and TMS320C6000 series, architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations

Unit 6: Code Composer Studio for application development for digital signal processing, On chip peripherals , Processor benchmarking

References:

1. Joseph Yiu, "The definitive guide to ARM Cortex-M3", 2nd Edition, Elsevier.
2. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications", 2nd Edition,TMH.
3. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication.
4. Steve furber, "ARM System-on-Chip Architecture", Pearson Education.
5. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley Technical references and user manuals on www.arm.com, NXP Semiconductor.

6. www.nxp.com and Texas Instruments www.ti.com.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-158)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO 1**	**PSO 2**
MEC-158.1	3	-	-	-	-	-	1	3	1
MEC-158.2	2	-	-	-	-	-	1	2	-
MEC-158.3	3	-	-	-	-	-	-	2	1

MEC-111: ADVANCED COMMUNICATION NETWORKS LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

MEC-111.1 Identify the different types of network devices and their functions within a network.
MEC-111.2 Demonstrate the concepts of sub-netting.
MEC-111.3 Explore different routing protocols .
MEC-111.4 Implement the network design and shared resources between the networks.

List of Experiments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
   a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-111)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
MEC-111.1	3	3	2	-	-	-	-	3	2
MEC-111.2	3	3	2	-	-	-	-	2	2
MEC-111.3	3	3	2	-	-	-	-	3	2
MEC-111.4	3	3	2	-	-	-	-	3	3

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MEC-112: RTL SIMULATION AND SYNTHESIS WITH PLDS LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of the laboratory work, students will be able to

MEC-112.1 Students will be able to understand to identify, formulate, solve and implement problems in signal processing, communication systems etc using RTL design tools.

MEC-112.2 Students will be able to understand the use of EDA tools like Cadence, Mentor Graphics and Xilinx.

List of Experiments:

1. Verilog implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator, Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, bidirectional), 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
2. Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
3. Vending machines - Traffic Light controller, ATM, elevator control.
4. PCI Bus & arbiter and downloading on FPGA.
5. UART/ USART implementation in Verilog.
6. Realization of single port SRAM in Verilog.
7. Verilog implementation of Arithmetic circuits like serial adder/ subtractor, parallel adder/subtractor, serial/parallel multiplier.
8. Discrete Fourier transform/Fast Fourier Transform algorithm in Verilog.

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-112.1)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-112.1	3	3	2	-	-	-	1	3	2
MEC-112.2	3	3	2	-	-	1	2	3	3

MEC-113: WIRELESS AND MOBILE COMMUNICATION LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

MEC-113.1 Illustrate the Cellular concepts in GSM and CDMA networks.

MEC-113.2 Demonstrate GSM handset and various fault insertion techniques.

MEC-113.3 Apply the usage of various AT commands in GSM.

MEC-113.4 Analyze CDMA concept using DSSS kit.

MEC-113.5 Agility in the use of wireless communications laboratory equipment for calibration, measurements, processing and analysis of data.

List of Experiments:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.
3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and videocalls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.
6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De- Interleaver.
8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-113)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-113.1	3	3	2	-	-	-	1	3	2
MEC-113.2	3	3	2	-	-	-	1	3	3
MEC-113.3	3	3	2	-	-	-	2	2	2
MEC-113.4	3	3	1	-	-	1	2	2	2
MEC-113.5	3	3	2	-	-	1	2	3	3

MEC-114: MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of the laboratory work, students will be able to:

MEC-114.1 Analyze floating point processor architecture and its architectural support for higher level language.

MEC-114.2 Apply the linear systems approach to signal processing problems using high-level programming language on DSP processor.

MEC-114.3 Develop prototype codes using commonly available on and off chip peripherals on the Cortex M3 and DSP development boards.

List of Experiments:

PART-A

Experiments to be carried out on Cortex-M3 development boards and using GNU tool chain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. Sample sound using a microphone and display sound levels on LEDs.

PART-B

Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

1. To develop an assembly code and C code to compute Euclidian distance between any two points
2. To develop assembly code and study the impact of parallel, serial and mixed execution
3. To develop assembly and C code for implementation of convolution operation
4. To design and implement filters in C to enhance the features of given input sequence/signal

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-114)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
MEC-114.1	3	-	-	-	-	1	1	2	1
MEC-114.2	2	-	-	-	1	1	2	2	2
MEC-114.3	3	-	-	-	3	-	1	3	1

M-MC-100: RESEARCH METHODOLOGY AND IPR

Periods/week	Credit	Max marks: 100
L:2 T:0	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to:

M-MC-100.1 Understand research problem formulation.

M-MC-100.2 Analyze research related information

M-MC-100.3 Follow research ethics

M-MC-100.4 Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

M-MC-100.5 Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

M-MC-100.6 Understand 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.

Unit 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

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 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.

Unit 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.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 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.

References:

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, "Research Methodology: A Step by Step Guide for beginners",2nd Edition.
4. Halbert, 2007. "Resisting Intellectual Property", Taylor & Francis Ltd.
5. Mayall, 1992, "Industrial Design", McGraw Hil.
6. Niebel, 1974, "Product Design", McGraw Hill.
7. Asimov, 1962, "Introduction to Design", Prentice Hall.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016, "Intellectual Property in New Technological Age.
9. T. Ramappa, 2008, "Intellectual Property Rights Under WTO", S. Chand.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-MC-100)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
M-MC-100.1	3	-	-	-	-	1	1	2	1
M-MC-100.2	2	-	-	-	1	1	2	2	2
M-MC-100.3	3	-	-	-	3	-	1	3	1
M-MC-100.4	1	-	-	1	-	2	2	1	1
M-MC-100.5	-	-	1	1	2	2	2	1	1
M-MC-100.6	1	-	-	1	1	1	1	2	2

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M-MC-001: STRESS MANAGEMENT BY YOGA

Periods/week	Credit	Max marks: 100
L:2 T:0	0	Continuous Evaluation: 50
Duration of Examination: 2 Hrs		End Semester Examination: 50

Course Outcomes:

Students will be able to:

M-MC-001.1 Develop healthy mind in a healthy body thus improving social health also.

M-MC-001.2 Improve efficiency.

Syllabus Contents:

- Definitions of Eight parts of yog. (Ashtanga),
- Yam and Niyam.

Do`s and Don't's in life

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha
  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

- Asan and Pranayam
  i) Various yog poses and their benefits for mind & body,
  ii) Regularization of breathing techniques and its effects-Types of pranayam

References:

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Articulation Matrix

CO Statement (M-MC-100)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
M-MC-001.1	1	-	-	-	2	2	2	-	1
M-MC-001.2	1	-	-	-	1	1	2	1	2

SEMESTER-II

MEC-201: ANTENNAS AND RADIATING SYSTEMS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-201.1 Demonstrate parametric variation of designed antenna for various applications.

MEC-201.2 Analyze & design array antenna.

MEC-201.3 Design application based antennas.

MEC-201.4 Analyze & design practical antennas and enhance their characteristics parameters.

Unit 1: Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Unit 2: Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Unit 3: Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Unit 4: Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Unit 5: Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Unit 6: Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

References:

1. Constantine A. Balanis, 2016, "Antenna Theory Analysis and Design", 4th edition, John. Wiley & Sons
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, 2002, "Antennas for All Applications", Tata McGraw-Hill.
3. R.C.Johnson and H.Jasik, 1984, "Antenna Engineering hand book", Mc-Graw Hil.
4. I.J.Bhal and P.Bhartia, 1980, "Micro-strip antennas", Artech house.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-201)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-201.1	3	3	2	2	2	2	2	3	2
MEC-201.2	3	3	2	2	2	3	2	3	3
MEC-201.3	3	3	3	2	2	3	2	3	3
MEC-201.4	3	3	3	2	2	3	2	3	3

MEC-202: ADVANCED DIGITAL SIGNAL PROCESSING

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-202.1 Design frequency-selective digital filters.

MEC-202.2 Understand the basics of multirate DSP, solve numerical problems and write algorithms.

MEC-202.3 Use engineering tools to design and analyze digital signal processing systems.

MEC-202.4 Implement power spectrum estimation techniques.

MEC-202.5 Apply signal processing techniques in different areas.

Unit 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, parallel realization of IIR.

Unit 2: Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.

Unit 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.

Unit 4: Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm.

Unit 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, Eigen analysis Algorithms for Spectrum Estimation.

Unit 6: Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References:

1. J.G.Proakis and D.G.Manolakis, 2007, Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall
2. N. J. Fliege, 1999 "Multirate Digital Signal Processing: Multirate Systems -Filter Banks-Wavelets", 1st Edition, John Wiley and Sons Ltd.
3. Bruce W. Suter, 1997, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press.
4. M. H. Hayes, 2002, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc.
5. S.Haykin, 2001, "Adaptive Filter Theory", 4th Edition, Prentice Hall.

6. D.G.Manolakis, V.K. Ingle and S.M.Kogon, 2000, "Statistical and Adaptive Signal Processing", McGraw Hill.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
eSessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-202)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-202.1	-	-	2	-	2	-	3	2	2
MEC-202.2	-	-	1	-	1	-	2	2	2
MEC-202.3	2	-	1	1	2	-	2	2	2
MEC-202.4	1	1	-	-	2	-	2	1	1
MEC-202.5	2	-	1	2	2	-	1	2	2

MEC-251: SATELLITE COMMUNICATION

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-251.1 Visualize the architecture of satellite systems as a means of high speed, high range communication system.

MEC-251.2 Explain and analyze link budget of satellite signal for proper communication

MEC-251.3 State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.

MEC-251.4 Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Unit 1: Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Unit 2: Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Unit 3: Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Unit 4: Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit 5: Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Unit 6: Modulation and Multiple Access Schemes used in satellite communication.Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.

References

1. Timothy Pratt and Others, 2010, "Satellite Communications", 2nd Edition,Wiley India.
2. S. K. Raman,2011, "Fundamentals of Satellite Communication", PearsonEducation India.
3. Tri T. Ha, 2009, "Digital Satellite Communications", Tata McGraw Hill.
4. Dennis Roddy, 2008, "Satellite Communication", 4th Edition , McGraw Hill.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-251)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-251.1	2	2	1	-	2	-	2	2	2
MEC-251.2	1	1	1	-	2	-	1	2	2
MEC-251.3	2	1	1	-	2	1	2	2	2
MEC-251.4	2	-	1	-	2	-	3	3	3

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MEC-252: INTERNET OF THINGS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination : 100

Course Outcomes:

At the end of this course, students will be able to

MEC-252.1 Understand what IoT technologies are and what is required in certain scenarios.

MEC-252.2 Discuss the types of technologies that are available and in use today and can be utilized to implement IoT solutions.

MEC-252.3 Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

Unit 1: Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.

Unit 2: Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.

Unit 3: Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.

Unit 4: Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.

Unit 5: Operating systems requirement of IoT environment, study of mbed, RIoT, andContiki operating systems, Introductory concepts of big data for IoT applications.

Unit 6: Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.

References:

1. A Bahaga, V. Madisetti, , 2014 , "Internet of Things- Hands on approach", VPT publisher.
2. McEwen, H. Cassimally, 2013, "Designing the Internet of Things", Wiley.
3. CunoPfister,, 2011, "Getting started with Internet of Things", 1st edition , Maker Media.
4. Samuel Greenguard,2015, "Internet of things", MIT Press.

Web resources :

1. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things1.html
2. https://developer.mbed.org/handbook/AnalogIn
3. http://www.libelium.com/50_sensor_applications/

Note:

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2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-252)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-252.1	2	-	2	1	1	1	1	2	2
MEC-252.2	2	-	2	-	2	-	2	2	2
MEC-252.3	3	1	2	1	1	-	2	2	3

MEC-253: ANALOG AND DIGITAL CMOS VLSI DESIGN

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-253.1 Students will be able to understand the methodology to design, analyze, optimize and simulate the analog and digital circuits using CMOS constrained by the design metrics.

MEC-253.2 Students will be able to understand the way to connect the individual gates to form the building blocks of a system.

MEC-253.3 Students will be able to understand the advanced technology to design the analog and digital circuits.

MEC-253.4 Students will be able to understand the use of EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice.

Unit 1: Review: Basic MOS structure and its static behavior, Quality metrics of a digital design: Cost, Functionality, Robustness, Power, and Delay, Stick diagram and Layout, Wire delay models. Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation, Dynamic behavior, Power consumption.

Unit 2: Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model. Combinational logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Unit 3: Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit. Advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET etc.

Unit 4: Single Stage Amplifier: CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Commongate stage, Cascade stage, Choice of device models. Differential Amplifiers: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Unit 5: Passive and active current mirrors: Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage and difference pair, Noise.

Unit 6: Operational amplifiers: One stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP, Other compensation techniques.

References:

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", 2nd Edition Prentice Hall electronics and VLSI series.
2. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", 2nd Edition, Wiley.
3. Behzad Razavi , 2007, "Design of Analog CMOS Integrated Circuits", TMH.
4. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", 3rd Edition, Oxford.
5. R J Baker, 2008, "CMOS circuit Design, Layout and Simulation", IEEE Inc..
6. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", 3rd Edition, TMH.
7. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", 3rd Edition , PHI.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-253)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-253.1	3	3	2	-	-	-	1	3	2
MEC-253.2	3	3	1	-	-	-	2	3	3
MEC-253.3	3	3	2	-	-	-	1	2	2
MEC-253.4	3	3	2	-	-	1	3	2	2

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MEC-254: NANO MATERIALS AND NANOTECHNOLOGY

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of the course, students will be able to:

MEC-254.1: Classify different nanomaterials based on their design and the basic science behind the design and fabrication of nano scale systems.

MEC-254.2: Describe the processes involved in the designing and implementation of nanomaterials and nano devices.

MEC-254.3: Design inter disciplinary projects based on nanotechnology and its techniques applicable to different domains such as electronics, biotechnology, medical etc.

Unit 1: Nanomaterials in one and higher dimensions.

Unit 2: Applications of one and higher dimension nano-materials.

Unit 3: Nano-lithography, micro electro-mechanical system (MEMS) and nano-phonics.

Unit 4: Carbon nanotubes – synthesis and applications.

Unit 5 and 6: Interdisciplinary arena of nanotechnology.

References:

1. Kenneth J. Klabunde and Ryan M. Richards, 2009, Nanoscale Materials in Chemistry John Wiley and Sons.
2. A I Gusev and A ARempel , 2008, Nanocrystalline Materials, Cambridge International Science Publishing.
3. Bharat Bhushan, 2010, Springer Handbook of Nanotechnology, 3rd Edition, Springer.
4. Kamal K. Kar, 2011,Carbon Nanotubes: Synthesis, Characterization and Applications, 1st Edition, Research Publishing Services, ISBN-13: 978-9810863975.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-254)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-254.1	1	-	-	1	-	1	1	3	2
MEC-254.2	1	1	-	-	-	1	1	2	1
MEC-254.3	1	1	-	1	-	2	2	3	3

MEC-255: MARKOV CHAIN AND QUEUING SYSTEM

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-255.1 Apply Markov Chains and regenerative processes to model a wide variety of systems and phenomena.

MEC-255.2 Design a queuing system governed by a random process.

MEC-255.3 Analyze telecommunication systems modelling using Markov chains processes and queuing models.

Unit 1: Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.

Unit 2: Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.

Unit 3: Discrete time Markov chains: definitions and properties, matrix representation, Perron- Frobenius theory.

Unit 4: Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death processes.;Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.

Unit 5: Fundamental queuing results: Little's theorem, invariance of the mean delay, Conservation law. Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.

Unit 6: Advanced queuing models: priority, vacation and retrials in queues.

References:

1. Cliffs, 1989, "Stochastic Modelling and the Theory Queues", Prentice Hall.
2. P.Bremaud, 1999, "Markov Chains", Springer-Verlag.
3. E.Seneta, 1981, "Non Negative Matrices and Markov Chains", Springer Series in Statistics, Springer.
4. R.Gallager, 1996. "Discrete Stochastic Processes", Kluwer Academic Press.
5. L.Kleinrock, 1976, "Queuing Systems", vols I and II, John Wiley and Sons.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.

2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-255)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-255.1	2	-	-	-	-	-	1	3	2
MEC-255.2	3	-	1	-	-	1	1	3	2
MEC-255.3	2	-	-	-	-	1	1	3	3

MEC-256: MIMO SYSTEM

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-256.1 Evaluate channel modeling and propagation, MIMO Capacity, space-time coding, MIMO receivers.

MEC-256.2 Design the codebooks for MIMO systems (e.g. MIMO-OFDM).

MEC-256.3 Analyze cooperative and coordinated multi-cell MIMO.

MEC-256.4 Implement MIMO systems in 4G(LTE, LTE-Advanced, WiMAX).

Unit 1: Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Unit 2: Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

Unit 3: The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Unit 4: Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer.

Unit 5: Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.

Unit 6: Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References:

1. Claude Oestges, Bruno Clerckx, 2010, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",1st Edition, Academic Press.
2. Mohinder Janakiraman, 2004, "Space - Time Codes and MIMO Systems", Artech House Publishers.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-256)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-256.1	3	3	2	-	-	-	-	3	2
MEC-256.2	3	3	3	-	-	-	-	3	2
MEC-256.3	3	3	2	-	-	-	-	3	3
MEC-256.4	3	3	2	-	-	-	-	3	3

MEC-257: VLSI DESIGN VERIFICATION AND TESTING

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-257.1 Apply Front end design and verification techniques and create reusable test environments.

MEC-257.2 Analyze the use of procedural statements and routines in testbench design with system verilog.

MEC-257.3 Demonstrate and apply randomization concepts in designing testbench.

MEC-257.4 Illustrate OOP concepts for designing test bench with system verilog.

Unit 1: Verification guidelines: Verification Process, Basic Testbench functionality, directed testing, Methodology basics, Constrained-Random stimulus, Functional coverage, Testbench components, Layered testbench, Building layered testbench, Simulation environment phases, Maximum code reuse, Testbench performance.

Unit 2: Data types: Built-in data types, Fixed-size arrays, Dynamic arrays, Queues, Associative arrays, Linked lists, Array methods, Choosing a storage type, Creating new types with typedef , Creating user-defined structures, Type conversion, Enumerated types, Constants strings, Expression width.

Unit 3: Procedural statements and routines: Procedural statements, tasks, functions and void functions, Routine arguments, Returning from a routine, Local data storage, Time values Connecting the testbench and design: Separating the testbench and design, Interface constructs, Stimulus timing, Interface driving and sampling, Connecting it all together, Top-level scope Program – Module interactions.

Unit 4: SystemVerilog Assertions: Basic OOP: Introduction, think of nouns, Not verbs, your first class, where to define a class, OOP terminology, Creating new objects, Object de-allocation, Using objects, Static variables vs. Global variables, Class methods, Defining methods outside of the class, Scoping rules, Using one class inside another, Understanding dynamic objects, Copying objects, Public vs. Local, Straying off course building a testbench.

Unit 5: Randomization: Introduction, What to randomize, Randomization in SystemVerilog, Constraint details solution probabilities, Controlling multiple constraint blocks, Valid constraints, In-line constraints, The pre_randomize and post_randomize functions.

Unit 6: Random number functions, Constraints tips and techniques, Common randomization problems, Iterative and array constraints, Atomic stimulus generation vs. Scenario generation, Random control, Random number generators, Random device configuration.

References:

1. Chris Spears, " System Verilog for Verification", 2nd Edition Springer.
2. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
3. IEEE 1800-2009 standard (IEEE Standard for System Verilog— Unified Hardware Design, Specification, and Verification Language).

System Verilog website –

1. www.systemverilog.org
2. http://www.sunburstdesign.com/papers/CummingsSNUG2006Boston_SystemVerilogEvents.pdf
   General reuse information and resources
   www.design-reuse.com
   OVM, UVM(on top of SV) www.verificationacademy.com

Verification IP resources

1. http://www.cadence.com/products/fv/verification_ip/pages/default.aspx
2. http://www.synopsys.com/Tools/Verification/FunctionalVerification/VerificationIP/Pages/default.aspx

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-257)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-257.1	3	2	-	2	-	-	2	3	3
MEC-257.2	3	2	-	2	-	-	2	3	2
MEC-257.3	3	2	-	2	-	-	2	3	2
MEC-257.4	3	2	-	3	-	-	3	3	3

MEC-258: NETWORK SECURITY AND CRYPTOGRAPHY

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-258.1 Describe network security services and compare encryption techniques.

MEC-258.2 Apply authentication and security in the network applications.

MEC-258.3 Analyze existing authentication and key agreement protocols, identify the weaknesses of these protocols.

MEC-258.4 Develop SSL or Firewall based solutions against security threats, employ access control techniques to the existing computer platforms such as Unix and Windows NT.

Unit 1: Security - Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Unit 2: Number Theory - Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Unit 3: Private-Key (Symmetric) Cryptography - Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Unit 4: Public-Key (Asymmetric) Cryptography - RSA, Key Distribution and Management,Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Unit 5: Authentication - IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6: System Security - Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

References:

1. William Stallings, "Cryptography and Network Security, Principles and Practices",3rd Edition, Pearson Education.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", 2nd Edition.Prentice Hall
3. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres.

4. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", 2nd Edition.Pearson Education
5. Richard Bejtlich, 2013 , "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", William Pollock Publisher. Elective IV Physical Design Automation.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-258)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-258.1	3	3	1	-	-	-	2	3	2
MEC-258.2	3	3	1	2	-	-	2	3	3
MEC-258.3	3	3	-	2	-	-	2	3	3
MEC-258.4	3	3	2	3	-	-	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

MEC-211: ANTENNAS AND RADIATING SYSTEMS LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

MEC-211.1 Demonstrate EM based simulation software and testing equipments.

MEC-211.2 Design Microstripline antenna for various application.

MEC-211.3 Design & analyze array antenna.

MEC-211.4 Design application based antenna.

List of Experiments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.
9. Case study.

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-211)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-211.1	3	3	3	2	2	2	2	3	3
MEC-211.2	3	3	3	2	2	2	2	3	3
MEC-211.3	3	3	3	2	2	2	2	3	3
MEC-211.4	3	3	3	2	2	2	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

MEC-212: ANALOG AND DIGITAL CMOS VLSI DESIGN LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

MEC-212.1 Students will be able to understand the methodology to design the digital and analog Circuit using CMOS.

MEC-212.2 Students will be able to understand the way to draw the layouts.

MEC-212.3 Students will be able to understand the use of EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice.

List of Experiments:

1. Use VDD=1.8V for 0.18um CMOS process, VDD=1.3V for 0.13um CMOS Process and VDD=1V for 0.09um CMOS Process.
   a) Plot ID vs. VGS at different drain voltages for NMOS, PMOS.
   b) Plot ID vs. VGS at particular drain voltage (low) for NMOS, PMOS and determine Vt.
   c) Plot log ID vs. VGS at particular gate voltage (high) for NMOS, PMOS and determine IOFF and sub-threshold slope.
   d) Plot ID vs. VDS at different gate voltages for NMOS, PMOS and determine Channel length modulation factor.
   e) Extract Vth of NMOS/PMOS transistors (short channel and long channel). Use VDS = 30mV
      To extract Vth use the following procedure.
      i. Plot gm vs VGS using NGSPICE and obtain peak gm point.
      ii. Plot y=ID/(gm)1/2 as a function of VGS using Ngspice.
      iii. Use Ngspice to plot tangent line passing through peak gm point in y (VGS) plane and determine Vth.
   f) Plot ID vs. VDS at different drain voltages for NMOS, PMOS, plot DC load line and calculate gm, gds, gm/gds, and unity gain frequency.
      Tabulate your result according to technologies and comment on it.
2. Use VDD=1.8V for 0.18um CMOS process, VDD=1.2V for 0.13um CMOS Process and VDD=1V for 0.09um CMOS Process.
   a) Perform the following
      i. Plot VTC curve for CMOS inverter and thereon plot dVout vs. dVin and determine transition voltage and gain g. Calculate VIL, VIH, NMH, NML for the inverter.
      ii. Plot VTC for CMOS inverter with varying VDD.
      iii. Plot VTC for CMOS inverter with varying device ratio.
   b) Perform transient analysis of CMOS inverter with no load and with load and determine tpHL, tpLH, 20%-to-80% tr and 80%-to-20% tf. (use VPULSE = 2V, Cload = 50fF)
   c) Perform AC analysis of CMOS inverter with fanout 0 and fanout 1. (Use Cin= 0.012pF, Cload = 4pF, Rload = k)
3. Use Ngspice to build a three stage and five stage ring oscillator circuit in 0.18um and 0.13um technology and compare its frequencies and time period.

4. Perform the following
   a) Draw small signal voltage gain of the minimum-size inverter in 0.18um and 0.13um technology as a function of input DC voltage. Determine the small signal voltage gain at the switching point using Ngspice and compare the values for 0.18um and 0.13um process.
   b) Consider a simple CS amplifier with active load, as explained in the lecture, with NMOS transistor MN as driver and PMOS transistor MP as load, in 0.18um technology.
      (W/L)MN=5, (W/L)MP=10 and L=0.5um for both transistors.
      i. Establish a test bench, as explained in the lecture, to achieve VDSQ=VDD/2.
      ii. Calculate input bias voltage if bias current=50uA.
      iii. Use Ngspice and obtain the bias current. Compare its value with 50uA.
      iv. Determine small signal voltage gain, -3dB BW and GBW of the amplifier using small signal analysis in Ngspice (consider 30fF load capacitance).
      v. Plot step response of the amplifier for input pulse amplitude of 0.1V. Derive time constant of the output and compare it with the time constant resulted from -3dB BW
      vi. Use Ngspice to determine input voltage range of the amplifier
5. Three OPAMP INA. Vdd=1.8V Vss=0V, CAD tool: Mentor Graphics DA. Note:
   Adjust accuracy options of the simulator (setup->options in GUI). Use proper values of resistors to get a three OPAMP INA with differential-mode voltage gain=10. Consider voltage gain=2 for the first stage and voltage gain=5 for the second stage.
      i. Draw the schematic of op-amp macro model.
      ii. Draw the schematic of INA.
      iii. Obtain parameters of the op-amp macro model such that
   a. low-frequency voltage gain = 5x104,
   b. unity gain BW (fu) = 500KHz,
   c. input capacitance=0.2pF,
   d. output resistance =_,
   e. CMRR=120dB
      iv. Draw schematic diagram of CMRR simulation setup.
      v. Simulate CMRR of INA using AC analysis (it's expected to be around 6dB below CMRR of OPAMP).
      vi. Plot CMRR of the INA versus resistor mismatches (for resistors of second stage only) changing from -5% to +5% (use AC analysis). Generate a separate plot for mismatch in each resistor pair. Explain how CMRR of OPAMP changes with resistor mismatches.
      vii. Repeat (iii) to (vi) by considering CMRR of all OPAMPs to be 90dB.
6. Technology: UMC 0.18um, VDD=1.8V. Use MAGIC or Microwind.
   a) Draw layout of a minimum size inverter in UMC 0.18um technology using MAGIC Station layout editor. Use that inverter as a cell and lay out three cascaded minimum-sized inverters. Use M1 as interconnect line between inverters.
   b) Run DRC, LVS and RC extraction. Make sure there is no DRC error. Extract the netlist.
   c) Use extracted netlist and obtain tPHLtPLH for the middle inverter using Eldo.
   d) Use interconnect length obtained and connect the second and third inverter.
      Extract the new netlist and obtain tPHL and tPLH of the middle inverter. Compare new values of delay times with corresponding values obtained in part 'c'.

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-212.1)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-212.1	3	3	2	-	-	-	1	3	2
MEC-212.2	3	3	2	-	-	1	2	3	3
MEC-212.3	3	3	1	-	-	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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MEC-213: ADVANCED DIGITAL SIGNAL PROCESSING LAB

Periods/week	Credit	Max marks: 100
P:4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

MEC-213.1 Design frequency selective digital filters using software.

MEC-213.2 Apply various transforms in time and frequency domain.

MEC-213.3 Understand the concept of decimation and interpolation practically.

MEC-213.4 Realize different types of filters.

List of Experiments:

1. Basic Signal Representation
2. Correlation Auto And Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation Of T/F
17. Parallel Realization of IIR filter

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-213)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
MEC-213.1	3	1	2	-	2	1	2	3	3
MEC-213.2	3	-	2	1	2	-	2	2	2
MEC-213.3	3	1	2	-	3	1	3	2	3
MEC-213.4	3	-	2	-	2	-	2	2	2

MEC-214: VLSI DESIGN VERIFICATION AND TESTING LAB

Periods/week	Credit	Max marks: 100
P: 4	2	Continuous Evaluation: 50
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of the laboratory work, students will be able to:

MEC-214.1 Design sequential circuits with set up and hold analysis.

MEC-214.2 Demonstrate layout of a system, DRC, LVS, Extraction using EDA tool Cadence Virtuoso

List of Experiments:

1. Sparse memory
2. Semaphore
3. Mail box
4. Classes
5. Polymorphism
6. Coverage
7. Assertions

Note: 20% new experiment will be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-214)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
MEC-214.1	3	1	-	2	-	-	2	3	3
MEC-214.2	3	1	-	2	-	-	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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EC-M-200: MINI PROJECT WITH SEMINAR

Periods/week	Credit	Max marks: 150
P:4	2	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 50

Course Outcomes:

At the end of this course, students will be able to

EC-M-200.1 Understand contemporary / emerging technology for various processes and systems.

EC-M-200.2 Share knowledge effectively in oral and written form and formulate documents.

The students are required to search / gather the material / information on a specific a topic, comprehend it and present / discuss in the class.

Course Articulation Matrix

CO Statement (EC-M-200)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
EC-M-200.1	3	1	2	1	2	1	2	3	3
EC-M-200.2	3	3	3	1	2	1	2	3	2

M-MC-002: ENGLISH FOR RESEARCH PAPER WRITING

Periods/week — Max marks: 100
P:2 — Continuous Evaluation: 50
Duration of Examination: 2 Hrs — End Semester Examination: 50

Course Outcomes:

Students will be able to:

M-MC-002.1 Understand that how to improve your writing skills and level of readability
M-MC-002.2 Learn about what to write in each section
M-MC-002.3 Understand the skills needed when writing a Title
M-MC-002.4 Ensure the good quality of paper at very first-time submission

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 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.

Unit 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.

Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

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
3. Highman N, 1998, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, 2011, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London.

Course Articulation Matrix

CO Statement (M-MC-002)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
M-MC-002.1	1	3	2	1	3	-	3	1	2
M-MC-002.2	1	3	2	1	3	-	3	1	2
M-MC-002.3	1	3	1	2	2	-	2	1	1
M-MC-002.4	2	3	1	2	1	1	1	2	2

SEMESTER-III

MEC-351: PATTERN RECOGNITION AND MACHINE LEARNING

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-351.1 Apply pattern recognition techniques and modeling to real-world .

MEC-351.2 Demonstrate a variety of pattern classification and pattern classifier combination techniques.

MEC-351.3 Design neural network and SVM for classification.

MEC-351.4 Develop machine independent and unsupervised learning techniques.

Unit 1: Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis.

Unit 2: Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

Unit 3: Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning.

Unit 4: Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine.

Unit 5: Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

Unit 6: Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering.

References:

1. Richard O. Duda, Peter E. Hart, David G. Stork, 2001, "Pattern Classification", 2nd Edition John Wiley & Sons.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, 2009, "The Elements of Statistical Learning", 2nd Edition, Springer.
3. C. Bishop, 2006, "Pattern Recognition and Machine Learning", Springer.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-351)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
MEC-351.1	2	-	-	-	-	-	3	2	-
MEC-351.2	-	-	-	-	-	-	1	1	-
MEC-351.3	3	-	-	-	1	-	2	3	2
MEC-351.4	3	-	-	-	-	-	3	3	2

MEC-322: REMOTE SENSING

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-322.1 Demonstrate remote sensing system functioning.
MEC-322.2 Analysis of Data processing in remote sensing system.
MEC-322.3 Evaluate image data of remote sensing system.
MEC-322.4 Design sensor for remote sensing system.

Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms – LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc.

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film - Optomechanical electro optical sensors –across track and along track scanners multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

1. Lillesand. T.M. and Kiefer. R.W, 2000, "Remote Sensing and Image interpretation", 6thEdition, John Wiley & Sons.
2. John R. Jensen, 1995, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, Prentice Hall.
3. Richards, John A., Jia, Xiuping, 2013, "Remote Sensing Digital Image Analysis",5th Edition, Springer-Verlag Berlin Heidelberg.
4. Paul Curran P.J.,1984, Principles of Remote Sensing, 1st Edition, Longman Publishing Group.
5. Charles Elachi, Jakob J. van Zyl, 2006, "Introduction to The Physicsand Techniques of Remote Sensing", 2nd Edition, Wiley Series.
6. Sabins, F.F.Jr, 1978, "Remote Sensing Principles and Image Interpretation", 3rd Edition, W.H. Freeman& Co.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-322)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-322.1	3	3	2	2	2	2	2	3	2
MEC-322.2	3	3	2	2	2	2	2	3	2
MEC-322.3	3	3	2	2	2	2	2	3	2
MEC-322.4	3	3	2	2	2	2	2	3	2

MEC-353: LOW POWER VLSI DESIGN

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-353.1 The students will be able to understand the impact of power on system performance and Reliability, also identify the sources of power dissipation in digital IC systems.

MEC-353.2 The students will be able to understand the basic analysis methods along with Characterize and model power consumption.

MEC-353.3 The student will be able to understand the leakage sources and reduction techniques.

MEC-353.4 The student will be able to understand the design of low power memory and microprocessor.

Unit 1: Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit 2: Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3: Low Power Clock Distribution: Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew Vs. tolerable skew, chip & package co-design of clock network.

Unit 4: Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

Unit 5: Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit 6: Low Power Microprocessor Design System: power management support, architectural trade offs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

References

1. P. Rashinkar, Paterson and L. Singh, 2002, "Low Power Design Methodologies", Kluwer Academic
2. Kaushik Roy, Sharat Prasad, 2000, "Low power CMOS VLSI circuit design", John Wiley sons Inc..
3. J.B.Kulo and J.H Lou, 1999, "Low voltage CMOS VLSI Circuits", Wiley.
4. A.P.Chandrasekaran and R.W.Broadersen, 1995, "Low power digital CMOS design", Kluwer.
5. Gary Yeap, 1998, "Practical low power digital VLSI design", Kluwer.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-353)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-353.1	3	3	2	-	-	-	1	3	2
MEC-353.2	3	3	2	-	-	-	2	3	3
MEC-353.3	3	3	1	-	-	-	2	2	2
MEC-353.4	3	3	2	-	-	1	3	2	2

MEC-354: SELECTED TOPICS IN MATHEMATICS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-354.1 Characterize and represent data collected from experiments using statistical methods.

MEC-354.2 Model physical process/systems with multiple variables towards parameter estimation and prediction.

MEC-354.3 Represent systems/architectures using graphs and trees towards optimizing desired objective.

Unit 1: Probability and Statistics: - Definitions, conditional probability, Bayes Theorem and independence. - Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev inequality.

Unit 2: Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. - Pseudo random sequence generation with given distribution, Functions of a Random Variable.

Unit 3: Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bi-variate normal distribution. - Stochastic Processes: Definition and classification of stochastic processes, Poisson process - Norms, Statistical methods for ranking data.

Unit 4: Multivariate Data Analysis - Linear and non-linear models, Regression, Prediction and Estimation - Design of Experiments – factorial method - Response surface method.

Unit 5: Graphs and Trees: - Graphs: Basic terminology, multi graphs and weighted graphs, paths and circuits, shortest path Problems, Euler and Hamiltonian paths and circuits, factors of a graph, planar graph and Kuratowski's graph and theorem, independent sets, graph colouring.

Unit 6: Trees: Rooted trees, path length in rooted trees, binary search trees, spanning trees and cut set, theorems on spanning trees, cut sets , circuits, minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

References:

1. Henry Stark, John W. Woods, "Probability and Random Process with Applications to Signal Processing", 3rd Edition,Pearson Education.
2. C. L. Liu, "Elements of Discrete Mathematics", 2nd Edition , Tata McGraw-Hill.
3. Douglas C. Montgomery, E.A. Peck and G. G. Vining, 2001, "Introduction to Linear Regression Analysis", John Wiley and Sons.
4. Douglas C. Montgomery, 2001, "Design and Analysis of Experiments", John Wiley and Sons.

5. B. A. Ogunnaike, 2010, "Random Phenomena: Fundamentals of Probability and Statistics for Engineers", CRC Press.

Note:

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2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (MEC-354)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
MEC-354.1	3	-	2	-	1	-	3	1	2
MEC-354.2	3	-	2	-	2	-	2	1	2
MEC-354.3	2	1	2	-	2	-	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

M-ID-001: BUSINESS ANALYTICS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

M-ID-001.1. Demonstrate the knowledge of data analytics.

M-ID-001.2. Depict the ability of thinking critically in making decisions based on data and deep analytics.

M-ID-001.3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

M-ID-001.4. Demonstrate the ability to translate data into clear, actionable insights.

Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications, Pearson FT Press.
2. James Evans, Business Analytics, Pearsons Education.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-001)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-001.1	2	2	2	-	2	-	3	1	2
M-ID-001.2	3	2	2	-	2	-	2	2	2
M-ID-001.3	3	3	1	-	2	-	2	2	2
M-ID-001.4	2	3	1	-	2	-	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

M-ID-002: INDUSTRIAL SAFETY

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of the course, students will be able to:

M-ID-002.1 Apply standard safety procedures in an industrial environment.
M-ID-002.2 Be familiar with standard workplace hazard/warning signs and labels.
M-ID-002.3 Be familiar with standard categories of hazardous materials.
M-ID-002.4 Identify hazard and potential hazard areas.
M-ID-002.5 Develop safety programs to prevent or mitigate damage or losses.
M-ID-002.6 Assess safety practices and programs.
M-ID-002.7 Conduct safety audits and improve safety practices.

Unit 1: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit 2: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit 3: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit 4: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit 5: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References:

1. Higgins & Morrow , Maintenance Engineering Handbook, , Da Information Services.
2. H. P. Garg , Maintenance Engineering,S. Chand and Company.
3. Audels , Pump-hydraulic Compressors, Mcgraw Hill Publication.
4. Winterkorn, Hans, Chapman & Hall London , Foundation Engineering Handbook.

Note:

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2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-002)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-002.1	1	1	-	2	2	3	1	1	1
M-ID-002.2	2	2	2	-	2	-	2	1	2
M-ID-002.3	1	2	3	-	2	-	3	2	2
M-ID-002.4	2	1	2	-	1	2	2	2	2
M-ID-002.5	2	2	3	1	2	2	2	1	1
M-ID-002.6	2	2	1	-	3	1	2	2	2
M-ID-002.7	1	3	3	-	2	1	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

M-ID-003: OPERATIONS RESEARCH

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

M-ID-003.1. Apply the dynamic programming to solve problems of discreet and continuous variables.

M-ID-003.2. Apply the concept of non-linear programming.

M-ID-003.3. Carry out sensitivity analysis

M-ID-003.4. Model the real world problem and simulate it.

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

References:

1. H.A. Taha, 2008, Operations Research, An Introduction, PHI.
2. H.M. Wagner, 1982, Principles of Operations Research, PHI, Delhi.
3. J.C. Pant, 2008, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi.
4. Hitler Libermann, 2009, Operations Research: McGraw Hill Pub.
5. Pannerselvam, 2010, Operations Research: Prentice Hall of India.
6. Harvey M Wagner, 2010, Principles of Operations Research: Prentice Hall of India.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-003)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-003.1	3	1	2	-	1	-	3	1	2
M-ID-003.2	3	1	2	-	1	-	2	2	1
M-ID-003.3	3	1	1	-	1	-	1	1	1
M-ID-003.4	2	1	3	1	1	-	2	1	2

M-ID-004: COST MANAGEMENT OF ENGINEERING PROJECTS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

On successful completion of this course, the student should be able to:

M-ID-004.1. Demonstrate an understanding of, and apply, the fundamentals of project planning and project management.

M-ID-004.2. Prepare and evaluate cost estimates, tender documentation and contract documentation.

M-ID-004.3. Administer and supervise contracts in accordance with the relevant Standards and/or Codes of Practice.

M-ID-004.4. Critically evaluate professional practice principles and their application to an engineering environment.

UNIT 1: Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost.

UNIT 2: Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities.

UNIT 3: Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT 4: Cost Behaviour and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.

UNIT 5: Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT 6: Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-004)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-004.1	2	2	2	-	1	-	2	1	2
M-ID-004.2	1	3	2	1	-	1	1	2	2
M-ID-004.3	1	3	2	-	2	-	2	1	2
M-ID-004.4	3	2	1	-	2	-	2	2	2

M-ID-005: COMPOSITE MATERIALS

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, the student will be able to:

M-ID-005.1. Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.

M-ID-005.2. Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.

M-ID-005.3. Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites

M-ID-005.4. Apply knowledge of composite mechanical performance and manufacturing methods to a composite design project

M-ID-005.5. Critique and synthesize literature and apply the knowledge gained from the course in the design and application of fibre-reinforced composites.

Unit 1: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behaviour of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit 3: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit 5: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. R.W.Cahn, Material Science and Technology – Vol 13 – Composites– VCH, West Germany.
2. WD Callister, 2007, Jr Materials Science and Engineering, An introduction., Adapted by R. Balasubramaniam, John Wiley & Sons.
3. ed-Lubin , Hand Book of Composite Materials.
4. K.K.Chawla , Composite Materials.
5. Deborah D.L. Chung, Composite Materials Science and Applications.
6. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, Composite Materials Design and Applications.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-005)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-005.1	2	2	2	-	1	-	2	2	2
M-ID-005.2	1	2	3	1	1	1	3	2	2
M-ID-005.3	3	3	2	-	2	-	2	1	1
M-ID-005.4	2	2	1	-	-	-	2	-	-
M-ID-005.5	2	2	-	-	-	-	1	-	-

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(Deemed to be University under section 3 of the UGC Act 1956)

M-ID-006: WASTE TO ENERGY

Periods/week	Credit	Max marks: 200
L: 3 T: 0	3	Continuous Evaluation: 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Outcomes:

M-ID-006.1. To enable students to understand of the concept of Waste to Energy.
M-ID-006.2. To link legal, technical and management principles for production of energy from waste.
M-ID-006.3. To learn about the best available technologies for waste to energy.
M-ID-006.4. To analyze case studies for understanding success and failures.
M-ID-006.5. To facilitate the students in developing skills in the decision making process.

Unit 1: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit 2: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit 3: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit 4: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit 5: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Desai, Ashok V, 1990, Non Conventional Energy, Wiley Eastern Ltd.
2. Khandelwal, K. C. and Mahdi, S. S, 1983,Biogas Technology - A Practical Hand Book, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.
3. Challal, D. S , 1991, Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.
4. C. Y. WereKo-Brobby and E. B. Hagan, 1996, Biomass Conversion and Technology, John Wiley & Sons.

Note:

1. In the semester examination, the examiner will set 8 questions in all covering the entire syllabus. Students will be required to attempt any five questions.
2. Use of calculators will be allowed in the examination. However, only ordinary scientific calculators will be permissible.
3. The scheme of awarding the grades to a student in the course will be supplied by the University to the examiner.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (M-ID-006)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2
M-ID-006.1	1	2	2	-	-	-	2	1	1
M-ID-006.2	1	2	-	-	1	-	2	1	1
M-ID-006.3	1	2	2	-	-	-	2	2	2
M-ID-006.4	2	2	1	-	-	-	1	2	2
M-ID-006.5	2	3	2	-	-	-	2	2	2

MEC-300: DISSERTATION PHASE – I

Periods/week	Credit	Max marks: 300
P: 20	10	Continuous Evaluation: 200
Duration of Examination: 4 Hrs		End Semester Examination: 100

Course Outcomes:

At the end of this course, students will be able to

MEC-300.1. Demonstrate knowledge of contemporary issues in their chosen field of research.

MEC-300.2. Consolidate the literature search to identify and formulate the engineering problem

MEC-300.3. Design engineering solutions to complex problems utilizing a systems approach.

MEC-300.4. Apply knowledge and abilities in practical activities with regards to relevant scientific professional and social judgments.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following: Literature survey Problem Definition

- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Synopsis

Guidelines for Dissertation Phase – I

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include Springer/Science Direct. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, a record of continuous progress.

- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the phase-I work.

Distribution of Marks for Internal Assessment of Dissertation Phase-I

	Criteria	Weightage	Marks	
1	Attendance	20%	40	**Project Coordinator + Project Guide**
2	Projects Selection and Specification	20%	40	**Project Coordinator + Project Guide +DPC**
3	Literature review	20%	40	
4	Synopsis	20%	40	
5	Final Presentation and Viva	20%	40	
	Total	100%	200	

Note: Marks for all criteria mentioned above from Sr. No. 2 to 5 is separately given by both Project Guide and DPC out of max. marks mentioned against each criteria. The final calculation of total internal assessment for project is done as follows:

Marks obtained by student= A + (0.6*P)+(0.4*D)

Where "A" are the Marks Given on the Basis of Attendance against serial no. 1 "P" are the marks given by Project Guide out of Total marks against serial no. 2 to 5 and "D" are the marks given by Departmental Project Committee out of Total marks against serial no. 2 to 5.

Distribution of Marks for External Assessment of Dissertation Phase - I			
	Criteria	**Weightage**	**Marks**
1	Synopsis	20%	20
2	Presentation	20%	20
3	Viva	60%	60
	Total	100%	100

Course Articulation Matrix

CO Statement (MEC-300)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-300.1	3	3	2	-	-	-	1	3	2
MEC-300.2	3	3	2	-	-	-	1	3	3
MEC-300.3	3	3	2	1	1	2	2	3	3
MEC-300.4	3	3	3	2	2	2	2	3	3

SEMESTER-IV

MEC-400: DISSERTATION PHASE – II

Periods/week	Credit	Max marks: 600
P: 32	16	Continuous Evaluation: 400
Duration of Examination: 3 Hrs		End Semester Examination: 200

Course Outcomes:

At the end of this course, students will be able to

MEC-400.1. Select the engineering tools/components for solving the identified engineering problem.

MEC-400.2. Apply the identified concepts and engineering tools to arrive at design solution(s) for the identified engineering problem

MEC-400.3. Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions

MEC-400.4. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following: Literature survey Problem Definition

- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – II

- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

Distribution of Marks for Internal Assessment of Dissertation Phase - II

	Criteria		Weightage	Marks	
1	Attendance		10%	40	**Project Coordinator + Project Guide**
2	Design of Project		20%	80	**Project Coordinator + Project Guide +DPC**
3	Implementation of Project		20%	80	
4	Testing & Evaluation		10%	40	
5	Project Report	Organization and Clarity	10%	40	
		Contents	10%	40	
6	Final Presentation and Viva		20%	80	
	Total		100%	400	

Note: Marks for all criteria mentioned above from Sr. No. 2 to 6 is separately given by both Project Guide and DPC out of max. marks mentioned against each criteria. The final calculation of total internal assessment for project is done as follows:

Marks obtained by student= A + (0.6*P)+(0.4*D)

Where "A" are the Marks Given on the Basis of Attendance against serial no. 1 "P" are the marks given by Project Guide out of Total marks against serial no. 2 to 6 and "D" are the marks given by Departmental Project Committee out of Total marks against serial no. 2 to 6.

Distribution of Marks for External Assessment of Dissertation Phase-II

	Criteria	Weightage	Marks
1	Project Report	20%	40
2	Presentation	20%	40
3	Viva	60%	120
	Total	100%	200

Course Articulation Matrix

CO Statement (MEC-400)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
MEC-400.1	3	3	2	1	1	1	2	3	3
MEC-400.2	3	3	2	1	1	1	2	3	3
MEC-400.3	3	3	2	1	1	2	2	3	3
MEC-400.4	3	3	2	1	2	2	2	3	3

Appendix-A : List of courses having relevance to the Local/Regional, National and Global Development needs

Course Code	Course Name	Regional	National	Global
MEC-101	Advanced Communication Networks			√
MEC-102	Wireless and Mobile Communication			√
MEC-151	*Wireless Sensor Networks			√
MEC-152	*Optical Networks			√
MEC-153	**RTL Simulation and Synthesis with PLDs			√
MEC-154	**Programming Languages for Embedded Softwares			√
MEC-155	*Cognitive Radio			√
MEC-156	*DSP Architecture			√
MEC-157	**CAD of Digital System			√
MEC-158	**Microcontrollers and Programmable Digital Signal Processors			√
M- MC-100	Research Methodology and IPR			√
MEC-111	*Advanced Communication Networks Lab			√
MEC-112	**RTL Simulation and Synthesis with PLDs Lab			√
MEC-113	*Wireless and Mobile Communication Lab			√
MEC-114	**Microcontrollers and Programmable Digital Signal Processors Lab		√	
M-MC-001	Stress Management by Yoga		√	
MEC-201	Antennas and Radiating Systems			√
MEC-202	Advanced Digital Signal Processing			√
MEC-251	*Satellite Communication			√
MEC-252	*Internet of Things		√	
MEC-253	**Analog and Digital CMOS VLSI Design			√
MEC-254	**Nano materials and Nanotechnology		√	
MEC-255	*Markov Chain and Queuing System		√	
MEC-256	*MIMO System			√
MEC-257	**VLSI Design Verification and Testing			√
MEC-258	**Network Security and Cryptography			√
EC-M-200	Mini Project with Seminar			√
MEC-211	*Antennas and Radiating			√

	Systems lab			
MEC-212	**Analog and Digital CMOS VLSI Design Lab			√
MEC-213	*Advanced Digital Signal Processing Lab		√	
MEC-214	**VLSI Design Verification and Testing Lab			√
M-MC-002	English for Research Paper Writing	√		
MEC-351	*Pattern Recognition and Machine learning	√		
MEC-352	*Remote Sensing			√
MEC-353	**Low power VLSI Design			√
MEC-354	**Selected Topics in Mathematics			√
M-ID-001	Business Analytics			√
M-ID-002	Industrial Safety			√
M-ID-003	Operations Research		√	
M-ID-004	Cost Management of Engineering Projects		√	
M-ID-005	Composite Materials		√	
M-ID-006	Waste to Energy		√	

Appendix B: List of courses having focus on Employability, Entrepreneurship and Skill Development

Course Code	Course Name	Employability	Entrepreneurship	Skill development
MEC-101	Advanced Communication Networks	√		
MEC-102	Wireless and Mobile Communication	√		
MEC-151	*Wireless Sensor Networks			√
MEC-152	*Optical Networks			√
MEC-153	**RTL Simulation and Synthesis with PLDs			√
MEC-154	**Programming Languages for Embedded Softwares			√
MEC-155	*Cognitive Radio	√		
MEC-156	*DSP Architecture	√		
MEC-157	**CAD of Digital System	√		
MEC-158	**Microcontrollers and Programmable Digital Signal Processors			√
M- MC-100	Research Methodology and IPR		√	
MEC-111	*Advanced Communication Networks Lab	√		
MEC-112	**RTL Simulation and Synthesis with PLDs Lab	√		
MEC-113	*Wireless and Mobile Communication Lab	√		
MEC-114	**Microcontrollers and Programmable Digital Signal Processors Lab	√		
M-MC-001	Stress Management by Yoga	√		
MEC-201	Antennas and Radiating Systems	√		
MEC-202	Advanced Digital Signal Processing	√		
MEC-251	*Satellite Communication	√		
MEC-252	*Internet of Things			√
MEC-253	**Analog and Digital CMOS VLSI Design	√		
MEC-254	**Nano materials and Nanotechnology	√		
MEC-255	*Markov Chain and Queuing System			√
MEC-256	*MIMO System			√
MEC-257	**VLSI Design Verification and Testing			√
MEC-258	**Network Security and Cryptography	√		
EC-M-200	Mini Project with Seminar	√		
MEC-211	*Antennas and Radiating Systems lab	√		
MEC-212	**Analog and Digital CMOS VLSI Design Lab			√
MEC-213	*Advanced Digital Signal Processing Lab	√		
MEC-214	**VLSI Design Verification and Testing Lab			√
M-MC-002	English for Research Paper Writing		√	
MEC-351	*Pattern Recognition and Machine learning			√

MEC-352	*Remote Sensing	√		
MEC-353	**Low power VLSI Design	√		
MEC-354	**Selected Topics in Mathematics	√		
M-ID-001	Business Analytics	√		
M-ID-002	Industrial Safety			√
M-ID-003	Operations Research	√		
M-ID-004	Cost Management of Engineering Projects	√		
M-ID-005	Composite Materials	√		
M-ID-006	Waste to Energy	√		

Appendix C: List of courses and proposed activities relevant to Professional Ethics, Gender, Human Values, Environment and Sustainability

Course Code	Course Name	Environmental Sustainability	Gender Sensitization	Professional	Human Values
M-MC-001	Stress Management by Yoga				√