Babu Banarasi Das University, Lucknow

Department of Electronics and Communication Engineering

School of Engineering
Master of Technology

Internet & Wireless Communication

Evaluation Scheme (Full Time) (w.e.f Session 2015-16)

SEMESTER I									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MAS2002	Linear algebra and random process	4	0	0	40	60	100	4
C	MEC2101	Advance Wireless Communication Systems	4	0	0	40	60	100	4
C	MCS2101	Advance Computer Networks	4	0	0	40	60	100	4
C	MCS2012	Introduction to Wireless Networking	4	0	0	40	60	100	4
GE		Generic Elective-I	4	0	0	40	60	100	4
C	MEC2151	Advance Wireless Communication Laboratory	0	0	2	40	60	100	1
C	MEC2152	Seminar	0	0	2	100	-	100	1
C	MEC2153	Technical Paper Presentation *	0	0	2	100	-	100	1
	Total		20	0	6	440	360	800	23

SEMESTER II									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2201	Wireless MIMO Communications	4	0	0	40	60	100	4
C	MCS2202	Network and System Security	4	0	0	40	60	100	4
C	MEC2204	CDMA and OFDM for wireless Communication	4	0	0	40	60	100	4
C	MEC2202	Introduction to Mobile Computing	4	0	0	40	60	100	4
GE		Generic Elective-II	4	0	0	40	60	100	4
C	MEC2251	MIMO Wireless Communication Lab	0	0	2	40	60	100	1
C	MEC2252	Mini Project	0	0	2	100	-	100	1
C	MEC2253	Research Methodology & Practices **	0	0	2	100	-	100	1
	Total		20	0	6	440	360	800	23

SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2351	State of Art Seminar ***	-	-	-	200	-	200	4
C	MEC2352	Thesis –I #	-	-	-	400	-	400	16
	Total					600		600	20

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2451	Thesis –II ##	-	-	-	200	800	1000	28
	Total					200	800	1000	28

* Technical paper presentation provides a platform for the student to do some original research that has not been done before, have a latest research paper (for reference) published in a refereed journal, and then give a presentation.

** The mission of the course is to impart research skills to the beginners and help them to improve the quality of Research. The student is expected to develop the most appropriate methodology for their Research Studies, and then give a presentation on research overview and its methodologies. This may include various steps to conduct the research.

*** The student needs to perform a literature survey and will give a state of art presentation and will submit a synopsis clearly mentioning the problem statement. The presentation and synopsis will be evaluated internally within two months of the start of the semester and the result will be intimated to the students so as to proceed for Thesis-I.

The student will develop a workable model for the problem they have proposed in synopsis.

This is in continuation with Thesis-I. The required experimental/mathematical verification of the proposed model will be done in this semester.

Generic Elective – I		
1.	MEC2031	Statistical Signal Processing
2.	MEC2012	Modelling and Simulation of Wireless Communication Systems
3.	MEC2013	Mobile Satellite Communication
4.	MEC2021	Smart Antennas

Generic Elective – II		
1.	MEC2014	Global Positioning Systems
2.	MEC2022	Advance Optical Communication
3.	MEC2023	Multimedia Communication Systems
4.	MEC2032	Spread Spectrum Communication

BabuBanarasi Das University, Lucknow

Department of Electronics and Communication Engineering

School of Engineering
Master of Technology

Internet & Wireless Communication

Evaluation Scheme (Part Time) (w.e.f Session 2015-16)

SEMESTER I									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MAS2002	Linear algebra and random process	4	0	0	40	60	100	4
C	MCS2101	Advance Computer Networks	4	0	0	40	60	100	4
GE		Generic Elective-I	4	0	0	40	60	100	4
	Total		12	0	0	120	180	300	12

SEMESTER II									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2202	Introduction to Mobile Computing	4	0	0	40	60	100	4
C	MCS2202	Network and System Security	4	0	0	40	60	100	4
GE		Generic Elective-II	4	0	0	40	60	100	4
	Total		12	0	0	120	180	300	12

SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2101	Advance Wireless Communication Systems	4	0	0	40	60	100	4
C	MCS2012	Introduction to Wireless Networking	4	0	0	40	60	100	4
C	MEC2151	Advance Wireless Communication Laboratory	0	0	2	40	60	100	1
C	MEC2152	Seminar	0	0	2	100	-	100	1
C	MEC2153	Technical Paper Presentation*	0	0	2	100	-	100	1
	Total		8	0	6	320	180	500	11

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2204	CDMA and OFDM for wireless Communication	4	0	0	40	60	100	4
C	MEC2201	Wireless MIMO Communications	4	0	0	40	60	100	4
C	MEC2251	MIMO Wireless Communication Lab	0	0	2	40	60	100	1
C	MEC2252	Mini Project	0	0	2	100	-	100	1
C	MEC2253	Research Methodology & Practices **	0	0	2	100	-	100	1
	Total		8	0	6	320	180	500	11

SEMESTER V									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2351	State of Art Seminar ***	-	-	-	200	-	200	4
C	MEC2352	Thesis –I #	-	-	-	400	-	400	16
	Total					600		600	20

SEMESTER VI									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MEC2451	Thesis –II ##	-	-	-	200	800	1000	28
	Total					200	800	1000	28

* Technical paper presentation provides a platform for the student to do some original research that has not been done before, have a latest research paper (for reference) published in a refereed journal, and then give a presentation.

** The mission of the course is to impart research skills to the beginners and help them to improve the quality of Research. The student is expected to develop the most appropriate methodology for their Research Studies, and then give a presentation on research overview and its methodologies. This may include various steps to conduct the research.

*** The student needs to perform a literature survey and will give a state of art presentation and will submit a synopsis clearly mentioning the problem statement. The presentation and synopsis will be evaluated internally within two months of the start of the semester and the result will be intimated to the students so as to proceed for Thesis-I.

The student will develop a workable model for the problem they have proposed in synopsis.

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Generic Elective – I		
5.	MEC2031	Statistical Signal Processing
6.	MEC2012	Modelling and Simulation of Wireless Communication Systems
7.	MEC2013	Mobile Satellite Communication
8.	MEC2021	Smart Antennas

Generic Elective – II		
5.	MEC2014	Global Positioning Systems
6.	MEC2022	Advance Optical Communication
7.	MEC2023	Multimedia Communication Systems
8.	MEC2032	Spread Spectrum Communication

MEC2101-Advance Wireless Communication Systems

Course Objective:

1. The main objective of this course is to build an understanding about the basic cellular concept, system interference and system capacity.
2. It provides the knowledge about the various fading effect and models.
3. It introduces the concept of error probability in different fading channel like AWGN.

Learning Outcome:

1. The students will understand the cellular system design fundamentals such as frequency reuse, cell coverage and handoff strategies.
2. Students will understand the error performance of digital modulation technique over AWGN and Fading channels.
3. Students will be able to find the capacity of wireless channel and learn about different diversity techniques.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Cellular Concepts – System Design Fundamentals** Cellular concept**,** Channel reuse**,** Channel assignment strategies**,** Handoff strategies**,** Interference and system capacity**,** Improving capacity in cellular system, Coverage of cellular systems	30 Hours	1
II	**Mobile Radio Propagation** Large Scale Path Loss: Free space propagation model-Basic propagation mechanisms (Reflection, diffraction and Scattering)-ground reflection model-Diffraction Model-Practical link budget design-Outdoor and indoor propagation models, Small scale fading and multipath: Small scale multipath propagation-Impulse response model of a multipath channel-Small scale multipath measurements parameters of mobile multipath channels-Types of small scale fading	30 Hours	1
III	**Performance of digital modulation over wireless channels** Error Probability for BPSK and QPSK over AWGN channel, Error Probability for M- ary PSK over	30 Hours	1

	AWGN channel, Error Probability for M-ary PAM and M-ary QAM over AWGN channel, Error Probability for FSK over AWGN channel, Error Probability for MSK and GMSK over AWGN channel, Outage and error probability analysis in Fading channels		
IV	**Capacity of Wireless Channels and Diversity Techniques** Capacity in AWGN, Capacity of Flat Fading Channel, Channel Distribution Information (CDI) known, Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity of Frequency Selective Fading channels, Introduction to Diversity Techniques: Time diversity-Frequency diversity-Space diversity-Polarization diversity	30 Hours	1

Text/ Reference Books:

1. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2007.
2. T.S. Rappaport, "Wireless Communications," Pearson Education, 2008.
3. Raj Pandya, "Mobile and Personal Communication Systems and Services," Prentice Hall of India, 2002.
4. William C.Y. Lee, "Wireless and Cellular Telecommunications," 3rd edition, Tata McGraw Hill, 2006.

MEC2151-Advance Wireless Communication Laboratory

List of Experiments

1. Modeling of free space propagation model
2. Modeling of two- ray ground reflection model.
3. Modeling of Knife-edge diffraction model.
4. Modeling of Log-normal shadowing in land mobile communication
5. Performance of digital modulation scheme in Gaussian channel.
6. Modeling of Okumura-Hata propagation model.
7. Performance of digital modulation scheme in Gaussian channel.
8. Generation of Rayleigh & Exponentially distributed random variable with the help of Gaussian distributed random variable.
9. Generation of Rayleigh fading channel with the help of Matlab function.

MEC-2201Wireless MIMO Communications

Course Objective:

1. The main objective of this course is to give the comprehensive idea about the basic concept of fading channels, their Probability of Error/Outage Probability and Different Diversity Technique.
2. To impart the knowledge about MIMO Channel Modeling, Capacity and Orthogonal Space Time Block Coding.

Learning Outcome:

1. At the end of the course student will be able understand the fading channels and calculate Error Probability and Outage Probability.
2. Students will be able to calculate the average SNR at the output of the combiner and Error/Outage Probability.
3. Students will be able to model a MIMO Channel and find its capacity.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Basic Concept Of Fading Channels** Wireless Channels**,** Error/ Outage probability over fading channels**,** Diversity techniques**,** Diversity Combining Scheme**:** Maximal Ratio Combining (MRC)-Equal Gain Combining (EGC)-Selection Combining (SC)-Generic Selection Combining (GSC)-Switch and Stay Combining (STC) diversity**,** Multiple antennas in wireless communications.	30 Hours	1
II	**Capacity of MIMO channels** Capacity and Information rates of noisy, AWGN and fading channels, Capacity of MIMO channels, Capacity of non-coherent MIMO channels, Constrained signaling for MIMO communications.	30 Hours	1
III	**MIMO Channel Coding** Transmit diversity with two antennas: The Alamouti scheme, Orthogonal and Quasi-orthogonal space-time block codes, Linear dispersion codes, Generic space-time trellis codes, Basic space-time code design principles, Representation of space-time trellis codes for PSK constellation, Performance analysis for space-time trellis codes, Comparison of space-time block and trellis codes, Development of concatenated codes, Concatenated codes for AWGN	30Hours	1

	and MIMO channels, Turbo coded modulation for MIMO channels, Concatenated space-time block coding.		
IV	**MIMO frequency-selective channels and MIMO OFDM** MIMO frequency-selective channels, Capacity and Information rates of MIMO FS fading channels, Space-time coding and Channel detection for MIMO FS channels, MIMO OFDM systems.	30Hours	1

Text/ Reference Books:

1. Tolga M. Duman and Ali Ghrayeb, "Coding for MIMO Communication systems", John Wiley &Sons, West Sussex, England, 2007
2. M. Janakiraman, "Space-time codes and MIMO systems", Artech House, 2004
3. E.G. Larsson and P. Stoica, "Space-time block coding for Wireless communications", Cambridge University Press, 2003
4. H. Jafarkhani, "Space-time coding: Theory & Practice", Cambridge University Press, 2005
5. A.B. Gershman and N.D. Sidiropoulus, "Space-time processing for MIMO communications", Wiley, Hoboken, NJ, USA, 2005

MEC2204-CDMA and OFDM for Wireless Communication

Course Objective:

1. The main objective of this subject is to provide the basicknowledge of multiple access environment and the techniques used like CDMA and OFDMA.
2. It gives the introduction to advanced signal detection and estimation principles with applications in wireless communication systems.

Learning Outcome:

1. At the end of the course students will have a good understanding of CDMA and OFDM concepts.
2. Students will understand about the channel estimation, equalization, synchronization methods used in spread spectrum systems.
3. Students will also get the idea of single carrier and multi carrier Spread spectrum techniques.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Principles of Code Division Multiple Access** Spread spectrum technique – Direct sequence and frequency hopping spread spectrum communication system – PN codes and Walsh codes – Rake receiver – Capacity – Effects of loading, sectorization and voice activity – Power control – Hand off – Link structure – Forward link – Pilot, synchronization, paging and traffic channels – Reverse Link – access and traffic channel.	30 Hours	1
II	**Call Processing and Traffic** Call processing states – Initialization, idle, access and traffic states – Forward link and Reverse link analysis - Calculation of Ec/I0 and Eb/N0 – Traffic intensity – Grade of Service – Erlang-B and C models.	30 Hours	1
III	**OFDM Basics** OFDM principles – system model – Generation of sub carrier using IFFT, guard time and cyclic extensions – windowing - Choice of OFDM parameters - OFDM signal processing. **Coding, Modulation and Channel Estimation**	30 Hours	1

	FEC coding – Interleaving – QAM – Coded modulation – Synchronization – Synchronization using cyclic extension and special training symbols – Coherent detection – One and two dimensional channel estimation – Special training symbols – Decision directed channel estimation – Differential detection in the time and frequency domain.		
IV	**OFDMA and MC-CDMA** Frequency hopping in OFDMA - OFDMA system description – Channel coding, modulation, time and frequency synchronization, Combination of OFDM and CDMA - MC-CDMA, MT-CDMA and MC-DS CDMA systems, Difference between OFDMA and MC-CDMA .	30 Hours	1

Text/ Reference Books:

1. Samuel C Yang, "CDMA RF System Engineering," Artech House, 2008.
2. Richard Van Nee and Ramjee Prasad, "OFDM for Wireless Multimedia Communication," Artech House, 2007.
3. LajasHanzo, "OFDM and MC-CDMA for Broadband Multiuser Communications," 2003
4. KhaledFazal and Stephen Kaiser, "Multicarrier and Spread Spectrum Systems," 2008

MEC2202-Introduction to Mobile Computing

Course Objective:

1. The main objective of this course is to give the comprehensive idea about various mobile generation technologies their usage and network scenarios.
2. It gives the knowledge about mobile languages, its Future advancements and Wireless Application Protocol.

Learning Outcome:

1. At the end of the course students will have clear understanding of UMTS, HSPA, LTE, Wi MAX, Wi Fi, mobile radio link and its air interfaces.
2. They will learn about per-user throughput in Downlink and Uplink.
3. They will learn about Developing Mobile Computing applications and J2ME.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Evolution:** Evolution from 2G over 3G to 4G & 5G, Beyond 3G Network Architectures: UMTS, HSPA and HSPA+-LTE-Wi-MAX-Wi-Fi	30 Hours	1
II	**Network Capacity and Usage Scenarios** Usage in Developed Markets and Emerging Economies, Measuring Mobile Usage from a Financial Point of View, Cell Capacity in Downlink, Current and Future Frequency Bands for Cellular Wireless, Cell Capacity in Uplink, Per-user Throughput in Downlink, Per-user Throughput in the Uplink, Traffic Estimation Per User, Overall Wireless Network Capacity	30 Hours	1
III	**Mobile Computing and Overview** Mobile Computing, Developing Mobile Computing applications, Mobile Computing Architectures , Mobile Computing through Telephony, Short Message Service, Wireless Application Protocol	30 Hours	1
IV	**Introduction to Mobile Language and Future Advancements** J2ME**,** Voice over Internet Protocol and Convergence**,** Security Issues in Mobile Computing**,** Next Generation Networks (NGN): Concept and Overview.	30 Hours	1

Text/ Reference Books:

1. “Beyond 3G: Bringing Networks, Terminals and the Web together”, Martin Sauter, Wiley.

2. “Mobile Computing”, HasanAmmed, McGrawHill.

MEC2251-MIMO Wireless Communication Lab

List of Experiments

1. Generate Rayleigh distributed random variable with the help of complex Gaussian random variable of zero mean and unity variance. From the generated random variable plot the received power in dB.
2. Generate Rician distributed random variable with the help of complex Gaussian random variable of unity mean and unity variance. From the generated random variable plot the received power in dB.
3. Outage performance of single antenna transmitter receiver system in Rayleigh fading channel
4. Average error probability (BPSK) of single antenna transmitter receiver system in Rayleigh fading channel.
5. System modeling of multi-antenna receiver with Maximum Ratio Combining.
6. System modeling of multi-antenna receiver with Selection Combining.

Generic Elective I

MEC2031-Statistical Signal Processing

Course Objective:

1. The main purpose of this course is to provide the basic theory and methods necessary for the design of optimal signal processing algorithms.
2. It explores the role of probability modelling in the development of robust and consistent (matched) signal transformations.
3. The course reviews a range of frequency transforms and spectrum estimation techniques.

Learning Outcome:

1. At the end of the course students will have a good understanding of statistical signal processing of discrete signals and systems.
2. Students will learn about the tools and methods for using stochastic processes for signal modeling, filtering and estimation.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Signal modeling**- least square method, pade approximation, prony's method - linear prediction, Applications. FIR least squares Inverse filters, finite data records, stochastic models.	30 Hours	1
II	**Levinson-Durbin Recursion**- The lattice filter, Levinson Recursion, split Levinson Recursion.	30 Hours	1
III	**Wiener filtering**- FIR & IIR Wiener filter , discrete Kalman filter.	30 Hours	1
IV	**Spectrum estimation** - Non parametric methods, minimum variance spectrum estimation, maximum entropy method, parametric method.	30 Hours	1

Text/ Reference Books:

1. Monson Hayes, "Statistical Digital signal processing and modelling" John Wiley, & sons 1996.
2. D.G. Manolakis, V.K.Ingle, S.M.Kogon, "Statistical & Adaptive Signal Processing" McGrawHill, 2000.
3. Simon Haykin, "Adaptive Filter Theory" PHI, 1996.
4. S.M. Kay, "Modern Spectral Estimation" PHI, 1987.

MEC2012-Modeling and Simulation of Wireless Communication Systems

Course Objective:

1. The main objective of this subject is to provide basic concepts of probability theory and fundamental learning of wireless communication system simulation modelling.
2. It will make our students aware of the role of simulation in our practical life.

Learning Outcome:

1. After completion of the subject, the students will be able to understand various probability concepts and can model different channels via simulation.
2. Students will also learn about simulating various modulation schemes and communication system like CDMA.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Modeling and Simulation Approach** Review of stochastic process and their properties. Methods of performance evaluation-simulation approach- Advantages and limitations. System model steps and its types involved in simulation study. Basic concepts of modeling – modeling of systems, devices, random process and hypothetical systems. Error sources in simulation. Validation, simulation environment and software issues. Role of simulation in communication system and random process. Steps involved in simulation study.	30 Hours	1
II	**Generation and Parameter Estimation** Monte Carlo simulation, properties, random number Generation, Generating independent and correlated random sequences . Testing of random number generators. **Parameter estimation:** Estimating mean, variance, confidence interval, Estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Power Spectral Density of a process, Delay and Phase.	30 Hours	1
III	**Modeling Of Communication Systems** Information sources, source coding, base band	30 Hours	1

	modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modelingconsiderations for PLL. **Communication Channel Models** Fading and multipath channels- statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.		
IV	**Performance Estimation and Evaluation** **Estimation of Performance Measures -** Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasi-analytical Estimation. **Case Studies:** (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.	30 Hours	1

Text/ Reference Books:

1. M.C. Jeruchim, Philip Balaban and K.Samshanmugam, "Simulation of communication systems," Plemum press, New York, 2007.
2. M.Law and W.DavidKelton ," Simulation Modelling and analysis" ,Tata McGraw Hill, NewYork, 2008.
3. K.Hayes, "Modelling and Analysis of computer communication networks," Plenum press, NewYork,1984.
4. Banks, J.S.Carson, Nelson and D.M.Nicol, "Discrete –Event system simulation," 4th Edition, Prentice Hall of India, 2005 .
5. Z.Peebles , "Probability, Random Variable and Random Signal Principles," 4TH edition, Tata McGraw Hill, 2002.

MEC2013-Mobile Satellite Communication

Course Objective:

1. The main objective of this subject is to provide the basic knowledge of two different types of infrastructure networks i.e. satellite Communication and mobile Communication System.
2. To aware our students about the information flow among them in order to interchange the information.

Learning Outcome:

1. After completion of the subject, the student will be able to understand about the call flow and protocol integration among cellular and satellite communication.
2. They will also understand the role of gateway nodes in the inter communication of two different types of infrastructure network.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** Evolution, Spectrum Allocation, Regulatory considerations, Types of channels and its characteristics, Channel models for narrow and wideband channels. Basic mobile satellite system parameters & design, Design objectives-Network availability, Reliability, Service coverage, Network capacity.	30 Hours	1
II	**Mobile Satellite Network** GSM signaling and S-PCN signaling protocol architecture, Mobility management-cell location, location management, handover management. Resource Management-Resource allocation strategies, Network operation and procedures.	30 Hours	1
III	**Integrated Terrestrial Satellite Mobile Networks** Integration with PSTN-Protocol Architecture and access functions. Integration with GSM-Impact of integration on handover, location management and call set up procedures. CODECS for Mobile Satellite Communication.	30 Hours	1
IV	**Applications** Mobile satellite system for UMTS, GSM/EDGE,	30 Hours	1

	MOBILE IP, WLAN, Global Broadband services, ATM, GEO and Non GEO Mobile satellite systems.		

Text/ Reference Books:

1. Ray E. Sheriff and Y. Fun Hu, “Mobile Satellite communication Networks,” John Wiley & Sons, 2008.
2. Michael, J.Miller, BrankaVucetic and Les berry , “Satellite Communication:mobile and fixed services,” Kluwer Academic Publishers, 2007.
3. M.Richharia “Mobile Satellite Communications, Principles and Trends,” Pearson Education, 2007.
4. StojceDimovIllcev , “Global mobile satellite communication for maritime land and aeronautical Applications”. http://w15.easy-share.com/11522731.html .
5. Peter Alfred Swan and Carrie L.Devieux, “Global mobile satellite Systems: A systems overview”, 2003.

MEC2021-Smart Antennas

Course Objective:

1. The main objective is to provide a comprehensive and detailed treatment of various antenna array processing schemes, adaptive algorithms to adjust the required weighting on antennas.
2. To study about various diversity-combining methods to combat fading in mobile communications, and effects of errors on array system performance and error-reduction schemes.
3. The use of smart antennas in mobile communications to increase the capacity of communication channels has reignited research and development in this very exciting field.

Learning Outcome:

1. At the completion of this course the students will be able to know about various antenna array processing schemes, adaptive algorithms to adjust the required weighting on antennas.
2. Students will be able to do the performance comparisons.
3. Students will learn about various diversity-combining methods to combat fading in mobile communications, and effects of errors on array system performance and error-reduction schemes.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Array Antennas**: Basic Array characteristics, Linear Arrays- Patterns, Beamwidth, Sidelobes, grating lobes, bandwidth, planar Arrays- Array coordinates, beamwidth, grating lobes	30 Hours	1
II	**Adaptive Array Fundamentals** :- Antenna Null Rotation, Electronic Null Steering , Constrained Power minimization, Weak Signal Adaptation, Sidelobe canceller, the Davies Beamformer, Multiple Null Formation	30 Hours	1
III	**Vector and Matrix techniques for Adaptive Arrays** : Narrow Band Signals , Vector Inner Products, Angles Between Vectors, Orthogonality achieved by projections, output powers, covariance Matrices, Quadratic Forms	30 Hours	1
IV	**Optimal Antennas & Adaptive Solutions of**	30	1

	optimal Antennas:: Meaning of optimality, Eigen value, Solution for maximum SNIR, Least Mean Square (LMS) Error Criterion, Maximization Of Probability of Detection, Direct maximization of SNR, Optimization of power pattern, Meaning of Adaptivity, Gradient Methods, Real Time Least Mean square Error Algorithm.	Hours	

Text/ Reference Books:

1. J.E. Hudson, “Adaptive Array Principles”, Peter Peregrinus Ltd.

2. R.T Compton and JR, “Adaptive Antennas, Concepts and Performance”, Prentice Hall, New Jersey

3. Eli Brookner “Practical Phased Array Antenna Systems”, Editor Artech House, Boston, London

4. R.C. Hansen, “Phased Array Antennas”, Wiley Series in Microwave and optical Engg, John Wiley & Sons Inc, Wiley- Interscience Publication

5. R. A. Monzingo and TW Miller, “Introduction to Adaptive Arrays”, Wiley.

Generic Elective II

MEC2014-Global Positioning Systems

Course Objective:

1. The purpose of this course is to develop a strong foundation in the field of Global Positioning Systems.
2. The subject gives the students an in-depth knowledge about working of Global positioning receivers.
3. Students are exposed to various errors occurring in GPS and latest variant DGPS receivers and GPS applications.

Learning Outcome:

1. At the end of this course students will gain knowledge about the topics such as global positioning, Different types of signals used in the GPS systems and its accuracy limits.
2. They will also learn about various GPS Segments and latest versions of GPS and its application.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**GPS: Basic Concepts and Evolution** GPS History , GPS Overview, GPS Modernization Program Markets and Applications, Concept of ranging using TOA Measurements, Reference Coordinate systems, Position determination using PRN Codes, Time and GPS	30 Hours	1
II	**GPS Segments and GPS Satellite Characteristics** GPS Segments-Space Segment, Control Segment, User Segment, Modulations for Satellite Navigation, Legacy GPS Signals, Navigation Message Format, Modernized GPS Signals	30 Hours	1
III	**Satellite Signal Acquisition and other Parameters** GPS Receiver Code and Carrier Tracking, Carrier Tracking Loops, Code tracking loops, Loop Filters, Measurements Errors and Tracking Thresholds, Formation of Pseudo-range, delta pseudo-range and integrated Doppler, Signal Acquisition, Sequence of Initial receiver operations, Data demodulation, Use of digital processing, Radio frequency	30 Hours	1

	interference, Multipath, Ionospheric Scintillation		
IV	**Standalone GPS and Differential GPS** Measurement Errors, PVT Estimation concepts, GPS Availability, GPS Constellation, GPS Integrity, Introduction to differential GPS, Code based Techniques, Carrier Based Techniques, Message formats, GPS Inertial Integration, Sensor Integration in Land Vehicle system, Introduction to GNSS	30 Hours	1

Text/ Reference Books:

1. Elliot D. Kaplan and Christopher J. Hegarty, " Understanding GPS: Principles and Applications", Artech House INC. Second Edition.
2. MohinderS.Grewal, Lawrence R.Weill, Angus P.Andrews, "Global positioning systems - Inertial Navigation and Integration", John wily & sons, 2001

MEC2022-Advance Optical Communication

Course Objective:

1. The main objective of this course is to provide comprehensive idea about the working principle of optical communication.
2. The Operation and characteristics of optical sources and detectors as well as Optical amplification.

Learning Outcome:

1. At the end of the course students will be able to gain knowledge about the fundamentals of optical communication.
2. Students will learn the Principles of optoelectronic devices and how to differentiate between Amplifiers and Optical Amplifiers.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**A Review Of Optical Fibers** The Evolution of Fiber Optic System, Fiber optic cable, Basic Network Information Rates, Classification of optical fiber , Elements of an Optical Fiber Transmission link, Structure of Optical Fibers, Basic Optical laws and definitions, Modes and configurations-Step and Graded index fiber and their comparison	30 Hours	1
II	**Optical Losses And Sources** Optical Losses, Leaky modes, Dispersion - Material dispersion-Waveguide dispersion, Optical Sources, LASER operation, Fabry-Parot resonator, DFB LASER, Comparison of LED and LASER	30 Hours	1
III	**Optical Amplification** Semiconductor Optical amplifier, Semiconductor Laser Amplifier, Optical Pumping , Fiber nonlinear effect, WDM, System requirements of WDM techniques, Application of optical amplifier	30 Hours	1
IV	**Optical Detectors And Couplers** Photo Detectors and Characteristics, Resonant cavity enhancement (RCE) Photo Detector, Photo diodes, PIN photo detector, Avalanche photo detector, Avalanche multiplication noise, Effect of	30 Hours	1

	temperature on Avalanche gain, Power Launching and Coupling, Lensing scheme, Splicing techniques-Connectors-Splices		

Text/ Reference Books:

1. Gerd Keiser, Optical fiber communications, McGraw Hill, 3rdedition.
2. John. M. Senior, Optical fiber communications: principles and practice, Prentice Hall of India.
3. R. P. Khare, Fiber optic and optoelectronics, Oxford University press.

MEC2023-Multimedia Communication Systems

Course Objective:

1. The main objective of this subject is to provide the basicknowledge of Multimedia Communication Systems.
2. Students will understand various audio and video compression techniques as well as how they can provide the security to the data transmitting over the internet.

Learning Outcome:

1. At the end of the course students will have a good understanding of multimedia enabling technologies, services and applications.
2. They will gain the sound knowledge of basic Networking concepts and protocols.
3. They will understand about the functioning of Multimedia application in networking environment.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Introduction to Multimedia Communication, multimedia networks, its application, Multimedia Information and its representation, digitization principals, representation of text , images, audio & video.	30 Hours	1
II	**Text & Image Compression:** Text Compression: Principles, Static Huffman coding, Dynamic Huffman coding, Arithmetic coding, Lempel-ziv coding, Lempel-ziv-welsh coding Image Compression: Principles, Graphics Interchange format, Tagged image file format, digitized document, Digitized Pictures, Introduction to JPEG.	30 Hours	1
III	**Audio &Video Compression:** Audio Compression: Principles, DPCM, Adaptive differential PCM, Adaptive predictive coding, Linear predictive coding, Code-excited LPC Perceptual coding, MPEG audio coders, Dolby audio coders Video Compression : basic principle, video compression standards H.261, H.263, Introduction	30 Hours	1

	to MPEG		
IV	**Internet Application** Introduction, E-mail, TCP, UDP , security, Encryption Basics-Stream Ciphers, Block Ciphers, Properties of Crypto Algorithms, Types Of Cryptography, Various modes of Operation, Various algorithms -DES,3-DES	30 Hours	1

Text/ Reference Books:

1. Fred Halsall, "Multimedia Communications", Prentice Hall.

2. Richard E.smith, "Internet Cryptography", Pearson Education.

3. K. R. Rao, Zoran S. Bojkovic , Dragorad A. Milovanovic, "Multimedia Communication Systems: Techniques Standards, and Networks", Prentice Hall.

MEC2032-Spread Spectrum Communication

Course Objective:

1. The main purpose of this course is to make our students aware of basic concepts of spread spectrum (SS) communications and its major applications (e.g. anti-jamming, positioning, CDMA) and techniques for analyzing the systems.
2. The course will review these concepts and emphasize the various trade-offs in the design of such systems.

Learning Outcome:

1. At the end of the course students will have a good understanding of the principles and theory of spread spectrum communications with emphasis on Direct Sequence Spread Spectrum System and Frequency Hopping Spread Spectrum System.
2. Student will have in-depth knowledge about CDMA techniques and their applications in wireless communications like jamming and anti-jamming.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Origins of SS communications – Advantages of Spectrum spreading – Types of techniques used for spread spectrum – Processing gain and other fundamental parameters – Jamming methods – Linear Feedback shift register sequence generation – Msequence and their statistical properties. Introduction to Non-linear sequences – Gold codes; Kasami sequences & chaotic sequences	30 Hours	1
II	**Direct Sequence Spread Spectrum System:** Coherent direct sequence systems – Model of a DS/BPSK system, Chernoff bound – Performance of encoded DS/BPSK – Constant power and pulse jammer. Coded DS/BPSK Performance for known and unknown channel states	30 Hours	1
III	**Frequency Hopping SS System:** Non-coherent FH system model – Uncoded FH/BFSK performance under constant power broadband jammer – Partial band noise jammer – Multitone jammer. Coded FH/BFSK performance for partial and multitone jammer. Performance of FH/MDPSK in the presence of partial band multitone jamming	30 Hours	1

IV	**Synchronization of SS Receivers & Applications:** Acquisition and tracking in DS SS receivers & FH SS receivers – Sequential estimation – Matched filter techniques of acquisition and tracking – Delay locked loop – Tau-Dither loop. Applications:Space systems – Satellite communication. Anti-jam military communication – Low probability of intercept communication – Mobile communications.	30 Hours	1

Text/ Reference Books:

1. R.C. Dixon, "Spread spectrum systems", John Wiley, 1984.

2. M.K. Simon, J.K.Omura, R.A. Schiltz and B.K.Levitt, "Spread spectrum communication", Vol-I, II & IV, Computer Science Press, USA, 1985.

3. G.R.Coopeand, CD.Mc.Gillem, "Modern communications and spread spectrum", McGraw Hill, 1986.