ELECTRONICS AND COMMUNICATION ENGINEERING

M.TECH (WIRELESS COMMUNICATION)

(NON-CBCS)

REGULATIONS, CURRICULUM AND SYLLABUS

(With effect from the Academic Year 2013 – 14)

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

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REGULATIONS FOR POST GRADUATE (M.Tech.) PROGRAMMES IN THE DISCIPLINE OF ELECTRONICS AND COMMUNICATION ENGINEERING **(NON-CBCS)**
(WITH EFFECT FROM JULY 2013)
M.Tech. (Wireless Communication)

1.0 ELIGIBILITY

Candidates for admission to the first semester of four semester M.Tech(Wireless Communication) should have passed B.E / B.Tech in Electronics and Communication Engineering / Communication Engineering / Telecommunication Engineering / Electronics and Telecommunication Engineering / Information Technology through regular course of study from an AICTE approved institution or an examination of any University or authority accepted by the Pondicherry University as equivalent thereto, with at least 55% marks in the degree examination or equivalent CGPA.
Note:

1. Candidates belonging to SC/ST who have a mere pass in the qualifying examination are eligible.
2. There is no age limit for M.Tech. programmes.

2.0 ADMISSION

The admission policy for various M.Tech. programmes shall be decided by the respective institutes offering M.Tech. programmes subject to conforming to the relevant regulations of the Pondicherry University.

3.0 STRUCTURE OF M.Tech. PROGRAMME

3.1 General

3.1.1. The M.Tech. Programmes are of semester pattern with 16 weeks of instruction in a semester.

3.1.2 The programme of instruction for each stream of specialisation will consist of :

(i) Core courses (Compulsory)
(ii) Electives
(iii) Laboratory
(iv) Seminar
(v) Directed Study
(vi) Project work

3.1.3 The M.Tech. Programmes are of 4 semester duration.

3.1.4. Credits will be assigned to the courses based on the following general pattern:

(i) One credit for each lecture period
(ii) One credit for each tutorial period
(iii) Two credits for practical course
(iv) Two credits for seminar
(v) Twenty three credits for Project work divided into 9 credits for Phase-I and 14 credits for Phase – II

One teaching period shall be of 60 minutes duration including 10 minutes for discussion and movement.

3.1.5 Regulations, curriculum and syllabus of the M.Tech. programme shall have the approval of Board of Studies and other Boards/ Committees/ Councils, prescribed by the Pondicherry University. The curriculum should be so drawn up that the minimum number of credits and other requirements for the successful completion of the programme will be as given in Table – 1.

Table 1: Minimum credits and other requirements

Sl.No.	Description	Requirements
		M.Tech (Full-Time)
1	Number of semesters	4
2	Min. number of credits of the programme	72
3	Max. number of credits of the programme	75
4	Min. Cumulative Grade Point Average for pass	5
5	Min. successful credits needed for registering in the next semester	Sem. I: 10
		Sem. II: 25
		Sem. III: 40
6	Min. period of completion of programme (consecutive semesters)	4
7	Max. period of completion of programme(consecutive semesters)	8
8	Number of core and Elective courses	13
9	Seminar	1
10	Laboratory	1
11	Project work (semesters)	2

3.1.6 A core course is a course that a student admitted to the M.Tech. programme must successfully complete to receive the degree. A student shall register for all the core courses listed in the curriculum.

3.1.7 Elective courses are required to be chosen from the courses offered by the department(s) in that particular semester from among the approved courses. A core course of any M.Tech programme/department may be chosen as an elective by a student from any other M.Tech programme /department.

3.1.8 Each student is required to make a seminar presentation on any chosen topic connected with the field of specialization. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the material by the student. The seminar shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.

3.1.9 Project work is envisaged to train a student to analyze independently any problem posed to him/her. The work may be analytical, experimental, design or a combination of both. The project report is expected to exhibit clarity of thought and expression. The evaluation of project work will be a continuous internal assessment based on two reviews, an internal viva-voce and an external viva-voce examination.

3.1.10 The medium of instruction, examination, seminar, directed study and project work will be in English.

4.0 REQUIREMENTS TO APPEAR FOR UNIVERSITY EXAMINATION

4.1 A candidate shall be permitted to appear for university examinations at the end of any semester only if he / she secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration. Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by the University along with a medical certificate obtained from a medical officer not below the rank of Assistant Director to become eligible to appear for the examinations.

4.2 A candidate to secure eligibility towards continuing the Programme, he/she must have earned the minimum number of credits at the end of each semester as given in Table – 1. If he /she fails to satisfy this criterion in any semester, he/she shall be placed on scholastic probation in the succeeding semester.

4.3 His / Her conduct shall be satisfactory as certified by the Head of the institution.

5.0 EVALUATION

5.1 Evaluation of theory courses shall be based on 40% continuous internal assessment and 60% end-semester examination. Evaluation of laboratory course shall be based on 50% internal assessment and 50% end-semester examination. In each course, there shall be a 3 hour end-semester examination.

5.2 The seminar will be evaluated internally for 100 marks. The total marks for the project work will be 300 marks for phase-I and 400 marks for phase-II. The allotment of marks for external valuation and internal valuation shall be as detailed below:

Seminar (Internal valuation only): **100 Marks**

First review		30 marks
Second review		30 marks
Report and Viva voce		40 marks
	Total	**100 marks**

Project work – (Phase – I): 300 Marks

Internal valuation			
	Guide		50 marks
	First Evaluation		50 marks
	Second Evaluation		50 marks
		Total	**150 marks**
External valuation			
	Evaluation (External Examiner Only)		50 marks
	Viva voce (50 for Ext. + 50 for Int.)		100 marks
		Total	**150 marks**

Project work – (Phase – II): 400 Marks

Internal valuation			
	Guide		100 marks
	First Evaluation		50 marks
	Second Evaluation		50 marks
		Total	**200 marks**
External valuation			
	Evaluation (External Examiner Only)		50 marks
	Viva voce (75 for Ext. + 75 for Int.)		150 marks
		Total	**200 marks**

5.3 The end-semester examination shall be conducted by the Pondicherry University for all the courses offered by the department. A model question paper, as approved by the Chairperson, BOS (ECE), Pondicherry University, for each course offered under the curriculum should be submitted to the University. The University examination shall cover the entire syllabus of the course.

5.4 The University shall adopt the double valuation procedure for evaluating the end-semester examinations, grading and publication of the results. Each answer script shall be evaluated by two experts. If the difference between the total marks awarded by the two examiners is not more than 15% of end-semester examination maximum marks, then the average of the total marks awarded by the two examiners will be reckoned as the mark secured by the candidate; otherwise, a third examiner is to be invited to evaluate the answer scripts and his/her assessment shall be declared final.

5.5 Continuous assessment of students for theory courses shall be based on two tests (15 marks each) and one assignment (10 marks). A laboratory course carries an internal assessment mark of 50 distributed as follows: (i) Regular laboratory exercises and records – 20 marks (ii) Internal laboratory test– 20 marks and (iii) Internal viva-voce – 10 marks.

5.6 All eligible students shall appear for the University examination.

6.0 GRADING

6.1 The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying stipulated points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below in Table – 2.

TABLE 2: Letter Grade and the Corresponding Grade Point

Range of Total Marks	Letter Grade	Grade Points	Description
90 to 100	S	10	EXCELLENT
80 to 89	A	9	VERY GOOD
70 to 79	B	8	GOOD
60 to 69	C	7	ABOVE AVERAGE
55 to 59	D	6	AVERAGE
50 to 54	E	5	SATISFACTORY
0 to 49	F	0	FAILURE
Incomplete	FA	-	FAILURE DUE TO LACK OF ATTENDANCE/ FAILURE BY ABSENCE

6.2 A student is deemed to have completed a course successfully and earned the appropriate credit if and only if, he /she receives a grade of E and above. The student should obtain 40% of marks in the University examination in a subject to earn a successful grade.

6.3 A candidate who has been declared “Failed” in a course may reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(i) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(ii) The candidate should have attended all the university examinations.

(iii) The candidate should not have failed in more than two papers in the current university examination.

(iv) The request for revaluation must be made in the format prescribed and duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

(v) Revaluation is not permitted for practical courses, seminar and project work.

6.4 The internal assessment marks secured by a student in a theory course shall be considered only during the first appearance. For the subsequent attempts, the marks secured by the student in the University examination shall be scaled up to the total marks. Further, the marks secured by the student in the University examination in the latest attempt shall alone remain valid in total suppression of the University examination marks secured by the student in earlier attempts.

7.0 DECLARATION OF RESULTS, RANK AND ISSUE OF GRADE CARD

7.1 The results will be declared and the grade cards will be issued to the students after completing the valuation process.

7.2 The grade cards will contain the following details:

(i) The college in which the candidate is studying/has studied.

(ii) The list of courses enrolled during the semester and the grades scored.

(iii) The Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

7.3 GPA is the ratio of the sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and the sum of number of credits of all the courses

$$GPA = (\text{Sum of } (C \times GP) / \text{ Sum of } C)$$

The sum will cover all the courses the student has taken in that semester, including those in which he/she has secured F.

7.4 CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA. If a student has passed in a course after failing in earlier attempts, the grade secured by the student in the successful attempt only will be taken into account for computing CGPA.

7.5 To convert CGPA into percentage marks, the following formula shall be used:

$$\% \text{ Mark} = (CGPA - 0.5) \times 10$$

7.6 A candidate who satisfies the course requirements for all semesters and passes all the examinations prescribed for all the four semesters within a maximum period of 8 semesters reckoned from the commencement of the first semester to which the candidate was admitted, shall be declared to have qualified for the award of degree.

7.7 A candidate who qualifies for the award of the degree shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION** upon fulfilling the following requirements:

(i) Should have passed all the subjects pertaining to semesters 1 to 4 in his/her first appearance in 4 consecutive semesters starting from first semester to which the candidate was admitted.

(ii) Should not have been prevented from writing examinations due to lack of attendance.

(iii) Should have secured a CGPA of 8.50 and above for the semesters 1 to 4.

7.8 A candidate who qualifies for the award of the degree by passing all the subjects relating to semesters 1 to 4 and securing CGPA not less than 6.5 shall be declared to have passed the examination in **FIRST CLASS**.

7.9 All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

7.10 A student with CGPA less than 5.0 is not eligible for the award of degree.

7.11 For the award of University rank and gold medal, the CGPA secured from 1^{st} to 4^{th} semester should be considered and it is mandatory that the candidate should have passed all the subjects from 1^{st} to 4^{th} semester in the first appearance and he/she should not have been prevented from writing the examination due to lack of attendance and should not have withdrawn from writing the University examinations.

8.0 PROVISION FOR WITHDRAWAL

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution be granted permission by the University to withdraw from writing the entire semester examination as one unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire programme. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank/gold medal.

9.0 TEMPORARY DISCONTINUATION FROM THE PROGRAMME

If a candidate wishes to temporarily discontinue the programme for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the programme only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 4 years, including the period of discontinuance.

10.0 REVISION OF REGULATIONS AND CURRICULUM

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when requirement for the same arises.

11.0 POWER TO MODIFY

11.1 Notwithstanding anything contained in the foregoing, the Pondicherry University shall have the power to issue directions/ orders to remove any difficulty.

11.2 Nothing in the foregoing may be construed as limiting the power of the Pondicherry University to amend, modify or repeal any or all of the above.

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M.TECH. (WIRELESS COMMUNICATION)

CURRICULUM AND SCHEME OF EXAMINATION

(Total number of credits required for the completion of the programme: 72)

SEMESTER – I

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC 911	Applied Mathematics for Communication Engineers	3	1	0	4	40	60	100
2.	EC 912	Modern Digital Communication	3	1	0	4	40	60	100
3.	EC 913	Wireless Communication Systems	3	1	0	4	40	60	100
4.		Elective – I	3	0	0	3	40	60	100
5.		Elective – II	3	0	0	3	40	60	100
6.		Elective – III	3	0	0	3	40	60	100
7.	EC 918	Seminar	-	-	3	2	100	-	100
						23	340	360	700

SEMESTER – II

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC 914	Ubiquitous Computing	3	1	0	4	40	60	100
2.	EC 915	RF System Design for Wireless Communication	3	1	0	4	40	60	100
3.	EC 916	OFDM for Wireless Communication	3	1	0	4	40	60	100
4.		Elective – IV	3	0	0	3	40	60	100
5.		Elective – V	3	0	0	3	40	60	100
6.		Elective –VI	3	0	0	3	40	60	100
7.	EC 917	Wireless Communication Laboratory	-	-	3	2	50	50	100
						23	290	410	700

SEMESTER – III

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC 919	Project Phase – I	-	-	16	9	150	150	300
2.		Elective – VII	3	0	0	3	40	60	100
						12	190	210	400

SEMESTER – IV

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC 920	Project Phase – II	-	-	24	14	200	200	400
						14	200	200	400

LIST OF ELECTIVE SUBJECTS

SL.NO.	Code	SUBJECT
1	EC 921	Optical Networks
2	EC 922	Wireless Sensor Networks
3	EC 923	Modeling and Simulation of Wireless Communication Systems
4	EC 924	Advanced Techniques for Wireless Reception
5	EC 925	Cryptography and Network Security
6	EC 926	Multimedia Compression Techniques
7	EC 927	Information Theory and Advanced Coding Techniques
8	EC 928	Mobile Satellite Communication
9	EC 929	Advanced Image Processing
10	EC 930	Advanced Embedded Systems Design
11	EC 931	RF MEMS
12	EC 932	Microwave Integrated Circuits
13	EC 933	Radiating Systems
14	EC 903	Advanced Digital Signal Processing
15	EC 941	WCDMA for UMTS
16	EC 942	Free Space Optical Communication
17	EC 943	Low Power Wireless Communication System
18	EC 944	Nanotechnology
19	EC 945	Next Generation Wireless Networks

EC 911 APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Vector Spaces

Vector Spaces, Subspaces, Linearly Independence and dependence, Dimension and Bases, Rank – Nullilty dimension theorem, Inner product spaces, Orthogonality and Gram-Schmidt orthogonalization process, Diagonalization.

Unit 2: Discrete Random Variables and their Distributions

Random variables - Probability function – Moments – Moment Generation Function, Characteristic Function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial, Poisson Distributions and Relationship between various Discrete-Type distributions

Unit 3: Continuous Random Variables and their Distributions

Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.

Unit 4: Transformation of Random Variables

Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.

Unit 5: Queueing Models

Poisson Process – Markovian queues – Single and Multi-server Models – Little's Formula – Machine Interference Model – Steady State analysis – Self Service queue.

Text Book:

1. Kenneth Hoffman, "Linear Algebra", Prentice Hall of India Private Limited, New Delhi.
2. Michel K. Ochi , "Applied Probability and Stochastic Processes," John Wiley & Sons . ISSN – 0271-6356, 2008.
3. Donald Gross and Carl M. Harris, Fundamentals of Queuing theory, 2nd edition, John Wiley and Sons, New York (1985).

Reference Books:

1. Michael Artin, "Algebra" Prentice Hall of India Private Limited, New Delhi.
2. Paboulis, A. "Probability, Random variables and Stochastic Processes," Tata McGraw Hill, 1984.
3. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application," John Wiley & Sons, 2002.

EC 912 MODERN DIGITAL COMMUNICATION

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: REVIEW OF DIGITAL MODULATION TECHNIQUES

Base band and band pass communication; Signal space representation, Linear and nonlinear modulation techniques, M-ary modulation techniques; Spectral characteristics of digital modulation, Spread spectrum modulation techniques.

Unit 2: RECEIVERS FOR AWGN AND FADING CHANNELS

Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.

Unit 3: FUNDAMENTALS OF OFDM AND DS-CDMA

Multi-Carrier Transmission: Orthogonal Frequency Division Multiplexing (OFDM),Advantages and Drawbacks of OFDM, Applications and Standards.

Spread Spectrum Techniques: Direct Sequence Code Division Multiple Access, Advantages and Drawbacks of DS-CDMA, Applications of Spread Spectrum.

Multi-Carrier Spread Spectrum: Principle of Various Schemes, Advantages and Drawbacks,Examples of Future Application Areas.

Unit 4: TRELLIS CODED MODULATION

Coded modulation for bandwidth-constrained channels-Trellis coded modulation; Set Partitioning, Four –state Trellis-coded modulation with 8-PSK signal constellation, Eight-state Trellis code for coded 8-PSK modulation, Eight-state Trellis for rectangular QAM signal constellations, Decoding methods and implementation issues.

Unit 5: TURBO CODING

Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles; Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm(SOVA); Turbo Coding for AWGN channels, Turbo Coding for Rayleigh Channels, LDPC Codes.

Referenc:

1. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
2. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001
3. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
4. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.
5. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
6. Sergio Verdu, "Multiuser Detection", Cambridge University Press, 1998.
7. Andrea Goldsmith , "Wireless Communication ", Cambridge Univ. Press, 2006.
8. K. Fazel AND S. Kaiser, "Multi-Carrier andSpread SpectrumSystems (From OFDM and MC-CDMA to LTE andWiMAX)" 2ND edition, A John Wiley and Sons Publication.

EC 913 WIRELESS COMMUNICATION SYSTEMS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Cellular Concepts – System Design Fundamentals

Cellular concept-channel reuse- handoff strategies-dynamic resource allocation-interference and system capacity-improving capacity and coverage of cellular systems.

Second and third generation network standards: GSM standardization-architecture and function partitioning-GSM radio aspects-security aspects-protocol model-call flow sequences-evolution to 2.5G mobile radio networks. IS-95 service and radio aspects, key features of IS-95 CDMA systems-ECWDMA-UMTS physical layer-UMTS network architecture-CDMA 2000 physical layer.

Unit 2: Radio Wave Propagation

Free space propagation model- basic propagation mechanisms –reflection- ground reflection model-diffraction-scattering-practical link budget design-outdoor and indoor propagation models

Small scale fading and multipath: Small scale multipath propagation-Impulse response model of a mulitpath channel –small scale multipath measurements-parameters of mobile multipath channels - –types of small scale fading.

Unit 3: Capacity of Wireless Channels

Capacity of Flat Fading Channel- Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

Performance of digital modulation over wireless channels: Error probability of BPSK, FSK, MSK, GMSK, QPSK, M-ary PSK, M-ary QAM and M-ary FSK on AWGN channels- Fading– Outage Probability– Average Probability of Error –– Combined Outage and Average Error Probability.

Unit 4: Diversity

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme-basic concepts of RAKE receivers.

Unit 5: Multiple Access Techniques

Frequency division multiple access-time division multiple access-spread spectrum multiples access-space division multiple access- packet radio.

MIMO and multicarrier modulation: Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain –data transmission using multiple carriers-multicarrier modulation with overlapping subchannels-mitigation of subcarrier fading-basic concepts of OFDM.

Text Books:

1. Andrea Goldsmith, “Wireless Communications,” Cambridge University Press, 2005
2. T.S. Rappaport, “Wireless Communications,” Pearson Education, 2003

Reference Books:

1. Raj Pandya, “Mobile and Personal Communication Systems and Services,” Prentice Hall of India, 2002
2. William C.Y. Lee, “Wireless and Cellular Telecommunications,” Third edition, Mc. Graw Hill, 2006.

EC 914 UBIQUITOUS COMPUTING

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Context-Aware Computing

Ubiquitous or Pervasive Computing – Context – Definitions and types – Enumeration based – Role based – Context–Aware Computing and Applications – Core capabilities for Context awareness – Types – Developing Context-aware applications – Middleware support – Contextual services – Actuator services – Providing Location Context.

Unit 2: Emerging Technologies

Introduction-Bluetooth-Bluetooth protocol stack-Application Models-Radio Frequency Identification(RFID)- Zigbee Protocol(802.15.4)-Wireless Broad band (WiMAX)-Physical layer-MAC – Mobile IP-Cellular IP-IPv6-IPv6 Security-Migrating from IPv4 to IPv6-Java Card.

Unit 3: Wireless LAN

Introduction-Wireless LAN Advantages-IEEE 802.11 Standards- Architecture-Types of Wireless LAN-Ad Hoc vs Infrastucture mode-Mobility-Deployment-Mobile Ad Hoc networks and sensor networks-Security-Wi-Fi vs 3G

Unit 4: Internet networks and Interworking

Fundamentals of call processing-Intelligence in the Networks-Standards for Intelligence Networks-SS#7 Protocol Stack-Signal unit-signalling-IN conceptual model-Soft switch-Programmable networks-Technologies and Interfaces for IN.

Unit 5: Voice over Internet Protocol and Convergence

Voice over IP- H.323 Framework for VoIP- Session Initiation Protocol (SIP) - Comparison between H.323 and SIP-Real time protocols-Convergence Technologies-Call routing- VoIP applications-IP Multimedia Subsystems(IMS) Mobile VoIP – Cloud Computing – Applications – Limitation – Regulatory Issues – Security Concerns.

Text Books:

1. Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.
2. F. Adelstein and S.K.S. Gupta, “Fundamentals of Mobile and Pervasive Computing,” McGraw Hill, 2009.

Reference Books:

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff and Thomas Schack, “Pervasive Computing: Technology and Architecture of Mobile Internet Applications,” Addison-Wesley, ISBN: 0201722151, 2002.
2. Uwe Hansmann, L. Merk, M. Nicklous, T. Stober and U. Hansmann, “Pervasive Computing (Springer Professional Computing),” Springer Verlag, ISBN:3540002189, 2003.

EC 915 RF SYSTEM DESIGN FOR WIRELESS COMMUNICATION

Unit 1: **Fundamentals of System Design**
Linear Systems and Transformations - Nonlinear System Representation and Analysis Approaches - Noise and Random Process - Elements of Digital Base-Band System.

Unit 2: Radio Architectures and Design Considerations
Superheterodyne Architecture - Direct Conversion (Zero IF) Architecture - Low IF Architecture - Band-Pass Sampling Radio Architecture.

Unit 3: Receiver System Analysis and Design
Introduction - Sensitivity and Noise Figure of Receiver - Intermodulation Characteristics - Single Tone Desensitization - Adjacent/Alternate Channel Selectivity and Blocking Characteristics - Receiver Dynamic Range and AGC System - System Design and Performance Evaluation.

Unit 4: Transmitter System Analysis and Design
Introduction - Transmission Power and Spectrum - Modulation Accuracy - Adjacent and Alternate Channel Power - Noise Emission Calculation - Some Important Considerations in System Design.

Unit 5: Applications of System Design
Multimode and Multiband Superheterodyne Transceiver - Direct Conversion Transceiver.

Text Books:
1. Gu, Qizheng, "RF System Design of Transceivers for Wireless Communications," 1st ed. Corr. 2nd printing, 2005, XIV, 479 p. 125 illus., Hardcover, Springer, ISBN: 978-0-387-24161

Reference Books:
1. D.K.Misra, "Radio Frequency and Microwave Communication Circuits, Analysis and Design", John wiley & Sons., inc, 2004, kundli.
2. Pozar,D.M, "Microwave Engineering," Adison Wesley, 3rd Edition, 1990.

EC916 OFDM FOR WIRELESS COMMUNICATION

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1 : Fundamentals of Wireless Communication

History of Mobile Cellular Systems, 1st Generation, 2nd Generation, 3rdGeneration, Overview of 3G , Proposals for 3G Standard, WCDMA ,Advanced TDMA, Hybrid CDMA/TDMA OFDM, IMT 2000,3GPP,3GPP2, 3G Evolution Paths, Mobile WiMAX& 4G,HSDPA

Basics of Cellular Communication:

Radio Wave Propagation, Transmit and Receive Signal Models, Shadow Fading, Combined Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing.

Unit 2 : OFDM Basics

Introduction to Wireless OFDM – OFDM principles, system model – Generation of sub carrier using IFFT, Guard time and cyclic extension, windowing, choice of OFDM parameters, OFDM signal processing.

Unit 3 : Coding and Modulation

Introduction – Forward error correcting coding – Interleaving – Quadrature Amplitude modulation – Coded modulation

Synchronization: sensitivity to phase noise and frequency offset and timing errors – Synchronization using cyclic extension and special training symbols.

Unit 4 : Channel estimation for OFDM system

Coherent and Differential Detection – Coherent detection – one and two dimensional channel estimators, special training symbols, Decision directed channel estimation –Differential detection – Differential detection in the time and frequency domain – Differential amplitude and phase shift keying.

Orthogonal Frequency Division Multiple Access: Frequency hopping in OFDMA, Difference between OFDMA and MC-CDMA. OFDMA system description – channel coding, modulation, Time and Frequency synchronization, Initial modulation timing and frequency offset synchronization accuracy, power control, random frequency hopping operation – Dynamic channel allocation (simple and fast) – capacity of OFDMA.

Unit 5 :Application of OFDMA

Digital Audio Broadcasting – Front end Impairments in the OFDM modem – system simulation tools – Analysis andsimulation of the main front end effects – Terrestrial digital video broadcasting – Magic wand (Wireless ATM project). IEEE 802.11, Hyper LAN/ 2 and MMAC, Wireless LAN standards – OFDM parameters, channelization,OFDM signal processing, Training, Difference between IEEE 802.11, Hyper LAN/ 2 and MMAC.

Reference Books:

1 Richard Van Nee and Ranjee Prasad, “OFDM for Wireless Multimedia Communication”, Artech House, 2000.
2. Mare Engels, “Wireless OFDM systems”, Klumer Academic publishers, 2002.
3. Prasad. R, “Universal Wireless Personnel Communications”, Artech House, 1998.
4. WIRELESS COMMUNICATIONS by Andrea Goldsmith, Cambridge University Press.
5. Introduction to 3G Mobile Communications by JuhaKorhonen ,2nd edition, Artech House

EC 917 WIRELESS COMMUNICATION LABORATORY

1. Implementation of an adaptive equalizer based on LMS algorithm and studies the effect of step size on MSE.
2. Determination of error probabilities for orthogonal signaling using MATLAB employing
   (i) Hard Decision (ii) Soft decision decoding.
3. Simulation and analysis of the performance of a QPSK digital radio link in a Rayleigh fading environment.
4. Comparison of Digital modulation schemes over AWGN and flat fading channels.
5. Establishment of the setup to receive TV signal and measure the field strength of DD or some other channel using RF spectrum analyzer. Give detailed discussion on the results.
6. Experiments based on FPGA.
7. Experiments on Embedded System Design.
8. Characterization of MIC components.
9. Experiments on wireless application using network simulator 2/Glomosim.
10. Design and implementation of a network security algorithm along with any one type of authentication protocol for efficient and secure transmission of a variable size data.

EC 921 OPTICAL NETWORKS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Introduction to WDM optical networks-WDM networks architectures- issues in wavelength routed networks.

Wavelength routing algorithms: Introduction- Classification of RWA algorithms-RWA algorithms-fairness and admission control- distributed control protocols.

Unit 2: Wavelength Convertible Networks

Need for wavelength conversion-wavelength convertible node architectures-converter placement and allocation problems.

Wavelength rerouting algorithms: Benefits of wavelength rerouting-issues in wavelength rerouting-light path migration-rerouting schemes-rerouting in networks with sparse wavelength conversion-rerouting in multifiber networks.

Unit 3: Virtual Topology Design

Introduction- virtual topology design problems- virtual topology design sub problems-virtual topology design heuristics-need for virtual topology design reconfiguration.

Optical multicasting: Introduction to multicast routing-multicasting node architectures-multicast tree generation-source based tree generation-Steiner tree based generation.

Unit 4: Control and Management

Network management functions, management frame work and protocols, configuration management and adaptation management.

Network survivability: failures and recovery- protection in SONET- benefits of optical layer protection-restoration schemes in WDM networks-multiplexing schemes-Traffic grooming in WDM.

Unit 5: Optical Burst Switching

OBS node architecture-burst switching protocols-wavelength channel scheduling.

Optical packet switching and access networks: Introduction-optical packet switching node architecture- contention resolution protocols. Enhanced HFC-FTTC –PON architectures.

Text Books:

1. C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts, Design and Algorithms”, Prentice Hall of India, 2002.
2. Rajiv Ramaswami and Kumar N. Sivarajan, “ Optical Networks: A Practical Perspective, Second edition, Morgan Kaufmann Publishers, 2002.

Reference Book:

1. B.Mukherjee, “Optical Communication Networks”, Mc Graw Hills, New York, 1997.

EC 922 WIRELESS SENSOR NETWORKS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Cellular and Ad Hoc Wireless Networks-Applicationa of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Acces Scheme-Routing-Multicasting-Transport Layer Protocols-Pricing Scheme-Quality of Service Provisioning-Self Organization-Security-Addressing and Service Discovery-Energy management-Scalability-Deployment Considerations, Ad Hoc Wireless Internet.

Unit 2: Sensor Networks

Comparison with Adhoc wireless networks-Challenges for WSNs - Difference between sensor networks and Traditional sensor networks –Types of Applications –Enabling Technologies for Wireless Sensor Networks –Single Node Architectures –Hardware Components – Energy Consumption of Sensor Nodes, Issues in Designing a Multicast Routing Protocol.

Unit 3: Sensor Network Architecture

Data Dissemination-Flooding and Gossiping-Data gathering Sensor Network Scenarios –Optimization Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway – WSN to Internet Communication – Internet to WSN Communication –WSN Tunneling

Unit 4: **MAC Protocols**

MAC Protocols for Sensor Networks -Location Discovery-Quality of Sensor Networks-Evolving Standards-Other Issues- Low duty cycle and wake up concepts- The IEEE 802.15.4 MAC Protocols-Energy Efficiency -Geographic Routing Mobile nodes

Unit 5: Routing

Gossiping and Agent based Unicast Forwarding-Energy Efficient Unicast-Broadcast and Multicast-Geographic Routing-Mobile nodes-Security-Application Specific Support - Target detection and tracking-Contour/ edge detection-Field Sampling.

Text Books:

1. Holger Karl and Andreas Wiilig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley & Sons Limited 2008.
2. I.F .Akyildiz and Weillian, “A Survey on Sensor Networks”,IEEE Communication Magazine, August 2007.

Reference Books:

1. Wilson , “Sensor Technology hand book,” Elsevier publications 2005.
2. Anna Hac “Wireless Sensor Networks Design,” John Wiley& Sons Limited Publications 2003.
3. C.Siva Ram Murthy and B.S.Manoj “Ad Hoc Wireless Networks,” Pearson Edition 2005.

EC 923 MODELING AND SIMULATION OF WIRELESS COMMUNICATION SYSTEMS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: 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.

Unit 2: 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.

Unit-3: Modeling of Communication systems

Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.

Unit-4: 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.

Unit 5: 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.

Text Books:

1. M.C. Jeruchim, Philip Balaban and K.Sam shanmugam. “Simulation of communication systems,” Plemum press, New York, 2007.
2. M.Law and W.David Kelton ,” Simulation Modelling and analysis,” McGraw Hill, New York, 2008.

Reference Books:

1. K.Hayes, “Modelling and Analysis of computer communication networks,” Plenum press, NewYork,1984.
2. Banks, J.S.Carson, Nelson and D.M.Nicol, “Discrete –Event system simulation,” Prentice Hall of India, 4th Edition, 2005 .
3. Z.Peebles , ”Probability, Random Variable and Random Signal Principles,” Tata McGraw Hill, 4th edition 2002.

EC 924 ADVANCED TECHNIQUES FOR WIRELESS RECEPTION

(Common to M.Tech (ECE) and M.Tech (WC))

Unit-1: Blind Multiuser Detection

Wireless signaling environment, Basic receiver signal processing for wireless reception- matched filter/raked receiver, equalization and MUD. Linear receiver for synchronous CDMA- decorrelating and MMSE detectors. Blind MUD, direct and subspace methods.

Unit-2: Group Blind MUD

Linear group blind MUD for synchronous CDMA, Non-linear group blind multiuser detectors for CDMA-slowest descent search. Group blind multiuser detection in multipath channels- Linear group blind detectors.

Unit-3: Space-Time MUD

Adaptive array processing in TDMA systems-Linear MMSE combining, sub-space based training algorithm and extension to dispersive channels. Optimal space time MUD. Linear space time MUD-Linear MUD via iterative interference cancellation, single user space-time detection and combined single user/multiuser linear detection.

Unit-4: NBI Suppression

Linear predictive techniques-linear predictive methods. Non-linear predictive techniques-ACM filter, Adaptive non-linear predictor, Non-linear interpolating filters and HMM based methods. Code aided techniques-NBI suppression via Linear MMSE detector.

Unit-5: Signal Processing for Wireless Reception

Bayesian signal processing- Bayesian framework, batch processing Versus adaptive processing, Monte-Carlo methods. Signal processing for fading channels. Coherent detection in fading channels based on EM algorithm. Decision feedback differential detection in fading channels-Decision feedback differential detection in flat channels, Decision feedback space-time differential decoding.

Textbook:

1. X.Wang and H.V.Poor," Wireless Communication Systems," Pearson,2004
2. Iti Saha Misra,"Wireless Communications and Networks,"Tata McGraw Hill,2009.

EC 925: CRYPTOGRAPHY AND NETWORK SECURITY

(Common to M.Tech (ECE) and M.Tech (WC))

UNIT – I : Introduction to Cryptography and Network Security
Security Trends, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms,, Model for Network Security. Symmetric Ciphers: Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT – II: Data Encryption Standards (DES) and Advanced Encryption Standards (AES)
Block Ciphers and the Data Encryption Standard, Block Cipher Principles, Data Encryption Standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. Advanced Encryption Standard.

UNIT III: Public-Key Encryption and Hash Functions

Principles of Public-Key Cryptosystems, RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography. Message Authentication and Hash Functions: Authentication Requirements and Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs.

UNIT IV: Digital Signatures and Authentication Protocols
Digital Signatures, Authentication Protocols, Digital Signature Standard. Network Security Applications: Authentication Applications, Kerberos, X.509 Authentication Service, Public-Key Infrastructure**.**

UNIT V: Network Security
Electronic Mail Security, Pretty Good Privacy, S/MIME 457. IP Security: IP Security Overview, IP Security Architecture. Web Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security. Intruders: Intrusion Detection, Password Management. Firewalls and its Design Principles.

Text book:
1. William Stallings, “Cryptography and Network Security-Principles and practice,” 4th Edition, Prentice Hall of India, 2007.

Reference Books:
1. Michael E.Whitman and Herbert J.Mattord ,”Principles of Information security,” 1 st edition, 2003.
2. Bruce Schneier,”Applied Cryptography,” 2nd Edition, John Wiley & Sons, 1996.
3. Doughas R.Stinson, ’Cryptography-Theory and Practice’, CRC Press,1995.

EC 926 MULTIMEDIA COMPRESSION TECHNIQUES

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Introduction to Multimedia – components of multimedia- overview of multimedia software tools- Graphics and Image Data Representations –Graphics/image data types, popular file formats - Fundamental Concepts in Video – analog and digital video. Basics of Digital Audio – Storage requirements for multimedia applications -Need for Compression - Taxonomy of compression techniques

Unit 2: Data Compression

Huffman coding, Arithmetic coding – Adaptive methods – Adaptive Huffman Coding –– Adaptive Arithmetic Coding – Dictionary Methods– LZW algorithm.

Unit 3: Audio Compression

Digital audio- audio compression techniques - μ Law and A Law companding, ADPCM. Speech compression- waveform codecs-source codecs- hybrid codecs-Shorten compressor MPEG-1 audio layers

Unit 4: Image Compression

Image Transforms – orthogonal transforms- DCT, JPEG , progressive image compression- JBIG, JBIG2 standards , Vector quantization, Differential lossless compression –DPCM Wavelet based compression- Filter banks, DWT, Multiresolution decomposition, SPIHT and EZW Coders, JPEG 2000 standard

Unit 5: Video Compression

Video signal components - Video compression techniques – MPEG Video Coding– Motion Compensation – H.261 , H.263 Standard , .MPEG4 and H.264 codecs .

Text Books:

1. Mark S.Drew and Ze-Nian Li, “Fundamentals of Multimedia,” PHI, 1st Edition, 2008.
2. David Salomon, “Data Compression – The Complete Reference,” Springer Verlag New York Inc., 3rd Edition, 2008.

Reference Books:

1. L. Hanzo, P. J. Cherriman and J. Streit, “Video Compression and Communications From Basics to H.261, H.263, H.264,MPEG4 for DVB and HSDPA-Style Adaptive Turbo-Transceivers,” Second Edition, IEEE Communications Society, John Wiley & Sons Ltd, 2007.
2. Peter Symes, “Digital Video Compression,” McGraw Hill Pub., 2004.
3. Mark Nelson, “Data compression,” BPB Publishers, New Delhi, 1998.

EC 927 INFORMATION THEORY AND ADVANCED CODING TECHNIQUES

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Basics of Information Theory

Introduction to Information theory - Information –- Measure of Information – Average information content (Entropy) of symbols in long independent sequences - Average information content (Entropy) of symbols in long dependent sequences – Joint and conditional entropies - Mutual information - Markov statistical model for information sources – Entropy and information rate of Markov sources - Information measure for continuous random variables.

Unit 2: Source Encoding

Shannon's first fundamental theorem – Noiseless coding – Source with finite memory – Shannon's second fundamental theorem on coding for memory less noisy channels – Channel capacity theorem - Shannon's Encoding algorithm – Huffman Coding Algorithm.

Unit 3: Channels and Channel Capacity

Communication channels, Discrete communication channel - Rate of information transmission over a discrete channel - capacity of a discrete memoryless channel – Shannon – Hartley theorem and its implications.

Types of channels and their capacities – Binary channel - BSC, BEC - cascaded channels-symmetric channel –unsymmetric channel - channel capacity for MIMO system.

Unit 4: Error Correcting Codes

Types of errors – Linear block codes – Error detection and error correction – Single error correcting Hamming codes – Binary cyclic codes – Encoder, Syndrome calculation, error detection and correction - BCH Codes – Burst Error Correcting codes – Burst and random error correcting codes.

Unit 5: Error Correcting Codes

Gal'ois fields, vector spaces and matrices – Convolution codes and Trellis codes – Viterbi decoding of convolutional codes – Turbo codes – Encoding and Decoding- Trellis coded modulation - Majority logic decoding – Burst error correcting codes – Two dimensional codes – ARQ – Performance of codes.

Text Books:

1.J.Das,SK.Mullick and PK Chatterjee, " Principles of Digital Communication," WileyEastern Limited, 2008.

2. Ranjan Bose, "Information Theory Coding and Cryptography,"Tata McGraw Hill Education Private Ltd, New Delhi,2010.

Reference Books:

1. K. Sam Shanmugam, "Digital and Analog Communication Systems," John Wileyand sons, 1994

2. Simon Haykin, "Digital Communications," John Wiley and sons, 1988.

EC 928 MOBILE SATELLITE COMMUNICATION

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: 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.

Unit 2: 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.

Unit 3: 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.

Unit 4: Antennas and Mobile Terminals

Antennas for MSS, Architecture of Hand held, Vehicle mounted, Ship borne, Aeronautical terminals, CODECS for Mobile Satellite Communication.

Unit 5: Applications

Mobile satellite system for UMTS, GSM/EDGE,MOBILE IP, WLAN, Global Broadband services, ATM, GEO and Non GEO Mobile satellite systems.

Text Books:

1. Ray E. Sheriff and Y. Fun Hu, “Mobile Satellite communication Networks,” John Wiley & Sons, 2008.
2. Michael, J.Miller, Branka Vucetic 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.

Reference Books:

1. Stojce Dimov Illcev , “Global mobile satellite communication for maritime land and aeronautical Applications”. http://w15.easy-share.com/11522731.html
2. Peter Alfred Swan and Carrie L.Devieux, “Global mobile satellite Systems: A systems overview”, 2003.

EC 929 ADVANCED IMAGE PROCESSING

(Common to M.Tech (ECE) and M.Tech (WC))

UNIT I REVIEW OF DIGITAL IMAGE PROCESSING 10 hrs.

Digital Image Representation - Fundamental Steps in Image Processing - Elements of Digital Image Processing System - Elements of Visual Perception - Image Model – Sampling and Quantization – Basic Relationship between Pixels.

UNIT II IMAGE ENHANCEMENT 10 hrs.

Image Enhancement – Spatial Domain – Gray level transformations – Enhancement by Point Processing – Image Subtraction – Image Averaging – Spatial Filtering – smoothing – sharpening – Fourier Transform – Frequency Domain filters

UNIT III IMAGE RESTORATION AND IMAGE COMPRESSION 10 hrs.

Image Restoration – Image Degradation Model – Noise Models – Inverse Filtering – Geometric Transformation – Image Compression – compression model – error free compression – lossy compression.

UNIT IV IMAGE SEGMENTATION AND DESCRIPTORS 10 hrs.

Image Segmentation – Detection of Discontinuities – Region Based Segmentation – The Use of Motion in Segmentation – Representation – boundary descriptors – regional descriptors – use of principal components for description.

UNIT V COLOR IMAGE PROCESSING 10 hrs.

Color Image Processing – color fundamentals – Color Models – Pseudo Color Image Processing – Color Image Transformation – Smoothening and Sharpening – color segmentation – color image compression.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, PHI, 2008
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall, 1989
3. William K. Prat, “Digital Image Processing”, Wiley Publications, 1991
4. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing using MATLAB”, PHI, 2009

EC 930 ADVANCED EMBEDDED SYSTEMS DESIGN

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Introduction to Embedded systems – Embedded hardware, Embedded software, Classification and Examples of embedded systems, System on Chip, Design process. Skills required for an embedded system designer.

Overview of 8051 Architecture, Real world Interfacing, Introduction to advanced architectures – x86, ARM and SHARC architectures - Processor and Memory organization, Instruction level parallelism, Performance metrics, Processor and Memory selection.

Unit 2: Program Design and Analysis:

Formalism for system design using UML (Unified Modeling Language) Model for Program flow graph (flow graphs). Basic Compilation techniques, Optimization of execution time, program size, energy and power. Processes and Operating system: Multiple tasks and processes, context switching, OS states, structure, timing requirements, Scheduling policies, and Inter- process communication Mechanisms. Performance Evaluation of OS.

Unit 3: Real Time Scheduling

State-machines, State charts, traditional logics and real-time logic. Deterministic scheduling: assumptions and candidate Algorithms, RM (rate monotonic) and EDF (earliest deadline first), realizing the assumptions, priority inversion and inheritance, Execution time prediction: Approaches and issues, measurement of S/W by S/W, program analysis by timing scheme, prediction by optimization, system interferences and architectural complexities. Keeping time on computers: Timer applications, properties of real and ideal clocks, clock servers and clock synchronization, real time language features.

Unit 4: Real time operating systems

OS services, Process management, timer and event functions, Memory management, Device, file and I/O management, Interrupt Routines in RTOS environment, basic design using RTOSes, Performance metrics, OS security issues, Comparative study of sample of RTOS such as eCOS, real time Linux, Windows CE.

Unit 5: Embedded software development Process and Tools

Introduction to Embedded software development Process and Tools, Host and Target machines, Linking and locating software, getting embedded software into the target system, Issues in hardware and software co-design. Testing, simulation and debugging techniques and tools.

Case studies: Digital Camera hardware and software architecture, Mobile phone software for key inputs.

Text Books:

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing system Design,” 2nd Edition, Morgan Kaufmann Publishers, 2008.

Reference Books:

1. Raj Kamal, “Embedded Systems-Architecture, Programming and Design,” The McGraw Hill Companies, 2nd Edition, 2008.
2. Allan C. Shaw, “Real time systems & Software,” John Wiley & Sons, India Reprint, 2001.
3. Richard Zurawski, “Embedded Systems Handbook,” Industrial Information Technology series, Taylor and Francis group, the academic division of T&F Informa plc.

EC 931 RF MEMS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit I: INTRODUCTION TO RF MEMS TECHNOLOGIES

Need for RF MEMS components in communications, Space and defense applications, Materials and fabrication technologies, Special considerations in RF MEMS design.

Unit II: SWITCHING

RF MEMS relays and switches: Switch parameters, Actuation mechanisms, Bistable relays and microactuators, Dynamics of switching operation.

Unit III: COMPONENTS

MEMS inductors and capacitors: Micromachined inductor, Effect of inductor layout, Modeling and design issues of planar inductor, Gap tuning and area tuning capacitors, Dielectric tunable capacitors.

MEMS phase shifters: Types. Limitations, Switched delay lines, Micromachined transmission lines, coplanar lines, Micromachined directional coupler and mixer.

Unit IV: FILTERS

Micromachined RF filters: Modeling of mechanical filters, Electrostatic comb drive, Micromechanical filters using comb drives, Electrostatic coupled beam structures.

Unit V: ANTENNAS

Micromachined antennas: Microstrip antennas – design parameters, Micromachining to improve performance, Reconfigurable antennas

Text Books:

1. V.K. Varadan, K.J. Vinoy and K.A. Jose, RF MEMS and their Applications, John Wiley, 2002.
2. H.J. De Los Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2003.

Reference Books:

1. G. Rebeiz, RF MEMS: Theory, Design, and Technology, Wiley/IEEE Press, 2003
2. H.J. De Los Santos, Introduction to Microelectromechanical (MEM) Microwave Systems, Artech house, 1999.

EC 932 MICROWAVE INTEGRATED CIRCUITS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit I: MICROSTRIP LINES DESIGN ANALYSIS

Introducion, Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation, Numerical method, Hybrid mode analysis, Losses in microstrip, Introduction to slot line and coplanar waveguide.

Unit II: COUPLED MICROSTRIP, DIRECTIONAL COUPLERS AND LUMPED ELEMENTS

Introduction to coupled microstrip, Even and odd mode analysis, Branch line couplers, Design and fabrication of lumped elements for MICs, Comparison with distributed circuits.

Unit III: NON-RECIPROCAL COMPONENTS AND ACTIVE DEVICES

Ferromagnetic substrates and inserts, Microstrip circulators, Phase shifters, Microwave transistors, Parametric diodes and amplifiers, PIN diodes, Transferred electron devices, Avalanche, IMPATT, BARITT diodes.

Unit IV: MICROSTRIP CIRCUIT DESIGN AND APPLICATIONS

Introduction, Impedance transformers, Filters, High power circuits, Low power circuits, MICs in Satellite and Radar.

Unit V: MMIC TECHNOLOGY

Fabrication process of MMIC, Hubrid MMICs, Dielectric substances, Thick film and thin film technology and materials, Testing methods, Encapsulation and mounting of devices.

Text Book:

1. Gupta K.C and Amarjit Singh, “Microwave Integrated Circuits”, John Wiley, New York, 1975.

Reference Book:

1. Hoffman R.K."HandBook of Microwave integrated circuits", Artech House, Bostan, 1987.

EC 933 RADIATING SYSTEMS

(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Radiation and Antennas

Definition - Radiation principle - Hertzian dipole - different current distribution in linear antennas – radiation from half-wave dipole – Radiation pattern of alternating current element – centre fed vertical dipoles.

Unit 2: Linear Arrays and Array Synthesis

Uniform linear arrays – Broadside and end-fire arrays – Multiplication if patterns – Binomial array – Synthesis method – Schelkunoff Polynomial method – Fourier transform method – Dolph-Chebychev method – Taylors method – Amplitude Distributions

Unit 3: Aperture Antennas

Slot, Patch and Horn Antennas – Practical Design considerations of large aperture antennas – Terahertz antennas - Baluns

Unit 4: Antenna Measurements

Introduction – Basic concepts – Typical source of error in antenna measurements – Measurement range -Measurement of different antenna parameters – Antenna radiation patterns - impedance – radiation resistance – gain – directivity – beam width – radiation efficiency – aperture efficiency – polarization.

Unit 5: Antennas for Special Applications

Electrically small antennas – physically small antennas – the high gain omni - Antenna design consideration for satellite communication – ILS antennas – LEO satellite link antennas – antennas for terrestrial mobile communication systems – embedded antennas – UWB antennas for digital applications – plasma antenna.

Text Books:

1. John.D.Kraus and R.J.Marhetka " Antennas for all Applications," 3rd edition, Tata McGraw Hill, 2008.
2. Balanis.C.A, "Antenna Theory Analysis and Design," 2nd edition, John Wiley & Sons, 2008.

Reference Books:

1. K.D.Prasad, :Antenna and Wave Propagation," Satya Prakashan, New Delhi, 2004.
2. S.N.Raju, "Antenna Propagation," Pearson Education, 2005.

EC 903 ADVANCED DIGITAL SIGNAL PROCESSING

(Common to M.Tech (ECE) and M.Tech (WC))

Unit-1 Discrete Time Signals, Systems and Random Signal Processing

Discrete Time signals- Classification of signals-Discrete Time Fourier Transform (DTFT). Discrete Time Random Processes- Ensemble averages, Autocorrelation and Autocovariance matrices. **Adaptive Filters:** FIR adaptive filters -adaptive filter based on steepest descent method-LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation

Unit -2 Spectrum Estimation

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method, Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators-Modified periodogram, Bartlett and Welch methods, Blackman –Tukey method. Parametric Methods - AR, MA, ARMA model based spectral estimation. Parameter Estimation using Yule-Walker method.

Unit- 3 Linear Estimation and Prediction

Linear prediction-Forward and backward predictions, Solutions of the Normal equations- Levinson-Durbin algorithms. Least mean square error criterion -Wiener filterfor filtering and prediction, FIR Wiener filter and Wiener IIR filters, Discrete Kalmanfilter

Unit-4 Adaptive recursive (IIR) filters and Equalization

Adaptive recursive (IIR) filters. RLSadaptive filters-Exponentially weighted RLS- Sliding window RLS.
Equalization: MLSE – Linear equalization – Decision feedback equalization – MLdetectors – Iterative equalization – Turbo equalization. Adaptive linear equalizer –Adaptive decision feedback equalization – Blind equalization.

Unit 5 Multirate Digital Signal Processing

Mathematical description of sampling rate conversion - Interpolation andDecimation,Sampling rate conversion by a rational factor, direct form FIR structures, Polyphase filter structures. Multistage implementation of sampling rate conversion. Applications- Speech compression

Text Books:

1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling,” Wiley India,2008.
2. John G. Proakis and Dimitris G.Manolakis, “Digital Signal Processing,” Fourth Edition, Prentice Hall of India, New Delhi, 2007.
3. John G. Proakis and Masoud Salehi, “Digital Communications”, Fifth edition, McGraw Hill International edition, 2008.

Reference Books:

1. John G. Proakis et.al., “Algorithms for Statistical Signal Processing,” Pearson Education, 2002.
2. Dimitris G.Manolakis et.al., “Statistical and Adaptive Signal Processing,” McGrawHill, Newyork, 2000.
3. Michael weeks “Digital signal processing using matlab and wavelets” Infinity Science press.

EC 941 WCDMA FOR UMTS

Unit-1: Introduction

WCDMA in Third Generation Systems - Air Interfaces and Spectrum Allocations for Third Generation Systems - Schedule for Third Generation Systems - Differences between ECWDMA and Second Generation Air Interfaces - Core Networks and Services - UMTS Services and Applications - Main Parameters in ECWDMA - Spreading and Despreading - Multipath Radio Channels and Rake Reception - Power Control - Softer and Soft Handovers.

Unit-2: Radio Access Network Architecture

UTRAN Architecture - General Protocol Model - UTRAN–CN and Internal Interfaces - UTRAN Enhancement and Evolution - UMTS Core Network Architecture and Evolution.

Physical layer**:** Transport Channels and their Mapping to the Physical Channels - Spreading and Modulation - User Data Transmission, Signaling.

Unit-3: Radio Interface Protocols

Introduction, Protocol Architecture - Medium Access Control Protocol - Radio Link Control Protocol - Packet Data Convergence Protocol - Broadcast/Multicast Control Protocol - Multimedia Broadcast Multicast Service - The Radio Resource Control Protocol - Early UE Handling Principles.

Unit-4: Radio Resource Planning

Interference-Based Radio Resource Management - Power Control - Handovers - Measurement of Air Interface Load - Admission Control - Load Control (Congestion Control) - packet scheduling for user and cell specific over TCP.

Unit-5: UTRA TDD Modes

Introduction- UTRA TDD Physical Layer - UTRA TDD Interference Evaluation - HSDPA Operation with TDD - CDMA 2000: Introduction - Logical Channels - Multicarrier Mode Spreading and Modulation - User Data Transmission - Signaling - Physical Layer Procedures.

Text books:

1. Harri Holma and Antti Toskala , “WCDMA for UMTS Radio Access For Third Generation Mobile Communications,” 3rd Edition, John Wiley & Sons Ltd, 2004.
2. Ojampera T and Prasad R, “Wideband CDMA for third Generation Mobile Communication”, Arech House, 1998.

EC 942 FREE SPACE OPTICAL COMMUNICATION

Unit 1: Fundamentals of FSO Technology

Introduction – Maxwell's Equations – Electromagnetic wave propagation in free space - alternate bandwidth technologies – Fiber Vs FSO- Fiber Access – Overview of FSO Optical Transmitters – Receivers – Subsystems – Pointing, Acquisition and Tracking – Line of sight analysis.

Unit 2: FSO Networks

The Role of FSO in the network – factors affecting FSO – line of sight(LOS) – selecting transmission wave integration of FSO in Optical networks – installation of FSO systems – moving towards edge – and residential areas.

Unit 3: Long Distance FSO Communication

The FSO model – Applications – System descriptions and design – Introduction to Laser Satellite Communications – Characteristics, Modulation Techniques and Radiation effects – Laser Sources.

Unit 4: Optical Components for FSO

Optical waveguides – Optical Filters, Couplers, Amplifiers, Switches, Antennas, Interconnecting Equipments, and etc – Optical integrated circuits – semiconductor integrated optic devices.

Unit 5: Optical Signal Processing

Analog and Discrete systems – Noise and Stochastic processes – Filters – Power spectra estimation – Ambiguity function, Wigner distribution function and triple correlations.

Text Books:

1. Heinz, Phd. Willebrand, "Free Space Optics," Sams, 1st Ed., 2001.

Reference Books:

1. Morris Katzman, "Laser Satellite Communication," Prentice Hall Inc., New York, 1991.
2. Hiroshi Nishihara, "Optical Integrated Circuits," McGraw Hill, New York, 1992.
3. Pankaj K. Das, "Optical Signal Processing," Narosa Pub. House, 1993.

EC 943 LOW POWER WIRELESS COMMUNICATION SYSTEM

Unit 1: Introduction To Ultra-Wideband

Introduction, UWB Modulation Options - UWB Signaling Techniques - Data Mapping - Spectral Characteristics - Data Mapping and Transceiver Complexity - Modulation Performances in Practical Conditions

Unit 2: Ultra-Wideband Pulse Shaper Design

Transmit Spectrum and Pulse Shaper - FIR Digital Pulse Design - Optimal UWB Single Pulse Design - Optimal UWB Orthogonal Pulse Design.

Unit 3: Ultra-Wideband Channel Modeling

Principles and Background of UWB Multipath Propagation Channel Modeling -Channel Sounding Techniques - UWB Statistical-Based Channel Modeling -Impact of UWB Channel on System Design - Potential Benefits of MIMO.

Unit 4: Antenna Design Considerations

System Model - UWB Receiver Related Issues - TH-IR-UWB Receiver Options. Multiple-Access Interference Mitigation at the Receiver Side - Multiple-Access Interference Mitigation at the Transmitter Side. Effect of NBI in UWB Systems - Avoiding NBI - Canceling NBI.

Unit 5: Multiband OFDM System

Multiband Pulsed-OFDM UWB system. Medium Access Protocols - Network Applications. Multiple Access in UWB Sensor Systems - UWB Sensor Network Case Study -System Description-UWEN – Implementation - Location System - Position Calculation Methods. The 802.15.4 MAC Standard - Advanced MAC Design for Low-Bit-Rate UWB Networks

Text Book:

1. Huseyin Arslan, Zhi Ning Chen and Maria-Gabriella Di Benedetto, “Ultra Wideband Wireless Communication,”Wiley,October,2006.ISBN:978-0-471-71521-4. http://as.wiley.com/WileyCDA/WileyTitle/productCd-0470042389.html

Reference Books:

1. Homayoun Nikookar and Ramjee Prasad , “Introduction to Ultra wideband for wireless communications”, Springer, 2009.
2. Jeffrey H.Reed, “An introduction to ultra wideband Communication systems”, Prentice Hall PTR, Apr-05-2005.
3. Kayimiery siwiak and Debra mekeown, “Ultra-wideband Radio Technology”, John wiley &Sons Ltd., 2004. http://www3.interscience.wiley.com/cgi-bin/bookhome/109871419?CRETRY=1&SRETRY=0
4. Roberto alello and Anoj Batra, “Ultra wideband Systems, Technologies and applications,” Elsevier at 2006.

EC 944 NANOTECHNOLOGY

Unit 1: Introduction to Nanotechnology

Essence of Nanotechnology, Nano in daily life, Brief account of nano applications. Properties of nano materials – mechanical, electrical and Optical properities, Metal nano clusters, Semiconductor nano particles.

Unit 2: Nano Materials

Semiconductor hetero-structures, organic semiconductors, Carbon nanomaterials - Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes and Biological materials.

Unit 3: Growth, Fabrication and Measurement Techniques for Nanostructures

Top-down methods-Molecular manufacturing - Bottom-up methods Intermolecular-interactions, Lithography and Spectroscopic techniques.

Unit 4: Electron Transport in Semiconductors and Nanostructures

Electrons in traditional low-dimensional structures. Investigating and manipulating materials in the nanoscale - Electron microscopics, scanning probe microscopics, optical microscopics and X- ray diffraction.

Unit 5: Nano Devices

Electronic devices, Magnetic devices, Photonic devices, Mechanical devices, Fluidic devices, Quantum dot cellular automata and Biomedical devices.

Text Books:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap and Michael A. Stroscio, "Introduction to Nanoelectronics - Science, Nanotechnology, Engineering, and Applications," Cambridge Univesity Press, 2008.
2. Charles P. Poole Jr. and Frank J. Owens, "Introduction to Nanotechnology," John Wiley & Sons Publications, 2003.

Reference Book:

1. Earl Boysen and Richard Booker, "Nanotechnology", Wiley Publishing Inc., 2006.

EC 945 NEXT GENERATION WIRELESS NETWORKS

UNIT –I: Introduction

Evolution of Wireless Networks - Wireless Local Area Networks - Public Wide-Area Wireless networks . Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services - First Wave of Mobile Data Services: Text-Based Instant Messaging. Second Wave of Mobile Data Services: Low-Speed Mobile Internet Services. Current Wave of Mobile Data Services: High-Speed and Multimedia Mobile Internet Services. IP-Based Wireless Networks - 3GPP, 3GPP2.

UNIT –II: Wireless IP Network Architectures

3GPP Packet Data Networks - Network Architecture-3GPP2 Packet Data - MWIF All-IP Mobile Networks - Network Architectures - Access to MWIF Networks - Session Management.

UNIT –III: IP Multimedia Subsystems and Application-Level Signaling

Signaling in IP Networks -Session Initiation Protocol (SIP) -Session Description Protocol (SDP)
3GPP IP Multimedia Subsystem (IMS) - IMS Architecture 3.2.2 Mobile Station Addressing for Accessing the IMS - Reference Interfaces -Service Architecture - Registration with the IMS - Deregistration with the IMS -End-to-End Signaling Flows for Session Control 3GPP2 IP Multimedia Subsystem (IMS)

UNIT –IV: Mobility Management

Basic Issues in Mobility Management - Mobility Management in IP Networks - Mobility Management in 3GPP Packet Networks -Mobility Management in 3GPP2 Packet Data Networks -Mobility Management in MWIF Networks - Comparison of Mobility Management in IP, 3GPP, and 3GPP2 Networks .

UNIT –V: Quality of Service

Internet QoS - QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS in 3GPP2 -3GPP2 QoS Architecture -3GPP2 QoS Management -3GPP2 QoS Classes -QoS Attributes (QoS Profile) - Management of End-to-End IP QoS.

Text Books:

1. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-GenerationWireless NetworksSystems, Architectures, and Protocols," John Wiley & Sons, Inc. Publication, 2006.
2. Crosspoint Boulevard , "Wireless and Mobile All-IP Networks," Wiley Publication, 2005.

Reference Books:

1. Minoru Etoh, "Next Generation Mobile Systems3G and Beyond," Wiley Publications, 2005. http://www.ebookee.com/Next-Generation-Mobile-Systems-3G-amp-Beyond-repost-_330093.html
2. Savo Glisic **, "**Advanced Wireless Communications 4G Technologies," Wiley Publications, 2004.http://www.ebookee.com/Advanced-Wireless-Communications-4G-Technologies-Repost-_343539.html

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH
[WIRELESS COMMUNICATION (NON-CBCS)]

1. INFRASTRUCTURE :

(i) Building Infrastructure

Sl.No.	Building Details	Area(sq.m)	No. Required
1	Class/Tutorial Room	33	1
2	Laboratory	75	1
3	Project Lab	50	1

(ii) Equipment Infrastructure

Sl.No	Facilities/Equipment/Accessories	Qty.
1	Regulated Power Supply	10
2	CRO(100MHz)	2
3	Signal Generator and Function Generator	4
4	RF Spectrum Analyzer	1
5	Vector Network Analyzer	1
6	Radio Communication Analyser	1
7	Arbitrary Waveform Generator	1
8	Network Simulator Software	5
9	Pspice/Orcad/Multisim – Design Software	5
10	Matlab Software	5 Users
11	Digital Storage oscilloscope (100MHz)	1
12	Yagi uda antenna with booster and other accessories	1
13	Dish Antenna with Set top box	1
14	Audio Player with I/O Devices	1
15	PC with LAN connection	20
16	MIC trainer kit	2
17	Embedded System trainer kit	4

2. LIBRARY:

Number of books : 100
Titles : As required by the curriculum
Journals : 5 related International journals

3. FACULTY REQUIREMENT **:** As per AICTE norms

4. TEACHER TO STUDENT RATIO **:**As per AICTE norms